

The Management of Headache in Chiropractic Care: A Health Services Research Investigation

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Technology Sydney, April 2020.

CERTIFICATE OF ORIGINAL AUTHORSHIP

I, Craig Shane Moore, declare that this thesis, is submitted in fulfilment of the requirements for the award of Doctor of Philosophy, in the Australian Research Centre in Complementary and Integrative Medicine, Faculty of Health at the University of Technology Sydney. This thesis is wholly my own work unless otherwise reference or acknowledged. In addition, I certify that all information sources and literature used are indicated in the thesis. This document has not been submitted for qualifications at any other academic institution. This research is supported by the Australian Government Research Training Program.

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Published works by the author incorporated into the thesis

Of the five manuscripts contained in the thesis, four were published or accepted for publication and one was under review when the thesis was submitted. The manuscripts contained in this thesis are:

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2. Adams, J., Lauche, R., Peng, W., Steel, A., Moore, C., Amorin-Woods, L. & Sibbritt, D. 2017, 'A workforce survey of Australian chiropractic: the profile and practice features of a nationally representative sample of 2,005 chiropractors', *BMC Complementary and Alternative Medicine*, vo. 17, no. 14, pp. 1-8.
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4. Adams, J., Peng, W., Steel, A., Lauche, R., Moore, C., Amorin-Woods, L. & Sibbritt, D. 2017, 'A cross-sectional examination of the profile of chiropractors recruited to the Australian Chiropractic Research Network (ACORN): a sustainable resource for future chiropractic research', *BMJ Open*, vol. 7, no. 9, pp. 1-8.
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Pohlman, K., Swain, M., Wong, A. & Hartvigsen, J. 2018, 'Leadership and capacity building in international chiropractic research: introducing the chiropractic academy for research leadership (CARL)', *Chiropractic and Manual Therapies*, vol. 26, no. 5, pp. 1-6.

6. Adams, J., Steel, A., Moore, C., Amorin-Woods, L. & Sibbritt, D. 2016, 'Establishing the ACORN National Practitioner Database: strategies to recruit practitioners to a national practice-based research network', *Journal of Manipulative and Physiological Therapeutics*, vol. 39, no. 8, pp. 594-602.
7. Amorin-Woods, L., Moore, C. & Adams, J. 2018, 'How does a practiced-based research network facilitate evidence-informed practice within the chiropractic profession in Australia? A commentary', *Chiropractic Journal of Australia*, vol. 46, no. 2, pp. 173-85.

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Statement of contributions to jointly authored works contained in the thesis

The results presented in this thesis by compilation were or will be submitted for publication in peer-reviewed journals as five discrete manuscripts (one literature review paper and four original articles), presented in Chapter 2 and Chapters 4, 5, 6 and 7. For each of these manuscripts, I was primarily responsible for determining the research question, undertaking the analysis and drafting the manuscript.

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I take full responsibility for the accuracy of the findings presented in these publications and this thesis.

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Abstract

Aim: To explore Australian chiropractors' management of headache disorders and the profile and headache characteristics of those seeking headache management from chiropractors.

Method: The study samples were obtained from the Australian Chiropractic Research Network (ACORN) database (n=2005) and member practitioners (n=1680). The three distinct phases for this study project include a detailed literature review (Phase One), to examine the prevalence and features of those who seek help from manual therapy (MT) providers for headache management. This was followed by survey information collected from Australian chiropractors (Phase Two), enabling measurement of the proportion of chiropractors who 'often' manage migraine and the factors associated with this practice (n=1,869), followed by the analysis of the features of headache management provided by chiropractors and specifically of chiropractors who utilise International Classification of Headache Disorders (ICHD) primary headache classification criteria (n=381). A subsequent survey of patients (n=224) enabled analysis of the profile and headache features of those seeking help from ACORN practitioners (Phase Three).

Results: Phase One: Review of the international literature indicated the use of MT providers averaged 15.9% for those with migraine and 17.7% for those with non-migrainous headache disorders. Phase Two: A majority of surveyed chiropractors reported high migraine caseloads (n=990; 53.0%). Chiropractors with high migraine caseloads were more likely than other chiropractors to treat non-musculoskeletal disorders and multi-region spine pain. One in five new patients (21.1%) presented to

chiropractors with a chief complaint of headache. Most chiropractors use ICHD criteria for the diagnosis of primary (84.6%) and secondary (90.4%) headaches. Chiropractors reported most often collaborating with complementary and alternative medicine providers and general practitioners for headache and to provide advice on headache triggers and lifestyle, stress management and utilise manual therapies for headache management. Chiropractors who utilise primary headache classification criteria were more likely to believe this practice improves decision-making about primary headache patient referral/co-management. Phase Three: Approximately one in five headache patients who seek help from chiropractors have discrete features of migraine (20.5%), tension-type headache (16.5%), and one in three have features of more than one headache type (33%). Higher levels of headache impact occurred in patients with mixed headache (65.3%) and migraine (61.7%).

Conclusion: Internationally, headache management is a substantial within chiropractic practice in many western countries. The findings of this study provide insights for healthcare providers, patients and policymakers about the headache management provided by chiropractors. These findings call for further research to ensure the quality and safety of headache management by this provider.

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Abbreviations

ABS	Australian Bureau of Statistics
ACA	Australian Chiropractors Association
ACORN	Australian Chiropractic Research Network
AHPRA	Australian Health Practitioner Regulation Agency
AHRQ	Agency for Healthcare Research and Quality
AIHW	Australian Institute of Health and Welfare
APA	Australian Physiotherapy Association
APS	Australian Psychological Society
ARCCIM	Australian Research Centre in Complementary and Integrative Medicine
BEACH	Bettering the Evaluation and Care of Health
CAM	Complementary and Alternative Medicine
CBT	cognitive behavioural therapy
CCEA	Council on Chiropractic Education Australasia
EMG	electromyography
ER	Emergency room
GP	General practitioner
HDI	Headache Disability Inventory
HIT-6	Headache Impact Test
HSR	Health Services Research
ICHD	International Classification of Headache Disorders
MIDAS	Migraine Disability Assessment questionnaire
MOH	Medication overuse headache

MT	Manual therapy
NSAIDs	non-steroidal anti-inflammatory drugs
NSW	New South Wales
OR	odds ratio
PBRN	Practice-based research network
SD	standard deviation
US	United States
UTS	University of Technology Sydney
WFC	World Federation of Chiropractic
WHO	World Health Organization
YLD	Years lived with disability

1 Background

1.1 Chapter introduction

Drawing upon the methods and principles of health services research (HSR), this thesis presents a critical examination of the management of headache disorders by chiropractors and the utilisation of chiropractors by those with headache disorders. This background chapter defines the key themes and scope of this thesis study. The chapter introduces HSR as a framework for examining the topic. It provides the thesis aims, objectives and context of the research questions. Following this, the significance of the research topic and the study itself is outlined.

1.1.1 Defining health services research

While definitions of health services research evolve, the Association for Health Services Research in the United States (US) describes HSR as a:

... 'multidisciplinary field of inquiry, both basic and applied, that examines the use, costs, quality, accessibility, delivery, organisation, financing, and outcomes of healthcare services to increase knowledge and understanding of the structure, processes, and effects of health services for individuals and populations' (Lohr & Steinwachs 2002, p. 16).

In more simple terms, HSR is conducted to assess a range of factors that can affect the accessibility, use, efficiency and quality of health services (Bradley et al. 2011). In doing so, HSR enquiry incorporates several levels of healthcare to understand the influence

of patients, providers, organisations and policymakers on the quality of healthcare services (Ferlie & Shortell 2001). The field of HSR can, therefore, encompass factors directly related to both the provision and utilisation of healthcare services, both individually and collectively, that influence the planning, funding and quality of healthcare provision (Bowling 2014; Hanney et al. 2003).

One important aspect of HSR is the collection of epidemiological information (Oleske 2014). Epidemiology involves ‘the study of the distribution and determinants of health-related states or events (including disease) and the application of this study to the control of diseases and other health problems’ (World Health Organisation 2019, para. 1). While the origins of epidemiology began with the examination of infections and disease within the wider community, epidemiology has evolved to encompass the examination of specific subpopulations, including those found within hospitals and other clinical settings (Susser & Bresnahan 2001). Within such clinical settings, epidemiological information provides vital health services knowledge about the incidence and burden of disease at the point where direct contact and interaction with healthcare services occurs – knowledge that provides valuable stakeholder information regarding healthcare practice and treatment (Smith 2001).

Health Services Research utilises a range of data collection methods, including face-to-face interviews, survey questionnaires and health records (Andersen 2008; Archer et al. 2011; Sofaer & Firminger 2005). By employing these data collection methods, representative HSR information can be drawn directly from healthcare providers and/or health consumers. Gathering and evaluating this information can provide health services insights into issues of direct importance to key stakeholders and

decision-makers. These include government officials and policymakers who seek to reduce disease and improve the health of the community (Damschroder et al. 2009), insurers engaged in healthcare organisation and healthcare funding (Feldstein 2012), and providers at the frontline healthcare delivery. Most significantly, insights drawn from HSR can help to ensure that individuals achieve better health outcomes as a result of their engagement with healthcare provision (Rosenstock 2005; Steinwachs & Hughes 2008).

1.1.2 Health services research for the investigation of chiropractic care

Empirical enquiry into complementary and alternative medicine (CAM) has grown significantly in recent years to encompass a range of perspectives and research methods of relevance to the quality of CAM health services. Within CAM, the chiropractic profession is one provider group that is worthy of HSR examination (Khorsan 2008). The expanding workforce, infrastructure and patient reach of the chiropractic profession identifies the growing significance of HSR within chiropractic in order to build valuable knowledge about the role of this provider group within health systems (Maiers et al. 2018).

A recent global assessment of the chiropractic workforce across 193 countries estimated there are 103,469 practising chiropractors worldwide, and 81 countries providing direct access to chiropractic services, 51% of which provide government and/or private health coverage for chiropractic health services (Stochkendahl et al. 2019). The assessment further identified that chiropractic education was available in 48 institutions across 19 countries; 16 countries provided education accredited by an international accreditation council, government body, or both. With the growth and

delivery of chiropractic health services, HSR is needed to provide valuable knowledge on a range of issues of significance to the profession and to healthcare generally.

To date, HSR within chiropractic has emerged across a range of inter-related fields. This has included HSR examination of the safety of chiropractic treatment (Jevne, Hartvigsen & Christensen 2014; Kosloff et al. 2015), the role of chiropractors within interdisciplinary care (Hawk 2002; Wardle, Sibbritt & Adams 2013) and the cost and utilisation of chiropractic services (Comans et al. 2014; French, Densley, et al. 2013; Wardle, Sibbritt & Adams 2013). However, while HSR is an emerging research field within the discipline of chiropractic, there remain significant research gaps regarding the role of chiropractors within healthcare. Most notably, there is a lack of information on the contribution of chiropractors in reducing significant public health burdens and integration and positioning of chiropractors within multidisciplinary healthcare management.

These concerns were highlighted in recent national consensus projects – inclusive of researchers, providers and patients – which identified the need for more high-quality HSR as the highest research priority for the profession in order to address this lack of empirical research knowledge (French et al. 2017; Rubinstein et al. 2014). Beyond the profession, a range of government-supported strategic research plans and funding initiatives have also called for the prioritisation and expansion of HSR across the field of CAM, inclusive of the chiropractic profession, in order to assist healthcare policy related to CAM-based healthcare (Menard et al. 2015; National Health and Medical Research Council 2010; US Department of Health and Human Services: National Institutes of Health 2004).

In summary, the evidence generated by HSR enables exploration of a range of issues and questions of importance to a variety of stakeholders on the delivery and use of chiropractic health services. Consequently, HSR is appropriate for addressing the aim and objectives of the research outlined in this thesis study, as outlined in sections 1.2 below.

1.1.3 Health services research for the investigation of chiropractic care in the context of headache disorders

The research described in this thesis utilised an HSR approach to examine chiropractic healthcare provision for people with headache disorders and the use of chiropractors by those with headache disorders. Headache disorders represent a substantial burden for individuals, health systems and economies (Stovner et al. 2018; Vo et al. 2018).

Despite the broad-reaching impact of headache disorders, a global headache report, supported by the WHO, found information was lacking on the epidemiology of headache disorders and the quality and delivery of headache-related healthcare services (World Health Organization 2011).

Since most people with headache initially seek help from general practitioners (GPs) (Sanderson et al. 2013), to date, HSR examination of headache patient management has primarily been limited to conventional primary care settings (Ashina et al. 2015; Katsarava et al. 2018; Silberstein et al. 2018). However, many with headache also seek help beyond the confines of medical care. For example, the use of CAM providers for headache appears to be substantial, and CAM use for headache increases with headache severity, when headache burden is not resolved through medical care, or

when the side effects of medical headache treatments are significant (Adams, Barbery & Lui 2013).

The utilisation of chiropractors for headache is one such CAM provider that illuminates the growing need for more headache-related HSR. General population studies have identified the substantial use of chiropractors by those who experience headache disorders. For example, an international cross-sectional study found chiropractors were ranked as the second and third most popular headache care provider for people with migraine in Australia and the US, respectively (Sanderson et al. 2013). A national US survey found that the most popular CAM therapy utilised for headache management was manipulative therapy, as commonly utilised by chiropractors (Zhang et al. 2017). Limited research information suggests headache complaints also constitute a substantial proportion of chiropractic clinical practice. Headache has been identified as the third most common specific health complaint in people seeking help from Australian chiropractors (Brown et al. 2014) and one of the top five complaints for why people seek help from chiropractors internationally (Beliveau et al. 2017).

Despite the high prevalence use of chiropractors by people with headache, there remains little understanding of the critical aspects of headache patient healthcare delivery within chiropractic settings. Further, there has been limited investigation of the headache features or levels of headache burden found within chiropractic patient populations. Addressing these research gaps can help to inform the quality and safety of healthcare services delivery within the clinical field of headache. Moreover, this knowledge can advance understanding of issues relevant to the broader management of this significant public health burden, information that is important to healthcare

practice, health policy and those who experience headache disorders. This thesis responds to this critical gap in healthcare knowledge by implementing established and recognised HSR methods and by analysing data collected from a nationally representative sample of chiropractors.

1.2 Aims and scope of thesis

1.2.1 Research aim

The aim of this research is to describe Australian chiropractors' management of headache disorders and the profile and headache characteristics of those seeking headache management from chiropractors through the application of a health services research approach.

1.2.2 Research questions

Addressing the overall aims of the thesis project involved addressing research questions tied to the three phases of the study design. For heuristic reasons, the research questions are introduced below as they relate to each of the three phases of the thesis. These phases include – a detailed literature review (Phase One), a survey of chiropractic practitioners (Phase Two), and a survey of chiropractic headache patients (Phase Three) in order to answer the following five research questions:

Phase One:

- 1.a. What is the prevalence of manual therapy (MT) use for the management of headache disorders internationally?
- b. What are the characteristics of the users of MT providers for headache, including sociodemographic profile, motivations for use, communication about

MT provider use with other healthcare providers and self-reported effectiveness of MT for headache?

Phase Two:

2.a. What proportion of chiropractors who have a high caseload of migraine (treat 'often')?

b. What are the practitioner, practice and clinical management characteristics associated with chiropractors with a high migraine caseload?

3. How do chiropractors manage people with recurrent headaches, including their use of headache diagnosis, headache assessment instruments, and their approach to headache treatment and collaborative headache management?

4.a. What proportion of chiropractors use primary headache diagnostic criteria?

b. What are the headache management factors associated with chiropractors who use primary headache diagnostic criteria?

Phase Three:

5.a. What are the headache features and what is the level of headache burden in people who present to chiropractors for headache management?

b. Is headache type or the reasons for consulting a chiropractor associated with patient satisfaction with chiropractic headache management?

1.2.3 Significance and scope of thesis

While the literature contains considerable knowledge about the broader aspects of chiropractic patient care and the general use of chiropractors within healthcare, there remains little research information regarding headache patient management provided by chiropractors and the characteristics of people with headache seeking help from chiropractors. Crucially, there are significant HSR gaps regarding how chiropractors approach the diagnosis, assessment and treatment of this substantial patient population. In addition, little is known about the sociodemographic background, headache features and level of headache burden in those seeking chiropractic healthcare for headache management. The insufficient information within this field raises questions about the quality and safety of headache patient care by chiropractors. Accordingly, there is a need for a methodologically rigorous, nationally representative study to produce valuable new knowledge that can be used to address these issues. The outcomes of this research will inform headache patients about chiropractic health services delivery for headache. It will inform providers who seek to better understand healthcare utilisation and service delivery within the multidisciplinary landscape of headache management. Additionally, insights from this work will inform educational standards relevant to chiropractic headache practice. The development of government policy aimed at improving the quality, safety and effectiveness of headache patient management will also benefit from the outcomes of this work.

1.2.4 Organisation of thesis

This work is a thesis by compilation and describes a cohesive, inter-related body of research. The findings presented herein have been published (four articles) or submitted for publication (one article) in peer-reviewed journals (chapters 2, 4, 5, 6, 7). The structure of this thesis is as follows.

Chapter 1 presents background knowledge for subsequent chapters. The first section of the chapter explains the use of an HSR approach to chiropractic patient care generally and with regards to those with headache disorders specifically. This is followed by an outline of the broader significance of chiropractic within the Australian healthcare system and the wider significance of headache patient care, with an overview of the classification used for the diagnosis of common recurrent headaches. This is followed by an overview of the Australian healthcare system and a summary of the healthcare providers and headache treatment guidelines used for headache management.

Chapter 2 presents the findings of Phase One – a review of the international literature on the use of MT for headache. The review covered patient profile, patient motivations, patient communication and patients' self-reported effectiveness of MT provider use for headache. The end of chapter 2 features a discussion of the limitations of the review and highlights several research gaps in this broad topic. This work was published in the journal *BMC Neurology*.

Chapter 3 outlines the study design and study methods. This includes an overview of practice-based research networks (PBRNs) more generally, and the Australian Chiropractic Research Network (ACORN) PBRN utilised for data collection for the study.

This is followed by an outline of the survey research design and data collection methods used in the study and related data storage and management. The chapter finishes with an outline of the statistical analyses used within the study.

Chapter 4 contains findings for Phase Two of the study. It presents the prevalence of migraine management within chiropractic practice settings and the practitioner, practice and clinical management characteristics associated with chiropractors who often manage migraine. The findings were published in the journal *BMC Complementary and Alternative Medicine*.

Chapter 5 presents findings for Phase two of the study. It presents the prevalence of headache disorders within chiropractic clinical practice and a cross-sectional descriptive analysis of the features of headache management by chiropractors. These findings were published in the journal *BMC Neurology*.

Chapter 6 contains findings for Phase Two of the study. It presents the headache management characteristics associated with chiropractors who utilise primary headache diagnostic criteria. These findings were published in the journal *Chiropractic and Manual Therapies*.

Chapter 7 contains findings for Phase Three of the study. It presents results from a cross-sectional descriptive analysis of patients who present to chiropractors for headache management. A manuscript describing this work was submitted to the journal *Complementary Therapies in Medicine*.

Chapter 8 contains a discussion of the overarching themes from all three study phases. The chapter highlights important issues relating to headache patients, healthcare

providers, provider education and healthcare policy. The chapter also identifies the limitations and strengths of the study and areas for future research.

This thesis represents the first comprehensive HSR study of headache management within chiropractic clinical practice. Specifically, the research provides the first detailed examination of the management of headache disorders by chiropractors and provides new knowledge of the profile and clinical characteristics of people with headache seeking chiropractic management. Building upon the findings of the literature review in Phase One, the study provides novel empirical evidence about and understanding of chiropractors' diagnosis and management of headache disorders in Phase Two, and the features and burden of people with headache disorders seeking chiropractic care in Phase Three. The findings include valuable insights that can be used to improve healthcare provision associated with this significant public health challenge.

1.3 The wider significance of chiropractic healthcare

The focus of this research was the provision and use of chiropractic healthcare services. In order to examine the delivery and use of chiropractic services for the management of people with headache disorders, it is necessary to understand the broader significance of the chiropractic profession within the context of the Australian healthcare system. While chiropractic in Australia is a well-established, nationally registered healthcare profession, the emergence of chiropractic within healthcare has been unique with regard to its cultural identity, institutions, training, regulation and approach to patient management (Mootz et al. 2006). Accordingly, this chapter provides an overview of the role and identity of chiropractors within healthcare. This is followed by an outline of chiropractic training and education and a description of the

regulatory obligations of chiropractors within Australian healthcare. The section concludes with an outline of the characteristics of people who utilise the services of chiropractors and the features of chiropractic healthcare delivery generally. This information provides context to key factors relevant to chiropractic health services delivery and the obligations and responsibilities of the chiropractic profession within healthcare, including within the field of headache management.

1.3.1 The role and identity of chiropractic internationally and in Australia

This section begins with an outline of two cultural identities found within the chiropractic profession. These distinct identities have important implications for how chiropractors approach patient care.

1.3.1.1 Traditional role and identity of chiropractic

The role and identity of chiropractors within healthcare has long been controversial in Australia and internationally. In the late 1800s, Daniel David Palmer, the founder of chiropractic, developed the theory of the chiropractic 'subluxation' as the central premise that underpins chiropractic healthcare (Homola 2006). While exact definitions of the chiropractic subluxation have varied over time (Johnson 2011; Rome 2013), Palmer originally described it as a malalignment of spinal vertebra and was the first to postulate the theory that subluxated vertebrae were the cause of the majority of diseases (Palmer 1910). To this day, many chiropractors identify the chiropractic subluxation as relevant to their professional role and identity within healthcare (Clijsters, Fronzoni & Jenkins 2014; Johnson 2011).

Spinal manipulation, described by some chiropractors as a spinal 'adjustment', is postulated to relieve the adverse health impacts caused by chiropractic subluxations.

Palmer's original theory was that spinal adjustments would remove the nerve interference to bodily functions caused by subluxations in order to allow the body to heal itself of disease naturally (Palmer 1914). To date, however, no population-based epidemiological studies have identified the theorized health impacts of chiropractic subluxations (Mirtz et al. 2009). Moreover, clinical research has yet to identify meaningful changes to human health resulting from spinal manipulation of chiropractic subluxations via postulated neurological mechanisms. The lack of research evidence to validate subluxation-based chiropractic care has resulted in considerable debate about the identity and role of chiropractors within contemporary evidence-based healthcare (Engel, Beirman & Grace 2016; Ernst & Gilbey 2010; Harvey 2016).

1.3.1.2 Contemporary role and identity of chiropractic internationally and in Australia

In contrast to the scientific uncertainty that remains regarding the provision of chiropractic patient care founded upon the traditional chiropractic paradigm, the chiropractic profession, primarily over the last 20 years, has developed national and international chiropractic research agendas aimed at targeting recognised public health domains associated with spine-related health and disease (French et al. 2017; Rubinstein et al. 2014; Stuber, Bussi eres & Gotlib 2009). Common themes identified within the research priorities developed by the chiropractic profession include examination of the role of chiropractors within multidisciplinary care, how chiropractors approach the management of recognised musculoskeletal burdens, and the safety, effectiveness, and cost-effectiveness of chiropractic therapies. Additionally, several profession-based consensus documents identify the broader public health role of the profession as advocates of health promotion and disease prevention more

generally (Evans, Williams & Perko 2008; Hawk et al. 2012; Johnson & Green 2009).

The role of chiropractors for the management of spine-related complaints has been particularly emphasised by chiropractic representative organisations internationally and in Australia. The World Federation of Chiropractic (WFC) is a global not-for-profit organisation that exists 'to support, empower, promote and advance chiropractors and the chiropractic profession' (World Federation of Chiropractic 2009a, para. 1). The WFC was admitted into official relations with the WHO as a non-governmental organization in 1997 (Dynamic Chiropractic 1997); its members are 88 national chiropractic professional associations. In 2005, after extensive stakeholder consultation, a WFC taskforce report aimed to establish a public identity for chiropractic as the 'spinal health care experts in the healthcare system' (World Federation of Chiropractic 2005, p. 7). The WFC encouraged national chiropractic associations' implementation and alignment of such an identity by developing communication programs aimed at both the public and the wider profession. Identity statements contained in the report were designed to incorporate several aspects of chiropractic patient care. They included providing care aimed at improving the function of the neuromusculoskeletal system, providing a specialised approach to patient assessment and care without the use of drugs and surgery, and providing care founded on the best available research and clinical evidence, with an emphasis on the relationship between the spine and the nervous system. Further, the report identified chiropractors as highly qualified healthcare providers of manual treatments, exercise instruction and patient education, utilising a patient-centred and biopsychosocial

approach to patient care, and as healthcare professionals who collaborate with other healthcare professionals (World Federation of Chiropractic 2005).

In Australia, the largest professional association representing Australian chiropractors, with a membership of over 3000 practitioners, is the Australian Chiropractors Association (ACA) (Australian Chiropractors Association 2019b). In alignment with WFC precepts, the ACA has similarly identified chiropractic as a 'drug and surgery free modality of treatment concerned with the diagnosis, management and prevention of mechanical disorders of the musculoskeletal system (spine); and the effects of these disorders on the function of the nervous system and general health' (Australian Chiropractors Association 2019a, para. 1). Chiropractic Australia, the second largest professional association representing chiropractors in Australia, with a membership of approximately 1000 members, similarly identifies the role of chiropractors as "the non-surgical spine and musculoskeletal care experts" (Chiropractic Australia 2015).

1.3.2 Chiropractic training and education in Australia

In further understanding the role of chiropractors within Australian healthcare, it is essential to outline the educational standards required of both Australian and internationally trained chiropractors in order to be accredited to practice within Australia. Australian-trained chiropractors receive five years of public university education and training at undergraduate or masters level or both (Council on Chiropractic Education Australasia 2019). RMIT University and Central Queensland University offer Bachelor of Health Science (Chiropractic) undergraduate programs (three years) followed by a Master of Chiropractic postgraduate program (two years). The Macquarie University program (Sydney, New South Wales [NSW]) offers a

Bachelor of Chiropractic Science (three years) as the basis for entry into a Master of Chiropractic program (two years). Murdoch University (Perth, Western Australia) offers a double degree program of Bachelor of Chiropractic Science (three years) and Bachelor of Clinical Chiropractic (two years).

The Australian Government has granted authority to the Council on Chiropractic Education Australasia (CCEA) to accredit chiropractic programs in Australia, New Zealand, and Asia and to recognise chiropractic training programs in other countries accredited through affiliated chiropractic education councils (Council on Chiropractic Education Australasia 2004). All chiropractors from accredited overseas programs must pass a CCEA examination before being eligible for registration to practice in Australia. CCEA competency standards cover a broad range of skills, knowledge and capabilities that ensure that chiropractic graduates are competent to practise (Council on Chiropractic Education Australasia 2017). Standards relate to patient assessment, diagnostic decision-making, planning and implementation of patient care, disease prevention, health management and professional scientific development. The CCEA expects chiropractors to recognise their wider role and responsibilities in public health practice within the Australian health system (Council on Chiropractic Education Australasia 2004). As such, CCEA practice competency standards include performance criteria that identify determinants of health, including psychological, biological, cultural and social elements of health, and a demonstration of knowledge of the cause, pathology, clinical features, history and prognosis of clinical findings associated with public health priorities (Council on Chiropractic Education Australasia 2017). In addition, CCEA-accredited chiropractic programs recognise and support the need for

collaborative professional relationships with other healthcare providers, including for disease prevention, health maintenance and for the management of chronic conditions as appropriate (Council on Chiropractic Education Australasia 2017).

1.3.3 Chiropractic regulation and registration in Australia

An outline of the regulatory responsibilities of the chiropractic profession under Australian government law provides further knowledge and understanding regarding the role and obligations of chiropractors within Australian healthcare. All practising Australian chiropractors are registered with and regulated by the Australian Health Practitioner Regulation Agency (AHPRA) (Australian Health Practitioner Regulation Agency 2019a). The Chiropractic Board of Australia is one of the 15 nationally registered boards that works with AHPRA under a single National Registration and Accreditation Scheme (Chiropractic Board of Australia 2018).

The primary objectives of the National Registration and Accreditation Scheme are to ensure registered healthcare providers are suitably trained and qualified to keep the public safe by practising according to the national code of conduct as well as facilitating the provision of high-quality education and training (Australian Health Practitioner Regulation Agency 2019b). As such, the functions of the Chiropractic Board of Australia include the registration of chiropractors, the development of standards (codes and guidelines), handling complaints and disciplinary hearings, assessing chiropractors trained overseas who wish to practice in Australia, and approving accreditation standards and programs of study. Accordingly, Australian chiropractors are regulated under mandate to approach patient care and public health issues in accordance with evidence-informed healthcare standards of practice and to

work collaboratively with other healthcare providers when necessary.

To summarise this section, this thesis study draws upon an operationalised role of chiropractors as university-trained, nationally registered healthcare providers who provide evidence-based patient care for the diagnosis and management of musculoskeletal disorders, including those associated with the spine, and who provide guidance for health promotion and disease prevention. Accordingly, the next section of this chapter outlines the wider significance of the use and delivery of chiropractic patient care.

1.3.4 Trends in the use of chiropractors internationally and in Australia

Understanding the prevalence and characteristics of those who seek help from chiropractors furthers understanding of the role of chiropractors within healthcare. Research indicates that the use of chiropractors is substantial in many western countries. For example, a cross-sectional analysis of US national health survey data (n=42,525) found the lifetime and 12-month prevalence of use of chiropractic were 24% and 8.4%, respectively (Adams, Peng, Cramer, et al. 2017). In Great Britain, a national survey of 1794 adults found 1.6% had used a chiropractor in the previous 12 months (Thomas & Coleman 2004). In Scandinavia, telephone surveys conducted in Norway (n=1000) and Sweden (n=1001) found the proportions of adults who had ever used chiropractic were 11% and 30% respectively (Hanssen et al. 2005).

In Australia, survey research also indicates the substantial utilisation of chiropractors. In 2005, the Australian Bureau of Statistics (ABS) estimated 433,000 chiropractic consultations occurred in Australia across two weeks (equating to approximately 11 million visits per year) and identified the profession as the most frequently consulted

complementary healthcare provider in Australia (Australian Bureau of Statistics 2005). In 2008, in a national survey of 1067 adults, it was estimated that users of chiropractors averaged 8.4 visits, totalling approximately 19.1 million visits over the previous 12 months (Xue et al. 2008). The study found that 16.1% of participants had consulted a chiropractor at least once over the previous 12-month period. In 2015, an online survey of a nationally representative sample of Australian chiropractors estimated they managed around 21.3 million patient visits annually, based upon the average number of patient visits reported (Adams, Lauche, et al. 2017).

Finally, a scoping review of the global literature reported the use of chiropractors remained essentially constant between 1980 and 2015 (Beliveau et al. 2017). The review further identified that overall lifetime utilisation of chiropractic was approximately 22.2%, and the median 12-month usage of chiropractic was approximately 9.1% internationally.

1.3.5 Sociodemographic features of those who use chiropractic in Australia

Previous researchers have studied the profile and sociodemographic characteristics of people who seek help from Australian chiropractors. Findings suggest the typical user of chiropractic services is female, middle-aged, well-educated and in secure employment. For example, a telephone survey of 1067 Australian adults found most people seeking help from chiropractors were Australian born, female, aged between 35 and 64 years, employed, and with a post-secondary school education (Xue et al. 2008). Another Australian survey of 486 users of chiropractic identified that 67.1% of participating chiropractic patients were female, 45.1% were aged between 45–64 years, and 65% reporting an annual pre-tax income above \$40,000 (Brown et al. 2014).

A study of 7,519 Australian medical patients who also consulted with chiropractors found that users of chiropractic were, relative to non-users, more likely to be Australian-born, have a GP located in a rural area, and less likely to be aged 55–76 years, on a pension, government benefit or unemployed (French, Densley, et al. 2013).

1.3.6 Health complaints and treatment common within Australian chiropractic

There is limited information regarding the use of Australian chiropractors specific to headache and there is even less information regarding the headache management they provide. A national population survey of the Australian public found back pain (65.7%), neck pain (20.7%) and headache (9.3%) were the most common complaints for which people consulted chiropractors (Xue et al. 2008). The study also found that 32.3% of respondents sought help from chiropractors for reasons of general health and well-being. A cross-sectional survey of 486 patients systematically sampled from 100 chiropractic clinics across all Australian states and territories similarly found musculoskeletal complaints (68.7%), general health (21.2%) and headache (5.5%) were the three most common reasons for seeking help from chiropractors (Brown et al. 2014).

Research indicates that Australian chiropractic patient care primarily incorporates the use of MTs – defined here as hands-on treatments, such as manipulation, mobilisation and massage, applied to reduce pain and/or improve musculoskeletal function (Woodward, Herring & Windsor 2000) – and the provision of general health and lifestyle advice. For example, a recent national workforce survey of 2005 Australian chiropractors found that chiropractors report providing treatment for a variety of health complaints on an ‘often’ basis, with low back pain (axial) (94.7%), neck pain

(axial) (96.3%), and headache disorders (87.2%) the most common (Adams, Lauche, et al. 2017). While the study found the most common therapies employed by chiropractors were spinal manipulation/mobilisation (82.2%), soft tissue therapies (66.1%) and exercise therapies (49.3%), it did not identify the degree to which these therapies were utilised for headache alone. The study also reported that chiropractors on an 'often' basis conducted discussions on patient lifestyle factors, including physical activity (84.9%) and diet/nutrition (50.5%), again without identifying the degree to which these approaches were utilised for headache. Similarly, a study of 52 randomly selected Australian chiropractors in clinical practice in the state of Victoria (4464 patient encounters) found 60% of all patient encounters were defined as musculoskeletal (French, Charity, et al. 2013). The study found the most common specific complaint areas were back pain (49.7%), neck pain (11.4%) and headaches (2.9%), and MTs were the most frequently used treatment, followed by exercise prescription, advice on posture, the use of heat, ice and nutritional supplements.

Overall, there is only limited information that exists suggesting that headache is a common feature of chiropractic clinical practice. Limited information also suggests that chiropractic patient care most often includes the use of MTs and health/lifestyle advice, without specific knowledge about the care they provide for those with headache. Accordingly, the next section of this chapter outlines the wider significance of headache patient care, including a description of common recurrent headaches, their pathophysiology in the context of MT treatment, and the personal and societal burdens associated with recurrent headaches.

1.4 The wider significance of headache care

Common recurrent headache disorders are a significant public health challenge.

Globally, tension-type headache and migraine are the most common recurrent primary headaches (Vos et al. 2013). An estimated 3 billion people experienced a headache disorder in 2016, with tension-type headache and migraine affecting around 1.89 billion and 1.04 billion people, respectively, and with women between 15-49 years, the largest group affected (Stovner et al. 2018). From pooled studies, the global prevalence of current tension-type headache and current migraine is estimated to be 38% and 10% in adults, respectively (Stovner et al. 2007). While less common, cervicogenic headache is one of the most common recurrent secondary headaches and is estimated to affect up to 4.1% of adults (Sjaastad & Bakkevig 2008; Sjaastad & Fredriksen 2000).

The personal and societal burdens associated with tension-type headache and migraine are substantial. Most notably, migraine is one of the top 10 causes of years lived with disability (YLDs) according to the Global Burden of Disease (Vos et al. 2015). For all neurological disorders, migraine is reported as the second-largest contributor to disability-adjusted life years after stroke (Feigin et al. 2017). While there is less personal burden associated with tension-type headache, the societal burden of tension headache is substantial due to its higher overall prevalence and its impact on work productivity (Rasmussen, Jensen & Olesen 1992; Schwartz, Stewart & Lipton 1997).

The substantial prevalence of headache disorders and their health impact on individuals constitute a significant public health challenge. Consequently, the following

section contains a review of the headache classification criteria utilised for the diagnosis of recurrent headaches, both primary and secondary. This is followed by an outline of the potential role of MTs in recurrent headache management, followed by a description of the personal, economic and resource burden associated with common recurrent headaches.

1.4.1 Classification of recurrent primary headaches

An examination of headache management and clinical headache populations requires understanding of the criteria healthcare providers use to diagnose headache types. The third edition of the International Classification of Headache Disorders (ICHD) provides internationally recognised classification criteria for the diagnosis of headache disorders (Headache Classification Committee of the International Headache Society 2018). Headache diagnosis is primarily established after careful questioning of the patient regarding their headache characteristics, following ICHD criteria.

By definition, primary headache disorders occur in the absence of any other disorder that might otherwise be the cause of the headache, while secondary headache disorders occur in close temporal relation to another disorder recognised as a cause of headache (Olesen 2005). This section outlines the ICHD diagnostic criteria for common recurrent primary headaches that are the focus of the research in this thesis.

Tension-type headache

There are two commonly recognised types of tension-type headache: episodic tension-type headache (frequent and infrequent subtypes) and chronic tension-type headache. The ICHD diagnostic criteria for diagnosis of these tension-type headaches are described below.

Infrequent and frequent episodic tension headache

A classification of *infrequent* episodic tension-type headache requires headache frequency of at least 10 episodes of headache occurring on less than one day/month on average (less than 12 days/year), while a classification of *frequent* episodic tension-type headache requires at least 10 episodes of headache on 1–14 days/month on average for more than three months (at least 12 and less than 180 days/year). In addition, classification of both of these tension headache subtypes requires patient headache symptoms to fulfil the following criteria B–D: (B) headache lasting from 30 minutes to seven days; (C) at least two of the following four characteristics: (1) bilateral location (2) pressing or tightening (non-pulsating) quality (3) mild or moderate intensity (4) not aggravated by routine physical activity such as walking or climbing stairs; (D) both of the following: (1) no nausea or vomiting (2) no more than one of photophobia or phonophobia; (E) and not better accounted for by another ICHD-3 diagnosis' (Headache Classification Committee of the International Headache Society 2018, pp. 36-7).

Chronic tension-type headache

A classification of chronic tension-type is as follows: (A) headache occurring on average for greater than 3 months (180 days or more per year), fulfilling criteria B–D: (B) lasting hours to days, or unremitting; (C) at least two of the following four characteristics: (1) bilateral location; (2) pressing or tightening (non-pulsating) quality; (3) mild or moderate intensity; (4) not aggravated by routine physical activity such as walking or climbing stairs; (D) both of the following: (1)

no more than one of photophobia, phonophobia or mild nausea; (2) neither moderate or severe nausea nor vomiting; (E) and not better accounted for by another ICHD-3 diagnosis' (Headache Classification Committee of the International Headache Society 2018, p. 37).

Migraine

There are three commonly recognised types of migraine: migraine without aura, migraine with aura and chronic migraine. The ICHD diagnostic criteria for these migraine subtypes are described below.

Migraine without aura (common migraine)

A classification of migraine without aura is as follows: '(A) at least five attacks fulfil criteria B to D: (B) Headache attacks lasting 4–72 hours (when untreated or unsuccessfully treated); (C) headache has at least two of the following four characteristics: (1) unilateral location (2) pulsating quality (3) moderate or severe pain intensity; (4) aggravation by or causing avoidance of routine physical activity (e.g. walking or climbing stairs); and (D) during headache at least one of the following: (1) nausea and/or vomiting (2) photophobia and phonophobia; (E) not better accounted for by another ICHD-3 diagnosis' (Headache Classification Committee of the International Headache Society 2018, p. 19).

Migraine with aura

A classification of migraine with aura is as follows: '(A) at least two headache attacks fulfil criteria B and C: (B) one or more of the following fully reversible aura symptoms: (1) visual (2) sensory (3) speech and/or language (4) motor (5) brainstem (6) retinal; (C) at least three of the following six characteristics: (1) at

least one aura symptom spreads gradually over at least 5 minutes; (2) two or more aura symptoms occur in succession; (3) each individual aura symptom lasts 5–60 minutes; (4) at least one aura symptom is unilateral; (5) at least one aura symptom is positive; (6) the aura is accompanied, or followed within 60 minutes, by headache; and (D) not better accounted for by another ICHD-3 diagnosis’ (Headache Classification Committee of the International Headache Society 2018, p. 20).

Chronic migraine

A classification of chronic migraine requires headache to occur on at least 15 days/month for more than three months, where migraine features occur on at least eight days/month, and fulfil the following criteria: ‘(A) Headache (migraine-like or tension-type like) on at least 15 days/month for more than 3 months, and fulfils criteria B and C; (B) occurring in a patient who has had at least five attacks fulfilling criteria B–D for Migraine without aura and/or criteria B and C for Migraine with aura; (C) on at least 8 days/month for more than 3 months, fulfilling any of the following: (1) criteria C and D for migraine without aura; (2) criteria B and C for Migraine with aura; (3) believed by the patient to be migraine at onset and relieved by a triptan or ergot derivative; (D) and not better accounted for by another ICHD-3 diagnosis’ (Headache Classification Committee of the International Headache Society 2018, p. 24).

1.4.2 Classification of recurrent secondary headaches

By definition, the diagnosis of a secondary headache disorder is applied if a new headache occurs in close temporal relation to another disorder recognised to be a

cause of headache (Olesen 2005). This section outlines the ICHD diagnostic criteria for the common recurrent secondary headaches that are the focus of the research in this thesis.

Cervicogenic headache

A classification criteria of cervicogenic headache is as follows: '(A) any headache fulfilling criterion C; (B) clinical and/or imaging evidence of a disorder or lesion within the cervical spine or soft tissues of the neck, known to be able to cause headache; (C) evidence of causation demonstrated by at least two of the following: (1) headache has developed in temporal relation to the onset of the cervical disorder or appearance of the lesion; (2) headache has significantly improved or resolved in parallel with improvement in or resolution of the cervical disorder or lesion; (3) cervical range of motion is reduced and headache is made significantly worse by provocative maneuvers; (4) headache is abolished following diagnostic blockade of a cervical structure or its nerve supply; (D) not better accounted for by another ICHD-3 diagnosis' (Headache Classification Committee of the International Headache Society 2018, pp. 150-1).

Medication-overuse headache

A classification of medication-overuse headache is provided where an individual with a pre-existing primary headache develops a new headache in association with the overuse of headache medications in circumstances where headache fulfils the following criteria: '(A) headache occurring on 15 or more days per month in a patient with a pre-existing headache disorder; (B) regular overuse for more than 3 months of one or more drugs that can be taken for acute and/or symptomatic treatment of

headache; (C) not better accounted for by another ICHD-3 diagnosis' (Headache Classification Committee of the International Headache Society 2018, p. 122).

1.4.3 Pathophysiology of recurrent headaches in the context of manual therapy

The previous section of this thesis (1.3) identified headache as a common feature of chiropractic clinical practice and MTs as chiropractors' most frequently utilised approach to patient treatment. This section explores theorised pathophysiological pain mechanisms associated with recurrent headaches and the significance of MT methods for headache. A brief explanation of these pain mechanisms in relation to MT treatment methods further substantiates the need for closer examination of chiropractors' headache patient care.

Tension-type headache pathophysiology

Research into the pathophysiology of headache disorders is ongoing and evidence remains scarce regarding the role of MTs in reducing the burden of headache disorders. Primary headaches, such as tension-type headache and migraine, are the result of central nervous system dysfunction and considered to be genetically determined and independent of another disorder or condition (Cutrer & Smith 2013; Pietrobon & Moskowitz 2013; Russell 2007).

The origin of pain for tension-type headache appears to involve both peripheral and central pathways resulting from central sensitisation – a nervous system condition associated with the maintenance of chronic pain – due to prolonged peripheral input from peripheral muscle tissues (Ashina, Bendtsen & Ashina 2012). As such, peripheral activation of myofascial pain receptors (nociception) contribute to unfolding muscle pain and acute episodes of tension-type headache. As muscle pain episodes reoccur,

central nervous system sensitisation appears to lead to the progression of chronic tension-type headache (Bendtsen et al. 2016). While more research is needed, healthcare providers are advised to assess those with primary headaches for features of central sensitisation, including reduced pressure pain thresholds and hyperalgesia/allodynia (Arendt-Nielsen 2015; Nijs, Van Houdenhove & Oostendorp 2010). As such, treatment aimed at decreasing central sensitisation, including cognitive and educational approaches, and treatment targeting the peripheral nervous system, through the use of MTs, may be valuable (Fernandez-de-Las-Penas & Courtney 2014; Nijs, Van Houdenhove & Oostendorp 2010). Scientific research continues to evaluate the role of MTs in reducing nociceptive peripheral influence on the central nervous system in those with tension-type headache (de Tommaso & Fernández-de-las-Penas 2016; Fernandez-de-Las-Penas & Courtney 2014).

Migraine pathophysiology

Basic science and clinical research suggest migraine pain has a central origin involving the cortex and brainstem (Coppola, Pierelli & Schoenen 2007; Lambert 2010). In addition, indirect evidence suggests that migraine pain is influenced by peripheral input from within cervical spine structures that cause sensitisation of trigeminal nociceptive pathways (Levy 2010; Olesen et al. 2009). This latter mechanism may be more common in those who experience increased migraine frequency associated with underlying cervical spine dysfunction and neck pain (Ashina et al. 2015; Florencio et al. 2014; Ford et al. 2008). Despite this, there has been little research into whether reduced neck pain or related musculoskeletal dysfunction lessens migraine symptoms. Moreover, while the role of MTs in influencing the underlying musculoskeletal

mechanisms associated with migraine have been postulated, including that pre-existing cervical joint dysfunction contributes to an increase in migraine episodes (Fernández-de-las-Peñas, Cuadrado & Pareja 2006; Luedtke, Starke & May 2017), there is limited evidence to support such hypotheses.

Cervicogenic headache pathophysiology

Some evidence suggests central mechanisms are required to generate cervicogenic headache (Fernandez-de-Las-Penas & Courtney 2014; Vincent 2010b), while referred pain from the cervical spine is generally accepted as the primary cause of cervicogenic headache (Becker 2010). As Bogduk & Govind (2009) explained;

‘The mechanism underlying the pain involves convergence between cervical and trigeminal afferents in the trigeminocervical nucleus [...] nociceptive afferents from C1, 2 and 3 spinal nerves converge onto second-order neurons that also receive afferents from adjacent spinal nerves and from the first division of the trigeminal nerves, via the trigeminal nerve spinal tract’ (Bogduk & Govind 2009, p. 959).

Upper cervical spine pain convergence refers to areas of the head innervated by cervical spine nerves, while convergence with trigeminal afferents refers to the frontal, parietal and orbital areas of the head (Chua et al. 2012). Knowledge regarding how MTs influence underlying musculoskeletal mechanisms associated with cervicogenic headache remains sparse (Haldeman & Dagenais 2010; Zito, Jull & Story 2006).

1.4.4 The prevalence and burden of recurrent headaches in Australia and internationally

In light of the substantial use of chiropractors for headache management worldwide, the following section provides a more detailed outline of the prevalence, health burden and economic costs associated with common recurrent headaches.

Tension-type headache

Tension-type headache is reported to be the most common symptomatic condition globally (Vos et al. 2013). The global adult prevalence of current tension-type headache is approximately 40% (Jensen & Stovner 2008; Stovner et al. 2007), with a 1-year prevalences reported between 20% – 38% in the US and Asia and up to 80% in parts of Europe (Schwartz et al. 1998; Stovner et al. 2007). In a 12-year general population study set in Denmark, the lifetime prevalence of tension-type headache was reported to be 78%, with the majority (59%) experiencing infrequent episodic tension headache (Lyngberg et al. 2005a). The peak age for tension headache is reported to be 30–39 years, with a female preponderance (Lyngberg et al. 2005a; Schwaiger et al. 2009). Schwaiger et al. (2009) found that 47% of those with chronic tension-type headache experienced remission, while 12% of those with episodic tension-type headache went on to experience chronic tension headache. Chronic tension-type headache is estimated to affect 2–5% of the global population (Stovner et al. 2007; Yu & Han 2014). In the US, the one-year prevalence of chronic tension-type headache was estimated at 2.2%–2.6% (Schramm et al. 2013; Schwartz et al. 1998).

While tension-type headaches are less severe than migraines, the total impact of tension headache is reported to be greater when headache frequency is taken into

account (Abu Bakar et al. 2015; Stovner et al. 2007). Chronic tension-type headache evolves from an increase in the frequency of episodic tension headache (Headache Classification Committee of the International Headache Society 2018). Compared to infrequent or episodic tension-type headache, chronic tension headache causes far greater health burden (Silva Jr et al. 2004; Stovner et al. 2007), including increased psychiatric comorbidity, such as anxiety and depression (da Silva Jr et al. 2010; Holroyd et al. 2000). Uncertainty remains regarding the exact relationship between headaches and psychiatric comorbidity; some studies suggest a dose–response relationship, meaning higher psychiatric comorbidity occurs with increased headache frequency, while other studies suggest that psychiatric comorbidities lead to more frequent tension headache episodes and severity (Bergman-Bock 2017).

Migraine

While less common than tension-type headache, the prevalence of migraine is substantial. Migraine is reported to affect 17% of women and 6% of men in the US (Lipton et al. 2007) and over 17% of women and 8% of men in Europe (Schramm et al. 2013; Stovner & Andree 2010). The cumulative lifetime incidence for migraine was found to be 43% for women and 18% for men (Stewart et al. 2008). Based on information collected for the 2016 Global Burden of Disease study, a recent whitepaper report estimated that up to 4.9 million Australians are likely to experience migraine, with an estimated 7.6% experiencing chronic migraine (Deloitte Access Economics 2018).

The peak prevalence of migraine occurs between the ages of 18 and 44 years (Lipton et al. 2007; Smitherman et al. 2013) and is more common in Caucasians and African

Americans than in Asians (Burch, Rizzoli & Loder 2018). Migraine is also more common in vulnerable socio-economic populations, with prevalence increasing as household income decreases (Stewart, Roy & Lipton 2013; Winter et al. 2012). Accordingly, a higher migraine burden is reported in those without health insurance, unemployed and part-time workers (Blumenfeld et al. 2011; Buse et al. 2010). Each year, an estimated 2.5% of people with episodic migraine develop chronic migraine (Scher et al. 1998). The global prevalence of chronic migraine is estimated at 0.9%–5.1% (Natoli et al. 2009). A 1-year longitudinal study found that 7.6% of participants with episodic migraine experienced at least one period in which headache frequency would meet a diagnosis of chronic migraine (Serrano et al. 2017).

Migraine is associated with significant health burden. As noted earlier, when calculating the severity and prevalence of health loss as YLD, migraine is in the top 10 causes globally (Vos et al. 2015). As with tension-type headache, the level of disability associated with migraine increases with headache chronicity (Antonaci et al. 2011; Buse et al. 2013). For example, a study conducted across five European countries (France, Spain, Italy, UK and Germany) found chronic migraine caused a higher level of disability than episodic migraine, primarily due to the increased incidence of psychiatric disorders such as anxiety and depression (Bloudek et al. 2012). A large cross-sectional general population survey of European adults found the probability of comorbid anxiety and depression in people with migraine was 19% and 7%, respectively (Lampl et al. 2016). While further research is needed to understand the relationship between migraine and other health conditions, migraine is also associated with increased incidences of ischemic stroke, hypertension and hyperlipidemia

(Barbanti et al. 2010; Tietjen et al. 2007; Wang, Chen & Fuh 2010) and obesity (Bigal & Lipton 2006).

Medication overuse headache

As noted earlier, MOH is the result of the excessive use of acute symptomatic headache medications – analgesics, ergotamines, opioids, triptans and non-steroidal anti-inflammatory medications (Colas et al. 2004; Couch 2011; Diener & Limmroth 2004) – in people with pre-existing primary headaches (Peck, Roland & Smitherman 2018). Some evidence suggests MOH is more likely in people who are not seeking appropriate headache management, are poorly educated about their headache diagnosis, or exhibit excessive headache avoidance behaviours due to a heightened fear of experiencing headaches (Peck, Roland & Smitherman 2018). While affecting approximately 2% of adults, MOH is most common in those with chronic migraine (Stovner & Andree 2010; Westergaard et al. 2014). Similar to other chronic headaches, MOH is associated with increased anxiety and depression (Bendtsen et al. 2014) and a substantial increase in overall health burden (Raggi et al. 2015). While there is no evidence that MOH is responsive to MT-based treatment, all healthcare providers engaged in headache management have a responsibility to identify people who experience additional headaches as a result of the overuse of headache medications (Tepper 2012).

Cervicogenic headache

Few studies of the epidemiology of cervicogenic headache have been conducted. Findings suggest cervicogenic headache is one of the most common secondary headache disorders, with an adult lifetime prevalence of between 0.17%–4.6%

(Knackstedt et al. 2010; Nilsson 1995; Pereira Montero et al. 1996; Sjaastad & Bakketeig 2008).

There is conflicting evidence regarding the prevalences of cervicogenic headache in females and males (Knackstedt et al. 2010; Sjaastad & Bakketeig 2008; Vincent & Luna 1999). Limited evidence suggests the age of onset for cervicogenic headache is most often between 22 and 33 years (Knackstedt et al. 2010; Sjaastad & Bakketeig 2008), with onset common after whiplash (Drottning, Staff & Sjaastad 2002; Sjaastad, Fredriksen & Bakketeig 2009). While there is no definitive research on the prevalence of a chronic form of cervicogenic headache (i.e., 15 or more headache days per month), a general population study conducted in Norway identified the mean long-term duration of recurrent cervicogenic headache as approximately eight years (Knackstedt et al. 2010).

Information on the overall burden and disability associated with cervicogenic headache is also limited. When measuring overall health status using the short-form 36 questionnaire (SF-36), it was found that people with cervicogenic headache had significantly worse physical functioning scores and slightly worse bodily pain scores than those with migraine or tension-type headache (Suijlekom et al. 2003). Similar to primary headaches, pain severity, headache frequency and depressive symptoms may be significant determinants of disability in people with cervicogenic headache (Gesztelyi & Bereczki 2006).

1.4.5 Economic burden of recurrent headaches in Australia and internationally

Recurrent headache disorders cause substantial economic impact, including both indirect and direct costs. Indirect costs are associated with the reduced work

performance and lost workdays of people with headaches (Stovner & Hagen 2006).

Direct costs are associated with headache-related health care utilisation and the use of headache medications (Edmeads & Mackell 2002). The following information from Australia, Europe and the US provides insights into the significant indirect and direct costs of recurrent headaches. An understanding of the financial costs of headaches to society reinforces the need to examine their management, including by chiropractors.

Indirect and direct costs associated with recurrent headache disorders

Research into the economic costs associated with recurrent headaches has most often focused on migraine, because the associated indirect and direct costs are the largest. Little information is available for the economic costs associated with tension-type headache, while no information is available regarding the economic burden of cervicogenic headache.

In Europe, indirect costs make up the majority of the total economic burden associated with headaches (Stovner & Andree 2008). In a cross-sectional study conducted across eight European countries, the total annual cost of headache amongst adults aged 18–65 years was estimated at 173 billion euro, including costs of 111 billion euro (64%), 21 billion euro (12%) and 37 billion euro (21%) for migraine, tension-type headache and MOH, respectively (Linde et al. 2012). The same study found that 93% of the costs associated with migraine were indirect costs, with annual mean per-person costs primarily attributed to reduced productivity (765 euro) and absenteeism (371 euro). Similarly, the study found indirect costs for tension-type headache accounted for 92% of the financial burden, with annual mean per-person costs attributed mainly to reduced productivity (173 euro) and absenteeism (105 euro).

In comparison, a recent cross-sectional US study found that indirect costs per person per year were less than direct costs for those with migraine (Messali et al. 2016). The study estimated indirect and direct costs for people with chronic migraine of \$3300 and \$4943, respectively, and \$943 and \$1705 for episodic migraine, respectively. The same study found high proportions of the direct costs associated with migraine were attributed to pharmaceutical use for people with chronic migraine (80%) and with episodic migraine (70%). Utilising comparable international data, indirect and direct (health system) costs for migraine were calculated to be \$16.3 billion and \$14.3 billion, respectively, in Australia each year (Deloitte Access Economics 2018). The report further estimated that migraine-related absenteeism per person per annum was 5.2 days for those with chronic migraine and 2.8 days for those with episodic migraine.

Migraine is the most frequent cause of headache-related healthcare consultation in the US, Europe and Western Pacific countries such as Australia (World Health Organization 2011). In the US, it was estimated that migraine accounted for approximately one million emergency room (ER) visits at the cost of approximately \$700 million, and 22 million hospital outpatient visits at the cost of approximately \$3.2 billion (Insinga, Ng-Mak & Hanson 2011). Overall, consultation rates, including specialist consultation, are reported to increase as patient headache frequency increases regardless of headache type (Lyngberg et al. 2005b). Consequently, direct healthcare costs associated with chronic headache are higher than for episodic headache (Bloudek et al. 2012; Sanderson et al. 2013). In an analysis of data from the International Burden of Migraine Study across the US, Canada, Germany, France, UK and Australia, the highest levels of hospitalisation for headache were found to occur in

Canada and Australia (Sanderson et al. 2013). The cost of GP consultations for migraine in Australia was estimated at \$63.5 million (Britt H et al. 2016), and the costs associated with migraine-related specialist consultation and diagnostic testing in Australia were estimated at \$5.6 billion per year (Deloitte Access Economics 2018) when calculated from comparable European data (Bloudek et al. 2012).

1.5. The Australian healthcare system in the context of chiropractors

This section provides a brief outline of the wider Australian healthcare system, including a brief overview of the cost-sharing arrangements that exist between the government, health insurers and health consumers. This information contextualises chiropractors within the organisational framework of Australian healthcare and the factors that influence public access to healthcare providers, including chiropractors, for headache management in Australia.

Health care costs in Australia are covered by individuals as well as public and private sectors. In 2016–17, Australian health expenditure was \$180.7 billion, or 10% of gross domestic product (Australian Institute of Health and Welfare 2018). Of this, \$124 billion was funded by the Australian Government and \$56.5 billion by non-government sources, including \$30 billion by private individuals and \$21.7 billion from private health insurance. The Australian Government subsidises healthcare costs for Australian citizens under the Medicare scheme. Medicare covers costs associated with a range of healthcare services, including hospital care (including accommodation and theatre costs) as well as medical doctors and medical investigations (Australian Government Department of Human Services 2019). Australian GPs are the primary care gatekeepers; accordingly, GPs often coordinate patient care within the healthcare

system, including the referral of patients to hospitals, medical specialists or to allied health and CAM providers.

Private health insurance provides cover for healthcare costs that may not be covered under Medicare. This includes costs associated with private hospital care (hospital policies), medical consultation and related diagnostic testing, as well non-medical health services (ancillary policies), inclusive of chiropractic services (Australian Government Department of Health 2019). Chiropractors are recognised as primary health care providers within the Australian health system. The AIHW describes primary healthcare providers as those associated with a person's first point of contact where a person does not routinely need a referral, including medical and dental providers, nurses, pharmacists, physiotherapists, dietitians and chiropractors (Australian Institute of Health and Welfare 2016). The vast majority of chiropractic healthcare services are paid for by consumers, identified as 'out-of-pocket expenses', and by private health insurance. In addition, Medicare rebates are made available for a limited number of consultations with eligible healthcare providers, including chiropractors, when referred by a medical doctor under a Chronic Disease Management Plan (The Australian Government. Department of Health 2014). A chronic condition is defined as one that has existed for more than six months, for example asthma, cancer, cardiovascular disease, diabetes, stroke and musculoskeletal-related conditions.

1.5.1 Overview of headache care providers and treatment in Australia

In Australia, people with headache can seek help from a range of healthcare providers. In addition, chiropractors may collaborate with different healthcare providers when managing those with headache. This section therefore outlines the common headache

providers and treatments utilised in Australia for the management of headache disorders. For the purposes of this thesis, these headache providers are categorised into the following broad categories.

(1) Medical providers: healthcare professionals educated at medical schools and specialty colleges who are regulated and accredited by the Australian Medical Council (Australian Medical Council 2018). A practising medical doctor receives registration under categories including general and specialist registration groupings (Medical Board of Australia 2014). As such, GPs, neurologists and emergency care doctors are included under the terminology of 'medical provider' or 'medical practitioner' herein.

(2) Allied health providers: healthcare professionals identified as allied health are those traditionally associated with working closely with the medical profession, including pharmacists, physiotherapists and psychologists (Mazzotta 2016; Murad, Chatterley & Guirguis 2014; Verma, Paterson & Medves 2006).

(3) CAM providers: In Australia, the classification of acupuncturists, osteopaths and chiropractors as allied health or CAM remains unclear and varies depending on government institutions (Australian Government. Department of Health 2013; Australian Institute of Health and Welfare 2012), representative stakeholder organisations (Allied Health Professions Australia 2017) and the research literature (Xue et al. 2007; Zhang et al. 2007). Herein, these providers are identified under the umbrella term of CAM as identified by the WHO (World Health Organization 2014) and the Australian Medical Association; the latter describes CAM as a wide range of treatments and therapies, including acupuncture, chiropractic, osteopathy and naturopathy, not considered to be part of conventional medicine (Australian Medical

Association 2018).

1.5.2 Medical providers of headache management

General practitioners

As noted earlier, within the Australian healthcare system, GPs are the principal first point of contact for health consumers (Australian Bureau of Statistics 2017). GPs typically provide patients with the initial diagnosis of their headache and make decisions about headache treatment, patient referral or the need for further clinical investigations (Ridsdale et al. 2007). Headache disorders are one of the most common health problems presented to GPs in Australia and many other Western countries (Britt H et al. 2016; Latinovic, Gulliford & Ridsdale 2006; McCrone et al. 2011; Stark, Valenti & Miller 2007). A cross-sectional survey conducted across the US, Canada, Germany, France, UK and Australia found Australia had the highest proportion of primary care provider visits for headache over the previous three months (Sanderson et al. 2013). A sub-study conducted within the Australian Bettering the Evaluation and Care of Health (BEACH) program, a continuous national study of Australian GP activity (Family Medicine Research Centre 2016), found 11.5% of patients attending 191 Australian GPs had been diagnosed with migraine (Stark, Valenti & Miller 2007).

Headache medications commonly prescribed by GPs aim to reduce acute headache pain or to prevent future headaches. In Australia, GP-prescribed paracetamol, codeine and ibuprofen are the most common headache medications for the treatment of acute headaches (Charles & Britt 2005). Another Australian BEACH study identified that 79.3% of migraine patients were currently using acute migraine medications, while only 8.3% were taking preventative migraine medications (Stark, Valenti & Miller

2007). The study found that acute medications that were most often prescribed for less severe cases of migraine included simple analgesics or non-steroidal anti-inflammatory drugs (NSAIDs), while triptans and ergotamines were used for more severe and resistant cases, while beta-blockers and anticonvulsants were most commonly prescribed for migraine prevention.

Neurologists

Secondary care is medical care typically provided by a specialist upon referral by a GP in circumstances where more specialised knowledge, skill or equipment is needed. The Australian Department of Health defines neurology practice as that which 'involves the diagnosis and management of diseases affecting the central, peripheral and autonomic nervous systems and muscles' (Australian Government. Department of Health 2016, para. 1). Accordingly, neurologists are specialist medical doctors primarily involved in the diagnosis and treatment of conditions associated with the nervous system, including headache disorders. Neurologists receive headache-related referrals from GPs, particularly when patients have been less responsive to GP medical management and if advanced medical evaluation and clinical testing is needed for complex headache presentations (Ridsdale et al. 2007; Tedeschi, Russo & Tessitore 2012).

Headache patient referral from GPs to neurologists appears to be common in Australia. A study utilising information taken from 602,100 GP encounters across 6021 practices found GPs referred 11.4% of headache patient encounters, most often to neurologists and physiotherapists (Charles & Britt 2005). It has been estimated from UK data (Bloudek et al. 2012) that Australians with episodic migraine visit a neurologist or headache specialist approximately 0.4 times per year on average, while those with

chronic migraine visit a neurologist or headache specialist 1.7 times per year (Deloitte Access Economics 2018). More generally, the use of neurologists for headache is common. An international study found that neurologists are typically the second or third most common headache provider utilised in many Western countries, including Australia (Sanderson et al. 2013).

Beyond the prescription of acute and preventative headache medications, a range of specialist interventional treatments is utilised by neurologists, and other pain specialists, for headache. In Western countries, such treatments can include the use of occipital nerve blocks, a local anaesthetic injection administered in the upper neck for the treatment of migraine, cluster headache and cervicogenic headache (Moriggl & Greher 2018; Tang et al. 2017). Localised steroid injections can also be used either independently or in addition to the use of greater occipital nerve blocks for headache treatment (Kingston & Dodick 2018). Treatment of chronic headaches can also include the use of Anabotulinum A (Botox) intramuscular injections directed at specific head and neck areas (Lipton et al. 2016). More recently, calcitonin gene-related peptide injections have also been utilised for the prevention of migraine and cluster headache (Sun-Edelstein & Rapoport 2016).

Emergency departments

Emergency departments (EDs) are resourced with laboratory and imaging facilities sometimes needed for the assessment of those with more urgent or more complex headache presentations. Accordingly, headache patients with more severe headache pain, or headache symptoms are related to serious and potentially life-threatening underlying pathology, are more likely to attend EDs (Edlow et al. 2009; Goldstein et al.

2006). For example, in an Australian study of acute headache patients who attended hospital ERs in Queensland, a computed tomography head scan was utilised in 38% of cases and lumbar puncture in 4.7% of cases where serious underlying pathology was suspected (Chu et al. 2017). The same study found the median ED length of stay was 3.1 hours, after which the majority of patients were either discharged (57%) or admitted to the short-stay unit before discharge (23%).

The AIHW 2016–17 report on Australian ED care found headache was in the top 20 most common principal diagnoses for patients who were subsequently admitted to the hospital (Australian Institute of Health and Welfare 2017). Migraine symptoms, in particular, are the most common reason for attending hospital ERs for headache management (Cheng et al. 2016; Chu et al. 2017; Goldstein et al. 2006). An international study utilising a web-based survey of 16,663 adults who experience migraine found approximately 38% of those with chronic migraine and 27% of those with episodic migraine had visited a hospital ER over the previous three months in Australia (Sanderson et al. 2013). A study conducted within two Australian hospital ERs found paracetamol, NSAIDs and dopamine antagonists were the most common treatments provided for those who presented with migraine (Cheng et al. 2016).

1.5.3 Allied health providers

Beyond the headache management provided within conventional medical settings, several allied healthcare providers are engaged in headache patient care in Australia. This section provides a brief description of allied health providers who often provide care for those with headache, including pharmacists, physiotherapists and psychologists.

Pharmacists

Australian-trained pharmacists are university-educated (Marriott et al. 2008) and nationally registered healthcare providers under AHPRA (Pharmacy Board of Australia 2019). The Pharmaceutical Society of Australia describes the role of Australian pharmacists as preparing or supervising the dispensing of medicines and providing advice on medicines to other healthcare professionals and the public with regard to their use and safety (Pharmaceutical Society of Australia 2018). Australian pharmacists provide both prescription and over-the-counter medications to alleviate the symptoms of headache (Brooker 2018). Beyond pharmaceutical treatments, pharmacists also assist people with headache disorders by providing advice and information to assist with headache prevention (Giaccone et al. 2014).

Physiotherapists

Australian-trained physiotherapists are university or college educated (Australian Physiotherapy Council 2017) and nationally registered under AHPRA (Physiotherapy Board of Australia 2019). The Australian Physiotherapy Association (APA), which has over 26,000 members, describes physiotherapists as primary contact practitioners who help people 'recover from injury, reduce pain and stiffness, increase mobility and prevent further injury' (Australian Physiotherapy Association 2019b, para. 1).

Treatment methods commonly utilised by Australian physiotherapists include exercise programs, joint manipulation and mobilisation, soft tissue mobilisation (massage), acupuncture and dry needling (Australian Physiotherapy Association 2019b).

The APA identifies headache as one of the key complaints managed by the profession (Australian Physiotherapy Association 2019a). Physiotherapists are more likely to treat

patients with headaches when cervical spine musculoskeletal pain and dysfunction are contributing factors (Luedtke, Boissonnault, et al. 2016; Zito, Jull & Story 2006). In a study of 274 Australian physiotherapy patients across NSW and Western Australia, musculoskeletal conditions, including those associated with neck pain, were the most commonly reported reasons for physiotherapy consultation (Hush et al. 2012).

Another Australian study found the most common treatment approaches utilised by physiotherapists for headache management were cervical spine mobilisation (84.7%), spinal manipulation (42.1%), soft tissue massage (35.6%), postural education (30.2%) and muscle stretching (29.2%) (Grant & Niere 2000). Low to moderate-quality evidence suggests MTs, including those utilised by physiotherapists, are effective for the prevention of tension-type headache (Luedtke, Allers, et al. 2016; Mesa-Jiménez et al. 2015) and cervicogenic headache (Racicki et al. 2013).

Psychologists

Australian-trained psychologists have university degrees (Scott, Pachana & Sofronoff 2011) and are nationally registered healthcare providers under AHPRA (Psychology Board of Australia 2019). The Australian Psychological Society (APS), which has over 24,000 members, describes the goal of psychology as ‘not just to study human thinking and behaviour, but to put that knowledge into practice, to help people, communities, and society in general to solve day-to-day problems and improve quality of life’ (Australian Psychological Society 2019, para. 3).

The APS identifies the importance of psycho-behavioural treatments for the management of people with headache disorders (Australian Psychological Society 2016). Psychologists have been incorporated into interdisciplinary headache

management teams to assist with behavioural aspects of headache patient care, particularly for those with more complex and refractory headache presentations (Barton et al. 2014). Psychotherapies such as electromyography (EMG) biofeedback, cognitive behavioural therapy (CBT) and relaxation training can be valuable in the management of headache pain (Lee, Lee, et al. 2019; Penzien et al. 2015). In addition, psychologists provide care for people who experience headache-related psychiatric comorbidities, such as anxiety and depression (Jensen et al. 2010; Seng et al. 2014). Treatment guidelines provide strong recommendations for the effectiveness of psycho-behavioural therapies such as EMG biofeedback (level A recommendations) and CBT and relaxation training (level B recommendations) for the prevention of tension-type headache (Bendtsen et al. 2010).

1.5.4 Complementary and alternative medicine providers

Australians experiencing headache can seek help from a range of CAM providers. This section gives a brief description of several Australian CAM providers, including chiropractors, who commonly provide care for people with headache.

Acupuncturists

Australian-trained acupuncturists are educated in universities and private colleges (Zheng 2014) and nationally registered under AHPRA (Chinese Medicine Board of Australia 2019). The Australian Acupuncture and Chinese Medicine Association describes acupuncture as a treatment that ‘involves the insertion of fine, sterile, single use disposable needles into specific sites (acupuncture points) along the body’s energy pathways (meridians) to clear energy blockages and encourage the normal flow of

energy, or Qi through the body' (Australian Acupuncture and Chinese Medicine Association 2019, para. 2).

International studies show the popularity of acupuncture for the management of headache disorders in many Western countries (Kristoffersen et al. 2012; MacPherson, Sinclair-Lian & Thomas 2006; Wells et al. 2011). A global headache report compiled in collaboration with the WHO identified acupuncture as one of the three most frequently used CAM therapies for the management of headache disorders worldwide (World Health Organization 2011). Variable-quality evidence suggests acupuncture helps prevent tension-type headaches (Davis et al. 2008; Linde, Allais, Brinkhaus, Fei, Mehring, Shin, et al. 2016; Sun & Gan 2008) and migraine (Facco et al. 2008; Linde, Allais, Brinkhaus, Fei, Mehring, Vertosick, et al. 2016; Xu et al. 2018). International headache treatment guidelines recommend acupuncture (Level C recommendation) for the prevention of tension-type headache (Bendtsen et al. 2010).

Naturopaths and herbalists

Australian naturopaths and herbalists are not government-registered professions under AHPRA and are largely self-regulated. These providers commonly provide dietary and lifestyle advice, as well as guidance on the use of herbs and other nutritional supplements (Bensoussan et al. 2004; Smith et al. 2005). A national workforce survey of Australian CAM providers found 45% of naturopaths had a bachelor's degree or postgraduate qualification and 66.8% had qualifications up to advanced diploma level, while herbalists most often had a bachelor's degree (53%) or postgraduate qualification (28%) (Steel et al. 2018).

Some information suggests that the use of naturopaths and herbalists for headache is common. The WHO global headache report identified naturopathy as the third most frequently used CAM therapy for the management of headache disorders worldwide (World Health Organization 2011). A national US survey found that the prevalence of herbal therapy use amongst people with migraine and other severe headaches was 46.9% in the preceding 12 months (Rhee & Harris 2018). While headache treatment guidelines recommend particular herbs and dietary supplements for the prevention of episodic migraine (Holland et al. 2012), little is known about how naturopaths and herbalists employ such herbs and dietary supplements for headache.

Osteopaths

Australian-trained osteopaths are university educated (Vaughan, MacFarlane & Florentine 2014) and nationally registered under AHPRA (Osteopathy Board of Australia 2019). Osteopathy Australia is the largest professional representative body for Australian osteopaths reporting almost 2000 members and representation for 85% of Australian registered osteopaths (Osteopathy Australia 2018). Osteopathy Australia describes osteopaths as offering 'patient-centred approaches to healthcare and functional improvement which recognise the vital link between the structure of the body and the way it functions' with a focus on 'on how the skeleton, joints, muscles, nerves, circulation, connective tissue and internal organs function as a holistic unit' (Osteopathy Australia 2019, para. 2).

A survey of Australian osteopaths found their most-utilised therapeutic approach was MT, including soft tissue (71%), joint articulation (57%) and high-velocity manipulation (51%) (Orrock 2009). Limited variable quality evidence suggest MTs utilised by

osteopaths are effective for preventing migraine (Cerritelli et al. 2015; Triggian & Giannott 2013) and reducing headache-related comorbidity (D'Ippolito, Tramontano & Buzzi 2017).

Massage therapists

Australian-trained massage therapists are educated in private colleges, typically to diploma or advanced diploma level (Australian Bureau of Statistics 2016), and are largely self-regulated. A recent national study of Australian massage therapists found musculoskeletal conditions (79%), general health and well-being (72.7%) and pain management (63.1%) were the most commonly identified practice areas of interest (Steel et al. 2017). In Australia, the Association of Massage Therapists describes the range of soft tissue modalities commonly utilised by massage therapists as including therapeutic, relaxation, remedial and sports techniques (Association of Massage Therapists).

Limited variable quality clinical research suggests massage is helpful for the prevention of tension-type headache and migraine (Lawler & Cameron 2006; Moraska et al. 2015; Youssef & Shanb 2013). International headache treatment guidelines recommend (level C recommendation) for massage therapy for the prevention of tension-type headache (Bendtsen et al. 2010).

Chiropractors

Australian-trained chiropractors are university educated (Council on Chiropractic Education Australasia 2004) and are nationally registered under AHPRA (Australian Health Practitioner Regulation Agency 2019a). As outlined in section 1.3, the ACA identifies chiropractors as health professionals concerned with 'the diagnosis,

management and prevention of mechanical disorders of the musculoskeletal system, and the effects of these disorders on the function of the nervous system and general health' (Australian Chiropractors Association 2019a, para. 1). MTs, patient education and lifestyle advice are chiropractors' most common approaches to patient management (Adams, Lauche, et al. 2017). Low to moderate-quality evidence suggests MTs, including those utilised by chiropractors, help prevent tension -type headache (Posadzki & Ernst 2012) and cervicogenic headache (Chaibi & Russell 2012; Racicki et al. 2013). Preliminary clinical evidence suggests chiropractic MTs help prevent migraine (Chaibi, Tuchin & Russell 2011; Rist et al. 2019).

1.6 Treatment guidelines for the prevention of recurrent headaches

The aim of headache prevention is to decrease the frequency, severity and duration of future headache episodes and to improve function and decrease headache-related disability (Lipton & Silberstein 2015). As outlined, nationally registered healthcare providers, such as chiropractors, have a professional and regulatory obligation to provide headache patients with evidence-based information and treatment to reduce headache pain (see section 1.3). Accordingly, headache treatment guidelines summarise the current clinical research for the management of those with headache. This section outlines the recommendations of headache treatment guidelines for the common recurrent headaches that are the focus of this thesis.

1.6.1 Migraine

The American Academy of Neurology and the American Headache Society publish treatment guidelines for the pharmaceutical prevention of migraine (Silberstein et al. 2012). These guidelines report strong evidence for epilepsy drugs (Level A

recommendation), beta-blockers (Level A recommendation), sodium channel drugs (Level A recommendation), frovatriptan (for menstrual migraine; Level A recommendation), anti-depressants and triptans (level B recommendations). These recommendations are similar to those in other international pharmaceutical headache treatment guidelines (Pringsheim et al. 2012). An update of the American Academy of Neurology guidelines that is inclusive of complementary treatments provides additional recommendations for over-the-counter herbs and vitamin supplements for the prevention of migraine (Holland et al. 2012). It includes recommendations for the use of butterbur (Level A recommendation), feverfew (Level B recommendation), magnesium and riboflavin (Level B recommendations). Chiropractic-based guidelines for the treatment of migraine recommend MTs, including spinal manipulation and massage, for episodic or chronic migraine at the time of writing (Bryans et al. 2011). Importantly, there is no definitive guidance as to which individuals may benefit most from particular preventive treatments for migraine and in what circumstances.

1.6.2 Tension-type headache

While tricyclic antidepressants remain the drug of first choice for the prevention of tension-type headache, clinical studies report only modest preventative benefits (Jackson et al. 2017). As such, treatment guidelines recommend that non-drug therapeutic approaches be considered initially for tension-type headache. For example, the European Federation of Neurological Societies tension headache guidelines recommend non-drug therapies, including EMG biofeedback (Level A recommendation), CBT and relaxation training (Level B recommendation), physical therapy (including massage) and acupuncture (Level C recommendation) (Bendtsen et al. 2010). International guidelines for the non-pharmacological management of

persistent headaches associated with neck pain advise the use of low-load endurance cranio-cervical and cervico-scapular exercises as well as multimodal MTs (mobilisation/manipulation) for tension-type headache (Côté et al. 2019). Chiropractic-based guidelines for the treatment of tension-type headache recommend low-load cranio-cervical mobilisation for those with episodic or chronic tension-type headaches, while recommendations could not be made for the use of spinal manipulation for the treatment of chronic tension-type headache at the time of writing (Bryans et al. 2011). No definitive guidelines outline which individuals with tension headache would benefit most from preventive treatments and in what circumstances.

1.6.3 Cervicogenic headache

To date, there have been no published clinical trials of the effectiveness of pharmaceutical treatments for the prevention of cervicogenic headache. As a result, while individuals may often take analgesics or anti-inflammatory drugs for cervicogenic headache (Haldeman & Dagenais 2001), no drugs are currently recommended as effective for the management of this headache disorder (Bogduk & Govind 2009; Haldeman & Dagenais 2010). International guidelines for the non-pharmacological management of persistent headaches associated with neck pain advise the use of MTs (mobilisation/manipulation) for cervicogenic headaches of more than three months duration and advise that there is no additional benefit when these therapies are combined, including with exercises (Côté et al. 2019). International chiropractic-based guidelines recommend spinal manipulation, mobilisation and deep neck flexor exercises for the treatment of cervicogenic headache (Bryans et al. 2011).

1.7 Chapter summary

This chapter provides detailed background information on HSR in the context of chiropractic healthcare provision generally and chiropractic headache management specifically. It outlines the wider significance of chiropractic within Australian healthcare, the profile and characteristics of those who consult chiropractors, including those with headache, and the features of chiropractic healthcare delivery, including the substantial use of MT-based treatment. This is followed by an overview of the wider significance of headache, including the classification criteria utilised for the diagnosis of recurrent headaches, their pathophysiology in the context of MT, as well as the burden of recurrent headaches. The chapter concludes with a description of the healthcare providers and treatments available for headache management in Australia and an overview of headache treatment guidelines.

Importantly, the chapter highlights that despite the substantial public use of chiropractors for headache management worldwide, there is little information about the specific characteristics of chiropractors' headache patient management or the patient profile and headache features of people who seek help from chiropractors. An examination of these issues will improve our understanding of the public health role of chiropractors within the multidisciplinary field of headache patient care. This information will benefit providers, patients, educators of healthcare providers and healthcare policy to improve the safety and effectiveness of headache patient care.

2 Literature review

2.1 Chapter introduction

In line with the aim of this research, the purpose of this chapter is to provide a detailed overview of the current scientific literature on the wider use of MT providers by people with headache disorders in light of issues identified in chapter 1. The work presented in this chapter formed Phase One of the research and addressed research question 1 (see section 1.2.2). The literature review includes peer-reviewed articles on the use of MT providers for headache management, published in English between 2000 and 2015. The chapter reports on the prevalence of users of MT providers for headache management and their profile, motivations, communication and self-reported views on treatment effectiveness. The chapter closes with a discussion of the limitations of the review and highlights several research gaps that provide a broader framework for this thesis.

The work contained in this chapter was published as:

Moore, C.S., Sibbritt, D.W. & Adams, J. 2017, 'A critical review of manual therapy use for headache disorders: prevalence, profiles, motivations, communication and self-reported effectiveness', *BMC Neurology*, vol. 17, no. 61, pp. 1-11.

The published manuscript is presented in Appendix 1.

A critical review of manual therapy use for headache disorders: Prevalence, profiles, motivations, communication and self-reported effectiveness

2.2 Background

The co-occurrence of tension headache and migraine is very high (Lyngberg et al. 2005a). Respectively, they are the second and third most common disorders worldwide with migraine ranking as the seventh highest specific cause of disability globally (Vos et al. 2013) and the sixteenth most commonly diagnosed condition in the US (Burch et al. 2015). These common recurrent headache disorders place a considerable burden upon the personal health, finances and work productivity of sufferers (Bloudek et al. 2012; Burch et al. 2015; Lanteri-Minet 2014) with migraine further complicated by an association with cardiovascular and psychiatric co-morbidities (Antonaci et al. 2011; Kurth, Chabriat & Bousser 2012).

Preventative migraine drug treatments include analgesics, anticonvulsants, antidepressants and beta-blockers. Preventative drug treatments for tension-type headaches can include analgesics, NSAIDs, muscle relaxants and botulinum toxin as well as anticonvulsants and antidepressants. While preventative drug treatments are successful for a significant proportion of sufferers, headache disorders are still reported as under-diagnosed and under-treated within medical settings (Berger et al.

2012; Cevoli et al. 2009; Diamond et al. 2007; Lafata et al. 2010; Lipton et al. 2000; Lipton et al. 2007; Nicholson et al. 2006; Peres et al. 2007; Stark, Valenti & Miller 2007) with other studies reporting sufferers can cease continuing with preventative headache medications long-term (Diamond et al. 2007; Lipton, Buse, et al. 2013).

There is a number of non-drug approaches also utilized for the prevention of headaches. These include psychological therapies such as cognitive behavioral therapy, relaxation training and EMG (electromyography) biofeedback. In addition, there is acupuncture, nutritional supplementation (including magnesium, B12, B6, and Coenzyme Q10) and physical therapies. The use of physical therapies is significant, with one recent global survey reporting physical therapy as the most frequently used 'alternative or complementary treatment' for headache disorders across many countries (World Health Organization 2011). One of the most common physical therapy interventions for headache management is manual therapy (MT), (Bigal et al. 2008; Kristoffersen et al. 2012; Sanderson et al. 2013) which we define here as treatments including 'spinal manipulation (as commonly performed by chiropractors, osteopaths, and physical therapists), joint and spinal mobilization, therapeutic massage, and other manipulative and body-based therapies' (Department of Health and Human Services 2014).

Positive results have been reported in many clinical trials comparing MT to controls (Hoyt et al. 1979; Jull et al. 2002; Lawler & Cameron 2006; Marcus et al. 1998; Tuchin, Pollard & Bonello 2000), other physical therapies (Bove & Nilsson 1998; Haas et al. 2010; Parker, Tupling & Pryor 1978) and aspects of medical care (Boline et al. 1995; Castien et al. 2011; Hsieh et al. 2010; Nelson et al. 1998). More high-quality research is

needed however to assess the efficacy of MT as a treatment for common recurrent headaches. Recent systematic reviews of randomized clinical trials of MT for the prevention of migraine report a number of significant methodological short-comings and the need for more high quality research before any firm conclusions can be made (Chaibi, Tuchin & Russell 2011; Posadzki & Ernst 2011). Recent reviews of MT trials for tension-type headache and cervicogenic headache are cautious in reporting positive outcomes and the strong need for further robust research (Chaibi & Russell 2012, 2014; Mesa-Jiménez et al. 2015; Posadzki & Ernst 2012; Racicki et al. 2013). Despite the limited clinical evidence there has been no critical review of the significant use of MT by headache populations.

2.3 Methods

The aim of this study is to report from the peer-reviewed literature; 1) the prevalence of MT use for the treatment of common recurrent headaches and 2) factors associated with this use across several key themes. The review further identifies key areas worthy of further research in order to better inform clinical practice, educators and healthcare policy within this area.

2.3.1 Design

A comprehensive search of peer-reviewed articles published in English between 2000 and 2015 reporting new empirical research findings of key aspects of MT use among patients with migraine and non-migraine headache disorders was undertaken.

Databases searched were MEDLINE, AMED, CINAHL, EMBASE and EBSCO. The key words and phrases used were: 'headache', 'migraine', 'primary headache', 'cephalgia', 'chronic headache' AND 'manual therapy', 'spinal manipulation', 'manipulative

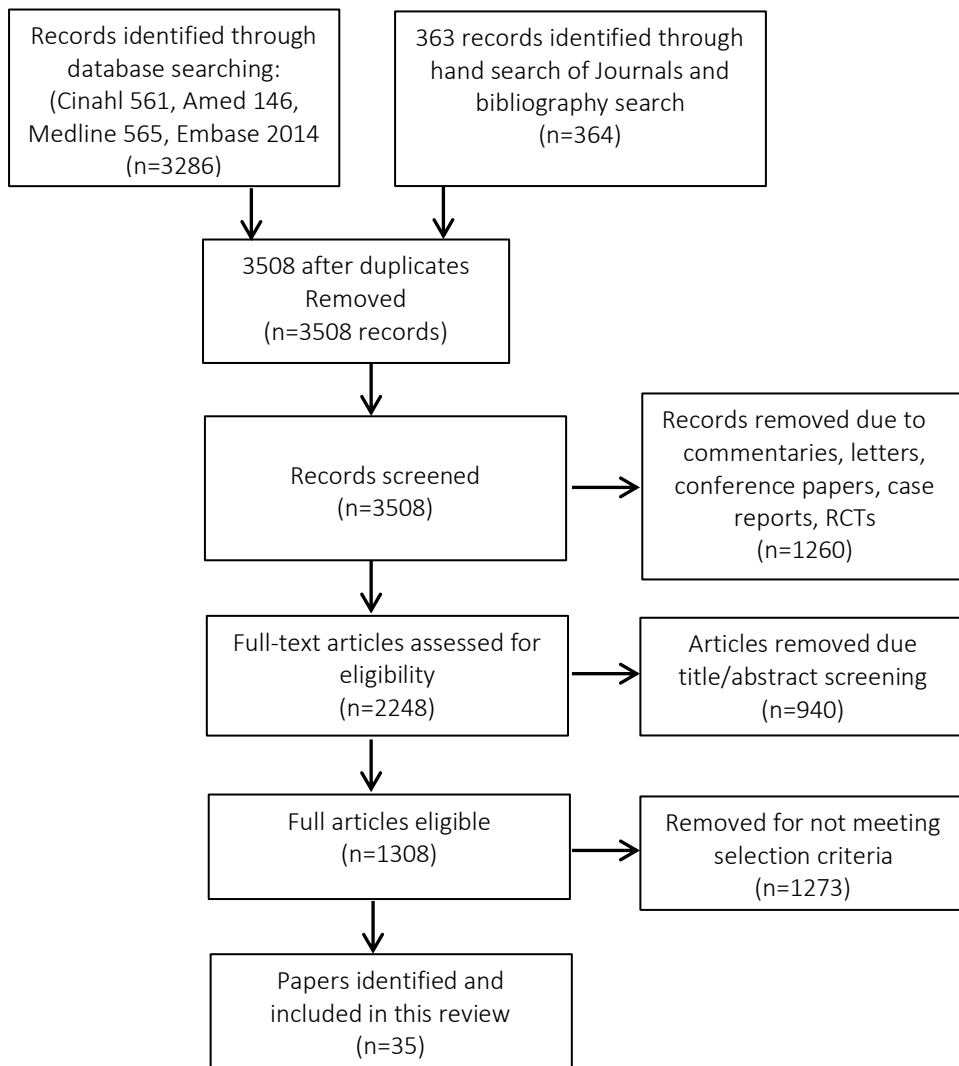
therapy', 'spinal mobilization', 'chiropractic', 'osteopathy', 'massage', 'physical therapy' or 'physiotherapy' AND then 'prevalence', 'utilization' or 'profile' was used for additional searches against the previous terms. The database search was accompanied by a hand search of prominent peer-reviewed journals. All authors accessed the reviewed literature (data) and provided input to analysis.

Due to the focus of the review, literature reporting randomized control trials and similar clinical research designs were excluded as were articles identified as letters, correspondence, editorials, case reports and commentaries. Further searches were undertaken of the bibliographies in the identified publications. All identified articles were screened and only those reporting new empirical findings on MT use for headache in adults were included in the review. Articles identified and selected for the review were research manuscripts mostly within epidemiological and health economics studies. The review includes papers reporting MT use pooled with the use of other therapies, but only where MT patients comprised a large proportion (as stated) of the included study population. Results were imported into Endnote X7 and duplicates removed.

2.3.2 Search outcomes, analyses and quality appraisal

Figure 2.1 outlines the literature search process. The initial search identified 3286 articles, 35 of which met the inclusion criteria. Information from each article was organized into a review table (Table 2.1) to summarise the findings of the included papers. Information is reported under two selected headache groups and within each individual MT profession - chiropractic, physiotherapy, osteopathy and massage therapy – where sufficient detail was available.

Figure 2.1: Flow chart of study selection



An appraisal of the quality of the articles identified for review was conducted using a quality scoring system (Table 2.2) developed for the critical appraisal of health literature used for prevalence and incidence of health problems (Loney et al. 1998) adapted from similar studies (Adams, Barberly & Lui 2013; Bishop et al. 2011; Fejer, Kyvik & Hartvigsen 2006). This scoring system was applicable to the majority of study designs involving surveys and survey-based structured interviews (29 of the 35 papers) but was not applicable to a small number of included studies based upon clinical records, secondary analysis or practitioner characteristics.

Two separate authors (CM and JA) independently searched and scored the articles.

Score results were compared and any differences were further discussed and resolved

by all the authors. The quality score of each relevant article is reported in Table 2.3.

Table 2.1: Research-based studies of manual therapy use for headache disorders

Authors Year	Country/ Region	Population/ Profession	Study Method	Sample size	Themes †	Prevalence use based on Headache Groupings
Ailliet et al 2010	Europe (Belgium)	Manual Therapy population / Chiropractic	Postal questionnaire by chiropractors	517 patients	1	Headache: Chiropractic 1.9%
Bethell et al 2013	North America	General population	Secondary analysis of national survey	2411	2	
Bigal et al 2008	North America	General population	Longitudinal study following a cohort of headache sufferers	Chronic migraine (520), Episodic migraine (9424)	1	Chronic migraine: Chiropractic 36.2% Physiotherapist 13.3% Episodic migraine: Chiropractic 25.7%, Physiotherapy 4.2%
Brown et al 2014	Australia	Manual Therapy population / Chiropractic	Cross-sectional survey completed by patients	486	1	Headaches: Chiropractic 5.5%
Cherkin et al 2002	North America	Manual Therapy population / Chiropractic	Practitioner completed questionnaire	2550	1	Headaches: Chiropractic Massachusetts 4.6%, Arizona 6.4%
Cooke et al 2010	North America	General population	Telephone survey to public	1210	1	Migraine: Chiropractic 6%, Massage 2%, Osteopathy 1%
Coulter et al 2002	North America	Manual Therapy population / Chiropractic	Patient questionnaires	1275	1	Headaches: Chiropractic 4.0%
Brown et al. 2013	Australia	Manual Therapy population / Chiropractic	Cross-sectional general population survey questionnaire	757	1	Headache: Chiropractic 45.5%

Table 2.1: Research-based studies of manual therapy use for headache disorders

Authors Year	Country/Region	Population/Profession	Study Method	Sample size	Themes †	Prevalence use based on Headache Groupings
French et al 2013	Australia	Manual Therapy population / Chiropractic	Cross-sectional observational practitioner survey	4464	1	Headaches: Chiropractic 4%
Gaul et al 2009	Europe (Germany/Austria)	Headache clinic population	Questionnaire based patient survey	432	1,2,3,4	Mixed primary headaches: Massage 46.1%, Physiotherapy 27.8%
Gaul et al 2011	Europe (Germany/Austria)	Headache clinic population	Questionnaire-based survey	448	1,2	Migraine (78.5%): Physiotherapy 18.7%, Massage 56.4%
Gaumer G 2006	North America	General population	Random telephone survey	800	1	Headaches: Chiropractic 5.3%
Goksel et al 2014	Europe (Turkey)	Headache clinic population	Patient questionnaire through interview	110	1,2,4	Migraine (64.6%): Massage 51%
Hartvigsen et al 2003	Europe (Denmark)	Manual Therapy / Chiropractic	Questionnaire data collected by practitioners	1897 patients	1	Headache: Chiropractic 4%
Jackson P 2001	North America	Manual Therapy population / Chiropractic	Postal questionnaire to chiropractors	1500	1	Headaches: Chiropractic 15.4%
Kristoffersen et al 2012	Europe (Norway)	General population	Cross-sectional epidemiological survey	405	1,2	All Primary Headaches: Chiropractic 28% Physiotherapy 52%
Kristoffersen et al 2013	Europe (Norway)	General population	Cross-sectional epidemiological postal survey and clinical interview	253 primary 82 secondary	4	

Table 2.1: Research-based studies of manual therapy use for headache disorders

Authors Year	Country/Region	Population/Profession	Study Method	Sample size	Themes †	Prevalence use based on Headache Groupings
Lambert et al 2010	Europe (UK)	Headache clinic population	Self-administered questionnaire	92	2,3	
Lyngberg et al 2005	Europe (Denmark)	General population	Medical doctor interviews	740	1	Mostly migraine: Chiropractic 9% Physiotherapy 5%
Malone et al 2012	North America	General population	On-line survey via migraine website	2735	1	Migraine: Massage 29.7%
Minen et al 2014	North America	Headache clinic population	Secondary analysis of baseline questionnaire data	225	1,2	Migraine with/without aura: Chiropractic 27.1%, Massage 18.2%, Physiotherapy 4.9%
Morin et al 2014	North America (Quebec)	Manual Therapy population	Prospective survey	1402	1	Migraine: Osteopathy 1.7% Headaches: Osteopathy 2.7%
Ndetan et al 2009	North America	General population	Secondary Survey analysis	31248	1	Headache: Chiropractic 15.1%
Orrock P 2009	Australia	Manual Therapy population / Osteopathy	Mailed practitioner questionnaire	2238 patient records	1	Headache: Osteopathy 10%
Ossendorf et al 2009	Europe (Germany)	Pain clinic population	Physician-administered structured interview and questionnaires	288 (136 with Headache)	1,4	Headache: Chiropractic 22%, Physiotherapy 35%, Osteopathy 9%, Massage 54%
Rossi et al 2005	Europe (Italy)	Headache clinic population	Physician-administered structured interview	481	1,2,3,4	Migraine: Massage 10.1%, Chiropractic

Table 2.1: Research-based studies of manual therapy use for headache disorders

Authors Year	Country/Region	Population/Profession	Study Method	Sample size	Themes †	Prevalence use based on Headache Groupings
						8.9%, Osteopathy 2.7%
Rossi et al 2006	Italy	Headache clinic population	Physician-administered structured interview	110	1,2,3,4	Headache (CTTH): Chiropractic 21.9%, Massage 17.8%
Rossi et al 2008	Europe (Italy)	Headache clinic population	Physician administered structured interview	100	1,2,4	Headache (cluster): Chiropractic 12%, Acupressure 12%
Rubinstein et al 2000	Europe (Netherland)	Manual Therapy population / Chiropractic	Retrospective patient questionnaires	833	1	Headache: Chiropractic 7%
Sanderson et al 2013	USA, Canada, UK, Germany, France and Australia	General population	Web-based screening questionnaire	16663	1,3	Chronic migraine: 10% USA Canada 10%, France/UK 0%, Germany 1%, Australia 14% Episodic Migraine: USA 7% Canada 4%, France/UK 1%, Germany 6%, Australia 14%
S von Peter et al 2002	North America	Headache clinic population	Patient interview using a standardized questionnaire	73	2,3,4	Tension, Migraine (27%) and other headaches: Chiropractic 15.1%, Massage 42.5%
Vukovic et al 2010	Europe (Croatia)	General population	Random cross-sectional survey questionnaire	616	1	Migraine: Chiropractic 9.5%, Physiotherapy 19.4% Tension headache: Chiropractic 4.0%, Physiotherapy 12.2%
Wells et al 2010	North America	General population	National cross-sectional	23,393	1	Migraine 18.5% and Headaches 15.7%:

Table 2.1: Research-based studies of manual therapy use for headache disorders

Authors Year	Country/ Region	Population/ Profession	Study Method	Sample size	Themes †	Prevalence use based on Headache Groupings
			survey sample			Chiropractic /massage pooled
Wells et al 2011	North America	General population	National cross-sectional survey sample	23,393	1,3	Migraine: Chiropractic 15.4%, Massage 15.1%
Xue et al 2008	Australia	General population	Cross-sectional telephone survey	1067	1	Headaches: Chiropractic 9.3%

Themes †: 1=MT prevalence use, 2=Profile and motivations, 3=Concurrent use, 4=Self-reported effectiveness

Table 2.2: Description of quality criteria and scoring for selected studies

Dimensions of Quality Assessment	Points Awarded[†]
Methodology	
A. Sampling strategy reported/appropriate to study design	1
B. Sample size >100	1
C. Response rate >75%	1
D. Low recall bias (prospective data collection or retrospective data collection within past 12 months)	1
Reporting of Participants characteristics	
E. Classification of migraine or headache type(s) reported	1
F. Age and sex	1
G. Ethnicity	1
H. Indicator of socioeconomic status (income, education)	1
Reporting of relevant MT factors	
I. Reporting of MT use for headache	1
J. Reporting of MT financial costs	1

[†]Maximum score of 10 points for studies applicable to this scoring system with each item weighted equally with 0 (criterion not fulfilled) or 1 (criterion fulfilled) point.

Table 2.3: Quality score for selected studies

Dimensions of Quality Assessment				
Authors/Year	Methodology	Participant characteristics	Reporting of MT use	Total score
Ailliet et al. 2010	A, B, C	F, H	I	6
Bigal et al. 2008	A, B, C, D	E, F, G, H		8
Brown et al. 2013	A, B, C, D	F, H		6
Brown et al. 2014	A, B, C, D	F, G, H	I	8
Cherkin et al. 2002	A, B, C, D	F, G	I	7
Cooke et al. 2010	A, B, D	E, F,		5
Coulter et al. 2002	A, B, D	F, G, H		6
French et al. 2013	A, B, D	F, G, H	I	7
Gaul et al. 2009	A, B, D	E, F, G, H	I	8
Gaul et al. 2011	A, B, D	E, F, H	I	7
Gaumer G, 2006	A, B, D	F, H		5
Goksel et al. 2014	A, B, D	E, F, H	I	7
Hartvigsen et al. 2003	A, B, C, D			4
Kristofferson et al. 2012	A, B,	E, F, G	I	6
Kristoffersen et al. 2013	A, B, D	E, F,	I	6
Lambert et al. 2010	A, D	F, G, H	I	6
Lyngberg et al. 2005	A, B, C, D	E, F		6
Malone et al. 2015	B, C, D	F,		4
Ossendorf et al. 2009	A, B, C, D	F, H	I	7
Rossi et al. 2005	A, B, D	E, F, H,	I	7
Rossi et al. 2006	A, B, D, E, F, H		I	7
Rossi et al. 2008	A, B, C, D	E, F, H		7
Rubinstein et al. 2000	A, B, C, D	F, H		6
Sanderson et al. 2013	A, B, C, D	E, F, G, H		8
von Peter et al. 2002	C, D	E, F, G, H	I	7
Vukovic et al. 2010	A, B, C, D	E, F,		6
Wells et al. 2010	A, B, D	F, G, H		6
Wells et al. 2011	A, B, D	F, G, H	I	7
Xue et al. 2008	A, B, D	F, G, H		6

Key: A-Sampling reported, B-Sample size >100, C-Response rate >75%, D-Low recall bias, E-Classification of headache type, F-Age and sex, G-Ethnicity, H-Socioeconomic status. Scoring: 1-4 poor quality, 5-6 low quality, 7-8 moderate quality, 9-10 high quality

2.4 Results

The key findings of the 35 articles were grouped and evaluated using a critical review approach adapted from previous research (Adams, Barbery & Lui 2013; Solomon & Adams 2015). Based on the limited information available for other headache types, prevalence findings are reported within one of two categories - either as 'migraine' for papers reporting studies where the population was predominately or entirely made up of migraine patients or as 'headache' for papers where the study population was predominately other headache types (including tension-type headaches, cluster headaches, cervicogenic headache) and/or where the headache type was not clearly stated. Ten papers reported findings examining prevalence rates for the 'migraine' category alone, 18 papers reported findings examining prevalence for the 'headache' category alone and 3 papers reported findings for both categories. Based on the nature of the information available, prevalence use was categorised by manual therapy providers. The extracted data was then analysed and synthesised into four thematic categories: *prevalence; profile and motivations for MT use; concurrent use and order of use of headache providers; and self-reported evaluation of MT treatment outcomes.*

2.4.1 Prevalence of MT use

Thirty-one of the reviewed articles with a minimum sample size (>100) reported findings regarding prevalence of MT use. The prevalence of chiropractic use for those with migraine ranged from 1.0% - 36.2% (mean: 14.4%) within the general population (Bigal et al. 2008; Cooke & Becker 2010; Kristoffersen et al. 2012; Lyngberg et al. 2005b; Sanderson et al. 2013; Vuković et al. 2010; Wells et al. 2011; Wells et al. 2010)

and from 8.9% - 27.1% (mean: 18.0%) within headache-clinic patient populations (Minen, Seng & Holroyd 2014; Rossi et al. 2005). The prevalence of chiropractic use for those reported as headache ranged from 4% - 28.0% (mean: 12.9%) within the general population (Gaumer 2006; Kristoffersen et al. 2012; Ndetan et al. 2009; Vuković et al. 2010; Wells et al. 2010; Xue et al. 2008); ranged from 12.0% - 22.0% (mean: 18.6%) within headache/pain clinic patient populations (Ossendorf et al. 2009; Rossi et al. 2006; Rossi et al. 2008) and from 1.9% - 45.5% (mean: 9.8%) within chiropractic patient populations (Ailliet, Rubinstein & de Vet 2010; Brown et al. 2013; Brown et al. 2014; Cherkin et al. 2002; Coulter I et al. 2002; French, Charity, et al. 2013; Hartvigsen et al. 2003; Jackson 2001; Rubinstein et al. 2000).

The prevalence of use of physiotherapy for those with migraine ranged from 9.0% - 57.0% (mean: 24.7%) within the general population (Bigal et al. 2008; Kristoffersen et al. 2012; Lyngberg et al. 2005b; Vuković et al. 2010) and from 4.9% - 18.7% (mean: 11.8%) within headache-clinic patient populations (Gaul et al. 2009; Minden, Seng & Holroyd 2014). The prevalence use of physiotherapy for those reported as headache ranged from 12.2% - 52.0% (mean: 32.1%) within the general population (Kristoffersen et al. 2012; Vuković et al. 2010) and from 27.8% - 35.0% (mean: 31.4%) within headache/pain clinic populations (Gaul et al. 2009; Ossendorf et al. 2009).

Massage therapy use for those with migraine ranged from 2.0% - 29.7% (mean: 15.6%) within the general population (Cooke & Becker 2010; Malone, Bhowmick & Wachholtz 2015; Wells et al. 2011) and from 10.1% - 56.4% (mean: 33.9%) within headache-clinic populations (Gaul, Schmidt, et al. 2011; Karakurum Goksel et al. 2014; Minden, Seng & Holroyd 2014; Rossi et al. 2005). Massage/acupressure use for those reported as

headache within headache/pain clinic patient populations ranged from 12.0% - 54.0% (mean: 32.5%) (Gaul et al. 2009; Ossendorf et al. 2009; Rossi et al. 2006; Rossi et al. 2008).

Osteopathy use for those with migraine was reported as 1% within the general population (Cooke & Becker 2010); as 2.7% within a headache-clinic patient population (Rossi et al. 2005) and as 1.7% within an osteopathy patient population (Morin & Aubin 2014). For headache the prevalence was 9% within a headache/pain clinic population (Ossendorf et al. 2009) and ranged from 2.7% - 10.0% (mean: 6.4%) within osteopathy patient populations (Morin & Aubin 2014; Orrock 2009).

The combined prevalence rate of MT use across all MT professions for those with migraine ranged from 1.0% - 57.0% (mean: 15.9%) within the general population; ranged from 2.7% - 56.4% (mean: 18.4%) within headache-clinic patient populations and was reported as 1.7% in one MT patient population. The combined prevalence rate of MT use across all MT professions for those reported as headache ranged from 4.0% - 52.0% (mean: 17.7%) within the general population; ranged from 9.0% - 54.0% (mean: 32.3%) within headache-clinic patient populations and from 1.9% - 45.5% (mean: 9.25%) within MT patient populations.

2.4.2 Profile and motivations for MT use

While patient socio-demographic profiles were not reported within headache populations that were exclusively using MT, several studies report these findings where MT users made up a significant percentage of the non-medical headache treatments utilized by the study population (range 40% - 86%: mean 63%). While findings varied for level of income (Gaul et al. 2009; Rossi et al. 2006) and level of

education, (Gaul et al. 2009; Gaul, Schmidt, et al. 2011; Karakurum Goksel et al. 2014) this patient group were more likely to be older (Gaul et al. 2009; Gaul, Schmidt, et al. 2011), female (Kristoffersen et al. 2012), have a higher rate of comorbid conditions (Bethell et al. 2013; Gaul et al. 2009; Rossi et al. 2006) and a higher rate of previous medical visits (Gaul et al. 2009; Kristoffersen et al. 2012; Rossi et al. 2006) when compared to the non-user group. Overall, this group were reported to have a higher level of headache chronicity or headache disability than non-users (Gaul et al. 2009; Gaul, Schmidt, et al. 2011; Kristoffersen et al. 2012; Lambert et al. 2010; Minen, Seng & Holroyd 2014; Rossi et al. 2006).

Several studies within headache-clinic populations report patient motivations for the use of complementary and alternative headache treatments where MT users made up a significant proportion of the study population (range 40% - 86%: mean 63%) (Gaul et al. 2009; Gaul, Schmidt, et al. 2011; Rossi et al. 2006; von Peter et al. 2002). From these studies the most common motivation reported by study patients was 'seeking pain relief' for headache which accounted for 45.4% - 84.0% (mean: 60.5%) of responses. The second most common motivation was patient concerns regarding the 'safety or side effects' of medical headache treatment, accounting for 27.2% - 53.0% (mean: 43.8%) of responses (Gaul et al. 2009; Gaul, Schmidt, et al. 2011; Rossi et al. 2006). 'Dissatisfaction with medical care' accounted for 9.2% - 35.0% (mean: 26.1%) of responses (Gaul et al. 2009; Gaul, Finken, et al. 2011; Rossi et al. 2006).

A limited number of reviewed papers (all from Italy) report on the source of either the referral or recommendation to MT for headache treatment (Rossi et al. 2006; Rossi et al. 2005; Rossi et al. 2008). From these studies, referral from a GP to a chiropractor

ranged from 50.0% - 60.8% (mean: 55.7%), while referral from friends/relatives ranged from 33.0% - 43.8% (mean: 38.7%) and self-recommendation ranged from 0% - 16.7% (mean: 5.6%). For massage therapy, referral from a GP ranged from 23.2% - 50.0% (mean: 36.6%), while referral from friends/relatives ranged from 38.4% - 42.3% (mean: 40.4%) and self-recommendation ranged from 7.7% - 38.4% (mean: 23.1%). For acupuncture, referral from a GP ranged from 33.0% - 50.0% (mean: 41.5%), while referral from friends/relatives was reported as 50% and self-recommendation ranged from 0% - 16.6% (mean: 8.3%). One study reported findings for osteopathy where referral from both GP's and friends/relatives was reported as 42.8% and self-recommendation was reported as 14.4%. Overall, the highest proportion of referrals within these studies was from GPs to chiropractors for chronic tension-type headache (56.2%), cluster headache (50%) and migraine (60.8%).

2.4.3 Concurrent use and order of use of headache providers and related communication of MT users

Several studies report on the concurrent use of medical headache management with complementary and alternative therapies. In those studies where the largest percentage of the patient population were users of MT's (range 57.0% – 86.4%: mean 62.8%), (Gaul et al. 2009; Rossi et al. 2006; von Peter et al. 2002) concurrent use of medical care ranged between 29.5% and 79.0% (mean: 60.0%) of the headache patient population.

These studies further report on the level of patient non-disclosure to medical providers regarding the use of MT for headache. Non-disclosure ranged between 25.5% - 72.0% (mean: 52.6%) of the patient population, with the most common reason

for non-disclosure reported as the doctor *'never asking'*, ranging from 37.0% - 80.0% (mean: 58.5%). This was followed by a patient belief that *'it was not important for the doctor to know'* or *'none of the doctor's business'*, ranging from 10.0% - 49.8% (mean: 30.0%). This was followed by a belief that either *'the doctor would not understand'* or *'would discourage'* these treatments, ranging from 10.0% - 13.0% (mean: 11.5%) (Lambert et al. 2010; Rossi et al. 2005).

One large international study reported the ordering of the typical provider of headache care by comparing findings between several countries for migraine patients (Sanderson et al. 2013). Primary care providers followed by neurologists were reported as the first and second providers for migraine treatment for nearly all countries examined. The only exception was Australia, where those with chronic migraine selected chiropractors as typical providers at equal frequency to neurologists (14% for both) while those with episodic migraine selected chiropractors at a greater frequency to neurologists (13% versus 5%). Comparatively, chiropractors were selected as the typical provider for those with chronic migraine by 10% in USA and Canada, 1% in Germany and 0% for UK and France. Chiropractors were selected as the typical provider for those with episodic migraine by 7% in USA, 6% in Germany, 4% in Canada and by 1% in both the UK and France.

2.4.4 Self-reported effectiveness of MT treatment outcomes

Several headache and pain-clinic population studies provide findings for the self-reported effectiveness of MT headache treatment. For chiropractic, patient self-reporting of partially effective or fully effective headache relief ranged from 27.0% - 82.0% (mean: 45.0%) (Ossendorf et al. 2009; Rossi et al. 2006; Rossi et al. 2005; Rossi

et al. 2008; von Peter et al. 2002). For massage therapy, patient self-reporting of partially effective or fully effective headache relief ranged from 33.0% - 64.5% (mean: 45.2%)(Karakurum Goksel et al. 2014; Ossendorf et al. 2009; Rossi et al. 2006; Rossi et al. 2005; von Peter et al. 2002), and for acupuncture this ranged from 33.4% - 50.0% (mean: 44.5%) (Rossi et al. 2006; Rossi et al. 2005; Rossi et al. 2008). For osteopathy and physiotherapy, one study reported effectiveness as 17% and 36% respectively (Ossendorf et al. 2009).

When results are combined across all MT professions the reporting of MT as either partially or fully effective ranged from 17.0% - 82.0% (mean 42.5%) (Karakurum Goksel et al. 2014; Ossendorf et al. 2009; Rossi et al. 2006; Rossi et al. 2005; Rossi et al. 2008; von Peter et al. 2002). In addition, one general population study provides findings for the self-reported effectiveness for chiropractic and physiotherapy at 25.6% and 25.1% respectively for those with primary chronic headache and 38% and 38% respectively for those with secondary chronic headache (Kristoffersen, Aaseth, et al. 2013).

2.5 Discussion

This paper provides the first critical integrative review on the prevalence and key factors associated with the use of MT treatment for headaches within the peer-reviewed literature. While study methodological limitations and lack of data prevent making strong conclusions, these findings raise awareness of issues of importance to policy-makers, educators, headache providers and future research.

Our review found that MT use was generally higher within medical headache-clinic populations when compared to general populations. However, the use of individual MT providers does vary between different regions and this is likely due to a number of

factors including variation in public access, healthcare funding and availability of MT providers. For example, the use of physiotherapy for some headache types may be relatively higher in parts of Europe (Kristoffersen et al. 2012; Ossendorf et al. 2009) while the use of chiropractors for some headache types may be relatively higher in Australia and the USA (Bigal et al. 2008; Sanderson et al. 2013). Overall, the prevalence use of MT for headache appears to be substantial and likely to be the most common type of physical therapy utilized for headache in many countries (Bigal et al. 2008; Cooke & Becker 2010; Kristoffersen et al. 2012; Sanderson et al. 2013). More high-quality epidemiological studies are needed to measure the prevalence of MT use across different headache types and sub-types, both within the general population and clinical populations.

Beyond prevalence, data is more limited regarding who, how and why headache patients seek MT. From the information available however, the healthcare needs of MT headache patients may be more complex and multi-disciplinary in nature compared to those under usual medical care alone. Socio-demographic findings suggest that users of MT and other complementary and alternative therapies have a higher level of headache disability and chronicity compared to non-users. This finding may correlate with the higher prevalence of MT users within headache-clinic populations and a history of more medical appointments. This may also have implications for future MT trial designs both in terms of the selection of trial subjects from inside versus outside MT clinical settings and the decision to test singular MT interventions versus MT in combination with other interventions.

Limited information suggests that a pluralistic approach toward the use of medical and non-medical headache treatments such as MT is common. While findings suggest MT is sought most often for reasons of seeking headache relief, the evidence to support the efficacy of MT for headache relief is still limited. MT providers must remain mindful of the quality of the evidence for a given intervention for a given headache disorder and to inform patients where more effective or safer treatment interventions are available. More research is needed to assess these therapies individually and through multimodal approaches and for studies to include long-term follow-up.

Information limited to Italy, suggests referral from GPs for MT headache treatment can be common in some regions, while this is less likely to be widespread given the issue of patient non-disclosure to medical doctors regarding the use of this treatment in other studies. High quality healthcare requires open and transparent communication between patients and providers and between the providers themselves. Non-disclosure may adversely influence medical management should unresponsive patients require further diagnostic investigations (Lamont, Alias & Win 2003) or the implementation of more effective approaches to headache management (Carville et al. 2012) or prevents discussion in circumstances where MT may be contraindicated (Puentedura et al. 2012). Primary headache providers may benefit from paying particular attention to the possibility of non-disclosure of non-medical headache treatments. Open discussion between providers and patients about the use of MT for headache and the associated outcomes may improve overall patient care.

Future Research

Despite the strong need for more high-quality research to assess the efficacy of MT as a treatment for headache, the substantial use of MT brings attention to the need for more public health and health services research within this area of headache management. The need for this type of research was identified in a recent global report on the use of headache-related healthcare resources (World Health Organization 2011). Furthering this information can lead to improvements in healthcare policy and the delivery of healthcare services.

The substantial use of physical therapies such as MT has been under-reported within many of the national surveys reporting headache-related healthcare utilization (Becker et al. 2008; Bloudek et al. 2012; Brandes 2002; Burch et al. 2015; Radtke & Neuhauser 2009). Regardless, the role of physical therapies in headache management continues to be assessed, often within mainstream and integrated headache management settings (Gaul, Visscher, et al. 2011; Wallasch, Angeli & Kropp 2012; Wallasch & Hermann 2012; Zeeberg, Olesen & Jensen 2005). Continuing this research may further our understanding of the efficacy and outcomes associated with a more multidisciplinary approach to headache management.

Further to this is the need for more research to understand the healthcare utilization pathways associated with those patients who use MT in their headache management. Little is known about the sociodemographic background, types of headaches, level of headache disability and comorbidities more common to this patient population. In turn, such information can provide insights that may be valuable to provider clinical decision-making and provider education.

2.6 Limitations

The design and findings of our review has a number of limitations. The design of the review was limited by a search within English language journals only. As a result, some research on this topic may have been missed. While the quality scoring system adopted for this review requires further validation, the data we collected was limited by the low to moderate quality of available papers which averaged 6.4 out of 10 points (Table 2.3). The low scoring was largely due to significant methodological issues and the small sample size associated with much of the collected papers. Much of the data on this topic was heterogeneous in nature (telephone, postal surveys and face-to-face interviews). There was a lack of validated practitioner and patient questionnaires to report findings, such as for questions on prevalence, where the time frames utilized varied between 'currently', 'last 12 months' and 'ever'.

Data on the prevalence of MT use for headache was limited particularly within individual MT provider populations when compared to data found within the general population and headache-clinic populations. Many studies assessed the use of MT for headache without identifying headache types. Only one study inside an MT population had reported the percentage of patients attending for reasons of migraine alone (osteopathy). The prevalence of MT use for headache was reported most within chiropractic patient population studies, however information was limited on the types of headache. We found no studies reporting the prevalence of headache patients within physiotherapy or massage therapy patient populations using our search terms.

A lack of data for some themes necessitated providing findings pooled with users of other non-medical headache providers. Data within many geographical regions was

very limited with the most limited data was on the source of referral to MT headache providers (three papers from Italy only). These limitations support the call for more research to be focused exclusively within MT populations and different regional areas before stronger conclusions can be drawn.

2.7 Conclusion

The needs of those with headache disorders can be complex and multi-disciplinary in nature. Beyond clinical research, more high-quality public health and health services research is needed to measure and examine a number of issues of significance to the delivery and use of MT's within headache management. With unmet needs still remaining for many who suffer recurrent headaches, clinicians should remain cognizant of the use of MT's and remain open to discussing this approach to headache management in order to ensure greater safety, effectiveness and coordination of headache care.

2.8 Chapter summary

This chapter has provided a comprehensive review of the international literature concerning the use of MT providers by those with headache disorders examining prevalence, profiles, motivations, communication and self-reported effectiveness. The review identified the significant prevalence of MT use for the management of headache, with chiropractors reported to be one of the most popular MT providers for primary headaches, such as migraine. The review of the existing literature also suggests an increased level of comorbid conditions, headache disability and headache chronicity are found within MT patient populations. In addition, findings from the review suggest the primary motivation for patients seeking headache management

from MT providers is for reasons of pain relief followed by concerns regarding the safety and side-effects of headache drug treatments. Despite this, the review also found that the concurrent use of both MT and medical headache management was substantial. There was considerable variation reported by users regarding the self-reported effectiveness of manual therapy for headache management.

In summary, this critical review highlights significant research gaps that exist regarding the headache within chiropractic healthcare settings. The frequent use of chiropractors by those with headache reported in the findings of the review raises questions regarding how chiropractors approach the management of this patient population. This is particularly important given the substantial burden of headache disorders on society and the substantial use of chiropractors for headache. Further, there is a need to understand better the key features associated with headache patients who seek help from chiropractors. This includes information regarding headache types, level of headache chronicity and disability and patient motivations associated with those with headache who seek help from chiropractors. This information is vital to understanding the role of chiropractors in meeting the healthcare needs of this clinical population.

3 Research design and methods

3.1 Chapter introduction

Chapter 2 contains a detailed literature review that responds to research question 1 and identifies research gaps that were addressed in the following phases of the research. Chapter 3 provides an overview of the research design and methodology for Phase Two (involving providers) and Phase Three (involving patients), designed to answer research questions 2–5 (see section 1.2). The chapter opens with an overview of PBRNs generally (beyond chiropractic-focused PBRNs), followed by more detailed information on the ACORN PBRN utilised for collecting data for the remaining phases of the study. The cross-sectional study design, data collection tools, data storage, statistical analyses and ethical considerations are presented within the context of each phase of the research.

Data collected for Phase Two were drawn from a secondary cross-sectional analysis of nationally representative ACORN baseline data of Australian chiropractors (research question 2) and two cross-sectional sub-studies of ACORN practitioners (research questions 3 and 4). Data utilised for Phase Three were drawn from a cross-sectional analysis of primary data collected, via ACORN practitioners, from a clinical population of headache patients under chiropractic management. Additional details of the study design and methodology utilised for each phase of the thesis can be found within Results chapters 4, 5, 6 and 7.

3.2 Practice-based research network design

As noted above, the research drew upon data collected from the ACORN PBRN. As such, it is important to outline the concept and definition of a PBRN for the purposes of healthcare research before introducing and outlining the features of ACORN.

3.2.1 Overview of practice-based research networks

A PBRN is a group of primary care practices that draws on the experience and insights of practising clinicians to identify research questions that will improve primary care practice (Agency for Healthcare Research and Quality 2018). Accordingly, PBRNs utilise a collective of field practitioners to recognise, contribute to, and answer valuable research questions to help improve daily clinical patient care. In doing so, PBRNs are typically linked with an academic or professional organisation to examine questions of significance to clinical practice (Lindbloom, Ewigman & Hickner 2004).

Described as ‘research laboratories’ for healthcare (Green & Dovey 2001, p. 556), PBRNs offer several benefits for conducting healthcare research. These include assisting clinical decision support for practitioners, improving the continuity and coordination of care between providers, improving the diagnosis and treatment of disease, and conducting healthcare research that is generalisable to real-world clinical practice settings (Mold & Peterson 2005; Pirotta & Temple-Smith 2017; Westfall, Mold & Fagnan 2007).

Practice-based research networks within primary care have grown in number, size and scope over recent decades (Mold & Peterson 2005; Schwartz et al. 2016). In 2002, the Agency for Healthcare Research and Quality (AHRQ) created a PBRN resource centre and registry to identify and support existing networks and promote the growth and

capacity of PBRN-based clinical research (Agency for Healthcare Research and Quality 2018). The ACORN PBRN is registered with AHRQ along with almost 200 other medical, allied health and CAM-based PBRNs internationally (Agency for Health Care Research and Quality n.d.).

Practice-based research networks can accommodate a range of research methodologies and fields, including those associated with health services and clinical research (Lee, Peng, et al. 2019; Lindbloom, Ewigman & Hickner 2004; Peterson et al. 2012). A recent literature review of CAM-based healthcare research conducted within PBRNs identified 51 publications in peer-reviewed journals, including from four chiropractic PBRNs and two osteopathic PBRNs (Lee, Peng, et al. 2019). The review noted a range of clinical and HSR methods were utilised, including examination of the prevalence and characteristics of patients and practices, doctor-patient communication, and the safety and delivery of CAM-related healthcare services. As such, PBRNs have been utilised to conduct CAM-based healthcare research to examine issues that are important to stakeholders including practitioners, patients, healthcare policymakers and healthcare educators (Adams et al. 2015).

3.2.2 The Australian Chiropractic Research Network

This section describes ACORN's PBRN model. It is followed by an outline of the role and function of the ACORN steering committee, ACORN promotion and recruitment, and a description of the development of the ACORN database questionnaire.

The Australian Chiropractic Research Network is a national PBRN resource for collecting health services information on chiropractors' daily patient care (Adams et al. 2016). The ACORN PBRN was independently designed and established in 2015 by a

group of senior researchers at the Australian Research Centre in Complementary and Integrative Medicine (ARCCIM) at the University of Technology Sydney (UTS). The aim of ACORN was to establish a nationally representative sample of practising Australian chiropractors in order to enable rigorous healthcare research. As with other PBRNs (Gilbert et al. 2013; Lipowski 2008; Sloane, Dolor & Halladay 2009), ACORN was intended to bring together health researchers and practising clinicians to collect and analyse research information on a range of issues.

The infrastructure and design of PBRNs varies. A common PBRN design involves centralised data collection and management systems. This design allows for the ongoing collection of research information over time and is typically coordinated by a research centre with standardised quality assurance measures (Hawk, Long & Boulanger 1998; Pace & Staton 2005; Williams et al. 2012). ACORN's PBRN design is based upon a sub-study model whereby researchers can recruit subgroups of practitioners and/or their patients using independent data collection instruments and management systems (Adams et al. 2018; Steel et al. 2017).

All PBRN designs have strengths and weaknesses. The key advantage of PBRNs based on centralised data collection and management systems is their ability to accommodate continuous, ongoing, real-time data collection about daily clinical practice (Peterson et al. 2012). Their disadvantages include that a single electronic data collection system may not meet the needs of particular research projects and designs (Pace & Staton 2005). In comparison, a sub-study PBRN model has the flexibility to accommodate research designs requiring independent data collection tools and instruments that may not be accessible within a centralised electronic data

collection system (Adams et al. 2015). Accordingly, the ACORN project accommodates independent sub-study designs that utilise autonomous data collection tools while still allowing for the collection of patient information, including from patient records.

ACORN's sub-study PBRN design has been used within other CAM disciplines, including osteopathy, acupuncture, massage therapy and naturopathy (Adams et al. 2018; Steel, Adams & Sibbritt 2014).

3.2.3 ACORN PBRN steering committee

The ACORN steering committee coordinates the decision-making and governance of the ACORN PBRN. The committee members include senior healthcare researchers from the participating academic institution (UTS) with expertise in epidemiology, biostatistics and survey design. The committee also includes chiropractic clinicians, including the thesis candidate (Craig Moore). The selection of chiropractic clinicians as steering committee members was based on their substantial clinical experience as practitioners within the field of chiropractic as well as their backgrounds in chiropractic education and postgraduate qualifications in clinical research and/or public health. The initial purpose of the ACORN PBRN steering committee was to develop the overarching aims and purpose of the ACORN project in the context of chiropractic. As with other PBRNs (Gilbert et al. 2011; Mays & Hogg 2012), the role of the ACORN steering committee is to provide governance – oversight, management and safeguarding of research utilising the ACORN PBRN resource, including the approval, design, planning and dissemination of sub-study findings (Adams et al. 2016).

3.2.4 ACORN PBRN promotion and recruitment

Invitations to practitioners to participate in ACORN were sent to all registered

practising Australian chiropractors to achieve maximum practitioner participation and representation. Details of the promotion and establishment of the ACORN PBRN have been provided in detail elsewhere (Adams et al. 2016).

Australian Chiropractic Research Network membership promotion was informed by methods common to previous PBRN promotional and recruitment strategies (Gilbert et al. 2008; McAleavey et al. 2015) and involved a multi-faceted approach (Adams et al. 2016). This included extensive branding of ACORN information material and the questionnaire and invitation packs. Significant promotion was directed at members of the two recognised Australian professional chiropractic associations – the Chiropractors Association of Australia (now the ACA) and the Chiropractic and Osteopathic College of Australia. ACORN membership promotion was conducted via regular e-mails and newsletters to association members as well as national and local conference events and the ACORN website (www.acorn-arccim.com/pbrn). Promotion to non-members was conducted via searches through publicly available online information.

Practitioner recruitment was conducted via an invitation pack distributed in hard copy and online (using the *SurveyGizmo* tool) and was also made available via the ACORN website (Adams et al. 2016). The invitation pack included the two-page ACORN baseline questionnaire and a consent form to join ACORN as a member practitioner to participate in future ACORN sub-study research. Recruitment was conducted between March 2015 and July 2015. Recipients were invited to complete a consent form to join the ACORN network and to complete the ACORN baseline questionnaire. The extensive recruitment period and wide-ranging practitioner search methods were employed in

an attempt to achieve a large, nationally representative sample with respect to age, gender and location (Adams et al. 2016). Two thousand and five chiropractors (43% of all 4684 registered Australian chiropractors) completed the baseline ACORN questionnaire. Of the 2005 respondents, 1680 (36% of all 4684 registered Australian chiropractors) agreed to join the ACORN database as member practitioners (Adams et al. 2016). The ACORN PBRN sample has the most extensive coverage of voluntary participants of any national PBRN for any healthcare profession internationally (Adams et al. 2016).

3.2.5 ACORN PBRN database questionnaire development

The ACORN baseline data collection involved distribution of a cross-sectional questionnaire designed and developed by the ACORN steering committee (see Appendix 2). The two-page questionnaire aimed to collect wide-ranging practitioner-relevant baseline information that could be used to facilitate future sub-study research to address issues relevant to clinical practice within Australian chiropractic (Adams, Peng, Steel, et al. 2017). The questionnaire collected information on practitioner socio-demographic characteristics, practice settings and approaches to clinical practice. The key psychometric properties and design of the ACORN questionnaire were drawn from previous PBRN initiatives (Gilbert et al. 2013; Pomernacki et al. 2015; Selby, Cornuz & Senn 2015). Pilot testing of the questionnaire was conducted with field chiropractors who provided feedback on the topics covered, format, wording and duration before finalising the 21 items. Approved changes were further tested with practitioners, including those on the ACORN committee, to optimize understanding across a diverse range of practice settings.

The first section of the ACORN questionnaire asks questions about practitioner socio-demographic characteristics (age, gender, years in practice, highest level of professional chiropractic qualifications, memberships of professional associations, professional roles in education, memberships of research and political organisations, and languages spoken in daily practice). The second section contains questions about practice characteristics (average weekly number of patient care hours and patient visits, types of health professionals working in the same practice location, professional referral relationships, region and number of practice location(s), and use of diagnostic imaging and electronic records). The third section of the questionnaire includes questions on patient clinical management, with responses on a four-point Likert frequency scale ('never', 'rarely', 'sometimes' or 'often'). This section was divided into five subsections about the frequency with which chiropractors discuss areas of health promotion in their patient management plans; treat patients with particular conditions; treat particular patient subgroups; employ particular chiropractic treatment methods; and employ particular musculoskeletal interventions.

In summary, the ACORN baseline questionnaire allows for sub-study designs involving secondary data analysis. In addition, the information can be used for nested primary data collection sub-studies conducted via engagement with ACORN practitioner members.

3.2.6 ACORN PBRN database

A more detailed description of the ACORN practitioner database sample has been outlined elsewhere (Adams, Lauche, et al. 2017). The ACORN PBRN sample has been shown to be broadly representative of the chiropractic profession in Australia with

regard to key indicators in the AHPRA chiropractic database (Chiropractic Board of Australia) (Table 3.1) including age ($p=0.134$) and gender ($p=0.956$), and generally representative of practice location nationally (Adams, Peng, Steel, et al. 2017).

Table 3.1: Comparison of ACORN and AHPRA membership demographic characteristics (June 2015)

Characteristic	ACORN (%)	AHPRA (%)	p-value
Gender			0.956
male	63	63	
female	37	37	
Age groups			0.134
<30	16	18	
30-39	31	30	
40-49	26	26	
50-59	18	16	
60+	9	10	
State (primary)			0.023
NSW	34	35	
VIC	25	26	
QLD	15	16	
WA	13	13	
SA	9	7	
ACT	2	1	
TAS	1	1	
NT	1	1	

ACORN: Australian Chiropractic Research Network; Australian Health Practitioner Regulation Agency. AHPRA: Australian Chiropractic registrant data: March 2015, Chiropractic Board of Australia, Melbourne.

source: (Adams et al. 2016).

The sub-study data collected for Phase Two of this thesis was through a secondary data analysis of the ACORN baseline information to answer research question 2 and through the collection of new primary data via direct engagement with ACORN practitioner members to answer research questions 3 and 4. For Phase Three and research question 5, new primary data was collected via engagement with ACORN practitioner members who identified eligible study participants (headache patients).

3.3 Survey research design for Phase Two and Phase Three

This section outlines the survey design utilised for Phase Two and Phase Three of this research, which drew upon an observational survey design commonly utilised in HSR (Patten & Newhart 2017; Salazar, Crosby & DiClemente 2015). While experimental study designs involve the active allocation of a treatment or intervention of interest to the study population, observational study designs are appropriate for identifying the prevalence of an outcome of interest within the study population and to test for associations with that outcome of interest without the use of any direct intervention to influence it (Patten & Newhart 2017). The survey research design utilised for this thesis uses targeted questions with the aim of generalizing the results taken from a sample to a larger population or subgroup of people (Patten & Newhart 2017). For this research, information was gathered from a sample of both chiropractors (Phase Two) and patients of chiropractors (Phase Three) to make inferences about the wider practitioner and patient populations, respectively.

3.3.1 Cross-sectional survey methods

Surveys are described as cross-sectional if they are employed at one time point (Mann 2003). This research used cross-sectional survey methods to study practitioners and patients at one point in time to estimate the prevalences of particular characteristics. Cross-sectional survey methods can also be used to determine whether there is a statistically significant relationship between an outcome of interest (the dependent variable) and other (independent) variables of interest (Maltby et al. 2014).

In Phase Two, the initial outcomes of interest were the prevalence of treating migraine (reported in the ACORN baseline questionnaire) and the independent variables

associated with chiropractors with a high migraine caseload i.e. those chiropractors who treat migraine on an 'often' basis (research question 2). The second outcome of interest in Phase Two was the use of primary headache diagnostic criteria i.e. yes/no (reported in the practitioner survey questionnaire) in the analysis of independent variables associated with chiropractors who report utilising primary headache diagnostic criteria (research question 4). In Phase Three, the outcome of interest was whether headache type or the reasons for consulting a chiropractor were significantly associated with patient satisfaction with headache management by a chiropractor (research question 5).

The strengths of cross-sectional study designs are that they require fewer resources than experimental designs and can provide prevalence estimates that are often useful for public health planning, including where findings identify a significant demand on healthcare resources or providers (Levin 2006). In addition, they can be used for generating hypotheses that can be studied more rigorously using more sophisticated experimental designs (Mann 2003). A weakness of cross-sectional studies is that they only provide a snapshot of the population at a single point in time, whereas results may be different at another time point. In addition, they do not allow identification of cause and effect (Mann 2003).

In summary, cross-sectional study designs are appropriate to ascertain the prevalence of an outcome of interest and to investigate associations between it and other variables (Levin 2006). In the context of this research, a cross-sectional study design was appropriate for assessing outcomes of interest and related associations with regard to practitioners in Phase Two, and patients in Phase Three.

3.3.2 Survey questionnaire design

Phase Two practitioner sub-study questionnaire design

The purpose, development and content of the ACORN database questionnaire that produced data for the secondary cross-sectional analysis to address research question 2 (Phase Two) was outlined in section 3.2. This section outlines the purpose, development and content of the practitioner survey used to address research question 3 and 4 (Phase Two).

The practitioner sub-study survey administered in Phase Two was designed to examine the prevalence of headache within chiropractic practice settings and chiropractors' approach to headache management across a range of clinical domains relevant to frontline headache patient care. Practitioners were sent an invitational email to participate (see Appendix 3). The invitational email contained a link to an online questionnaire (see Appendix 4). With no validated survey instruments available, the research team developed a questionnaire that aimed to understand headache patient management by chiropractors. Accordingly, the questionnaire adopted key themes relevant to evidence-based, primary-care headache patient management, namely, patient assessment, diagnosis, treatment delivery and the integration of multidisciplinary management (Becker et al. 2015; Duncan, Watson & Stein 2008). The key themes adopted were further developed after consideration of the 'WHO: Lifting the Burden' report which tabled key challenges facing effective healthcare delivery to mitigate the effects of headache in society (World Health Organization 2011) and after consideration of previous questionnaires similarly utilised to examine the frontline

management of people with headache (Kernick, Stapley & Hamilton 2008; Vuillaume De Diego & Lanteri-Minet 2005).

An introduction outlined the purpose, content and duration of the questionnaire. The first section of the questionnaire included questions on practitioner demographics and the prevalence of headache management in daily practice. This was followed by questions about the prevalence of headache patients, both as new patients and on routine visits, in patient consultations over the previous two weeks. Subsequent sections focused on specific areas applicable to frontline headache patient management identified in previous research within primary care settings (Kernick, Stapley & Hamilton 2008; Vuillaume De Diego & Lanteri-Minet 2005; World Health Organization 2011), including the use of headache diagnostic criteria and related beliefs about the role of headache diagnosis. Questions regarding the use of headache diagnostic criteria were based on the classification criteria reported in ICHD-3 Beta for primary and secondary headaches (Headache Classification Committee of the International Headache Society 2013). These were followed by questions on the use of headache outcome measures and headache disability instruments, including patient headache diaries (Phillip, Lyngberg & Jensen 2007), the Migraine Disability Assessment questionnaire (MIDAS) (Stewart, Lipton & Kolodner 2003) and the Headache Disability Inventory (HDI) (Jacobson et al. 1995).

The next section asked about practitioner collaboration with other headache providers (sending/receiving headache patient referrals), including collaboration with GPs, medical specialists (via GPs), psychologists, osteopaths and other CAM practitioners (including acupuncturists, herbalists, naturopaths, massage therapist and counsellors)

and reasons for collaboration. The final section targeted practitioner approaches to headache treatment and management, including questions about treatment aims, methods and volume. The headache management questions were directed at headache types previously reported as those treated by chiropractors (Adams, Barbery & Lui 2013; Kristoffersen et al. 2012; Moore, Sibbritt & Adams 2017). All practitioner response options were reported as dichotomous (yes/no) answers or as ratings on a 4-point or 5-point Likert scale.

The practitioner questionnaire was pilot tested with 10 randomly selected chiropractors from different sociodemographic backgrounds. Findings from pilot testing were discussed by the wider research team (including the PhD candidate) to assist decisions about survey duration and the selection of the survey themes and options. In doing so, the research team considered practitioner understanding of the nature and purpose of selected headache instruments, treatment terminology and practitioners' views on the relevance of survey questions.

Phase Three patient sub-study questionnaire design

This section outlines the purpose, development and content of the patient survey utilised to address research question 5 in Phase Three. The patient sub-study survey was designed to examine the sociodemographic profile, headache features and the levels of headache severity, chronicity and disability of people who present to Australian chiropractors for headache management. Each participating chiropractor was posted a study pack containing 10 sealed envelopes (700 in total) for patient distribution. Each sealed envelope contained printed background information to the

research (see Appendix 5) and a link to an online questionnaire (see Appendix 6).

With no validated instruments available inclusive of all of the headache types assessed for this study, the key themes adopted for the questionnaire were developed after considering similar patient questionnaires about headache features and headache impact (Buse et al. 2012; Steiner, Gururaj, et al. 2014). As with similar questionnaires (Andree et al. 2010; Steiner, Gururaj, et al. 2014), questions relating to headache features were informed by the ICHD headache classification criteria for headache diagnosis (Headache Classification Committee of the International Headache Society 2018). The Headache Impact Test (HIT-6) instrument was chosen because it is the only validated instrument for assessing headache disability, encompassing six questions across six representative categories (pain, social/role functioning, vitality, cognitive functioning, and psychological distress) (Kosinski et al. 2003; Yang et al. 2011).

The first section of the Phase Three questionnaire collected information on patient headache characteristics based on ICHD-3 diagnostic criteria for migraine, tension headache and cervicogenic headache (Headache Classification Committee of the International Headache Society 2013). Selection of these headache disorders was based upon previous research on chiropractic clinical populations (Adams, Barbery & Lui 2013; Kristoffersen et al. 2012; Kristoffersen, Lundqvist, et al. 2013; Moore, Sibbritt & Adams 2017). Headache chronicity was assessed using ICHD criteria (15 or more headache days per month for the past three months) (Headache Classification Committee of the International Headache Society 2018). Level of headache pain intensity was assessed using a numerical rating scale for pain (Boonstra et al. 2016).

The second section of the Phase Three questionnaire collected information on participants' level of headache disability using the HIT-6 questionnaire, a validated measure of headache impact (Haywood et al. 2017; Sauro et al. 2010). Response options to each question are 'never', 'rarely', 'sometimes', 'very often', and 'always' where each response option is provided a score of 6,8,10,11 or 13 points, respectively, giving total HIT-6 scores ranging from 36–78 points. Patient headache disability level is translated using four score categories: little or no impact (36–49), moderate impact (50–55), substantial impact (56–59) and severe impact (60–78) (Ware, Bjorner & Kosinski 2000).

The third section of the Phase Three questionnaire explored the reasons patients seek help from chiropractors for their headache. Participants were asked to select an answer from listed options – seeking help with headache prevention, headache relief during an attack, headache-related stress, being more in control of headaches, reducing the effects of headaches on relationships, and reducing the effects of headaches on the ability to work. Participants were also asked about their level of satisfaction with chiropractic headache management. The last section of the questionnaire collected information on patient sociodemographic characteristics, including their age, gender, level of health insurance and education, and employment status.

The questionnaire was pilot tested with a convenience sample of 10 headache patients from different sociodemographic backgrounds to help refine its content. Findings from pilot testing were discussed by the wider research team (including the PhD candidate) to assist decisions about survey duration, themes and response options. In doing so,

the research team considered patient understanding of the nature and purpose of the selected survey questions.

3.3.3 Sampling methods

The method by which a study sample is selected is important to the external validity of a survey (i.e., the degree to which the sample represents the larger population under examination) (Etikan & Bala 2017). As it is rarely feasible to administer a survey questionnaire to all members of a population, methods of sampling and statistics are used to obtain a sample that is representative of the population of interest. Random sampling allows for each participant to be selected by chance and gives a closer estimate of larger populations and for appropriated statistical analysis to be performed (Clark et al. 2003). In Phase Two of this research, a random sample of chiropractors was selected from the ACORN database practitioner membership to complete the online sub-study questionnaire. In Phase Three a random sample of ACORN practitioners was invited to recruit headache patients to complete the patient sub-study questionnaire. All headache patients were invited to participate via consecutive (non-random) sampling. While less representative, consecutive sampling is often chosen for practical reasons, including to reduce costs and to ease recruitment across multiple sites (Clark et al. 2003). Inclusion criteria was English speaking adults (over 18 years), with a chief complaint of headache.

3.4 Data collection and management

Data collection methods for the ACORN database are outlined above (sections 3.2 and 3.3). The ACORN practitioner database (n=2005) is maintained in a fully secured software management system on a password-protected computer at UTS and only the

ARCCIM research team has access. Data collected for the secondary analysis of 1869 practitioners who had previously reported 'often' providing treatment for patients with migraine in the ACORN PBRN database questionnaire was stored on a similarly password-protected computer with only team access.

To collect data to answer research questions 3 and 4, practitioners were emailed invitations to participate (see Appendix 3) containing an embedded link to the online survey questionnaire (see Appendix 4). Emails were sent to a random sample of 1050 practitioners who reported 'often' treating patients with headache disorders in the ACORN database questionnaire. Three follow-up reminder emails were sent out during the recruitment period (August to November 2016). Data collected from 381 respondents were stored on a password-protected computer that could only be accessed by the research team.

For research question 5, an initial invitational email (see Appendix 7) was sent to a second random sample of 900 practitioner members of the ACORN database who reported 'often' treating patients with headache disorders in the ACORN PBRN database questionnaire. Seventy chiropractors consented to facilitate patient recruitment; each consenting chiropractor then received a study pack by post. The study pack contained a script for practitioners to follow when discussing the study with headache patients (see Appendix 8) and 10 sealed envelopes to give them. Each sealed envelope contained the study background leaflet with a link to the online questionnaire (see Appendix 5). Consenting practitioners were invited to distribute the sealed envelopes to patients who presented with a chief complaint of headache (but not at their initial consultation for this problem). Headache patients then completed

the online questionnaire (see Appendix 6). Data collected from 224 respondents were stored on a password-protected computer that could only be accessed by the research team.

Each questionnaire administered for the different phases of this research advised respondents that the information provided was anonymous and that consent was implied by choosing to complete the survey. No incentives were offered to practitioners or patients to participate in the sub-study surveys. All survey data collected for these sub-studies were de-identified. All data was cleaned by removing incomplete or incorrect data in order to prepare the data for analysis and a review of anomalies and statistical outliers was conducted to identify any potential errors.

3.5 Statistical analyses

As noted earlier, this research included a secondary analysis of the ACORN database questionnaire, and primary analysis of data collected directly from ACORN practitioner respondents and from headache patient respondents. Quantitative methods are used to describe research findings to allow numerical values, through the use of statistical analysis, to represent the data observations (Patten & Newhart 2017). Quantitative statistics, including descriptive or inferential statistics, are commonly used to analyse survey data (Korn & Graubard 2011).

This study used both descriptive and inferential statistics. Descriptive statistics were used to describe the sample without drawing conclusions about the population from which it was taken (Stewart 2018). Summary statistics were used to describe the data (participant responses), with categorical data presented using numbers and

percentages and continuous descriptive data using means and standard deviations (SDs). Inferential statistics uses sample data to make inferences about a study population to test a hypothesis using the sample to draw conclusions (Stewart 2018). Accordingly, this research used Student's t-test to determine the significance of the difference between two groups of continuous data, while Pearson's chi-squared test or Fisher's exact test was used to determine the association between two categorical variables to assess whether the frequency of an outcome was significantly different in two or more groups (Peat. J & Barton 2005). The chi-squared test is used when the cell sizes are expected to be large (80% of the expected cell frequencies greater than 5), while Fisher's exact test was used to test an association between two categorical variables with small cell sizes (expected values less than 5) (Peat. J & Barton 2005).

In addition, a multiple logistic regression model was applied to examine associations between a dependent binary (outcome) variable and several independent (predictor) variables to enable the estimation of odds ratios (ORs) and allow for measures of association to be adjusted for potential confounding factors (Peng, Lee & Ingersoll 2002), as outlined below in section 3.5.1. In order to build the most parsimonious model using a likelihood ratio test, a backward stepwise process was employed (Wagner & Shimshak 2007). Statistical significance was set at $p < 0.05$. ORs were reported with 95% confidence intervals.

3.5.1 Phase Two sub-study statistical analysis

For research question 2 (see section 1.2.2), data are presented as absolute and relative frequencies or as means and standard deviations. The bivariate associations between survey items and the dependent variable were first explored using Student's t-test or

Pearson's chi-squared tests, as applicable. Multiple logistic regression analysis was used to identify independent predictors of frequency of treating people with migraine which was dichotomised into chiropractors who treat those with migraine 'often' and 'less often' (responses represented by 'never', 'rarely, and 'sometimes'). Included in the regression model were questionnaire items with associations from the bivariate analysis ($p \leq 0.25$) (Hosmer & Lemeshow 2000). A backward stepwise procedure utilising a likelihood ratio test was chosen to establish the independent predictors of chiropractors who 'often' treat those with migraine. Statistical software SPSS 22.0 and Stata 13.1 were used for the statistical analyses.

For research question 3 (see section 1.2.2), descriptive statistics are presented, as appropriate, to describe participant responses. Participant views about the role of ICHD primary and secondary headache diagnostic criteria were reclassified from five into three groups: strongly disagree/disagree, neutral, and agree/strongly agree. Participant collaboration with other headache-related healthcare providers was reclassified from four into two groups: never/rarely and sometimes/often. These groupings were the result of the very low number of responses reported within some Likert categories. Additionally, the reporting of chiropractic headache management was categorised as often/almost every headache patient or never/rarely. Statistical analysis was conducted using Stata 13.1.

For research question 4 (see section 1.2.2), descriptive statistics are presented, as appropriate, to describe participant responses. Student's t-test and Pearson's chi-squared test or Fisher's exact test were used for sociodemographic comparisons of the survey population with the ACORN membership to test the significance of differences

in continuous and categorical variables respectively. Bivariate comparison of survey items for chiropractors who indicated the use of ICHD primary headache classification criteria (i.e. yes/no) involved use of Pearson's chi-squared test or Fisher's exact test as appropriate. The identification of independent variables associated with those chiropractors who used ICHD primary headache criteria involved multiple logistic regression. Questionnaire response items were dichotomised into 'strongly disagree/disagree/neutral' or 'agree/strongly agree'. Variables with significant associations ($p \leq 0.2$) in bivariate analyses were included in the regression model (Hosmer & Lemeshow 2000). Independent survey variables were dichotomised after consideration of similar research (Engel, Beirman & Grace 2016; Lee et al. 2018) and the distributions of the data. A backward stepwise procedure was selected to establish the most parsimonious model that predicted those practitioners who used ICHD primary headache diagnostic criteria. Stata 13.1 was used for all statistical analyses.

3.5.2 Phase Three sub-study statistical analysis

For research question 5 (see section 1.2.2), study population characteristics are reported using descriptive statistics with categorical data presented as frequencies and percentages and continuous descriptive data using means and SDs. Chi-square tests or Fisher's exact test were used, as applicable, to examine the association between reasons for consulting a chiropractor and the level of satisfaction with chiropractic headache management and to see if headache type was associated with patient satisfaction with chiropractic headache management. Statistical analyses were conducted using SPSS software (version 25).

3.6 Ethics approval

Ethics approval for the research was obtained from the Human Research Ethics Committee at UTS for the secondary analysis of the baseline questionnaire (no. ETH16-0474) (Appendix 9), the practitioner sub-study survey (no. ETH16-0639) (Appendix 10) and for the patient sub-study survey (no. ETH182196) (Appendix 11). All sub-study participants were provided with contact details (email, phone and post) for the research investigators. The secondary analysis and practitioner sub-study survey received ethics approval as Nil/negligible risk. Ethics approval was given for the patient sub-study after an extensive ethical review by the UTS Human Research Ethics Committee.

3.7 Chapter summary

This chapter describes the methodology and the study methods appropriate to each phase of the research. It outlines details on the PBRN facility utilised for data collection, the cross-sectional survey design, data collection and storage methods, sample selection and recruitment, statistical analysis and ethical considerations. Further details of research methodology are provided in the published and submitted articles in the Results chapters.

4 The treatment of migraine patients within chiropractic: analysis of a nationally representative survey of 1869 chiropractors

4.1 Chapter introduction

This chapter presents detailed results about the proportion and characteristics of Australian chiropractors who often manage migraine. The chapter provides the rationale for the study and presents findings that address research question 2 (see section 1.2.2).

The work contained in this chapter was published as follows:

Moore, C., Adams, J., Leaver, A. Lauche, R. & Sibbritt, D. 2017, 'The treatment of migraine patients within chiropractic: analysis of a nationally representative survey of 1869 chiropractors', *BMC Complementary and Alternative Medicine*, vol. 17, no. 519, pp. 1-10.

A copy of the manuscript is shown in Appendix 12.

4.2 Rationale for this study within the research project

The projects' aim (section 1.2) required an initial understanding of the overall prevalence of migraine management by chiropractors and the characteristics of chiropractors who provide migraine management. While the literature review (chapter 2) identified that the use of chiropractors for the management of migraine is common within the general population internationally, there is little information on the prevalence of migraine management within chiropractic clinical settings. A clearer

picture of the prevalence of migraine management within chiropractic settings assists in understanding the wider headache management landscape beyond conventional medical settings and helps to determine whether primary headache management by chiropractors warrants closer examination through primary data collection. Moreover, understanding the practitioner, practice and clinical management characteristics of chiropractors with high caseloads of patients with migraine provides valuable insights for more detailed assessment of chiropractors' headache management (chapters 5 and 6).

The data utilised for this chapter were derived from the ACORN baseline survey (see Appendix 2). As noted earlier, the ACORN database is generally representative of the chiropractic profession across Australia in terms of gender, age and practice location (Adams, Peng, Steel, et al. 2017). Practitioner characteristics are described using responses to questionnaire items 1, 2, 3, 4 and 8. These demographic items were identified as factors that could influence features of patient management (Murphy-Cullen & Larsen 1984; Watson et al. 2006).

The treatment of migraine patients within chiropractic: analysis of a nationally representative survey of 1869 chiropractors

4.3 Introduction

Migraine is the seventh leading cause of years lived with disability (YLDs) and a common neurological disorder (Vos et al. 2013). During an attack, migraine symptoms are characterised by severe, throbbing, unilateral headaches associated with nausea, vomiting, photophobia and aggravation from physical activity and while less common, a migraine with aura is further associated with visual, sensory or speech related symptoms (Headache Classification Committee of the International Headache Society 2013). A variety of precipitating factors have been associated with triggering a migraine attack. Triggers reported include weather, stress, poor or over-sleeping, odours, missing meals and certain foods, menses and neck pain (Andress-Rothrock, King & Rothrock 2010; Kelman 2007).

Uncertainty remains regarding the mechanisms associated with the initiation of migraine pain. Evidence suggests migraine pain has a central origin involving the cortex and brainstem (Coppola, Pierelli & Schoenen 2007; Lambert 2010). Indirect evidence also suggests migraine pain has a peripheral origin whereby peripheral input from within cervical spine structures causes sensitization of trigeminal nociceptive pathways (Bartsch 2005; Fernández-de-las-Peñas et al. 2009; Levy 2010). This may be more common in sufferers with neck pain and may involve convergent nociceptive input via

the trigeminal nerve and the upper cervical afferents to the trigeminal cervical complex (Ashina et al. 2015; Florencio et al. 2014; Ford et al. 2008). Interpretation of this indirect evidence may have implications for the role of manual therapies in the treatment of migraine (Nijs et al. 2011; Nijs, Van Houdenhove & Oostendorp 2010). To date however, clinical trials to support the effectiveness of manual therapies, including soft tissue therapies, spinal manipulation and spinal mobilisation, for the prevention of migraine remains limited, of poor quality and sometimes conflicting (Bryans et al. 2011; Chaibi, Tuchin & Russell 2011; Posadzki & Ernst 2011). Despite this clinical uncertainty, physical therapies, which may include manual therapies, are reported as the most frequently used complementary and alternative therapies for the management of headaches worldwide.

Chiropractors are one of the most common complementary and alternative medicine (CAM) providers globally (Ong et al. 2004; Thomas, Nicholl & Coleman 2001; World Health Organization 2011; Zodet & Stevans 2012). The use of chiropractic for the treatment of headaches appears to be substantial (Brown et al. 2013; Kristoffersen et al. 2012; Ossendorf et al. 2009) with migraine likely to be one of the most common headache types chiropractors manage (Moore, Sibbritt & Adams 2017; Sanderson et al. 2013; Wells et al. 2011). Consequently, there is a need to better understand how many chiropractors have a high migraine caseload and whether this is more common to a particular type of chiropractor. While the treatment of migraine by chiropractors may be substantial, no research to date has reported on how prevalent such treatment is within the profession or the features of those chiropractors who provide it. In response, this study aimed to investigate the proportion of Australian chiropractors

with a high migraine caseload; and the practitioner characteristics, practice characteristics and clinical management factors associated with frequent management of patients with migraine by chiropractors.

4.4 Methods

The analyses presented in this paper were drawn from a questionnaire distributed during recruitment for a national practice-based research network (PBRN) titled the Australian Chiropractic Research Network (ACORN) project. This national project is independently designed and conducted by senior researchers at the Australian Research Centre in Complementary and Integrative Medicine (ARCCIM), University of Technology Sydney. The ACORN 21-item questionnaire examining practitioner, practice and clinical management characteristics was distributed to all registered chiropractors across Australia (approval # 2014000027) (Adams et al. 2016). The secondary analyses sub-study reported in this paper were undertaken following ethical approval from the Human Research Ethics Committee of the University of Technology Sydney (approval # ETH16-0474).

4.4.1 Recruitment and sample

Recruitment for the ACORN PBRN occurred through a profession-wide recruitment strategy conducted from March through to June 2015. An invitation pack was distributed to all registered Australian chiropractors who were invited to both complete the baseline ACORN questionnaire and to consent to participate in the ACORN PBRN project. Distribution was via post (hard copy), email (survey link) and at several regional profession-based conferences and was also made available through the official ACORN website (SurveyGizmo™). The invitation pack was similarly re-

distributed with four reminders starting four weeks after the initial invitation (Adams et al. 2016).

A total of 2,005 chiropractors (43% of the 4,684 Australian chiropractors registered at time of recruitment) completed the baseline ACORN practitioner questionnaire.

Participants were generally representative of the wider profession with regards to a number of key indicators when compared to registered chiropractors identified by AHPRA (Australian Health Practitioner Regulation Agency) at the time of recruitment (Chiropractic Board of Australia 2015) including age ($p=0.065$) and gender ($p=0.634$).

While the ACORN baseline sample is also generally representative of the wider chiropractic population regarding practice location, slight differences were found in terms of the distribution by location with the questionnaire sample slightly over-represented by chiropractors from South Australia, the Australian Capital Territory, Tasmania and the Northern Territory ($p < 0.01$) (Adams et al. 2016).

4.4.2 Instrument

The ACORN questionnaire collected information across three key domains (see Additional file 1). The first was practitioner characteristics (age, gender, education, professional qualifications and memberships in professional associations, years in private practice and professional roles in education, research and other professional areas). The second domain was practice characteristics (average patient care hours, number of weekly patient visits, place, number and type of practice location(s), types of health professionals working in the chiropractor's practice location, professional referral relationships and use of diagnostic imaging and electronic records). The third domain was clinical management characteristics where all response categories were

on a four-point Likert frequency scale ('never', 'rarely', 'sometimes' or 'often'). This domain was divided into five sub-sections including frequency with which chiropractors discuss listed aspects of health promotion in their care plans; treat patients presenting with a range of listed conditions; treat patient subgroups and utilise listed treatment methods and interventions.

4.4.3 Statistical analyses

Statistical analyses were conducted using statistical software Stata 13.1 and SPSS 22.0 on those chiropractors who provided an answer to the question on how often they treat patients with migraine (n=1869; 93.2% of all questionnaire respondents). The dependent variable was the frequency of treatment of patients with migraine; 'never', 'rarely', 'sometimes' or 'often', which was dichotomised into those who treat patients with migraine 'often' and those who treat patients with migraine 'less often' (represented by the 'never', 'rarely' and 'sometimes' responses). Data are presented as means and standard deviations, or absolute and relative frequencies.

The bivariate associations between all survey items and the outcome variables were firstly explored using Student's t-test or chi-square tests, where applicable.

Independent predictors of frequency of treating patients with migraine were identified using multiple logistic regression analysis. ACORN survey items with associations from the bivariate analyses ($p \leq 0.25$) were included in the regression model. A backward stepwise procedure employing a likelihood ratio test was chosen to determine the independent predictors of chiropractors who treat patients with migraine 'often'.

Statistical significance was set at $p < 0.05$. Odds ratios were reported with 95% confidence intervals.

4.5 Results

Of the 1869 chiropractors, 62% were male with a mean (SD) age of 42.1 (12.1) years and most had a Bachelor or Master's degree qualifications (96%). Participants had worked for an average of 15.8 (11.3) years in practice and worked an average of 27.3 (12.6) patient care hours each week. The majority of chiropractors reported managing patients with migraine 'often' (n=990; 53.0%). Fewer participants reported managing patients with migraine 'sometimes' (n=765; 40.9%) and only a small percentage reported managing patients with migraine 'rarely' (n=106; 5.7%) or 'never' (n=8; 0.4%).

Chiropractors with a high migraine caseload ('often' group) were more often older (p=0.001), had more years in practice (p<0.001), worked a greater number of patient-care hours per week (p<0.001) and reported a greater number of patient visits per week (p<0.001) than those chiropractors with a lower migraine caseload (Table 4.1). The practice setting of chiropractors with a high migraine caseload was more often rural (p=0.017) and they less often shared their practice location with a GP (p=0.046) or psychologist/counsellor (p=0.043) while more often had a referral relationship with an occupational therapist (p=0.016), podiatrist (p=0.016) and/or exercise physiologist (p=0.031). Additionally, these chiropractors more often used imaging in their practice (p<0.001) but less often had diagnostic ultrasound on site (p=0.008) than those chiropractors with a lower migraine caseload (Table 4.2).

Table 4.1: Distribution of practitioner characteristics across frequency of practitioner treating patients with migraine.

Characteristic	Treat patients with migraine		p-value
	Never/rarely/ sometimes (n=879)	Often (n=990)	
Age in years (mean±sd)	41.3±11.7	43.1±12.3	0.001
Gender			
male n (%)	531 (60.7)	624 (63.4)	0.237
female n (%)	344 (39.3)	361 (36.6)	
Qualification n (%)			
Diploma n (%)	20 (2.3)	21 (2.1)	0.718
Advanced diploma n (%)	6 (0.7)	8 (0.8)	
Bachelor n (%)	304 (34.9)	344 (35.0)	
Doctor of Chiropractic n (%)	245 (28.1)	296 (30.1)	
Masters n (%)	288 (33.0)	308 (31.4)	
PhD n (%)	9 (1.0)	5 (0.5)	
Years in practice (mean±sd)	14.9±11.0	16.8±11.6	<0.001
Patient care hours/week (mean±sd)	26.0±11.2	28.0±10.4	<0.001
Patient visits/week (mean±sd)	78.1±53.8	95.5±59.2	<0.001

Table 4.2: Distribution of practice characteristics across frequency of practitioner treating patients with migraine.

Characteristic	Treat patients with migraine		p-value
	Never/rarely/sometimes (n=879)	Often (n=990)	
Location			
Urban n (%)	685 (79.6)	727 (74.9)	0.017
One location only	214 (24.5)	257 (26.0)	0.441
Other health professionals in practice location			
General practitioner	68 (7.7)	54 (5.5)	0.046
Podiatrist	93 (10.6)	86 (8.7)	0.165
Medical specialist	26 (3.0)	25 (2.5)	0.567
Physiotherapist	85 (9.7)	91 (9.2)	0.724
Chiropractor	504 (57.3)	595 (60.1)	0.226
Exercise physiologist	56 (6.4)	69 (7.0)	0.605
Psychologist	126 (14.3)	111 (11.2)	0.043
Occupational therapist	17 (1.9)	31 (3.1)	0.102
Referral relationships			
General practitioner	483 (54.9)	581 (58.7)	0.103
Psychologist	119 (13.5)	147 (14.8)	0.418
Physiotherapist	259 (29.5)	329 (33.2)	0.080
Occupational therapist	59 (6.7)	97 (9.8)	0.016
Podiatrist	323 (36.7)	418 (42.2)	0.016
Medical specialist	129 (14.7)	168 (17.0)	0.176
Exercise physiologist	120 (13.7)	171 (17.3)	0.031
Using imaging at least often	332 (38.1)	549 (55.7)	<0.001
Having imaging on site			
X-ray	138 (15.7)	144 (14.5)	0.487
Magnetic resonance imaging (MRI)	36 (4.1)	26 (2.6)	0.077
Surface electromyography (SEMG)	30 (3.4)	50 (5.1)	0.081
Diagnostic ultrasound	35 (4.0)	19 (1.9)	0.008
Thermography	33 (3.8)	55 (5.6)	0.067

Table 4.3 displays the clinical management characteristics of chiropractors with a high migraine caseload. The clinical management plans of chiropractors with a high migraine caseload more often included advice on diet/nutrition ($p<0.001$), smoking/drugs/alcohol ($p<0.001$), physical activity ($p=0.005$), occupational health and safety ($p<0.001$), pain counselling ($p<0.001$), nutritional supplements ($p<0.001$) and medications (including for pain/inflammation) ($p<0.001$) than those chiropractors who less often managed patients with migraine. In addition, those chiropractors with a high migraine caseload more often treated patients presenting with neck, thoracic and low back pain, upper and lower limb disorders, postural disorders, degenerative conditions (all $p<0.001$), non-musculoskeletal conditions ($p<0.001$), other headache disorders (excluding migraine) including cervicogenic and tension type headaches ($p<0.001$) and spine health maintenance/prevention ($p<0.001$) than chiropractors with a lower migraine caseload. In addition, they were more likely to treat pregnant women ($p<0.001$), athletes/sports people ($p<0.001$), Aboriginal and Torres Strait Islander people (ATSI) ($p<0.012$), patients with work injuries ($p<0.001$) and traffic injuries ($p<0.001$), patients from non-English speaking ethnic groups ($p<0.035$), people receiving post-surgical rehabilitation ($p<0.001$), and younger and older patients (all $p<0.001$) than those chiropractors with a lower migraine caseload. The treatment techniques/methods more often used by chiropractors with a high migraine caseload were high velocity, low amplitude (HVLA) spinal manipulation ($p=0.023$), drop-piece techniques ($p=0.015$), sacro-occipital techniques ($p<0.001$), instrument adjusting ($p=0.001$), biophysics ($p=0.040$), applied kinesiology ($p=0.001$), functional neurology ($p<0.001$), dry needling ($p=0.006$), heat/cryotherapy ($p=0.002$), orthotics ($p<0.001$) and extremity joint manipulation methods ($p<0.001$).

Table 4.3: Distribution of clinical management characteristics across frequency of practitioner treating patients with migraine.

Characteristic	Treat patients with migraine		p-value
	Never/rarely/sometimes (n=879)	Often (n=990)	
Care plan includes (discussed often)			
Diet/nutrition	379 (43.2)	565 (57.4)	<0.001
Smoking/drugs/alcohol	171 (19.5)	295 (30.1)	<0.001
Physical activity/fitness	724 (82.8)	861 (87.5)	0.005
Occupational health and safety	325 (37.4)	439 (44.8)	0.001
Pain counselling	175 (20.2)	285 (29.3)	<0.001
Nutritional supplements	261 (29.8)	435 (44.1)	<0.001
Medications (including pain/inflammation)	165 (19.1)	264 (27.0)	<0.001
Conditions (treated often)			
Neck pain: Axial	780 (88.8)	967 (97.8)	<0.001
Neck pain: Referred/radicular	374 (42.5)	799 (80.7)	<0.001
Thoracic pain: Axial	654 (74.8)	922 (93.4)	<0.001
Thoracic pain: Referred/radicular	227 (26.1)	632 (64.4)	<0.001
Low back pain: Axial	793 (90.5)	968 (98.2)	<0.001
Low back pain: Referred/radicular	600 (68.5)	910 (92.2)	<0.001
Lower limb musculoskeletal disorders	395 (45.0)	729 (73.8)	<0.001
Upper limb musculoskeletal disorders	416 (47.4)	748 (76.1)	<0.001
Postural disorders	442 (50.5)	765 (77.7)	<0.001
Degenerative spine conditions	642 (73.1)	986 (99.7)	<0.001
Headaches (tension, cervicogenic)	642 (73.0)	986 (100.0)	<0.001
Migraine disorders			
Spine health maintenance/prevention	529 (60.3)	834 (84.8)	<0.001
Non-Musculoskeletal conditions	106 (16.8)	306 (41.2)	<0.001
Patient groups (treated often)			
Child: <4 years	198 (22.7)	362 (36.8)	<0.001
4-18 years	363 (41.6)	627 (63.6)	<0.001
Older: >65 years	574 (65.8)	794 (80.6)	<0.001

Aboriginal and Torres Strait islander	8 (0.9)	24 (2.5)	0.012
Pregnant women	233 (26.8)	448 (45.7)	<0.001
Athletes/sports people	339 (39.1)	572 (58.5)	<0.001
Work Injuries	250 (38.9)	418 (42.8)	<0.001
Traffic Injuries	58 (6.7)	196 (20.1)	<0.001
Post-Surgical Rehabilitation	32 (3.7)	88 (9.0)	<0.001
Non-English-speaking ethnic groups	43 (5.1)	72 (7.5)	0.035
<hr/>			
Techniques/methods (used often)			
Drop-piece	443 (51.0)	549 (56.7)	0.015
Pelvic blocking/sacro-occipital	343 (39.7)	465 (48.1)	<0.001
Instrument Adjusting	420 (48.4)	545 (56.0)	0.001
Chiropractic Biophysics	28 (3.3)	49 (5.4)	0.040
HVLA manipulation/mobilisation	694 (80.0)	821 (84.1)	0.023
Applied kinesiology	113 (13.1)	182 (19.1)	0.001
Flexion-Distraction	65 (7.6)	81 (8.5)	0.472
Functional Neurology	71 (8.4)	168 (17.8)	<0.001
Extremity Manipulation	443 (50.9)	648 (66.5)	<0.001
<hr/>			
Musculoskeletal Interventions (used often)			
Dry Needle or acupuncture	98 (11.3)	153 (15.7)	0.006
Soft tissue therapies	573 (65.9)	650 (66.1)	0.905
Electro-modalities	71 (8.6)	103 (10.6)	0.147
Heat/cryotherapy	118 (13.7)	184 (18.9)	0.002
Orthotics	55 (6.4)	134 (13.8)	<0.001
Exercise therapy/rehabilitation	411 (47.7)	497 (51.1)	0.140

Logistic regression analysis identified a range of factors independently associated with the likelihood of a chiropractor having a high migraine caseload. These factors included the chiropractor often discussing medications with their patients (including for pain/inflammation) (OR=1.55; 95%CI: 1.09, 2.21), treating patients with neck pain (axial) (OR=2.89; 95%CI: 1.18, 7.07), neck pain (referred/radicular) (OR=1.88; 95%CI: 1.28, 2.77), thoracic pain (referred/radicular) (OR=2.52; 95%CI: 1.58, 3.21), low back

pain (referred/radicular) (OR=1.78; 95%CI: 1.11, 2.85), upper limb musculoskeletal disorders (shoulder, elbow, wrist, hand) (OR=1.67; 95%CI: 1.20, 2.31), providing spinal health maintenance/prevention (OR=1.59; 95%CI: 1.12, 2.25), treating non-musculoskeletal disorders (OR=3.06; 95%CI: 2.13, 4.39), treating athletes/sports people (OR=1.65; 95%CI: 1.22, 2.23), employing functional neurology methods in their patient management (OR=1.63; 95%CI: 1.02, 2.61) and less often having a psychologist/counsellor located in the same practice as the chiropractor (OR=0.53; 95%CI: 0.34, 0.86) (Table 4.4).

Table 4.4: Logistic regression output for chiropractors that treat migraine often compared to never/rarely/sometimes.

Factors	Odds Ratio	95% C.I.	p-value
Non-musculoskeletal disorders	3.058	2.132, 4.388	<0.001
Neck pain (Axial)	2.889	1.181, 7.068	0.020
Thoracic pain (Referred/radicular)	2.252	1.580, 3.210	<0.001
Neck pain (Referred/radicular)	1.881	1.280, 2.764	0.001
Low back pain (Referred/radicular)	1.783	1.115, 2.851	0.016
Upper limb Musculoskeletal disorders	1.668	1.206, 2.308	0.002
Athletes or Sports people	1.653	1.225, 2.231	0.001
Functional Neurology	1.632	1.020, 2.610	0.041
Spinal health maintenance/prevention	1.586	1.116, 2.252	0.010
Discussing medication (Including pain/inflammation)	1.555	1.093, 2.213	0.014
Psychologist/counsellor in same practice	0.543	0.342, 0.862	0.010

4.6 Discussion

4.6.1 Prevalence of migraine management

Our study found a large proportion of Australian chiropractors report managing a high migraine caseload. This appears to support previous studies which have identified a high prevalence of headache in chiropractic patient populations (4.6% - 15.4%) (Brown et al. 2014; Jackson 2001; Rubinstein et al. 2000) and a high prevalence of chiropractic use within the general migraine population (10%-29%) (Bigal et al. 2008; Kristoffersen et al. 2012; Sanderson et al. 2013; Wells et al. 2011). The high use of chiropractors by those with migraine would suggest these providers are likely to be addressing some of the healthcare needs of this population and raises several questions for further research enquiry.

For instance, there is a need to better understand all of the relevant patient management approaches included within chiropractic migraine management and whether these approaches vary from those reported in routine Australian chiropractic practice which favours spinal manipulation, soft tissue therapy and exercise prescription (Clijsters, Fronzoni & Jenkins 2014). For instance, while management of public health and lifestyle factors, have been captured in recent chiropractic workforce data (Adams, Lauche, et al. 2017; Australian Government 2015) there has been no detailed examination on how these aspects of patient management are utilised in the management of migraine. For example, little is known about the role chiropractors play in patient education regarding migraine triggers associated with diet, fatigue and stress or improving headache-related coping skills and pain management. While more high quality research is still needed to assess the effectiveness of individual manual

therapies for the treatment of migraine, understanding the use of these management approaches by chiropractors and their influence on migraine health outcomes, both individually and synergistically, may prove helpful in the design of future clinical trials that aim to assess the overall effectiveness of chiropractic migraine management.

Chiropractic clinical trials have yet to incorporate any multimodal aspects of chiropractic care that may influence underlying migraine mechanisms and have been limited to the assessment of unimodal manual therapy interventions for which headache treatment guidelines report only weak evidence or level III recommendations (Campbell, Penzien & Wall 2000; Sarchielli et al. 2012).

4.6.2 Factors associated with high migraine caseload

Our analyses did not identify any practitioner characteristics (practitioner age, gender or place of education) that were associated with a high migraine caseload, suggesting that a broad cross-section of the Australian chiropractors are frequently managing those with migraine. However, our research highlights several practice-setting and clinical management characteristics associated with chiropractors managing a high migraine caseload and which raise valuable questions about the therapeutic or philosophical approaches that may be common to chiropractic migraine management.

Our study found chiropractors with a high migraine caseload were associated with treating spine regions (cervical, thoracic and lumbar) including referred and radicular spine symptoms associated with noxious stimulation of nerve endings and direct nerve root compression respectively (Bogduk 2009), as well as treating upper limb disorders. Previous studies report manual therapies, particularly manipulative therapies, to be the most common therapies utilised by chiropractors when treating the spine and

upper limb (Carlesso et al. 2014; Clijsters, Fronzoni & Jenkins 2014; McHardy et al. 2008; Pribicevic, Pollard & Bonello 2009; van de Veen et al. 2005). Spinal manipulation in particular is reported to be the most popular treatment modality utilised by Australian chiropractors (Adams, Lauche, et al. 2017) and the only therapeutic modality to be evaluated by the profession for the treatment of migraine (Chaibi, Tuchin & Russell 2011). While unclear from our findings directly, these associations may suggest a greater preference for the use of manual therapies when compared to the use of other therapies amongst chiropractors with a high migraine caseload. More research is needed to assess the use of other therapeutic approaches that may also fall within the scope of chiropractors in their management of migraine. This could include the use of relaxation methods, herbs, minerals, supplements and physical therapies as identified within non-pharmaceutical migraine treatment guidelines (Becker et al. 2015; Holland et al. 2012; Pringsheim et al. 2012; Sarchielli et al. 2012). More research is also needed to understand the clinical circumstances within which chiropractors decide to refer patients with migraine to other healthcare providers for management and treatment that is outside their scope of practice.

Our analyses identified chiropractors with a high migraine caseload as more likely to provide treatment of patients with non-musculoskeletal conditions. While migraine itself is classified as a neurological disorder, the classification of migraine as a non-musculoskeletal condition is less straight forward when considering evidence of an association with neck pain and the potential role of neck pain in migraine pathophysiology (Ashina et al. 2015; Calandre et al. 2006; Fernández-de-las-Peñas, Cuadrado & Pareja 2006; Florencio et al. 2014). However, the treatment of a number

of non-musculoskeletal conditions with manual therapies by chiropractors is controversial, (Ernst & Gilbey 2010; Harvey 2016) not least because of the significant methodological limitations in related clinical trials (Clar et al. 2014; Ferrance & Miller 2010) and concerns raised about the lack of biological plausibility to support how manual therapies, such as spinal manipulative therapy (SMT), might influence the underlying pathophysiology of these conditions (Mirtz et al. 2009). On the other hand, higher headache disability and chronicity is more common amongst those who seek complementary medicine including chiropractic (Kristoffersen et al. 2012; Minen, Seng & Holroyd 2014) and this is associated with greater levels of anxiety and depression (Lantéri-Minet et al. 2005; Lipton, Buse, et al. 2013). With the interest by some chiropractors toward improving overall patient health, including mental and emotional well-being (Adams, Lauche, et al. 2017; Dehen et al. 2010; Hawk et al. 2010), more research is needed to understand whether the association with treatment of patients with non-musculoskeletal conditions may relate to care that is aimed to assist in the management of common migraine comorbidities, such as anxiety and depression, or toward the management of non-musculoskeletal conditions unrelated to migraine.

Our study also found chiropractors with a high migraine caseload are associated with providing spinal health maintenance and prevention. While there is limited research to identify a universal evidence-based definition of chiropractic maintenance care (Hawk et al. 2012; Leboeuf-Yde & Hestbæk 2008), the role of preventative care is well recognised within healthcare settings including for the prevention of migraine (Serrano et al. 2013), which often presents as a chronic or recurring condition (Buse et al. 2012; Lanteri-Minet 2014). As such, the need to help sufferers through ongoing support,

advice or treatment may be clinically indicated under a prevention paradigm. While ongoing SMT may be a popular component of chiropractic prevention (Jamison & Rupert 2001; Rupert 2000), more research is needed to understand all of the therapeutic modalities and approaches utilised under this therapeutic paradigm. With few clinical trials having included sufficient long-term follow-up to assess the benefits of chiropractic spinal health maintenance and prevention, no robust conclusions can be yet made about the long-term outcomes associated with this approach to care both for the management of conditions associated with the spine or the effect this type of care may have on those with migraine.

Our analyses identified chiropractors with a high migraine caseload as more likely to not have a psychologist/counsellor practicing at the same practice location. While psychologists can be a key healthcare provider for those with headache (Campbell, Penzien & Wall 2000; Lipchik et al. 2006; Smitherman, Maizels & Penzien 2008) it may be difficult to explain why chiropractors with a high migraine caseload are less likely to practice alongside psychologists. Possible explanations may be the potential influence of existing incentives for greater collaboration and therefore proximity between psychologists and other healthcare providers (Australian Government 2017) or the possibility that chiropractors who often manage migraine may have a more independent therapeutic approach to the management of psychological aspects of patient health (McDonald, Durkin & Pfefer 2004) suggesting less proximity reflects less inter-disciplinary collaboration with psychologists when managing this patient population. Alternatively, this could simply reflect a more general trend for Australian psychologists to work in independent private practice settings (Stokes et al. 2010).

The association with discussing medications (including for pain/inflammation) by chiropractors who often manage migraine raises valuable questions about the nature of these patient discussions. These discussions may reflect the practitioners aim to assist migraine patients to manage their health '*without the use of drugs or surgery*', a defining therapeutic and philosophical approach to patient care encouraged by chiropractic political bodies (Chiropractic 2013; Chiropractors Association of Australia 2016a) promoting better health without an unnecessary dependence on medications. These discussions may also reflect patient's raising concerns or dissatisfaction with migraine medications, a finding that has been reported as a key predictor for the use of complementary medicine including chiropractic for this patient population (Gaul et al. 2009; von Peter et al. 2002). As a result, discussing current and previous migraine medications may be more common place inside consultations with migraine patients. More research is needed to understand the nature of discussions regarding migraine medications and whether these discussions extend beyond the normal documentation of current and previous treatments for a presenting complaint as expected for registered chiropractors under regulatory guidelines (Chiropractic Board of Australia 2014).

4.7 Limitations

Our secondary analysis of the ACORN cross-sectional survey provides an opportunity to answer a number of questions and identify further pertinent questions for future enquiry regarding chiropractic migraine management. Drawing strong conclusions from our research may be limited due to our analysis being secondary and the quality and fit of existing data to our research. As such, it cannot be concluded that the

associations drawn from this secondary analysis are unique to the management of migraine patients. Our findings rely on practitioners understanding the classification criteria for migraine headache and the retrospective recall of practitioners when answering the original ACORN questionnaire. The Likert categories provided in the ACORN questionnaire ('never', 'rarely', 'sometimes', 'often') for the frequency of migraine management are also subject to practitioner interpretation of these terms. There would also be a risk of selection bias if the features of the practitioners responding to the ACORN survey are less than representative of the wider profession. While the associations reported from our secondary analysis of the ACORN cross-sectional survey are preliminary, the findings nevertheless are valuable in helping to generate hypotheses to further explore the management and effectiveness of headache and migraine management by chiropractors.

4.8 Conclusions

Migraine appears to be a significant component of chiropractic caseload. There is a need for more high-quality research to better understand how chiropractors manage this patient population and to understand the prevalence, burden and comorbidities associated with migraine patients who seek help from these providers. Such information is important in helping to inform safe, effective and coordinated care for migraine sufferers within the wider health system.

4.9 Chapter summary

The research findings presented in this chapter indicate that a substantial proportion of chiropractors report the frequent management of migraine. These findings highlight the need for healthcare providers to be mindful that the management of migraine by

chiropractors may be common. Certain practice and clinical management characteristics were found to predict the frequent management of migraine by chiropractors. These findings raise questions about the effectiveness and safety of headache management by chiropractors and the need for a more detailed examination of how chiropractors approach key aspects of headache patient management in the context of primary care settings. This includes the use of headache diagnosis, headache assessment tools, approaches to interdisciplinary headache patient management and headache treatment. In addition, these findings raise further questions about the headache types, level of headache severity, chronicity and disability found within chiropractic patient populations. A detailed examination of these practitioner and patient factors are needed to help guide safe, effective and coordinated headache-related healthcare delivery.

5 The management of common recurrent headaches by chiropractors: A descriptive analysis of a nationally representative survey

5.1 Chapter introduction

This chapter present detailed results of a study of Australian chiropractors' management of recurrent headaches. The chapter provides the rationale for the study and presents findings that address research question 3 (see section 1.2.2).

The work presented in this chapter was published as:

Moore, C., Leaver, A., Sibbritt, D., Adams, A. 2018, 'The management of common recurrent headaches by chiropractors: a descriptive analysis of a nationally representative survey', *BMC Neurology*, vol. 18, no. 171, p. 1-9.

The published article is shown in Appendix 13.

5.2 Rationale for the study within the research project

Following on from the findings of the previous study, which suggested chiropractors often provide management of those with migraine, one of the most common headache types (Burch, Rizzoli & Loder 2018), it is important to understand the headache management provided within chiropractic settings. Further, since chiropractic patient care can be diverse (Clijsters, Fronzoni & Jenkins 2014), and since the previous study suggested that chiropractors who often manage migraine should incorporate a range of approaches to patient management, it is important to

understand the characteristics of headache management by chiropractors in more detail and from a range of perspectives. This includes how chiropractors approach key aspects of headache patient management, including headache diagnosis, patient assessment, treatment and interdisciplinary collaboration. The following research into headache patient management expands the current knowledge of headache management by chiropractors, the health professionals favoured by many people with headache disorders (Bigal et al. 2008; Sanderson et al. 2013). It identifies the significance of diagnosis within chiropractic headache patient assessment, the influence of headache types on patient care, and the determinants of interdisciplinary engagement between chiropractors and other headache providers.

The data utilised in this chapter was derived from a questionnaire distributed directly to Australian chiropractors (see Appendix 4). A key methodological feature of this chapter is the use of descriptive statistics to derive measures of central tendency and dispersion of score variance (Scott & Mazhindu 2014).

The management of common recurrent headaches by chiropractors: a descriptive analysis of a nationally representative survey

5.3 Background

Tension headache and migraine are the most common recurrent primary headaches globally (Vos et al. 2013) and cervicogenic headache is one of the most common recurrent secondary headaches (Sjaastad & Bakketeig 2008; Sjaastad & Fredriksen 2000). While less information is available regarding the burden and economic impact associated with cervicogenic headache (Gesztelyi & Bereczki 2006; Suijlekom et al. 2003), the societal impact of tension headache and migraine are significant and well documented (Lanteri-Minet 2014; Yu & Han 2014; Zebenholzer et al. 2015).

In the collaborative study between the World Health Organisation (WHO) and the '*Lifting The Burden*' campaign, survey information was collected from neurologists and general practitioners in order to better understand how these providers approach headache diagnosis and management (World Health Organization 2011). The findings of the report provided important insights into the use of headache diagnostic criteria, headache assessment tools, headache treatment and interdisciplinary collaboration. While headache is most often managed by general practitioners and neurologists, the report also found headache patients report a clear preference for the use of complementary and alternative treatments for headaches including physical based therapies and acupuncture.

The use of chiropractors for headache management appears to be significant. In a recent national US study, manipulative-based physical therapies were reported to be the most frequently used complementary and alternative treatments for migraine and headache patients (Zhang et al. 2017). In North America, a general population study reported between 25.7% - 36.2% of migraine headache patients had sought help from chiropractors at some time (Bigal et al. 2008). In Australia, chiropractic utilisation by those with headache was reported to be 9.3% in the preceding 12 months (Xue et al. 2008). Notably, one international study found chiropractors to be the second and third most common health care provider by those with migraine in Australia and the United States respectively (Sanderson et al. 2013).

While the use of chiropractors for the management of headache disorders appears to be significant, little is understood about how this provider group manage this substantial patient population. With increasing research examination on interdisciplinary headache management (Gaul et al. 2016; Nicol, Hammond & Doran 2013), more information is needed to understand the role of chiropractors within the interdisciplinary headache management landscape. Gathering this information can offer important insights that may help to guide more effective and coordinated healthcare delivery between providers and improve the management of headache patients. In direct response to this important research gap, this paper reports on a) the prevalence of patients who present to chiropractors with headache and b) how chiropractors approach key aspects of headache patient management appropriate to primary care settings including the use of headache diagnostic criteria, headache

assessment tools, approach to headache treatment and interdisciplinary engagement with other headache providers.

5.4 Methods

The study collected data via an online cross-sectional survey distributed to Australian practicing chiropractors who were recruited members of the Australian Chiropractic Research Network (ACORN) - a national practice-based research network (PBRN) (Adams et al. 2016). Those recruited to the ACORN PBRN database are broadly representative of the wider national population of Australian chiropractors in terms of the key indicators of gender distribution, age distribution and practice location (Adams, Peng, Steel, et al. 2017). Full details of the original recruitment of chiropractors to join the national-based ACORN PBRN has been reported elsewhere (Adams et al. 2016). This ACORN PBRN sub-study was approved by the Human Research Ethics Committee at the University of Technology Sydney (Approval number: ETH16-0639).

5.4.1 Recruitment of participants

Practitioner recruitment for the sub-study was a random sample of chiropractors taken from the nationally representative ACORN database. A sample of 1,050 participants was selected using the random number generator function in Microsoft Excel 2016. Recruitment was conducted between August and November 2016 with participants invited to complete a 31-item online headache questionnaire using the SurveyMonkey™ platform. An embedded link to the headache questionnaire was emailed to invited participants who received three reminders during the recruitment period.

5.4.2 Instrument

The questionnaire introduction explained the approximate duration, purpose and contents of the study and that survey completion was voluntary, and that respondent information was anonymous. Consent was implied by completing the survey and no incentives were offered to participate in the study. As there are no previously validated instruments for the assessment of provider headache management across several clinical areas, the key themes and questions adopted for our study questionnaire were developed after consideration of the 'WHO: Lifting the Burden' report and other surveys examining primary care management of headache patients (Kernick, Stapley & Hamilton 2008; Vuillaume De Diego & Lanteri-Minet 2005; World Health Organization 2011). The headache disorders selected for the study were based upon headache types previously reported as common to chiropractic headache patient populations (Adams, Barbery & Lui 2013; Kristoffersen et al. 2012; Moore, Sibbritt & Adams 2017).

The questionnaire collected information on practitioner characteristics (i.e. gender, years in practice, place of education and practice location). Practitioner reporting of headache patient prevalence were based on practitioner consultations over the previous two weeks. Questions about the use of headache diagnostic criteria were based on the International Classification of Headache Disorders (ICHD-3 Beta) criteria for primary and secondary recurrent headaches (Headache Classification Committee of the International Headache Society 2013). Preceding the questions on primary headaches, the online questionnaire provided a direct link to ICHD-3 Beta diagnostic criteria. Preceding the questions on secondary headaches, a direct link was similarly

provided to the ICHD-3 Beta diagnostic criteria. Questions regarding the use of headache assessment instruments were based on the use of the *Migraine Disability Assessment* questionnaire (MIDAS) (Stewart et al. 2000), *Headache Disability Inventory (HDI)* (Jacobson et al. 1994) and the use of patient headache diaries (Phillip, Lyngberg & Jensen 2007). For headache management, the questionnaire included questions on multi-disciplinary engagement with other providers (sending and receiving headache patient referrals) and questions on chiropractor's approach to headache management including treatment aims, therapeutic methods and treatment volume. For questions regarding headache management by chiropractors, headaches were divided into headaches of less than 3 months' duration and headaches of more than 3 months' duration.

The questionnaire was pilot tested with 10 chiropractors in private clinical practice from different socio-demographic backgrounds who provided feedback on content, wording and survey length. Feedback from pilot testing resulted in further changes to the length and wording of the instrument. The final version of the online survey was estimated to take around 15 minutes to complete. All questionnaire items were either dichotomous (yes/no) or reported as ratings on a 4-point or 5-point Likert scale.

5.4.3 Statistical analyses

Participant perceptions regarding the role of ICHD diagnostic criteria for primary and secondary headaches are re-categorized into 3 groups: strongly disagree/disagree; neutral and agree/strongly agree and the reporting of participant collaboration with other healthcare providers for the management of headache are consolidated into 2 groups: never/rarely; and sometimes/often. This was due to the very low number of

responses reported within some of the Likert categories provided for these questions. A minimum mean agreement score is used to report participant headache treatment aims (very unimportant/somewhat unimportant/neutral/somewhat important/very important). The reporting of chiropractic headache management provided by chiropractors are categorized as: often/almost every headache patient compared to never/rarely. Descriptive statistics are used to describe responses by participants. Continuous descriptive data are presented using means and standard deviations and categorical data presented using numbers and percentages. Statistical analysis was based upon the total number of completed surveys (n=321) and conducted using software Stata 13.1.

5.5 Results

5.5.1 Practitioner characteristics

The questionnaire was completed by 381 practitioners, giving a response rate of 36.2%. This number represents 12.1% of the total number of practicing chiropractors in Australia at the time of recruitment. Participants mean number of years in practice was 18.1 years (SD=10.9). When comparing survey participants to the ACORN database, survey respondents are generally representative for gender (64% male vs 63%) ($p=0.379$), and place of practice: New South Wales (35.1% vs 34%), Victoria (23.2% vs 25%), Queensland (15.2% vs 15.0%), Western Australia (14.7% vs 13%), South Australia (8.5% vs 9.0%), Australian Capital Territory (1.6% vs 2%), Tasmania (0.9% vs 1%) and Northern Territory (0.5% vs 1%) ($p=0.916$) (Adams et al. 2016). These non-significant p values show no difference in distributions between samples for gender and place of practice, suggesting survey respondents are generally representative of the ACORN

database participants. The distribution of these participant demographic characteristics are consistent with national registration records reported by the Chiropractic Board of Australia (*Chiropractic Board of Australia. Chiropractic Registrant Data 2016*).

5.5.2 Headache prevalence

In the previous two-week period the mean total number of new consultations reported by participants was 7.1 (SD=4.8) where a chief complaint of headaches accounted for 1.5 (SD=1.7) new consultations and a secondary complaint of headaches accounted for 2.5 (SD=2.3) new consultations. In the previous two-week period the mean number of total patient consultations (new and routine treatment visits) was 170.9 (SD=107.3) where a chief complaint of headaches accounted for 21.5 (SD=28.6) total consultations and a secondary complaint of headaches accounted for 28.2 (33.8) total consultations.

5.5.3 Headache treatment plans

In terms of the number of initial treatment visits normally provided for a new patient presenting with headaches of less than 3 months duration for each of migraine, tension headache and cervicogenic headache, between 28% - 29.6% of participants reported providing less than 5 treatments, 54.2% - 55.5% provided between 5-10 visits and 14.9% - 16.5% reported providing more than 10 visits across all 3 headache types. For the duration of an initial headache treatment plan for a new patient presenting with headaches of less than 3 months duration - migraine, tension headache and cervicogenic headache (grouped); 11.8% of participants reported providing treatment for less than 2 weeks, 50.3% reported 2 – 4 weeks, 33.0% reported 4-8 weeks and 4.4%

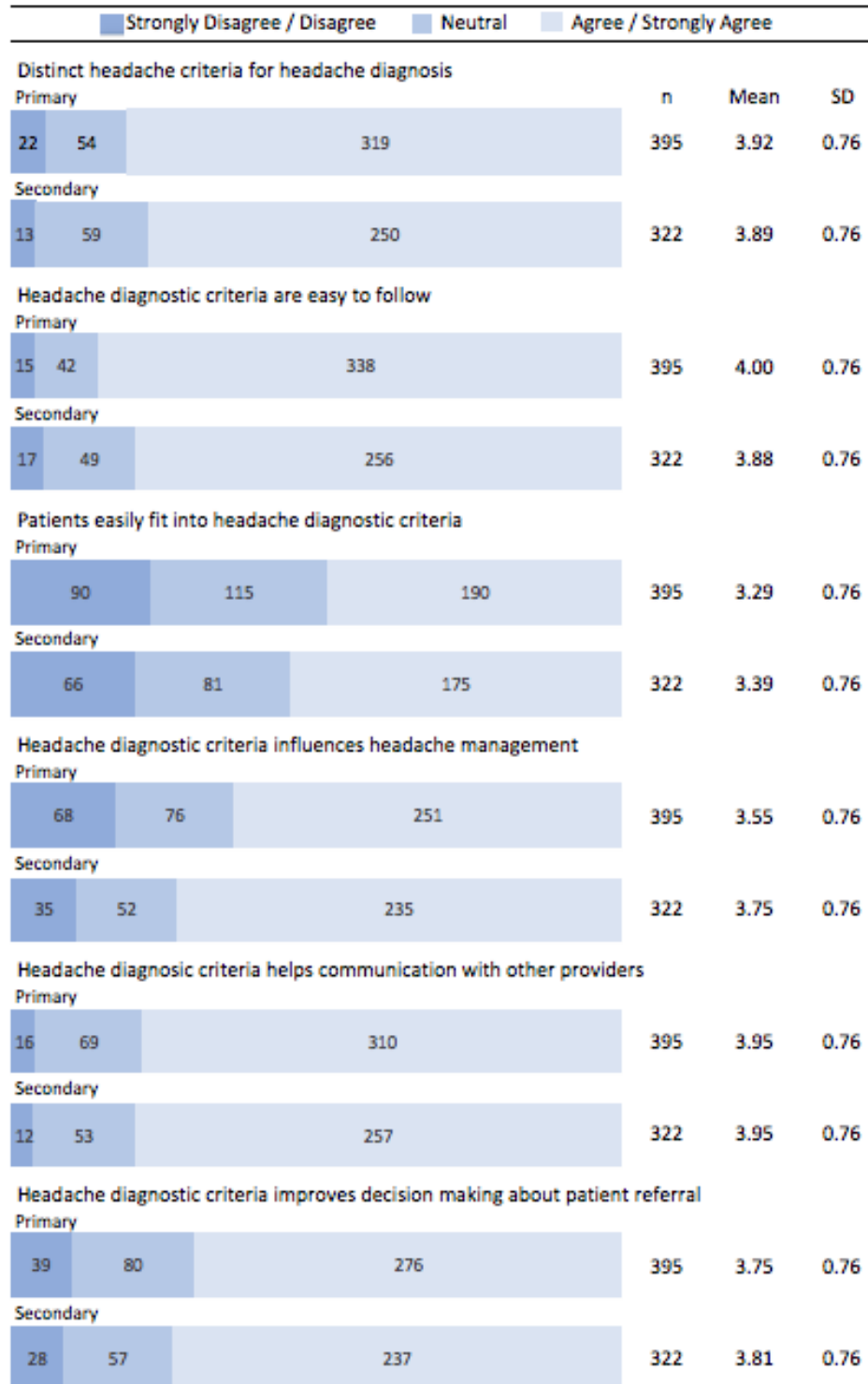
reported treatment for more than 8 weeks. With regards to the frequency of treatment during an initial headache treatment plan for a new patient presenting with headaches of less than 3 months duration (i.e. migraine, tension headache and cervicogenic), 16.0% of participants reported providing one treatment per week, 72.5% two treatments per week, 11.0% three treatments per week and 0.5% reported providing more than three visits per week. In terms of the number of initial treatment visits for a new patient presenting with headaches for more than 3 months duration for each of migraine, tension headache and cervicogenic headache, between 10.7% - 12.0% of participants reported providing less than 5 treatments, 46.3% - 50.3% provided between 5-10 visits and between 38.0% - 43.0% reported providing more than 10 visits across all 3 headache types. For the duration of an initial headache treatment plan for a patient presenting with headaches for more than 3 months duration - migraine, tension headache and cervicogenic headache (grouped), 4.7% of participants reported providing treatment for less than 2 weeks, 32.2% reported 2 – 4 weeks, 46.9% reported 4-8 weeks and 16.2% reported an initial treatment period of more than 8 weeks.

5.5.4 Headache classification

The majority of participants reported being familiar with ICHD headache criteria for primary (98.3%; n=411) and secondary (81.2%; n=324) headaches and using these criteria for classifying primary (84.6%; n=334) and secondary (90.4%; n=291) headaches. Figure 5.1 provides the mean score for participants' perceptions regarding ICHD criteria for the diagnosis and management of primary and secondary headaches independently. The mean scores (0=no agreement, 5=high agreement) across all

domains were high for participant agreement on the clinical utility of ICHD classification for a range of listed clinical purposes. There was a strong agreement amongst participants that ICHD criteria were easy to follow for primary (mean=4.00; SD=0.76) and secondary headaches (mean=3.88; SD=0.76) and represent distinct criteria for primary (mean=3.92; SD=0.76) and secondary headaches (mean=3.89; SD=0.76) and helps communication with other providers for primary (mean=3.95; SD=0.76) and secondary headaches (mean=3.96; SD=0.76). There was relatively less agreement amongst participants that patients easily fit into ICHD criteria for primary (mean=3.29; SD=0.76) and secondary headaches (mean=3.39; SD=0.76).

Figure 5.1: Chiropractors views regarding ICHD diagnostic criteria for primary and secondary headaches (strongly disagree/disagree/neutral/agree/strongly agree).



5.5.5 Multidisciplinary care

The level of interdisciplinary collaboration between chiropractors and other healthcare providers in managing patients with headaches is reported in Table 5.1. The most

frequent collaboration between chiropractors and other providers for headache management was reported to be with other Complementary and Alternative Medicine (CAM) providers, followed by GPs for both referring and receiving headache patient referrals. The frequency of chiropractors referring headache patients to GPs was reported as substantially higher than the frequency of chiropractors receiving headache patient referrals from GPs.

The reasons chiropractors 'sometimes' or 'often' refer headache patients to other providers was to: investigate headache red-flags (83.4%; n=324); assist with acute headache pain (57.1%; n=224); assist with headache-related coping skills (53.8%; n=211); assist with headache prevention (44.9%; n=176); and confirm headache diagnosis (32.9%; n=129).

Table 5.1: Interdisciplinary collaboration by chiropractors with other healthcare providers for headache management (sometimes/often compared to never/rarely).

Provider	Receiving (sometimes/often) n=392	Referring (sometimes/often) n=392
CAM practitioner	66.1% (n=259)	66.3% (n=260)
General practitioner	29.6% (n=116)	59.9% (n=235)
Medical specialist (via GP)	3.8% (n=15)	42.6% (n=167)
Dentist	25% (n=98)	40.3% (n=158)
Psychologist	10.9% (n=43)	16.6% (n=65)
Physiotherapist	11.7% (n=46)	13.3% (n=52)
Osteopath	5.3% (n=21)	3.8% (n=15)

Survey key: Medical specialist (via GP) e.g. neurologist, psychiatrist. CAM practitioner e.g. acupuncturist, herbalist, naturopath, massage therapist, counsellor.

5.5.6 Chiropractic headache management

The mean scores (0=no agreement, 5=high agreement) across all domains were high for participant agreement on the importance of a range of headache treatment outcomes. There was a minimum mean agreement score of 4.23 out of 5 for: the importance of treatment providing headache prevention; improving headache recovery and headache pain relief; improving headache-related coping skills; and patient health and well-being.

The most frequent therapeutic approach by participants for migraine management was advice on headache triggers (94.1%), stress management (89.4%) and non-thrust spinal mobilisation (88.4%). The most frequent therapeutic approach by participants for tension headache management was advice on headache triggers (90.9%), stress management (90.1%) and soft tissue therapies (massage, myofascial, stretching or trigger point therapy) to the neck/shoulder area (88.1%). The most frequent therapeutic approach by participants for cervicogenic headache management was prescription exercises for the neck/shoulders (91.7%), spinal manipulation (90.6%) and soft tissue therapies (massage, myofascial, stretching or trigger point therapy) to the neck/shoulder area (88.3%) (Table 5.2).

When asked about the use of headache assessment instruments, a significant percentage of participants reported 'never' or 'rarely' using MIDAS (96.2%) and HDI (87.3%) headache instruments. The use of headache diaries was reported as 'sometimes' or 'almost every headache patient' by 41% of the chiropractors (data not shown).

Table 5.2: Headache management characteristics by chiropractors (often/almost every headache patient compared to never/rarely).

Treatment approach	Migraine (often/almost all) (n=387)	Tension headache (often/almost all) (n=382)	Cervicogenic headache (often/almost all) (n=382)
<i>Joint-based manipulative therapies</i>			
Spinal manipulation	318(82.2%)	337(87.5%)	349(90.6%)
Non-thrust spinal mobilisations	264(88.4%)	252(65.5%)	252(65.5%)
Instrument adjusting	279(72.1%)	270(70.1%)	273(70.9%)
Drop-piece methods	133(34.4%)	148(38.4%)	153(39.7%)
<i>Soft-tissue based and exercise therapies</i>			
Soft tissue to neck/shoulders	331(85.3%)	339(88.1%)	340(88.3%)
Electro-physical therapies	30(7.8%)	30(7.8%)	30(7.8%)
Soft-tissue/exercise to temporomandibular	252(65.1%)	249(64.7%)	233(60.5%)
Exercises – neck/shoulders	311(81.6%)	337(87.5%)	353(91.7%)
<i>Patient advice and education</i>			
Advice on headache triggers	364(94.1%)	350(90.9%)	338(87.8%)
Advice on diet and fitness	331(85.6%)	336(87.3%)	327(84.9%)
Stress management	346(89.4%)	347(90.1%)	337(87.5%)

Survey key: Spinal manipulation (manual adjusting/manipulation (including Diversified, Gonstead); Drop piece methods (drop-piece/Thompson or similar); Soft tissue – neck/shoulders (massage, myofascial, stretching or trigger points to neck/shoulders); Electro-physical therapies (including TENS, ultrasound)

5.6 Discussion

Results from our study suggest that a large percentage of new and routine chiropractic patient consultations are related to headache management with around one in five new patients presenting to chiropractors with a chief complaint of headache and more than one in three presenting with a secondary complaint of headache. This substantial level of headache caseload within chiropractic clinical settings raises questions about the factors that influence the preference and use of chiropractors for the management of headache compared to the use of other headache providers and treatments.

Previous evidence suggests that patient dissatisfaction with preventative headache drug treatments are likely to be an important predictor for headache patient use of manual therapy providers (Moore, Sibbritt & Adams 2017). However, there is a need for more robust research to assess the effectiveness of manual therapies for the prevention of recurrent headaches. To date, systematic reviews report significant methodological short-comings for clinical trials that aim to assess the prevention of migraine with manual therapies (Chaibi, Tuchin & Russell 2011; Posadzki & Ernst 2011), while limited, moderate quality evidence appears to support the potential role of manual therapies for the prevention of tension-type headache (Lozano López et al. 2016; Mesa-Jiménez et al. 2015) and cervicogenic headache (Chaibi & Russell 2012; Racicki et al. 2013).

Our study results suggest some aspects of headache patient management by chiropractors are consistent with that of medical providers. For example, the proportion of chiropractors reporting the use of primary and secondary headache diagnostic criteria in our study (84.6% and 90.4% respectively) compares favourably

with the use of headache diagnosis found within medical care (Kernick, Stapley & Hamilton 2008; World Health Organization 2011). While headache diagnosis is likely to improve clinical decision-making when managing the healthcare needs of headache sufferers (Kingston & Halker 2017), there is currently limited, poor quality information reporting on the proportion of migraine (Sanderson et al. 2013), tension headache (Kristoffersen et al. 2012), and cervicogenic headache within chiropractic clinical settings. As such, more information is needed to better understand the types of headaches and level of headache burden more common to chiropractic clinical settings and how the management of headache patients is influenced by headache diagnosis including approaches to patient examination, education, referral and treatment.

Of note, practitioner use of secondary headache criteria for cervicogenic and medication over-use headache was reported slightly more often than practitioner familiarity with these secondary headache criteria. Poor familiarity with secondary headache criteria raises concerns about the risk to patient outcomes should chiropractors fail to appropriately diagnose secondary headaches. Such concerns could have serious consequences for secondary headaches needing urgent medical management (Nelson & Taylor 2014). While fully understanding this finding requires further empirical investigation, another explanation may be that some chiropractors are less familiar with at least some secondary headache diagnostic criteria listed, a finding that may relate to medication overuse headache, a secondary headache condition that can go unrecognized in clinical settings (Obermann & Katsarava 2007). Additionally, this finding may also relate to practitioner concerns regarding the clinical utility of the diagnostic criteria associated with cervicogenic headache, an issue that

has been reported elsewhere (Antonaci, Bono & Chimento 2006; Fredriksen, Antonaci & Sjaastad 2015; Sjaastad & Bakketeig 2008). If so, these results may add weight to the need for further research examination into provider understanding, use and acceptance of cervicogenic headache criteria within primary care clinical settings.

The high rate of headache referral (receiving/referring) between chiropractors and other CAM providers in our study is consistent with findings from previous research in Australia and the US (Adams, Lauche, et al. 2017; Pohlman et al. 2010). The pattern of high referral between chiropractors and other CAM providers may be influenced by a number of factors including the influence of chiropractic organisations who sometimes promote a drugless approach to patient care (Chiropractors Association of Australia 2016b; World Federation of Chiropractic 2005) or the higher percentage of chiropractors working at the same practice location as other CAM providers when compared to those practicing alongside other healthcare providers (Adams, Lauche, et al. 2017).

Our study identified that less than one in three chiropractors sometimes or often receive headache referrals from GPs. While the implication of these findings requires further empirical inquiry, this low rate of headache referral from GPs may be due to factors including GP concerns about the current level of evidence to support the effectiveness of manual therapies for the management of headache or a less favourable GP attitude toward chiropractors as reported in a recent survey which found that 60% of Australian GPs never referred patients to a chiropractor (Engel, Beirman & Grace 2016). With systematic reviews reporting evidence to support the potential role of manual therapies for some headache types (Chaibi & Russell 2014;

Mesa-Jiménez et al. 2015; Racicki et al. 2013), further research may be needed to better understand the current barriers to collaborative headache management that may exist between these providers. This research priority would seem important given the unmet needs remaining for some headache sufferers under medical care (Gaul et al. 2009; Malone, Bhowmick & Wachholtz 2015; Rossi et al. 2006; Starling & Dodick 2015) and the high use of manipulative therapy providers by headache patients (Moore, Sibbritt & Adams 2017; Sanderson et al. 2013; Zhang et al. 2017).

While the low frequency of headache patient referral between chiropractors and physiotherapy and osteopathic providers in our study may be partly explained by the use of similar approaches to headache treatment (Grant & Niere 2000; Schabert & Crow 2009), the low frequency of headache patient referral between chiropractors and psychologists deserves further consideration. Psychologists are a significant healthcare provider for the management of headache pain (Bendtsen et al. 2010; Pringsheim et al. 2012) and for the management of headache-related comorbidities such as anxiety and depression. (Jensen et al. 2010; Seng et al. 2014). As such, this finding raises questions about whether chiropractors managing headache are fully aware of the psycho-behavioural approaches available to assist in the management of headache. In comparison, the higher frequency of headache patient referral to GPs and medical specialists (via the GP) by chiropractors appears to suggest there are circumstances where chiropractors are working together with medical providers for the management of headache, a finding further supported by the high frequency of referral for the investigation of headache red-flags reported in our study. More information reporting on the types of headaches, level of headache chronicity and

disability found within chiropractic headache populations would further help researchers and clinicians to better comprehend the related healthcare needs of this patient population and the clinical circumstances where greater interdisciplinary collaboration is warranted between chiropractors and other headache-related healthcare providers.

The most common therapeutic approaches reported by chiropractors in our study for the management of headache was providing advice on headache triggers, stress management, spinal manipulation, soft tissue therapies and prescriptive neck exercises. Helping patients both identify and manage headache triggers is recognised as an important aspect of headache patient management for those who present with migraine and tension headache within primary care settings (Haque et al. 2012). However, the role of manual and exercise therapies for the management of those with recurrent headaches remains less certain with systematic reviews reporting stronger evidence for manual therapies for the prevention of cervicogenic and tension headache (Mesa-Jiménez et al. 2015; Racicki et al. 2013) and limited and conflicting evidence for the prevention of migraine (Posadzki & Ernst 2011). As such, more robust research is needed to assess the effectiveness of both unimodal and multi-modal approaches to headache management by chiropractors, including for the management of both acute and chronic headache sub-types.

The chiropractors in our study most often provided between 5 and 10 treatments during an initial headache treatment plan while a slightly higher average number of treatments were provided for those with headaches of longer duration (more than 3 months). This number of treatments is similar to the number of treatments associated

with significant improvement in headache outcomes for spinal mobilisation and manipulation reported in previous tension headache and cervicogenic headache studies (Castien et al. 2011; Haas et al. 2010; Haas et al. 2018). While information is limited regarding the relative costs associated with chiropractic headache management, one recent US study compared the cost of headache care using risk-adjusted scores that would otherwise affect the level of healthcare utilization (Hurwitz et al. 2016). This study found headache treatment costs were significantly higher both for medical doctor-only care when compared to chiropractic-only care and for medical doctor care combined with physical therapy care compared to medical doctor care combined with chiropractic care.

Our study found chiropractors more frequently engage the use of patient headache diaries, an approach to headache assessment that can help to reduce patient difficulty in recalling headache characteristics and their response to headache treatment (Jensen et al. 2011). However, the use of formal headache instruments such as MIDAS and HDI was comparatively low, a finding reported within other primary care settings (Minen et al. 2016; World Health Organization 2011). These validated headache instruments can assist health care providers to better understand headache disability, exacerbations and remissions and circumstances that indicate the need for specialty care (Jacobson et al. 1994; Lipton et al. 2001; Stewart, Lipton & Kolodner 2003). As such, the low use of validated headache instruments reported in our study raises questions about best practice with regards to chiropractors more fully assessing headache patients to better understand clinical findings associated with more complex headache patient presentations.

A key strength of our study is the nationally representative cross-sectional sample of chiropractors in order to provide important preliminary information on the current state of chiropractic headache practice. It is however important to acknowledge several limitations to our study. While the online survey provided a direct reference and link to the ICHD-3 classification criteria for primary and secondary headaches, a comprehensive list of the headache criteria was not provided within the survey prior to asking respondents if they were familiar with the diagnostic criteria for the primary and secondary headaches listed. Furthermore, the survey has not aimed to explore diagnosis and management of chronic headache types (more than 15 headache days per month over a 3-month period). The response rate for our sample (36%), while similar to other studies of this type, is limited to 12% of the total practitioner population nationally. As a result, there may be important differences in the headache management characteristics between survey respondents and non-respondents. This would include the risk of selection bias that may result from the random selection of chiropractors within a PBRN compared to outside the PBRN. The Likert categories utilized in parts of the survey questionnaire are open to practitioner interpretation and findings are based upon self-report and retrospective recall and subject to recall bias. In addition, our study did not provide any assessment of adverse events that may result from manual therapies for the management of headaches. However, these findings draw upon a national sample of chiropractors in order to provide valuable insights for future investigation to further our understanding of the management of headache patients by this provider group.

5.7 Conclusions

Our national-based sample suggests headache is a substantial proportion of chiropractic caseload. While some aspects of chiropractic headache management, including the acceptance and use of headache diagnostic criteria, appears to be consistent with good clinical practice, other aspects of chiropractic headache management raise questions worthy of further research enquiry. Critically, there is a need for more detailed information on the proportion of headache types and level of headache chronicity and disability found within chiropractic headache patient populations. This information will help practitioners, researchers and policymakers to better understand the healthcare needs associated with headache patients who seek help from this common provider of headache management.

5.8 Chapter summary

Results presented in this chapter indicate that headache management is common within chiropractic daily practice. This knowledge highlights the need for healthcare providers to be aware of the frequent management of headache by chiropractors and to inquire into the use of chiropractors by those with headache disorders. Findings from this chapter show that some aspects of Australian chiropractors' headache management are not aligned with optimal clinical practice. For example, more than half of the participants reported never or rarely implementing headache diaries. Failure to use headache diaries may impair the ability of chiropractors to provide an accurate headache diagnosis. In addition, findings show chiropractors rarely used common headache disability instruments. Awareness of headache-related disability

can improve provider understanding of the broader healthcare needs of people with increased headache burden (Sauro et al. 2010).

Furthermore, while findings show chiropractors most often utilise manual therapies, stress management and patient education for headache management, clinical research is needed to assess the effectiveness of this multi-model approach to chiropractors' headache patient management. Chapter findings additionally identify that while chiropractors often collaborate with conventional and CAM providers for headache co-management, they less often collaborate with psychologists, despite the potential role of psychologists in the management of headache pain (Harris et al. 2015) and headache-related psychiatric comorbidity (Jensen & Rasmussen 2012). Chapter findings also identify that headache-related referrals from GPs is infrequent. This finding appears to be consistent with the findings from previous studies that suggest a general unwillingness by GPs to refer patients to chiropractors (Engel, Beirman & Grace 2016). Results from this chapter also show chiropractors' substantial use of headache diagnosis, which is fundamental to determining appropriate headache treatment (Kingston & Halker 2017; Lipton, Buse, et al. 2013). However, additional research is required to more thoroughly investigate the impact of headache diagnosis on chiropractors' headache patient care.

6 Prevalence and factors associated with the use of primary headache diagnostic criteria by chiropractors

6.1 Chapter introduction

This chapter presents detailed results of a study of Australian chiropractors' use of primary headache classification and the characteristics associated with chiropractors who do so. The chapter will provide the rationale for the study and presents findings that address research question 4 (see section 1.2.2).

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The published article is shown in Appendix 14.

6.2 Rationale for the study within the research project

Chapter 4 of this study indicates that migraine consultation is common within Australian chiropractic clinical practice. Chapter 5 further identified the high level of headache consultation more generally in Australian chiropractic clinical practice and the characteristics of chiropractors' headache management. Beyond understanding common approaches to headache patient management by Australian chiropractors, it is important to closely examine the influence of headache diagnosis on chiropractors

who manage this patient population. Since headache diagnosis is considered a pillar of effective headache patient management (Kingston & Halker 2017; Lipton, Buse, et al. 2013), closer attention to the influence of the use of primary headache diagnosis on chiropractors' is warranted, because a considerable proportion of chiropractors report the utilisation of primary headache diagnostic criteria in patient care. This chapter provides insights into how the use of primary headache diagnostic criteria is associated with the clinical beliefs, attitudes and practice behaviours of chiropractors who manage primary headache patients.

The data utilised for this chapter were derived from a survey of practising Australian chiropractors (see Appendix 4). The demographic data came from responses to questions 1, 2, 3 and 4 of the questionnaire. Response to questionnaire items related to headache patient management (questions 13, 19, 20, 21, 22, 24, 25, 26) were used as variables and their associations with use of primary headache diagnostic criteria were determined. A key methodological feature of this chapter is the use of multiple logistic regression analysis for a single dichotomous outcome (use of primary headache diagnostic criteria – yes/no) and independent variables such as practitioner beliefs and practice behaviours associated with headache management (Hosmer & Lemeshow 2000).

Prevalence and factors associated with the use of primary headache diagnostic criteria by chiropractors

6.3 Background

The global adult prevalence of tension-type headache and migraine is reported to be approximately 40% and 10%, respectively (Jensen & Stovner 2008; Lipton et al. 2007; Stovner et al. 2007). These headaches constitute a substantial burden on the personal health and productivity of sufferers (Bendtsen & Jensen 2006; Malone, Bhowmick & Wachholtz 2015) and cause a significant drain on healthcare resources (Latinovic, Gulliford & Ridsdale 2006; Linde et al. 2012). While those with chronic tension headache can sometimes report greater headache pain than those with migraine (Abu Bakar et al. 2015), migraine is one of the top 10 causes of years lived with disability (Vos et al. 2015) and the third leading cause of disability for those under the age of fifty (Steiner, Stovner & Vos 2016).

Significant challenges remain regarding the management of headache patients.

Headache patients are often poorly or under diagnosed (Kernick, Stapley & Hamilton 2008), under treated (Diamond et al. 2007; Silberstein et al. 2005) or can fail to receive effective interdisciplinary management (Barton et al. 2014; Nicol, Hammond & Doran 2013). Such challenges have led international headache organisations (European Headache Federation n.d.; Lifting the Burden: The Global Campaign Against Headache

n.d.; National Headache Foundation n.d.) and headache researchers (Lipton, Buse, et al. 2013; Peters et al. 2012) to call for more effective health care service delivery for this significant patient population. While general practitioners (GPs) are typically the first point of contact for those with primary headaches (Latinovic, Gulliford & Ridsdale 2006; Stark, Valenti & Miller 2007), sufferers can enter the healthcare system via a range of health care providers (Grant & Niere 2000; Kristoffersen et al. 2012; Nicholson 2010). The use of chiropractors for headache management is likely most often for primary headaches, with studies reporting substantial use in the North America (Wells et al. 2010; Zhang et al. 2017), Australia (Sanderson et al. 2013) and parts of Europe (Kristoffersen et al. 2012; Vuković et al. 2010). Despite the substantial use of chiropractors by those with primary headaches, little is known about how these practitioners manage this patient population. Such information can improve our understanding of headache-related health care delivery services and the role of these providers within the wider landscape of headache patient management.

The 3rd edition of International Classification of Headache Disorders (ICHD) outlines the current criteria utilised for headache diagnosis (Headache Classification Committee of the International Headache Society 2018). Headache diagnosis is a key determinant that will influence practitioner decision-making around headache patient care. While a recent study reported the high use of headache diagnosis by chiropractors (Moore et al. 2018), there is little information regarding how primary headache diagnosis influences the clinical management of headaches by these providers. In direct response, the aim of this study was to draw upon a national sample of chiropractors to identify the headache patient management factors associated with those practitioners

who utilised [International Classification of Headache Disorders (ICHD) primary headache diagnostic criteria].

6.4 Methods

The data analysed in this study was drawn from a questionnaire distributed to members (chiropractors) of a national practice-based research network (PBRN) titled the Australian Chiropractic Research Network (ACORN) project (Adams et al. 2016).

This study was approved by the Human Research Ethics Committee at the University of Technology Sydney (Approval number ETH16-0639).

6.4.1 Recruitment and sample

Detailed information about the ACORN PBRN recruitment and data base has been previously reported (Adams, Peng, Steel, et al. 2017; Adams et al. 2016), but briefly, ACORN recruitment was conducted via an invitation pack that included a baseline questionnaire disseminated between March and June 2015 to all registered Australian chiropractors. Invitation pack distribution was via email (with an embedded link to online questionnaire), postal distribution (hard copy questionnaire), regional chiropractic conferences (hard copy questionnaire) and the official ACORN website (with an embedded link to the online questionnaire). Forty-three percent (n=1680) of all registered Australian chiropractors joined the ACORN network database. The socio-demographic profile of the ACORN database is representative of the wider chiropractic profession across Australia in terms of gender, age and practice location (Adams, Peng, Steel, et al. 2017).

Participants for this PBRN sub-study were randomly selected from the ACORN practitioners who had reported that they 'often' provided treatment for patients with

headache disorders in the ACORN PBRN invitation pack questionnaire. Participants were asked to complete a 31-item cross-sectional online survey between August and November 2016. An embedded link to the questionnaire was emailed to chiropractors. Three further reminders to complete the survey were sent out during the recruitment period. Participation in the survey was further promoted within routine email newsletters sent out by the Australian Chiropractors Association during that period.

6.4.2 Questionnaire

The introduction to the questionnaire explained the purpose, contents and approximate duration of the study and that respondent information was anonymous and survey completion voluntary. No incentives were offered to participate, and consent was implied by completing the survey. Questionnaire items specifically developed for this study aimed to examine chiropractic headache management across several clinical themes considered important to frontline headache management practice. With no validated instruments available, the key themes adopted for our study questionnaire were developed after consideration of past surveys examining the management of headache patients in primary care settings (Kernick, Stapley & Hamilton 2008; Vuillaume De Diego & Lanteri-Minet 2005; World Health Organization 2011). The survey collected information on practitioner characteristics, including gender, place of education, practice location and years in practice. Prevalence of headache in chiropractic practice was based on self-report on patient consultations over the previous two weeks. The use of formal diagnostic criteria for headaches was based on International Classification of Headache Disorders (ICHD-3 Beta) criteria (Headache Classification Committee of the International Headache Society 2013). The

survey design included descriptions of primary headache criteria for migraine, tension-type headache and cluster headache and for secondary headache criteria for cervicogenic and medication overuse headache. The use of headache treatment outcome instruments was based on the use of the Headache Disability Index (HDI) (Jacobson et al. 1994), Migraine Disability Index (MIDAS) (Stewart, Lipton & Kolodner 2003) and standard patient headache diaries (Phillip, Lyngberg & Jensen 2007). Patient management included questions on collaboration with other healthcare providers associated with headache management (sending and receiving) and questions on the basis for patient referral. The questions on headache management provided a list of therapeutic approaches for headache including patient education on headache triggers, physical therapies and manual therapies utilised for headache (e.g. spinal manipulation, mobilisation, massage therapy).

The primary headache management questions included in the questionnaire were based upon primary headaches previously reported as most often treated by chiropractors (Adams, Barbary & Lui 2013; Kristoffersen et al. 2012; Moore, Sibbritt & Adams 2017) and after consultation with 10 practicing Australian chiropractors during survey pilot testing. The pilot testing findings were discussed between all members of the research team to assist decisions about survey duration and the selection of the survey themes and item options. This included the selection of headache treatment outcome measures, where we considered practitioner familiarity and understanding of the nature and purpose of select outcome instruments as well as treatment terminology and their views on relevance to headache management. All questionnaire items were either reported as ratings on a 4-point or 5-point Likert scale or as

dichotomous (yes/no).

6.4.3 Statistical analyses

Summary statistics were presented by number (percentage), mean (SD) as appropriate. In-order to test the differences in continuous and categorical variables by group, we have used Student's t-test and chi-square test or Fishers exact test respectively (Table 6.1). Bivariate comparison of clinical management characteristics, headache referral characteristics, importance of headache treatment outcomes and headache management characteristics were made between chiropractors who indicated the use ICHD headache classification criteria for the diagnosis of primary headaches (i.e. yes/no) using chi-square/Fishers exact test as appropriate (Tables 6.2-6.5).

Multiple logistic regression modelling was then performed to identify independent predictors associated with those chiropractors who use ICHD primary headache criteria (presented in Table 6.6). Questionnaire response items are dichotomized into "Strongly disagree/Disagree/Neutral" versus "Agree/Strongly agree" with bivariate associations of $p < 0.2$ included in the regression model. The independent survey variables were dichotomized after consideration of previous research (Engel, Beirman & Grace 2016; Lee et al. 2018) and the distribution of the data. A backward stepwise procedure was chosen to determine the most parsimonious model that predicts those chiropractors who use primary headache diagnostic criteria. Statistical significance was set at $p < 0.05$. Odds ratios were reported with 95% confidence intervals. All statistical analyses were conducted using the statistical software Stata 13.1.

6.5 Results

A total of 1050 chiropractors were invited to participate of which 381 (36.2%) completed the questionnaire. As shown in Table 6.1, the sub-study sample of participants was compared to the wider ACORN sample and was shown to be similar across gender ($p=0.379$), place of practice ($p=0.916$) suggesting survey respondents are generally representative (non-significant p values) of the ACORN database participants while our sample was slightly more experienced than the ACORN database members for years in practice ($p=0.003$). The majority of questionnaire respondents were male (64%) and the average number of years in practice was 18.1 (SD=10.9) years. Most participants were educated in Australia including New South Wales (38.6%), Victoria (35.6%), Western Australia (9.7%) and Queensland (0.8%). Place of practice amongst the participants was greatest in New South Wales (35.1%), followed by Victoria (23.2%), Queensland (15.2%), Western Australia (14.7%), South Australia (8.5%), Australian Capital Territory (1.6%), Tasmania (0.9%) and Northern Territory (0.5%). Participant demographic characteristics were consistent with national chiropractic registration records (Chiropractic Board of Australia).

Table 6.1: Comparison of survey population with ACORN membership based on demographic characteristics.

Characteristic	Survey Population	ACORN Database	p-value
Gender (%)			
Male	64	63	p=0.379
Female	36	37	
Place of Practice (%)			p=0.916
New South Wales	35.1	34	
Victoria	23.2	25	
Queensland	15.2	15	
Western Australia	14.7	13	
South Australia	8.5	9	
Australian Capital Territory	1.6	2	
Tasmania	0.9	1	
Northern Territory	0.5	1	
Place of Education (%)			
New South Wales	38.6	N. A	
Victoria	35.6	N. A	
Queensland	0.8	N. A	
Western Australia	9.7	N. A	
Other	15.3	N. A	
Years in Practice (mean±sd)	18.1±10.9	15.6±11.2	p=0.003

N. A: denotes comparative data not available for place of education.

6.5.1 Factors associated with ICHD use for primary headaches

The majority of chiropractors reported utilising ICHD criteria for the diagnosis of primary headaches (84.6%). The clinical management characteristics of chiropractors who use or do not use the ICHD primary headache classification criteria are presented in Table 6.2. Chiropractors who use ICHD diagnostic criteria for primary headaches were more likely to believe that: ICHD criteria are distinct for the diagnoses of primary headache types; believe ICHD criteria are easy to follow; believe primary headaches easily fit into ICHD diagnostic criteria; believe ICHD criteria influences management of patients with primary headaches; ICHD criteria helps communication with other healthcare professionals; and improves decision-making about patient referral or co-management for those with primary headaches (all $p < 0.001$). In addition, those

chiropractors who use primary headache diagnostic criteria were also more likely to use a Migraine Disability Assessment Test (MIDAS); the Headache Disability Inventory (HDI); and patient headache diaries (all $p < 0.001$).

Table 6.2: Clinical management characteristics across the use of ICHD primary headache diagnostic criteria.

Chiropractic headache classification/assessment		Used diagnostic criteria for primary headache types		p-value
		No (n=61)	Yes (n=334)	
Headache classification criteria (views)		%	%	
ICHD primary headache diagnostic criteria are distinct for the diagnosis of primary headaches	Strongly disagree	3	1	<0.001
	Disagree	10	4	
	Neutral	34	10	
	Agree	46	66	
	Strongly agree	7	19	
ICHD primary headache diagnostic criteria are easy to follow	Strongly disagree	5	1	<0.001
	Disagree	5	2	
	Neutral	23	8	
	Agree	62	67	
	Strongly agree	5	22	
Patients with primary headache easily fit into ICHD primary headache diagnostic criteria	Strongly disagree	6	1	<0.001
	Disagree	43	17	
	Neutral	25	29	
	Agree	23	46	
	Strongly agree	3	5	
ICHD primary headache diagnostic criteria influences headache management	Strongly disagree	13	2	<0.001
	Disagree	41	9	
	Neutral	28	17	
	Agree	18	58	
	Strongly agree	0	14	
ICHD primary headache diagnostic criteria helps communication with other healthcare professionals	Strongly disagree	5	0	<0.001
	Disagree	13	1	
	Neutral	36	14	
	Agree	41	60	
	Strongly agree	5	25	
ICHD primary headache diagnostic criteria improves decision-making about patient referral or co-management	Strongly disagree	10	1	<0.001
	Disagree	29	4	
	Neutral	36	17	
	Agree	23	58	
	Strongly agree	2	20	
Headache outcome criteria (use)				
Use of Migraine Disability Assessment Test (MIDAS)	Never	97	69	<0.001
	Rarely	3	27	
	Often	0	4	
	All new headache patients	0	1	
Use of Headache Disability Inventory (HDI)	Never	91	60	<0.001
	Rarely	9	24	

	Often	0	12	
	All new headache patients	0	3	
Use of Headache Diary	Never	43	18	<0.001
	Rarely	40	37	
	Often	14	42	
	All new headache patients	3	4	

Table 6.3 shows the referral characteristics of chiropractors who use or do not use the ICHD primary headache classification criteria. Chiropractors who used the ICHD primary headache diagnostic criteria were more likely to receive a headache referral from a general practitioner, medical specialist (including neurologist, rheumatologist, orthopaedic, psychiatrist), psychologist, CAM practitioners (including acupuncturist, herbalist, naturopath, massage therapist, counsellor) (all $p < 0.001$) and dentist ($p = 0.002$), compared to chiropractors who do not use the ICHD primary headache diagnostic criteria and less likely to receive headache referrals from a physiotherapist ($p = 0.684$) or osteopath ($p = 0.154$) although these associations were not statistically significant. Further, chiropractors who use the ICHD primary headache diagnostic criteria were also more likely to refer headache patients for further management to general practitioners ($p < 0.001$), medical specialists ($p < 0.001$), psychologist ($p = 0.004$), dentist ($p = 0.001$), and CAM practitioners (including acupuncturist, herbalist, naturopath, massage therapist, counsellor) ($p = 0.001$), compared to chiropractors do not use the ICHD primary headache diagnostic criteria and were less likely to refer a headache patient to a physiotherapist ($p = 0.106$) although these associations were not statistically significant. Chiropractors who use ICHD primary headache criteria were more likely to refer patients for reasons of confirming headache diagnosis ($p < 0.001$), improve coping skills ($p < 0.001$), investigate headache red-flags ($p < 0.001$), provide pain relief for acute headache attacks ($p = 0.004$) and to provide headache prevention

($p=0.004$), compared to chiropractors do not use the ICHD primary headache diagnostic criteria.

The importance of headache treatment outcomes of chiropractors who use or do not use the ICHD primary headache classification criteria are presented in Table 6.4.

Chiropractors who use ICHD primary headache criteria are more likely to aim their treatment toward improving the recovery from an episode of headaches i.e. postdromal headache period ($p=0.043$), to provide pain relief during headache episode ($p=0.049$) and improve headache related coping skills ($p=0.001$) and less likely to aim treatment toward headache prevention ($p=0.317$) or to improve headache patient overall health and well-being ($p=0.411$) although these associations were not statistically significant.

Table 6.3: Headache referral characteristics across the use of ICHD primary headache diagnostic criteria.

Chiropractic headache referral		Used diagnostic criteria for primary headache types		p-value
		No (n=61)	Yes (n=334)	
Headache referral (receiving)		%	%	
Headache referral from GP	Never	42	27	<0.001
	Rarely	46	40	
	Sometimes	7	29	
	Often	5	4	
Headache referral from medical specialist (neurologist, rheumatologist, orthopaedic, psychiatrist)	Never	89	77	<0.001
	Rarely	9	19	
	Sometimes	2	4	
	Often	0	1	
Headache referral from Psychologist	Never	89	68	<0.001
	Rarely	9	19	
	Sometimes	2	11	
	Often	0	2	
Headache referral from Dentist	Never	67	40	0.002
	Rarely	21	33	
	Sometimes	9	23	
	Often	4	5	
Headache referral from Physiotherapist	Never	74	67	0.684
	Rarely	19	21	
	Sometimes	7	10	
	Often	0	2	
Headache referral from Osteopath	Never	89	78	0.154
	Rarely	11	16	
	Sometimes	0	5	
	Often	0	1	
Headache referral from CAM practitioners (inc. acupuncturists, herbalist, naturopath, massage therapist, counsellor)	Never	28	11	<0.001
	Rarely	28	19	
	Sometimes	35	47	
	Often	9	23	
Headache referral (sending)				
Headache referral to GP	Never	19	7	<0.001
	Rarely	46	29	
	Sometimes	33	55	
	Often	2	9	
Headache referral to medical specialist (neurologist, rheumatologist, orthopaedic, psychiatrist) via GP	Never	25	17	<0.001
	Rarely	58	36	
	Sometimes	18	42	
	Often	0	4	
Headache referral to Psychologist	Never	74	47	0.004
	Rarely	19	34	
	Sometimes	7	16	
	Often	0	2	
Headache referral to Dentist	Never	39	15	0.001
	Rarely	32	42	

	Sometimes	26	37	
	Often	4	5	
Headache referral to Physiotherapist	Never	72	54	0.106
	Rarely	21	31	
	Sometimes	7	13	
	Often	0	2	
Headache referral to Osteopath	Never	91	74	0.025
	Rarely	7	21	
	Sometimes	2	4	
	Often	0	0	
Headache referral to CAM practitioners (eg. acupuncturist, naturopath, massage therapist, counsellor)	Never	23	7	0.001
	Rarely	28	23	
	Sometimes	33	50	
	Often	16	20	
Headache referral (reasons)				
Headache referral to confirm headache diagnosis	Never	54	21	<0.001
	Rarely	32	43	
	Sometimes	12	32	
	Often	2	4	
Headache referral to improve coping skills and headache disability management	Never	39	11	<0.001
	Rarely	26	31	
	Sometimes	33	47	
	Often	2	10	
Headache referral to investigate headache red-flag	Never	0	1	<0.001
	Rarely	42	12	
	Sometimes	42	51	
	Often	16	36	
Headache referral to provide pain relief for acute headache attacks	Never	26	10	0.004
	Rarely	33	29	
	Sometimes	33	48	
	Often	7	12	
Headache referral to help provide headache prevention	Never	37	17	0.004
	Rarely	33	35	
	Sometimes	25	39	
	Often	5	9	

Table 6.4: Importance of headache treatment outcomes across the use of ICHD primary headache diagnostic criteria.

Chiropractic headache management/treatment		Used diagnostic criteria for primary headache types		p-value
		No (n=61)	Yes (n=334)	
Importance of treatment outcomes		%	%	
Treatment aimed to prevent headache episodes	Very unimportant	11	5	0.317
	Somewhat unimportant	0	0	
	Neutral	0	1	
	Somewhat important	13	10	
	Very important	77	84	
Treatment aimed to improve recovery from episode of headaches	Very unimportant	9	4	0.043
	Somewhat unimportant	2	1	
	Neutral	0	1	
	Somewhat important	27	16	
	Very important	62	78	
Treatment aimed at pain relief during headache episode	Very unimportant	9	3	0.049
	Somewhat unimportant	0	1	
	Neutral	5	3	
	Somewhat important	41	32	
	Very important	45	61	
Treatment aimed to improve headache coping skills	Very unimportant	7	2	0.001
	Somewhat unimportant	11	3	
	Neutral	16	8	
	Somewhat important	32	35	
	Very important	34	52	
Treatment aimed to improve overall health and well-being	Very unimportant	9	4	0.411
	Somewhat unimportant	0	2	
	Neutral	2	3	
	Somewhat important	12	16	
	Very important	77	75	

Table 6.5 shows the approaches to primary headache management of chiropractors who use or do not use the ICHD primary headache classification criteria. For patients with migraine, chiropractors who use primary headache diagnostic criteria were also more likely to: provide non-thrust spinal mobilisations (p=0.001); provide massage, myofascial technique, stretching or trigger-points to neck/shoulder area (p<0.001); use soft tissue or exercise therapy to temporo-mandibular region (p<0.001); prescribe exercises for the neck and shoulder region (p<0.001); provide advice on stress management (p=0.019) and headache triggers (p=0.005), compared to chiropractors

do not use the ICHD primary headache diagnostic criteria. They were less likely to provide manual manipulation ($p=0.751$), instrument adjusting ($p=0.407$), drop piece adjusting (0.944), electro-physical therapies ($p=0.236$) and advice on diet or fitness ($p=0.057$) although these associations were not statistically significant. For patients with tension headache, chiropractors who use primary headache diagnostic criteria were more likely to: provide non-thrust spinal mobilisations ($p=0.003$); use massage, myofascial technique, stretching or trigger-points to neck/shoulder area ($p<0.001$); use soft tissue or exercise therapy to temporomandibular region ($p=0.017$); prescribe exercises for the neck/shoulder region ($p<0.001$); provide advice on stress management ($p=0.002$) and headache triggers ($p<0.001$), compared to chiropractors do not use the ICHD primary headache diagnostic criteria. They were less likely to provide manual manipulation ($p=0.291$), instrument adjusting ($p=0.810$), drop piece adjusting ($p=0.662$), electro-physical therapies ($p=0.374$), and advice on diet and fitness ($p=0.480$) although these associations were not statistically significant.

The results of the multiple logistic regression modelling used to identify the important independent factors associated with chiropractors who use ICHD primary headache diagnostic criteria compared to those chiropractors who do not use ICHD primary headache diagnostic criteria are presented in Table 6.6. These factors include a belief that: the use of ICHD primary headache criteria will influence their management of patients with primary headaches (OR=7.86; 95%CI: 3.15, 19.6); improve decision-making about primary headache patient referral/co-management (OR=2.35; 95%CI: 1.01, 5.47); and not referring headache patients to assist with headache prevention (OR=0.16; 95%CI: 0.03, 0.80). Chiropractors who use ICHD criteria for the diagnosis of

Table 6.5: Headache management characteristics across the use of ICHD primary headache diagnostic criteria.

Chiropractic headache management		Used diagnostic criteria for primary headache types		p-value
		No (n=61)	Yes (n=334)	
Chiropractic headache management - migraine		%	%	
Manual adjusting/manipulation (including Diversified, Gonstead)	Never	7	5	0.751
	Rarely	14	12	
	Often	45	51	
	Almost every migraine patient	34	32	
Non-thrust spinal mobilisations	Never	18	9	0.001
	Rarely	37	19	
	Often	34	58	
	Almost every migraine patient	11	14	
Instrument adjusting	Never	14	9	0.407
	Rarely	18	18	
	Often	48	58	
	Almost every migraine patient	20	14	
Drop piece, Thompson or similar	Never	29	29	0.944
	Rarely	34	37	
	Often	22	28	
	Almost every migraine patient	5	6	
Massage, myofascial technique, stretching or trigger-points to neck/shoulder area	Never	9	2	<0.001
	Rarely	25	9	
	Often	48	42	
	Almost every migraine patient	18	47	
Electro-physical therapies (TENS, ultrasound etc)	Never	89	77	0.236
	Rarely	9	15	
	Often	2	7	
	Almost every migraine patient	0	2	
Soft tissue or exercise therapy to temporomandibular region	Never	29	5	<0.001
	Rarely	20	27	
	Often	41	54	
	Almost every migraine patient	11	14	
Prescriptive exercises for the neck/shoulder region	Never	14	2	<0.001
	Rarely	20	14	
	Often	46	52	
		20	33	

	Almost every migraine patient			
Advice on stress management	Never	2	0	0.019
	Rarely	16	9	
	Often	59	51	
	Almost every migraine patient	23	41	
Advice on diet or fitness	Never	2	1	0.057
	Rarely	12	14	
	Often	64	49	
	Almost every migraine patient	21	37	
Advice on Headache triggers	Never	0	0	0.005
	Rarely	14	5	
	Often	52	45	
	Almost every migraine patient	34	50	
Chiropractic headache management - tension headache				
Manual adjusting/manipulation (including Diversified, Gonstead)	Never	9	4	0.291
	Rarely	11	7	
	Often	36	42	
	Almost every tension headache patient	45	47	
Non-thrust spinal mobilisations	Never	27	11	0.003
	Rarely	27	21	
	Often	38	52	
	Almost every tension headache patient	9	16	
Instrument adjusting	Never	14	11	0.810
	Rarely	20	18	
	Often	48	55	
	Almost every tension headache patient	18	16	
Drop piece, Thompson or similar	Never	32	35	0.662
	Rarely	25	27	
	Often	38	30	
	Almost every tension headache patient	5	8	
Massage, myofascial technique, stretching or trigger-points to neck/shoulder area	Never	5	3	<0.001
	Rarely	27	6	
	Often	43	40	
	Almost every tension headache patient	25	51	
Electro-physical therapies (TENS, ultrasound etc)	Never	89	79	0.374
	Rarely	9	13	

	Often	2	6	
	Almost every tension headache patient	0	2	
Soft tissue or exercise therapy to temporo-mandibular region	Never	18	8	0.017
	Rarely	32	25	
	Often	43	50	
	Almost every tension headache patient	7	18	
Prescriptive exercises for the neck/shoulder region	Never	11	1	<0.001
	Rarely	20	8	
	Often	45	45	
	Almost every tension headache patient	25	46	
Advice on stress management	Never	2	0	0.002
	Rarely	14	9	
	Often	59	42	
	Almost every tension headache patient	25	49	
Advice on diet or fitness	Never	2	2	0.480
	Rarely	11	11	
	Often	59	48	
	Almost every tension headache patient	29	39	
Headache triggers advice	Never	7	0	<0.001
	Rarely	14	7	
	Often	46	47	
	Almost every tension headache patient	32	46	

primary headaches are also associated with: believing ICHD criteria are distinct criteria for the diagnoses of primary headache types (OR=3.64; 95%CI: 1.58, 8.39); ICHD primary headache diagnostic criteria influences the use of soft-tissue therapies to neck and shoulder region for tension headache (OR=4.33; 95%CI: 1.67, 11.19); the use headache diaries as a headache outcome measure (OR=3.52; 95%CI: 1.41, 8.77) and referral to investigate a headache red-flag (OR=2.67; 95%CI: 1.02, 6.96).

Table 6.6: Logistic regression analysis identifying associations with chiropractors who use ICHD primary headache diagnostic criteria.

Factors		Odds Ratio	95% C.I.	p-value
ICHD primary headache diagnostic criteria influences headache management	Strongly Disagree/Disagree/Neutral	1.00		
	Agree/Strongly Agree	7.86	3.15, 19.60	<0.001
ICHD primary headache diagnostic criteria improves decision-making about headache patient referral/co-management	Strongly Disagree/Disagree/Neutral	1.00		
	Agree/Strongly Agree	2.35	1.01, 5.47	0.046
Referral to investigate a headache red-flag	Never/Rarely/Sometimes	1.00		
	Often	2.67	1.02, 6.96	0.045
Referral to assist headache prevention	Never/Rarely/Sometimes	1.00		
	Often	0.16	0.03, 0.80	0.026
ICHD primary headache diagnostic criteria are distinct for the diagnosis of primary headaches	Strongly Disagree/Disagree/Neutral	1.00		
	Agree/Strongly Agree	3.64	1.58, 8.39	0.002
Massage, myofascial technique, stretching or trigger-points to neck/shoulder area for tension headache management	Never/rarely	1.00		
	Often/Almost every new patient with tension headache	4.33	1.67, 11.19	0.003
Headache diary	Never/Rarely	1.00		
	Often/Every new patient with headache	3.52	1.41, 8.77	0.007

6.6 Discussion

This is the first study to provide detailed information on the patient management features associated with primary headache diagnosis by chiropractors. The majority of chiropractors in our study report utilising ICHD criteria for the diagnosis of primary headaches, a finding which may suggest that chiropractors are sometimes the first point of provider contact for patients seeking help for the management of primary headache disorders. There are a number of factors that can challenge health care providers delivering an accurate primary headache diagnosis. These include the co-occurrence of migraine with both cervicogenic headache (Knackstedt et al. 2010) and tension-type headache (Lyngberg et al. 2005a), variations in headache characteristics found within headache types (Lieba-Samal et al. 2011) and the high prevalence of co-occurring neck pain associated with common recurrent headaches (Ashina et al. 2015; Bogduk & Govind 2009). With misdiagnosis resulting in suboptimal headache patient management (De Diego & Lanteri-Minet 2005; Kingston & Halker 2017), poor standards of headache diagnosis have raised concerns about the current level of headache education within primary health care curriculums (Kernick, Stapley & Hamilton 2008; Kingston & Halker 2017; Sheftell et al. 2005). Our study found almost half of those chiropractors engaged in primary headache diagnosis implement the use of patient headache diaries. The mixed use of headache diaries has been reported in other primary care settings (Minen et al. 2016). While this practice is likely to improve diagnostic accuracy (Jensen et al. 2011; Phillip, Lyngberg & Jensen 2007), further research would be valuable in assessing the reliability of primary headache diagnosis as undertaken by chiropractors, information that can similarly inform chiropractic educational curriculums. Despite the high percentage of chiropractors self-reporting

the utilisation of ICHD primary headache diagnostic criteria, uncertainty remains regarding how effectively chiropractors identify headache criteria in order to provide an accurate headache diagnosis.

Our study found several factors that were associated with chiropractors engaged in primary headache diagnosis. These chiropractors include a belief that the use of ICHD primary headache criteria influences their patient management. Previous studies have reported the use of manual therapies, exercise therapies and advice on headache triggers as common to chiropractic headache management (Clijsters, Fronzoni & Jenkins 2014; Moore et al. 2018). While advice on headache triggers is well recognised as an important aspect of primary headache management (Haque et al. 2012; Nicholson et al. 2011), the effectiveness of manual and exercise therapies for the prevention of primary headaches requires further evaluation. To date, research evidence supports the role of manual and exercise therapies for the preventative treatment of tension headache (Mesa-Jiménez et al. 2015; Van Ettehoven & Lucas 2006), while research supporting the role of these therapies for the prevention of migraine remains low quality and inconclusive (Chaibi, Tuchin & Russell 2011; Posadzki & Ernst 2011). In contrast, around 10% of chiropractors who use primary headache diagnosis were not associated with ICHD primary headache diagnostic criteria influencing headache management. While this finding requires further investigation, it may be that providing a diagnosis of the patient's headache type relates more to other motivations for a small number of practitioners. This could include to inform the headache patient or satisfy potential oversight from regulatory authorities. As such, more research is needed to examine how aspects of primary headache patient

management are potentially improved through the use of primary headache diagnosis within chiropractic clinical settings.

Our analysis found several factors associated with chiropractors engaged in primary headache diagnosis that were related to specific aspects of practitioner decision-making regarding headache patient management. For example, our study found chiropractors engaged in the use of ICHD primary headache diagnostic criteria are more likely to believe doing so improves decision-making related to headache patient referral/co-management. The health care needs of primary headache sufferers can sometimes be multifactorial and multidisciplinary in nature, particularly for those who present with more complex and chronic headache conditions where a greater use of pharmaceutical, behavioural and physical approaches to patient care may be needed (Becker 2017; Gunreben-Stempfle et al. 2009). Previous research has suggested that those with headaches seeking help from manual therapy providers are more likely have a higher rate of headache chronicity and disability than non-users (Moore, Sibbritt & Adams 2017). As such, the belief that primary headache diagnosis improves decision-making about headache patient referral/co-management associated with chiropractors engaged in primary headache diagnosis may reflect practitioner awareness regarding the multidisciplinary health care needs of many primary headache patients within chiropractic patient populations (Barton et al. 2014; Gaul, Visscher, et al. 2011).

An unexpected finding from our results was that chiropractors engaged in primary headache diagnosis are less likely to undertake patient referral to assist with headache prevention. A recent Australian study showed chiropractors refer headache patients to

both complementary health care providers (including acupuncturist, herbalist, naturopath, massage therapist, counsellor) and general practitioners (Moore et al. 2018). For tension headache, preventative treatment guidelines advise non-drug management first be considered (Bendtsen et al. 2010) and provide recommendations for behavioural treatments such as electromyography (EMG) biofeedback (level A), cognitive-behavioral therapy and relaxation training (level C), massage therapy (level C) and acupuncture (level C). In contrast, preventative treatment guidelines for migraine provide stronger recommendations for drug treatments (Level A) with additional recommendations also provided for several herbs and supplements such as butterbur (Level A), feverfew and magnesium (Level B) and coenzyme Q10 (level C) (Holland et al. 2012; Loder, Burch & Rizzoli 2012). Beyond headache diagnosis, provider referral to assist headache prevention requires careful consideration regarding a range of patient factors and circumstances including headache severity, headache comorbidities, patient treatment preferences and response to current care (Nicol, Hammond & Doran 2013; Zebenholzer et al. 2016; Zheng et al. 2014). While more research is needed to understand this finding, one possible explanation is that engagement with headache diagnosis leads to more practitioner certainty about their own capacity to provide sufficient preventative management for those with primary headaches. With increasing examination of the quality and integration of health services and providers engaged in preventative headache management (Gaul et al. 2016; Peters et al. 2012), more research examining the factors that influence headache patient co-management between chiropractors and other headache providers is warranted.

Our findings identified chiropractors engaged in primary headache diagnosis are more likely to refer headache patients to investigate a headache red-flag. This finding is not unexpected, since the use of headache diagnostic criteria is more likely to result in the identification of headache features associated with headache red-flag findings. The most important diagnostic consideration for frontline clinicians engaged in headache management is to rule out headaches caused by serious and potentially life-threatening underlying pathology. While rare, the underlying causes associated with headache red-flag symptoms can include stroke, sub-arachnoid haemorrhage, tumour, meningitis and artery dissection (carotid or vertebral) (Ravishankar 2016). Since headache features in those with an underlying brain tumour can be similar to those of tension headache and migraine (Nelson & Taylor 2014), and since neck stiffness and headache in those with underlying meningitis and arterial dissection (Debette & Leys 2009; Van de Beek et al. 2004), can be similar to those with cervicogenic headache, chiropractors need to be mindful of the possibility of serious underlying pathology when examining those who present with headache.

Our study found that chiropractors engaged in primary headache diagnosis are more likely to use soft tissue therapies such as massage, myofascial technique, stretching or trigger-points to neck/shoulder area for their patients with tension headache. This finding is interesting given a recent systematic review which found manual therapies, including soft tissue therapies, may be more effective than pharmacological care for reducing the short-term frequency, intensity and duration of tension headache (Mesa-Jiménez et al. 2015). Tenderness of myofascial trigger points of the neck and shoulder muscles are increased in patients with tension-type headache (Fernández-De-Las-

Peñas & Arendt-Nielsen 2017; Fernández-de-las-Penas et al. 2010). These active trigger-points appear to cause nociceptive input that contributes to peripheral and central sensitization in patients with chronic tension headache (Bendtsen & Fernández-de-la-Peñas 2011). While further research is needed, these findings appear to support soft tissue treatment approaches that are specifically aimed at addressing these muscular factors.

6.7 Limitations

Regression analysis of chiropractors engaged in primary headache diagnosis provides an excellent opportunity to better understand the primary headache management associated with this common headache provider. The self-reported nature of the data collected is a limitation of our study – the data may be subject to recall bias and the use of Likert categories are subject to practitioner interpretation. The headache management characteristics of chiropractors reported in this study may also be influenced by non-respondents to the survey when estimating chiropractors who use of ICHD primary headache criteria and the associations related to their headache management characteristics. Nonetheless, analysis of this cross-sectional survey provides valuable insights into primary headache health management associated with these popular providers and helps to identify key questions for further enquiry into chiropractic headache management.

6.8 Conclusions

Our research found that most chiropractors managing primary headaches are engaged in primary headache diagnosis and that this practice is likely to influence their clinical-decision making toward key aspects of primary headache patient management and co-

management. These findings highlight the need for closer examination of the clinical decision-making that underlies chiropractic primary headache management and the role of these providers toward reducing the burden of this significant public health issue. Gathering this information will help to improve our understanding of the role of chiropractors within multimodal, multidisciplinary headache patient management.

6.9 Chapter summary

Results presented in this chapter indicate that a substantial proportion of Australian chiropractors report the use of primary headache diagnostic criteria, consistent with good clinical practice and optimal patient care (Kingston & Halker 2017). In addition, certain clinical beliefs and practice behaviours were found to be associated with chiropractors who use primary headache diagnostic criteria in headache patient management and co-management. They included the implementation of headache diaries, a practice that is likely to improve the accuracy of headache diagnosis (Jensen et al. 2011), and the use of soft tissue therapies for the treatment of tension headache, a therapy that is supported by low to moderate-quality clinical evidence (Fernández-de-las-Peñas et al. 2006), and referral to investigate a headache red flag, a practice vital to headache patient safety (Ramanayake & Basnayake 2018). In contrast, the finding that chiropractors who use primary headache diagnostic criteria are less likely to refer headache patients for headache prevention is one that may not be consistent with the needs of people who are less responsive to headache management by chiropractors.

The findings presented in this chapter strengthen our understanding of the role and impact of primary headache diagnosis within chiropractic headache patient care. In

light of the features of headache management provided by chiropractors, reported in this and previous chapters, there is a need for additional research to examine the clinical features of this patient population. Gathering this information will help to contextualise the healthcare needs of headache patients seeking help from this provider.

7 The features and burden of headaches within a chiropractic clinical population: a cross-sectional analysis

7.1 Chapter introduction

This chapter presents detailed results of research into the features and burden of people with headache who seek help from chiropractors. The chapter provides the rationale for the study and presents findings that respond to research question 5 (see section 1.2.2).

The manuscript in this chapter was submitted for publication to the journal *Complementary Therapies in Medicine* and is currently under review.

The submitted manuscript is shown in Appendix 15.

7.2 Rationale for the study within the research project

Results presented in Chapter 4 show that Australian chiropractors often provide treatment for migraine sufferers, and include preliminary information on the practitioner, practice and clinical management characteristics of chiropractors with a high migraine caseload. Chapter 5 identifies the substantial prevalence of headache management within Australian chiropractic practice settings more generally. Chapter 5 also highlights the features of Australian chiropractors' headache management, including approaches to patient diagnosis, assessment, treatment and interdisciplinary headache management, and puts forward the suggestion that some aspects of

chiropractors' headache management are not aligned with optimal headache patient care. Chapter 6 highlights the substantial use of primary headache diagnostic criteria in chiropractic clinical practice and how the use of primary headache diagnostic criteria is associated with the clinical beliefs and practice behaviours of chiropractors with respect to headache management.

In summary, these chapters have provided a better understanding of the overall proportion of headache found within chiropractic clinical practice and the characteristics of headache patient management provided by chiropractors. Beyond understanding headache patient management by Australian chiropractors, it is important to closely examine the profile and clinical features of those with headache who seek help from these providers to respond to research question 5 (see section 1.2.2). This knowledge will help to understand the healthcare needs of this patient population and provide further context to the features of headache management reported in Chapters 4, 5 and 6.

The analyses reported in Chapter 7 involved primary data collected via a survey of people presenting to chiropractors with a chief complaint of headache. A key methodological feature of this chapter is the use of descriptive statistics, namely Chi-square tests and Fisher's exact test (Scott & Mazhindu 2014), as applicable, to examine associations between patient satisfaction with chiropractic headache management (survey question 30) and reasons for consulting a chiropractor and patient headache group.

The features and burden of headaches within a chiropractic clinical population: a cross-sectional analysis

7.3 Introduction

Collectively, headache disorders, such as tension-type headache, migraine and cervicogenic headache, affect over half of all adults (Sjaastad & Bakkevig 2008; Stovner et al. 2007; Vos et al. 2015). Headache disorders cause substantial personal suffering with adverse impacts on the family life, leisure time, social activities and work productivity of sufferers (Burton et al. 2009; Steiner, Stovner, et al. 2014; Suijlekom et al. 2003). While medical providers are the most common point of contact for those with headache (Latinovic, Gulliford & Ridsdale 2006; Ridsdale et al. 2007), many with headache remain under-diagnosed or refrain from seeking medical help (Katsarava et al. 2018; Kernick, Stapley & Hamilton 2008; Lipton et al. 2007).

The criteria utilised for headache classification are specified in the 3rd edition of International Classification of Headache Disorders (ICHD-3) (Headache Classification Committee of the International Headache Society 2018), with headache classification primarily established via patient self-report of their headache symptom profile. While the 'gold standard' for headache diagnosis is via face-to-face consultation with a neurologist, previous research suggests self-report instruments can be reliable for the screening of headache features within larger populations (Hagen et al. 2000; Lipton et al. 2003; Steiner, Gururaj, et al. 2014).

The epidemiology and burden of headaches found within primary care populations has previously been examined (Coeytaux & Linville 2007; Ridsdale et al. 2007). While much is known about the patient case-mix of those with headache under conventional care, many with headache also consult healthcare providers outside of medical settings (Lee, Bhowmick & Wachholtz 2016; Wells et al. 2011). For example, general population studies have identified chiropractors as popular providers for headache management (Kristoffersen et al. 2012; Moore, Sibbritt & Adams 2017; Sanderson et al. 2013) and headache has been identified as one of the most common health complaints within chiropractic clinical populations (Brown et al. 2014; Hartvigsen et al. 2003). However, while evidence suggests manual therapies, as commonly utilised by chiropractors, may help in the prevention of tension-type headache and cervicogenic headache, (Chaibi & Russell 2012; Mesa-Jiménez et al. 2015) the role of manual therapies for the prevention of migraine remains less certain (Rist et al. 2019), despite many with migraine also seeking help from chiropractors (Kristoffersen et al. 2012; Sanderson et al. 2013).

The substantial use of chiropractors for headache management highlights the need for more information to understand the headache features within this clinical population. Such information may improve our understanding of the use and role of chiropractors within the field of headache management. As such, the aims of this study were to estimate the headache features and the level of headache severity, chronicity and disability found in those who present to chiropractors for headache management. In addition, this study aims to ascertain if headache type or the reasons for consulting a

chiropractor were associated with patient satisfaction with headache management by a chiropractor.

7.4 Methods

The study collected data via an online cross-sectional survey from patients with headaches seeking help from Australian practicing chiropractors. This research was a sub-study of the Australian Chiropractic Research Network (ACORN), a national practice-based research network (PBRN) of Australian chiropractors (Adams et al. 2016). Members of the ACORN network database are representative of the wider national population of Australian chiropractors regarding age and gender and generally representative for practice location (with over-representation of chiropractors in one state) (Adams, Peng, Steel, et al. 2017). The research reported in this paper was approved by the Human Research Ethics Committee, University of Technology Sydney (Approval number: ETH182196).

7.4.1 Recruitment and participants

Invitational emails were limited to a random sample of 900 of the 1680 practitioner members of the ACORN database (31st May to June 15th, 2018) due to the competing demands on the ACORN practitioners. Seventy chiropractors responded to the invitation agreeing to facilitate patient recruitment for the study. Patient recruitment occurred between the 11th July and 15th November 2018. Each participating chiropractor was posted study instructions along with 10 sealed envelopes (700 in total) for patient distribution. Each envelope contained a study background leaflet with a link to the online questionnaire. The survey introduction explained how consent to participate is assumed by starting the survey. Consecutive patients presenting on a

regular consultation with a chief complaint of headache were informed of their eligibility to participate (avoiding recruitment of patients on an initial consultation).

Inclusion criteria for the study were adult patients aged between 18-65 years, presenting with a primary complaint of headache with an adequate understanding of the English language in order to complete the questionnaire. At the close of the consultation, practitioners informed eligible patients of the study and that completing the questionnaire was voluntary and that all information provided was anonymous. Only headache patients who expressed an interest in participating in the study were provided with a sealed envelope and those who did participate completed the online questionnaire after leaving the practice. The researchers did not inform practitioners of patient involvement in the study to protect patient privacy and to avoid patient coercion by practitioners. Practitioners were not asked to collect additional information and no incentives were offered to study practitioners or patients.

7.4.2 Questionnaire

The 35-item study questionnaire included 4 main sections. The first section of the survey collected information on patient headache characteristics based on ICHD-3 diagnostic criteria for migraine, tension-type headache and cervicogenic headaches (Headache Classification Committee of the International Headache Society 2018) utilising survey questions similar to previous surveys (Andree et al. 2010; Steiner, Gururaj, et al. 2014). These headache disorders were selected due to having been previously reported as headache types more common to chiropractic headache patient populations (Adams, Barbery & Lui 2013; Kristoffersen et al. 2012; Kristoffersen, Lundqvist, et al. 2013; Moore, Sibbritt & Adams 2017). A standard numerical rating

scale for pain (NPRS) was used to assess the level of headache pain intensity (Boonstra et al. 2016).

The second section of the survey questioned participants regarding headache disability using the Headache Impact Test (HIT-6) questionnaire. HIT-6 is reported to be a reliable and validated measure of headache disability (Kosinski et al. 2003; Yang et al. 2011). This instrument encompasses six questions across six representative categories commonly used to assess headache impact (pain, social functioning, role functioning, vitality, cognitive functioning, and psychological distress) (Kosinski et al. 2003).

Summed values for the response to each question produces a total HIT-6 score for the level of patient headache disability using four score categories: Little or no impact (36-49); Moderate impact (50-55); Substantial impact (56-59); and Severe impact (60-78) to indicate the level of headache impact experienced in daily life (Ware, Bjorner & Kosinski 2000). The survey was pilot tested with 10 headache patients to assist decisions about survey duration, survey wording and item options.

The third questionnaire section explored the reasons patients seek help from chiropractors for their headache (*“Please rank from the list below in order of importance the reasons why you seek help from the chiropractor for your headache”*).

Participants selected from options including: headache prevention, relief during a headache attack, help with headache related stress, feeling more in control of headache, reduce the effects of headaches on relationships and reduce the effects of headaches on ability to work. Participants were also questioned regarding their level of satisfaction with headache management by a chiropractor (*“Please select which option best describes your level of satisfaction with chiropractic management of your*

headaches”). The last section of the survey collected information on patient socio-demographics and related characteristics.

7.4.3 Headache classification

Not all ICHD-3 criteria for cervicogenic headache can be collected via a survey format. For example, patients were not asked to include clinical and/or imaging evidence of a disorder or lesion within the cervical spine or soft tissues of the neck or to ascertain if abolition of their headache has been demonstrated following a diagnostic blockade of the cervical spine. Classification of cervicogenic headache was provided when subjects met the minimum ICHD-3 diagnostic criteria (as per Criterion C). Patients were considered to have chronic headache if they reported experiencing headaches on at least 15 days per month on average for 3 months (Headache Classification Committee of the International Headache Society 2018). Participants who satisfied the criteria for more than one headache were classified as having ‘Mixed headache’. As with other studies, participants who did not meet the minimum ICHD-3 diagnostic criteria (for migraine, tension-type headache or cervicogenic headache) were categorised ‘Other headache’ (Kristoffersen, Lundqvist & Russell 2019; Minen, Loder & Friedman 2014; Peng & Wang 2014).

A scoring algorithm was applied within Microsoft excel for migraine, tension-type headache and cervicogenic headache classification criteria with a conditional logic formula applied to identify patient responses that met ICHD-3 classification for each of these headache types. Two separate authors (CM and AL) reviewed the excel formulae results to assess for accuracy.

7.4.4 Statistical analysis

Characteristics of the study population are reported using descriptive statistics with categorical data presented using frequencies and percentages and continuous descriptive data are presented using means and standard deviations. Chi-square tests or Fishers exact test were used, as applicable, to examine the association between reasons for consulting a chiropractor and the level of satisfaction with headache management by a chiropractor and to see if headache type was associated with patient satisfaction with headache management by a chiropractor. Statistical analyses were conducted using SPSS software (version 25). Statistical significance was set at $p < 0.05$.

7.5 Results

7.5.1 Study participants

Up to 700 eligible headache patients received an invitation to participate. Of those who participated in the study, 224 participants completed the section on headache characteristics and level of headache chronicity (i.e. minimum 32% response). Of these, 207 completed the section on their headache numerical pain score, 206 reported their level of satisfaction with headache management by a chiropractor, 205 reported their level of headache impact and 203 (29%) completed all sections of the survey including their sociodemographic details.

Table 7.1 shows that 55 participants were male (27.1%) and 148 (72.9%) were female. The majority of participants were aged between 51-65 years ($n=65$; 32.0%) and 41-50 years ($n=55$; 27.1%). The largest ethnic group were Anglo-European ($n=185$; 91.1%). Nearly a third of participants reported having a technical/private college level of

Table 7.1: Study population socio-demographic characteristics (n=203)

Characteristic	n (%)
Gender	
Male	55 (27.1%)
Female	148 (72.9%)
Age in years	
18-30	34 (16.7%)
31-40	39 (19.2%)
41-50	55 (27.1%)
51-65	65 (32.0%)
>65	10 (4.9%)
Ethnic background	
Anglo-European	185 (91.1%)
Asian	10 (4.9%)
Middle Eastern	7 (3.4%)
African	1 (0.5%)
Highest education	
No high school completion	19 (9.4%)
High school completion	25 (12.3%)
Technical/Private college	64 (31.5%)
University (Undergraduate)	45 (22.2%)
University (Postgraduate)	50 (24.6%)
Employment status	
Salary	92 (45.3%)
Self-employed	45 (22.2%)
Not working/part-time/casual worker	21 (10.3%)
Home duties	14 (6.9%)
Student	14 (6.9%)
Retired	13 (6.4%)
Unable to work	4 (2.0%)
Relationship status	
Single, never married	39 (19.2%)
Married or domestic partnership	143 (70.4%)
Widowed	2 (1.0%)
Divorced or separated	19 (9.4%)
Private health insurance	
No	31 (15.3%)
Yes (hospital and extras cover)	159 (78.3%)
Yes (Hospital only)	13 (6.4%)

education (n=64; 31.5%) as their highest level of education. Salaried workers represented the largest employment group (n=92; 45.3%) and the majority of participants were married or in a domestic partnership (n=143; 70.4%). Three out of four participants (n=159; 78.3%) reported having health insurance cover that included both hospital and extra insurance cover inclusive of chiropractic services.

7.5.2 Headache characteristics

Of those who completed the questionnaire section on headache characteristics (Table 7.2), 45% were classified as having features of a single headache type (n=101) and 33% were classified as having features of more than one headache type (mixed headache) (n=74) and 21.8% as having 'Other headache' (n=49). Of those with features of a single headache, 20.5% had features of migraine (n=46), 16.5% of tension-type headache (n=37) and 8% of cervicogenic headache (n=18). Of those with migraine, a similar proportion reported features of migraine with aura (n=22; 9.8%) and without aura (n=24; 10.7%). Fifty-seven participants (25.4%) reported a headache frequency consistent with chronic headaches. A total of 52 participants (25.1%) reported that their headache type had been previously diagnosed by a medical doctor. Of these, nearly two out of three (n=32; 61.5%) reported a diagnosis of migraine was given by a medical doctor. In terms of level of headache pain intensity, 88 participants (42.5%) provided a numerical pain score of 8 or more out of 10 for their headache severity (where 0=no pain and 10= worse pain imaginable).

Table 7.2: Distribution of study participants by headache group (n=224)

Headache group	n=224 (%)
Mixed headache	74 (33.0)
Migraine	46 (20.5)
Migraine without aura	24 (10.7)
Migraine with aura	22 (9.8)
Tension-type headache	37 (16.5)
Other headache	49 (21.8)
Cervicogenic headache	18 (8.0)
Chronic headache (>15 days/month)	57 (25.4)
Episodic headaches (<15 days/month)	167 (74.6)

7.5.3 Headache impact

The level of headache impact (HIT-6) for each headache group, combining both episodic with chronic headaches, are presented in Table 7.3. The average overall level of headache impact (HIT-6) across all headache groups was 59.0 (SD 6.8). The headache type with the largest proportion with a score range of severe headache impact was for those with features of mixed headache (n=47; 65.3%) and migraine (n=29; 61.7%) In total, 149 participants with episodic and chronic headaches combined (72.7%) reported substantial or severe levels of headache impact.

Table 7.3: Distribution of study participants level of headache disability for all headaches assessed using the Headache Impact Test (HIT-6) score (n=205)

Headache Groups	HIT-6 impact levels				Total n (%)
	Little or no impact	Moderate impact	Substantial impact	Severe impact	
Cervicogenic headache	1 (5.5%)	5 (27.7%)	5 (27.7%)	7 (38.9%)	18 (100%)
Migraine	1 (2.1%)	7 (14.9%)	10 (21.3%)	29 (61.7%)	47 (100%)
Mixed headache	6 (8.3%)	9 (12.5%)	10 (13.9%)	47 (65.3%)	72 (100%)
Tension-type Headache	10 (27.0%)	7 (18.9%)	7 (18.9%)	13 (35.1%)	37 (100%)
Other headache	3 (9.6%)	7 (22.5%)	7 (22.5%)	14 (45.2%)	31 (100%)
Totals	21	35	39	110	205

HIT-6 (Headache Impact test): Little or no impact (36-49); Moderate (50-55); Substantial (56-59); and Severe (60-78)

For those experiencing *less* than 15 headache days per month (episodic headaches), the average overall level of headache impact (HIT-6) was in the 'substantial' impact range of 58.0 (SD 6.6). The largest proportion of those with episodic headaches with a score range of severe headache impact on their daily life was the mixed headache group (n=31; 62.0%), followed by the migraine group (n=18; 58.1%) (data not shown). For those experiencing *more* than 15 headache days per month (chronic headaches), the average overall level of headache impact was in the 'severe' impact range of 62.1 (SD 6.3). The largest proportion of those with chronic headaches with a score range of severe headache impact on their daily life was the cervicogenic headache group (n=4; 80.0%). This was followed by those with mixed headache (n=16; 72.7%) and migraine (n=11; 68.7%) (data not shown).

7.5.4 Reasons and satisfaction with headache management

Table 7.4 shows the reasons why participants consulted a chiropractor for the management of headaches. Participants reported headache prevention (n=190; 92.2%), followed by seeking relief during a headache attack (n=166; 80.6%) and reducing the effects of headaches on ability to work (n=166; 80.6%) as the highest-ranking reasons for consulting a chiropractor for help with headaches.

The majority of participants (90.3%) reported they were either satisfied or very satisfied with the chiropractic management of their headaches (n=186). Table 7.5 shows the distribution of levels of satisfaction across the reasons for consulting a chiropractor. Those patients who were satisfied or very satisfied with headache management by a chiropractor were more likely to consider consulting a chiropractor to 'help with headache related stress' (p=0.019) or to be 'more control of their

headaches' ($p=0.032$) as being important, compared to those who were neutral or unsatisfied.

Table 7.4: Level of importance for reasons for consulting a chiropractor for the management of headaches (n=206)

Questionnaire Item	Important	Not important
Reason for consulting a chiropractor		
Headache prevention	190 (92.2%)	16 (7.8%)
Relief during a headache attack	166 (80.6%)	40 (19.4%)
Help with headache related stress	149 (72.3%)	57 (27.6%)
Feeling more in control of headaches	154 (74.7%)	52 (25.2%)
Reducing the effects of headaches on relationships	121 (58.7%)	85 (41.2%)
Reducing the effects of headaches on ability to work	166 (80.6%)	40 (19.4%)

Important=Moderately important, Important, Very Important. Not important=Not important, Low importance, Slightly important

The distribution of levels of satisfaction with headache management by a chiropractor based on patient headache group are presented in Table 7.6. It can be seen that there was no statistically significant association between headache type and patient satisfaction.

Table 7.5: Level of satisfaction with chiropractic headache management based on reason for consulting chiropractor for headache management (n=206)

Reason for consulting a chiropractor		Level of Satisfaction		p-value
		Very satisfied /Satisfied	Neutral/ Unsatisfied/ Very unsatisfied	
		n (%)	n (%)	
Headache prevention	Not Important	12 (6.5)	4 (20.0)	0.055
	Important	174 (93.5)	16 (80.0)	
Relief during a headache attack	Not Important	34 (18.3)	6 (30.0)	0.234
	Important	152 (81.7)	14 (70.0)	
Help with headache related stress	Not Important	47 (25.3)	10 (50.0)	0.019
	Important	139 (74.7)	10 (50.0)	
More in control of headaches	Not Important	43 (23.1)	9 (45.0)	0.032
	Important	143 (76.9)	11 (55.0)	
Reducing effects of headaches on relationships	Not Important	73 (39.2)	12 (60.0)	0.073
	Important	113 (60.7)	8 (40.0)	
Reducing effects of headaches on ability to work	Not Important	33 (17.7)	7 (35.0)	0.076
	Important	153 (82.3)	13 (65.0)	

Table 7.6: Level of satisfaction with headache management by a chiropractor based on patient headache group (n=206)

Headache Group	Level of Satisfaction		p-value
	Satisfied/ Very Satisfied	Neutral/ Unsatisfied/ Very unsatisfied	
	n (%)	n (%)	
Cervicogenic	17 (9.1)	1 (5.0)	0.233
Migraine	39 (21.0)	8 (40.0)	
Mixed headache	66 (35.5)	6 (30.0)	
Tension-type headache	28 (15.1)	4 (20.0)	
Other headache	36 (19.3)	1 (5.0)	

7.6 Discussion

Our study found a substantial proportion of those seeking help from chiropractors for headache management had features of recurrent primary headaches and high levels of headache severity, chronicity and disability. These patients were more often female, were aged between 41-65 and more often had a high level of socioeconomic status.

Our study found a similar proportion of participants had discrete features of either migraine or tension-type headache. However, while there is emerging good quality clinical evidence for manual therapies for the prevention of tension-type headache (Chaibi & Russell 2014; Mesa-Jiménez et al. 2015), level 1 evidence for manual therapies for the prevention of migraine remains limited and preliminary (Cerritelli et al. 2015; Rist et al. 2019). It may, therefore, be that the use of chiropractors by those with migraine could also relate to other aspects of chiropractic headache management beyond the role of manual therapies alone. For example, previous research has identified that chiropractors utilise a multimodal approach when managing those with migraine that incorporates stress management, patient education and advice on lifestyle factors (Moore et al. 2018). While this study found increased patient satisfaction with chiropractic headache management was associated with those motivated by the need to gain 'more control of their headaches', more research is needed to better understand the extent to which particular aspects of chiropractic patient care contribute to patient satisfaction with chiropractic headache management.

Our study found a substantial proportion of those with headache seeking help from chiropractors had headache features associated with increased headache burden,

including those with mixed headaches, increased headache severity and headache chronicity. Those with mixed headaches made up the largest headache group seeking help from chiropractors in our study, a finding that is likely explained by the high co-occurrence of migraine with tension-type headache (Kristoffersen et al. 2012; Lyngberg et al. 2005a). In addition, our study found a substantial proportion of those with headache seeking help from chiropractors scored their headache pain at the level of severe, and one in four reported a headache frequency consistent with a classification of chronic headache. Those with mixed, severe and chronic headaches more likely to experience greater headache burden (Blumenfeld et al. 2011; Buse et al. 2012; Fuensalida-Novo et al. 2017) and are more likely to seek professional help, including from healthcare providers outside of medical settings (Lee, Bhowmick & Wachholtz 2016; Silberstein et al. 2018; Zhang et al. 2017). More research is therefore needed to understand how chiropractors might assist those with increased headache burden. For example, clinical research evidence for the role of manual therapies for chronic headaches remains limited (Cerritelli et al. 2015; Chaibi & Russell 2014). In addition, many with chronic and disabling headaches commonly experience psychiatric comorbidities, such as anxiety and depression (Buse et al. 2010; Holroyd et al. 2000). While this study found those seeking 'help with headache-related stress' were more likely to be satisfied with chiropractic headache management, there is little detailed knowledge regarding how chiropractors seek to assist those with psychiatric disabilities commonly associated with increased headache burden.

In addition, our study found one in five participants were identified as having a headache features that failed to fulfil the minimum criteria needed to assign a

headache classification of either migraine, tension-type headache or cervicogenic headache. While uncertainty remains about the significance of this finding, the true proportion of those with headache who meet all of the required ICHD criteria needed for a distinct headache classification remains unclear (Lyngberg et al. 2005a; Rasmussen, Jensen & Olesen 1991) and overlapping headache characteristics are reported as common amongst those with recurrent headaches (Turkdogan et al. 2006; Vincent 2010a). Overlapping headache features may also help to explain why our study found there was no statistically significant association between headache grouping and patient satisfaction with chiropractic management. However, while those failing to fulfil the minimum criteria needed to assign a headache classification may partly be explained by the challenges of classifying headaches into discrete categories, it may also be a limitation of the self-report instrument utilised for the study.

Our study identified that many with headache seeking help from chiropractors experience increased levels of headache impact. Study participants with the highest level of headache impact were those with features of migraine and mixed headaches, a finding similarly identified in other studies (Smitherman et al. 2013; Steiner, Stovner, et al. 2014). High levels of headache burden can adversely impact patient quality of life, including their work, leisure and social activities (Steiner, Stovner, et al. 2014). In this regard, it was not surprising that many respondents were motivated to seek help from chiropractors in order to reduce the impact of headaches on their work-life and relationships. The increased levels of headache impact amongst those seeking help from chiropractors, as identified by the findings of this study, highlights the need for chiropractors to monitor and evaluate the level of headache burden in those who are

seeking their help. In doing so, it is incumbent upon chiropractors to carefully consider the healthcare needs of those who experience increased headache burden and to consider the role of other healthcare providers in assisting in these circumstances (Sahai-Srivastava et al. 2017; Zeeberg, Olesen & Jensen 2005).

Our study found nearly three out of every four patients who consult chiropractors with headache were female. A higher proportion of female patients with headache has been reported in those seeking help from Complementary and Alternative Medicine (CAM) (Rhee & Harris 2017) and medical providers (Hunt et al. 2011). This finding is likely influenced by the higher percentage of women who experience migraine and tension-type headache, the most common recurrent headaches (Finocchi & Strada 2014; Khil et al. 2012; Lyngberg et al. 2005a). Nearly two thirds of our sample were aged between 41 – 65 years, despite evidence that the peak age of migraine decreases after menopause (Mattsson 2003). Since the peak age of those with tension-type headache is reported to be between 30 – 39 years (Schwartz et al. 1998) and between 18 – 45 years for those with migraine (females) (Sheffield 1998; Smitherman et al. 2013), it may be that headache patients seeking help from chiropractors do so later than the age of peak incidence and later than seeking help from other primary care providers. Our study found the majority of chiropractic headache patients were well educated with nearly half having a university education, with two thirds being salary-workers or self-employed and three quarters reporting health insurance cover inclusive of chiropractic health services. With low employment status and lack of health insurance reported as economic barriers to medical headache treatment (Lipton, Serrano, et al. 2013), our findings may also suggest similar socioeconomic

barriers may exist regarding patient access to non-medical headache providers such as chiropractors.

7.7 Limitations

Our study has several limitations. The section of the questionnaire using self-report for headache features is unvalidated and this can increase the risk of an incorrect headache classification and the generalisability of the study findings. When considering this concern, we avoided participant grouping into 'probable' headache classification categories, as identified by ICHD, where increased overlap of headache features would increase the risk of misclassification. As such, study participants were only grouped under discrete headache categories when responses met all of the formal ICHD headache classification criteria. While favourable reliability of self-report headache instruments has been previously documented (Lipton et al. 2003; Lipton et al. 2015), future studies are needed to explore the validity of a self-report survey instruments for headache classification against that of face-to-face consultation. The low patient response rate and limited patient sample size may also result in headache groups and headache disability being under or over-represented. As such, our findings call for larger population studies to be conducted before robust conclusions can be made about the external validity of the findings. In addition, there is a need for future research to additionally assess the proportion of those seeking help from chiropractors who also have medication-overuse headache, known to be most common in those with chronic migraine (Stovner & Andree 2010; Westergaard et al. 2014).

7.8 Conclusions

Our study found a high proportion of patients who consult chiropractors for headache management experience features of common recurrent headaches. In addition, many of these patients experience high levels of headache pain, chronicity and headache-related disability. However, these findings highlight the need for larger population studies before robust conclusions can be made about the headache profile of this patient population.

7.9 Chapter summary

Results from this chapter suggest that a substantial proportion of people with headache seeking help from chiropractors experience discrete features of migraine, tension headache and cervicogenic headache, as well as mixed headaches (more than one headache type). While the findings suggest patient satisfaction was not associated with patient headache group, further research is needed to evaluate the safety and effectiveness of headache treatments, including MTs, provided by chiropractors for the management of common recurrent headaches. Findings from this chapter also suggest that high levels of headache chronicity, severity and overall disability are common in chiropractic clinical settings. High levels of headache chronicity and disability are often associated with increased headache-related stress (Saunders et al. 2008). While satisfaction with chiropractic headache management was associated with those who needed help with headache-related stress, further research is needed to evaluate the role and effectiveness of chiropractors in managing headache patient stress and the psychiatric comorbidities commonly associated with increased headache disability. The level of use of chiropractors by people with common

recurrent headaches calls for conventional care providers to be aware of and to consider the role of chiropractors in providing help for this patient population. A detailed discussion of the results of Chapters 4, 5, 6 and 7 is provided in Chapter 8.

8 Discussion

8.1 Chapter introduction

The body of work described herein provides essential new knowledge about headache management in Australia which has direct and immediate relevance to the quality and safety of headache patient care. This topic had not been previously investigated from a health services perspective. In doing so, this research utilised a nationally representative practitioner sample to investigate the role of chiropractors in headache management.

8.2 Primary findings of the thesis

Several key discussion topics are highlighted in the manuscripts within the individual results chapters. In order to complement and expand upon these discussions, this chapter examines four overarching themes (based on significant thesis findings). In presenting these four themes, the chapter highlights the implications of the findings with respect to headache-related healthcare provision by chiropractors and within the broader perspective of headache patient management. The four themes are:

- that headache management is substantial within Australian chiropractic clinical practice, and at a level not previously empirically identified, challenging commonly held views about the role of chiropractors in healthcare;
- that contemporary chiropractic headache care incorporates a broad range of therapeutic approaches beyond spinal manipulation – a finding of particular significance, given the popular assertion that chiropractic is predominately

focused on spinal manipulation and with possible implications regarding the role of chiropractors within the wider field of headache management;

- that Australian chiropractors frequently utilise headache classification in their approach to headache patient assessment –suggesting chiropractors utilise mainstream approaches to headache classification, despite a number of identified challenges associated with the reliability of such headache classification in chiropractic settings; and
- that chiropractors are selective in their collaboration with other healthcare providers around headache management, identifying more frequent collaboration with CAM providers and GPs but less frequent collaboration with psychologists – a finding with important implications for the wider role of chiropractors within multidisciplinary headache patient care.

Each of these themes is addressed in detail in the chapter sections to follow.

Additionally, the chapter explores the significance of key thesis findings for patients, providers, educators and policymakers with regard to headache care. The chapter closes with a discussion of the limitations of the research and possible directions for future research into chiropractors and headache patient management.

8.2.1 Substantial headache management within chiropractic challenges commonly held views about the role of this provider within healthcare

A key finding identified in this thesis is that headache management constitutes a substantial component of the clinical practice of many chiropractors: one in five new chiropractic patients presented with a chief complaint of headache, and one in three

with headache as a secondary complaint (see Chapter 5). While a small number of previous studies have identified headache as the third most common complaint treated within Australian chiropractic (Brown et al. 2014; French, Charity, et al. 2013), this thesis moves examination of the level of chiropractic headache management to a wider, more rigorous level of analysis. This thesis provides the first empirical evidence that Australian chiropractors manage a substantial caseload of headache patients by drawing upon a nationally representative sample of chiropractors.

The substantial level of chiropractic headache consultation identified herein may challenge commonly held societal views about the role of chiropractic and chiropractors within healthcare; namely, that chiropractors are mostly utilised for the management of spinal pain (primarily low back pain and neck pain) (Brown et al. 2014; Xue et al. 2008). In contrast, thesis findings identifying the extent to which the treatment of headache is commonplace amongst Australian chiropractors may challenge such commonly held views and may redefine common knowledge about the role of chiropractors within healthcare. However, as outlined later in this chapter, the extent to which this occurs will partly depend upon the approach taken by the profession in the eyes of key external audiences going forward. This includes in prosecuting its place as a trusted stakeholder within the field of headache management, as well as the extent to which the profession can establish the potential role and benefits of chiropractic patient management to those impacted by headache disorders.

For example, the high level of headache management by chiropractors identified herein may challenge commonly held views *within* conventional healthcare settings about the role of chiropractors for headache management. Spinal manipulation is well recognised as a substantial component of chiropractic patient care (Beliveau et al. 2017), and thesis findings show that this extends to the treatment of those with headache (see Chapter 5). This is despite concerns often raised about the safety and efficacy of chiropractic spinal manipulation by conventional care providers (GP News 2019; O'Neill & Willis 1994), concerns that are often amplified with the Australian mainstream media (ABC News 2019; Choice Magazine 2014; Sydney Morning Herald 2016). With the limited research evidence for the effectiveness of chiropractic approaches to headache management, conventional care providers may also be surprised by thesis findings identifying that seeking headache prevention and pain reduction were common motivations for seeking chiropractic management for headache (see Chapter 7). The substantial caseload of headache within chiropractic settings therefore raises questions about why many with headache are choosing to receive a treatment often characterised as unsafe, poorly validated and from a provider group positioned outside of conventional mainstream healthcare.

With uncertainty about the role of chiropractors in headache management, there is an opportunity for healthcare providers to consider and explore how this use relates to and is influenced by wider debates and views around the scientific credibility and safety of chiropractic patient care. In light of these debates, the extent to which the healthcare needs of people with headache can be resolved within conventional primary care settings alone remains unclear. For instance, evidence suggests that

many with headache can be dissatisfied with the effectiveness and side effects of headache drug treatments (Bigal et al. 2008; Lipton et al. 2019) and dissatisfaction with pharmaceutical headache treatments are common motivations for the use of chiropractors, and other MT providers, for headache management (Bethell et al. 2013; Gaul, Schmidt, et al. 2011; Rossi et al. 2006). While the majority of those with headache first seek help from conventional care providers (Latinovic, Gulliford & Ridsdale 2006; Sanderson et al. 2013), it is important for conventional care providers to consider the relationship between dissatisfaction with conventional headache treatments and a patient's decision to utilise chiropractic care, and other non-drug approaches, in their headache management journey.

The substantial management of headache within chiropractic settings also has broader implications for the role and contribution of chiropractors in helping to address current healthcare service delivery challenges within the field of headache patient management. Several health services issues are recognised as substantial barriers to the delivery of high-quality headache patient care. For example, many people with headache remain poorly or under-diagnosed by healthcare providers (Kernick, Stapley & Hamilton 2008), despite the role of headache diagnosis in the delivery of high-quality headache patient care (Silberstein 2016). Another health services issue associated with headache management is that many with headache remain poorly or under-treated (Minen et al. 2016), including many who are failing to seek professional help for headache at all (Katsarava et al. 2018). In addition, there is a need for greater collaboration between headache-related healthcare providers to better meet the healthcare needs of those with headache, particularly for those with chronic and

disabling headache disorders (Gaul, Visscher, et al. 2011). To date, the chiropractic profession has largely existed outside of coordinated mainstream patient management settings. However, should the profession wish to be identified as a trusted partner within the interdisciplinary field of headache patient care, the chiropractic profession will need to understand, recognise and be active as a stakeholder participant in helping to address the health services challenges currently facing headache.

With findings from this thesis demonstrating that headache patient care features large within chiropractic, there appears to be much potential for chiropractors to build upon their current standing within wider healthcare practice and service provision for headache in Australia. However, the extent to which such advances can be realised will be further influenced by the future focus of key stakeholders *within* the chiropractic profession and the wider debate about the role and identity of chiropractors within healthcare generally and how it potentially relates to the quality of headache patient care provided by chiropractors.

It is well recognised that two distinct and divergent healthcare identities exist within chiropractic, and which dictate conflicting approaches to patient care (see chapter 1). On the one hand, many chiropractors are advocates for the evidence-based model of patient care (Walker et al. 2013; Walker et al. 2014) favoured within conventional healthcare (Djulgovic & Guyatt 2017; Straus et al. 2011). In contrast, another sizeable component of the chiropractic profession advocates patient care according to the traditional, chiropractic model of patient management that has failed to meet current standards of evidence-based practice (Clijsters, Fronzoni & Jenkins 2014; Smith & Carber 2008).

The debate around these conflicting approaches to chiropractic patient care continue, both within and beyond the profession (Ernst & Gilbey 2010; Leboeuf-Yde et al. 2019; Schneider, Murphy & Hartvigsen 2016). However, the extent to which the chiropractic profession adopts mainstream evidence-based principles of patient care has important implications for the acceptance of chiropractors as respected, evidence-based healthcare providers both within healthcare generally, and within the field of headache management. As such, there is an urgent need for the chiropractic profession to reduce the confusion about its role and identity within healthcare should it wish to be better understood by the public, other providers and healthcare policymakers and to ultimately attract an accepted and well-established standing within the landscape of headache patient care.

8.2.2 Contemporary chiropractic headache management incorporates a range of therapeutic approaches beyond spinal manipulation

Another key finding from this thesis is that headache management by chiropractors incorporates a multimodal approach to headache patient care (inclusive of patient education, advice on lifestyle factors, stress management and MT methods) (see Chapter 5). This finding is significant because multimodal approaches to headache management have long been considered a mainstay of effective contemporary headache management (Lacerenza, Schoss & Grazi 2015; Silberstein 2016).

Identification of chiropractors' multimodal approach to headache management herein challenges the notion that chiropractic headache management is limited to spinal manipulation, and suggests that many chiropractors recognise that multifaceted mechanisms are associated with headache burden (in line with contemporary

biopsychosocial principles of patient care) (Lindau et al. 2003). It is therefore encouraging that most Australian chiropractors provide headache patient care that incorporates recognised biopsychosocial aspects of patient management.

Multimodal approaches to headache care are supported within primary care settings (Lacerenza, Schoss & Grazzi 2015) and endorsed within headache treatment guidelines (Bendtsen et al. 2010; Bryans et al. 2011; Côté et al. 2019) in order to achieve more effective patient outcomes. Multimodal approaches are considered particularly valuable for the management of those with chronic headache (Lacerenza, Schoss & Grazzi 2015; Przekop, Przekop & Haviland 2016). Since findings presented herein suggest chronic headaches may be common in those seeking help from chiropractors (see Chapter 7), multimodal approaches by chiropractors may have particular significance to the quality of the care provided for this headache subgroup. Although more research is needed to assess the effectiveness of multimodal care within chiropractic settings, this thesis finding suggests many chiropractors *are* following some of the recognised conventions that underline quality headache patient care – suggesting a potential level of competency amongst this provider group in adopting recognised aspects of headache management (Lacerenza, Schoss & Grazzi 2015; Silberstein 2016).

One of the multimodal aspects of chiropractic headache management identified in the findings from this thesis was the provision of patient education on headache triggers. Precipitating headache triggers can include tiredness, stress, hormones, missed meals, weather and sleep disturbance (Kelman 2007). Patient education about the identification and management of headache triggers is well recognised as an essential

aspect to patient management within headache treatment guidelines for those with primary headache disorders (Bendtsen et al. 2010; Pringsheim et al. 2012). Since findings from this thesis suggest features of migraine and tension headache are common to chiropractic clinical settings (see Chapter 7), patient education about headache triggers by chiropractors may be valuable in reducing the burden of headache disorders. Accordingly, this finding appears to suggest that chiropractors are understanding the clinical importance of patient education regarding headache triggers and the value of this approach as part of their management for those who present with headache disorders.

Another multimodal aspect to chiropractic headache management identified herein is advice on lifestyle factors such as exercise and diet (see Chapter 5). Advice on exercise and diet is often acknowledged as valuable to overall headache patient care (Finkel, Yerry & Mann 2013; Silberstein 2016). While further clinical research is needed, limited evidence suggests that exercise and diet may impact on the burden of headache disorders. For example, routine exercise may reduce the overall frequency of migraine episodes, while knowledge remains sparse about the level and type of exercise activity needed (Amin et al. 2018). Similarly, some evidence also suggests aspects of diet can play a role in the burden of headache disorders. However, much of the published literature on the topic has been specific to dietary triggers (Finocchi & Sivori 2012; Karli et al. 2005; Kelman 2007; Wöber et al. 2006) while evidence remains limited regarding the overall impact of diets for headache generally. For example, there is only limited evidence suggesting obesity increases migraine frequency (Peterlin, Rapoport & Kurth 2010) and that weight loss reduces the impact of migraine (Jahromi et al. 2014;

Verrotti et al. 2013). Research is also sparse regarding the benefit of specific types of diets on reducing the burden of headache (Barbanti et al. 2017; Ferrara et al. 2015). While it is beyond the scope of this thesis to evaluate the quality and nature of the exercise and diet-related advice provided by chiropractors for headache sufferers, it is important that chiropractors are aware of the limited research evidence within this area of chiropractic headache management and to be mindful of such limitations when approaching this aspect of headache patient management.

Another aspect of multimodal care provided by chiropractors identified herein was stress management (see Chapter 5). This finding is significant, because stress is a significant contributor to headache burden, and a common trigger for primary headaches, such as tension headache and migraine (Karli et al. 2005; Wöber et al. 2006). Accordingly, management aimed at reducing headache patient stress may improve the quality of life for those with headache (Martin 2016; Singer, Buse & Seng 2015). Notably, this research found that a large percentage of headache patients seeking help from chiropractors had high levels of headache-related disability (see Chapter 7) – a headache characteristic commonly associated with increased psychiatric comorbidity (Buse et al. 2010; Zeppenholzer et al. 2015). It is therefore unsurprising that many participating headache patients were motivated to seek help for headache-related stress and to reduce the impact of headaches on their work-life and relationships (see Chapter 7). The use of stress management by chiropractors therefore provides encouragement that chiropractors are engaged in a common primary care approach to headache patient management.

The final multimodal approach utilised by chiropractors for headache identified in the

findings from this thesis was the use of several MTs, inclusive of soft tissue therapies, spinal mobilisation and spinal manipulation (see Chapter 5). However, uncertainty remains about the effectiveness of MTs in reducing the burden of headache disorders. For example, current clinical research evidence to support the effectiveness of MTs for headache is limited and largely low to moderate in quality. Systematic reviews identify the need for rigorous, large-scale randomised clinical trials to assess the efficacy of MTs for the prevention of migraine before robust conclusions can be made (Chaibi, Tuchin & Russell 2011; Rist et al. 2019). In addition, while there is limited, good quality evidence to support the efficacy of MTs for tension headache (Mesa-Jiménez et al. 2015) and cervicogenic headache (Chaibi & Russell 2012; Racicki et al. 2013), more high-quality clinical research is needed because of substantial heterogeneity in existing studies. This finding therefore calls for some caution regarding this aspect of chiropractic headache patient care. As such, it is vital for chiropractors to evaluate headache treatment guidelines and to consider and compare the weight of the evidence for the effectiveness of MTs to other approaches for reducing the burden of headache disorders.

The reasons for Australian chiropractors' substantial use of MTs to treat headache requires further consideration. One explanation may relate to the fundamental use of MTs as the prevailing, traditional approach to patient care that is widely employed by chiropractors more generally. Spinal manipulation, in particular, is often identified as a central focus of the professional expertise of chiropractors (Chiropractor's Association of Australia 2010; World Federation of Chiropractic 2009b). Another explanation for the substantial use of MTs by chiropractors for headache may also relate to a lack of

practitioner awareness of the efficacy of other therapeutic approaches to headache management. For example, a survey of US physicians found only 28% were familiar with headache treatment guidelines (Minen et al. 2016). Globally, only 55% of primary care providers were reported to be using headache treatment guidelines when managing those with headache disorders (World Health Organization 2011).

Uncertainty therefore remains about the extent to which chiropractors understand and acknowledge the benefit of treatment approaches external to traditional chiropractic patient care as identified within headache treatment guidelines when providing care for this patient population.

Chiropractors' preference for using MTs for headache may also relate to other factors.

As outlined earlier, patient dissatisfaction with headache drug treatments is well recognised in the literature (Harpole et al. 2005; Katić et al. 2010; Lipton, Buse, et al. 2013) and a common motivation for seeking help from MT providers (see Chapter 2).

As such, patient dissatisfaction with headache drug treatments may also impact on the decision by chiropractors to advance the use of MTs as part of their overall approach to headache patient management despite the limited clinical research evidence.

However, despite frequent patient dissatisfaction with headache drug treatments and the popular preference for non-drug approaches (Adams, Barbery & Lui 2013; Gaul et al. 2009), closer research examination of the role of MTs in reducing the burden of headache disorders is needed.

The substantial use of MTs by chiropractors for headache management also raises important questions about patient safety. While spinal manipulation is one MT that is commonly utilised by chiropractors for headache, uncertainty remains about adverse

side effects from spinal manipulation. For example, previous systematic reviews have reported associations between chiropractic spinal manipulation and vertebral artery dissection, causing stroke or even death (Rothwell, Bondy & Williams 2001; Turner et al. 2018). In contrast, however, other reviews report that the quality of the research literature on this topic is questionable due to bias and confounding within available studies to date (Church et al. 2016; Nielsen et al. 2017). While research knowledge about the risks associated with spinal manipulation remains inconclusive, chiropractors need to inform patients what is currently known about the safety of spinal manipulation and other MTs used by chiropractors for headache management in order for patients to make informed decisions.

8.2.3 The use of headache classification by chiropractors is common, while challenges are associated with the reliability of headache classification in chiropractic settings

Findings presented herein show that most Australian chiropractors use headache classification as part of their approach to headache patient assessment (see Chapter 5). This thesis finding is significant given that headache classification plays an essential and core role in the provision of high-quality headache patient care, including to identify treatments better suited to particular headache types and to identify headache symptoms associated with serious underlying pathology (Silberstein & Rosenberg 2000).

Correspondingly, this thesis identifies that most chiropractors recognise the clinical utility of headache classification, including that headache classification influences their decisions about headache patient management (see Chapter 5). Such a view of headache classification appears broadly aligned with mainstream conventions about

the importance of headache diagnosis in directing appropriate patient care for particular headache types (Holland et al. 2012; Loder, Burch & Rizzoli 2012). Given that this thesis has identified a substantial caseload of headache within chiropractic clinical settings, there is an important opportunity for chiropractors to utilise headache diagnosis to ensure that those with headache receive the most effective headache management.

The classification of those with migraine is a notable example of where chiropractors must carefully evaluate the most appropriate approach to headache treatment.

Migraine is a highly debilitating headache disorder (Stovner et al. 2018; Vos et al. 2013), and findings from this thesis (see Chapter 7), and from other studies (Adams, Lauche, et al. 2017; Rossi et al. 2005) suggest features of migraine may be common amongst those who present to chiropractors. There is moderate to strong evidence for the effectiveness of pharmaceutical treatments (Loder, Burch & Rizzoli 2012) and psycho-behavioural treatments for assisting those with migraine (Kropp et al. 2017; Sullivan, Cousins & Ridsdale 2014). However, evidence for chiropractic MTs for migraine relief remains low quality and preliminary (Chaibi, Tuchin & Russell 2011; Rist et al. 2019). Accordingly, there is an essential responsibility for chiropractors, when utilising headache classification, to consider the most effective treatment options available for particular headache types, including treatments that are only available outside of chiropractic clinical settings.

This thesis identifies that most Australian chiropractors believe headache diagnosis improves their decision-making about headache patient referral (see Chapter 5). While little remains known about how headache diagnosis assists with headache patient

referral by chiropractors, one example where this may be critical relates to patient safety. The most critical diagnostic consideration for frontline practitioners engaged in headache management is to screen for headaches secondary to serious underlying pathology (Do et al. 2019). While rare, secondary headaches can be caused by conditions such as stroke, sub-arachnoid haemorrhage, tumour, meningitis or arterial dissection (Ravishankar 2016). It is therefore essential for chiropractors engaged in headache classification to comprehensively assess patient headache features using ICHD-3 (Headache Classification Committee of the International Headache Society 2018), in order to identify cases suggestive of serious underlying pathology where urgent medical referral is needed.

While it is promising that most chiropractors use headache classification and endorse headache diagnosis for important aspects of headache patient management, this thesis has also revealed findings that have adverse implications regarding the role of chiropractors in headache diagnosis. For example, this thesis identifies that many chiropractors never or rarely give patients headache diaries (see Chapter 5) –vital to improving recall of headache symptoms and establishing an accurate diagnosis (Jensen et al. 2011; Phillip, Lyngberg & Jensen 2007). This finding may therefore limit the reliability and certainty of the headache diagnosis provided by chiropractors and reduce the quality of headache patient care within chiropractic settings.

Another significant finding was that many chiropractors are unfamiliar with (at least some) ICHD diagnostic criteria associated with secondary headaches (see Chapter 5). As outlined earlier, a small minority of headache patients may have a secondary headache caused by serious underlying pathology that requires urgent medical

management (Nelson & Taylor 2014). Poor familiarity with ICHD secondary headache criteria may also relate to the diagnosis of other secondary headaches, including MOH. MOH is a headache type that can often go unrecognized in primary care settings (Obermann & Katsarava 2007; van Driel et al. 2018). As highlighted in the Background Chapter, MOH causes up to 5% of all headaches (Evers & Marziniak 2010; Tepper 2012) and is associated with significant health burden (Bendtsen et al. 2014) and is another secondary headache which requires appropriate medical management (Schmid et al. 2013). Accordingly, a lack of familiarity with ICHD secondary headache diagnostic criteria by chiropractors may have important implications for the quality and safety of headache patient care provided by the profession.

Another significant thesis finding that has adverse implications for the role of chiropractors in headache diagnosis was that lack of engagement by some chiropractors in the use of headache classification criteria. Findings from this thesis identified that 15% of Australian chiropractors surveyed are not engaged in the use of primary headache classification criteria and approximately 10% are not engaged in the use of secondary headache classification criteria as part of the headache patient management (see Chapter 5). Uncertainty remains regarding why some practitioners fail to use headache classification as part of their headache patient assessment. One explanation may relate to practical barriers that can impede the delivery of more evidence-based approaches to clinical practice. Previous studies have identified that while most chiropractors approve of evidence-based principles of patient care, insufficient time to review evidence-based literature and a lack of access to resource information can be common barriers to the delivery of evidence-based aspects of

patient care (Schneider et al. 2015; Walker et al. 2014). Practical barriers such as these may similarly apply to the lack of utilisation of headache classification by some chiropractors.

However, another explanation for the lack of engagement in the use of headache classification criteria by some chiropractors may relate to cultural factors within the profession. As outlined in the Background chapter, a considerable percentage of Australian chiropractors hold favourable views toward the traditional chiropractic paradigm of patient care, one that is focussed toward the detection and correction of chiropractic subluxations (Clijsters, Fronzoni & Jenkins 2014; de Luca et al. 2018). Such an approach to chiropractic patient care shifts the basis for patient management away from the evidence-based principles of patient diagnosis and this may have important implications for the quality and safety of chiropractic patient care, including for those with headache (Gíslason et al. 2019; Schneider, Murphy & Hartvigsen 2016). There is therefore a need for further research to evaluate the factors that influence the failure of some chiropractors to adopt headache diagnosis as part of their headache patient management. This knowledge may assist future implementation and translational research designs aimed at enhancing the adoption, acceptance and use of headache diagnosis, and other evidence-based aspects of patient care, within chiropractic patient care (Bussières et al. 2016).

8.2.4 Chiropractors are selective in their collaboration with other headache providers

This thesis provides new knowledge about the professional collaboration between chiropractors and other headache-related healthcare providers. Understanding the current level of collaboration between chiropractors and other healthcare providers is

crucial to identifying the potential role of chiropractors within multidisciplinary headache management. Findings from this thesis identified that collaborative relationships between chiropractors and other healthcare providers when managing those with headache was sometimes inconsistent and/or selective. For example, the majority of chiropractors more frequently refer headache patients to other CAM-based providers, while headache patient referral to psychologists was more infrequent. Thesis findings also found that while the majority of chiropractors frequently refer headache patients *to* GPs, they less frequently received headache referrals *from* GPs.

Chiropractic headache referral to psychologists is infrequent

This thesis identified that the majority of chiropractors never or rarely referred headache patients to psychologists (see Chapter 5), despite psychologists' potentially valuable contribution to managing the burden of headache (Singer, Buse & Seng 2015). There is moderate to strong Level 1 clinical evidence for psycho-behavioural therapies, such as EMG biofeedback and CBT for the prevention of primary headaches (Bendtsen et al. 2010; Penzien et al. 2015). Headache outcomes from these interventions are often equivalent to or greater than outcomes from pharmaceutical interventions, with fewer side effects (Harris et al. 2015). In addition, psychologists can also play an important role in the management of psychiatric disabilities, such as anxiety and depression, common in those with increased headache burden (da Silva Jr et al. 2010; Holroyd et al. 2000).

Given findings from this thesis suggest that many with headache seeking help from chiropractors experience increased levels of headache burden (see Chapter 7), the infrequent referral of headache patients to psychologists by chiropractors could

suggest chiropractors may sometimes be failing to identify the role of psychologists for headache management. One explanation for this finding may be that chiropractors are failing to recognise the clinical features of those with increased headache burden. For example, findings herein identified that there was limited utilisation of headache disability assessment instruments by chiropractors (see Chapter 5). Headache disability instruments provide healthcare practitioners with a broader understanding of the patients' response to current headache treatment (Maniu, Maniu & Neamțu 2018; Raggi et al. 2018) and assist practitioners in better understanding circumstances where interdisciplinary patient care is more likely needed (Sahai-Srivastava et al. 2017; Silberstein et al. 2018). Accordingly, the infrequent use of headache disability instruments by chiropractors may adversely impact on the ability of chiropractors to recognise the wider health impacts associated with headache, including circumstances where behavioural approaches to headache management may be valuable.

It may also be that the low level of headache referral to psychologists by chiropractors relates to other factors. For example, the chiropractic profession has largely existed outside of coordinated mainstream patient management settings and information remains limited about the interdisciplinary role of chiropractors within coordinated headache management (Bernstein et al. 2019). Accordingly, uncertainty remains regarding the evidence-based knowledge of chiropractors in identifying circumstances where psychologists and psycho-behavioural therapies may be valuable in assisting this patient population.

Chiropractic headache referral to CAM practitioners is frequent

Findings from this thesis identified that the majority of chiropractors sometimes or often refer headache patients to CAM providers (grouped together as including acupuncturists, herbalists, naturopaths, massage therapists or counsellors) (see Chapter 5). While further empirical research is needed to more closely examine which CAM providers are those more often associated with chiropractic headache patient referral, chiropractic collaboration with CAM providers for headache raises important questions about the factors that might influence the preference for chiropractors to collaborate with headache providers largely positioned outside of coordinated mainstream healthcare and how collaboration with CAM providers for headache influences the quality of chiropractic headache management. A greater understanding of these issues can have important implications for the quality of headache patient care provided by chiropractors.

Limited research evidence suggests acupuncture (Linde, Allais, Brinkhaus, Fei, Mehring, Shin, et al. 2016; Xu et al. 2018) and massage therapy (Moraska et al. 2015; Youssef & Shanb 2013) may be helpful for the treatment of primary headaches. In contrast, there is little research knowledge regarding the effectiveness of other CAM providers, such as counsellors, naturopaths and herbalists, for headache management. In this regard, it may be that chiropractic headache patient referral to other CAM providers is sometimes motivated by factors external to those directly related to external research evidence for the efficacy of the therapeutic approaches provided by certain CAM providers for headache.

For example, chiropractors often embrace holistic, wellness-based principles of patient

care (Clijsters, Fronzoni & Jenkins 2014; French, Charity, et al. 2013). Accordingly, the frequent headache patient referral by chiropractors to other CAM providers could suggest many chiropractors are seeking to coordinate care with providers who have similar holistic beliefs and healthcare philosophies to overall patient management to many chiropractors (Barrett et al. 2004; Moura, Warber & James 2002). More research is therefore needed to explore the level and factors that influence chiropractic referral with other CAM providers and the headache patient outcomes associated with the holistic approaches to patient care that are often promoted, theorised and shared amongst many CAM providers.

Chiropractic headache referral to medical practitioners is frequent

Most surveyed chiropractors sometimes or often referred headache patients to GPs (see Chapter 5), who have an important role in headache patient care, notably in providing evidence-based pharmaceutical treatments for pain management (Becker 2017). In addition, as gatekeepers within healthcare, GPs coordinate headache patient care with other healthcare providers, which is essential when headache symptoms are potentially associated with serious underlying pathology (i.e. red flag signs) where a GP referral to a neurologists is needed for more advanced diagnostic evaluation and treatment (Ridsdale et al. 2007; Tedeschi, Russo & Tessitore 2012). GP referral to neurologists may also be needed to assist people with chronic headaches that are refractory to treatment (Ridsdale et al. 2007; Silberstein 2016) and where those with chronic headaches have developed MOH (Kristoffersen & Lundqvist 2014). In these circumstances it is vital for chiropractors to support public health efforts to identify patients engaged in the excessive overuse of headache medications and to assist these

patients to seek appropriate medical management (Tepper 2012). While findings from this thesis show chiropractic referral to GPs for headache is frequent – a positive finding that suggests chiropractors are cognisant of the important and central role of GPs in headache patient management - little remains known about the circumstances that influence the decision by chiropractors to refer headache patients to GPs and how this improves the quality and safety of headache patient care.

In contrast, most participating chiropractors reported never or rarely receiving patient referrals from GPs for headache management (see Chapter 5). The low level of GP referral to chiropractors for headache suggested herein appears to be consistent with findings from other studies reporting a low level of GP referral to chiropractors generally. For example, research suggests many GPs hold unfavourable views toward professional collaboration with chiropractors. In a cross-sectional survey sent to 1486 Australian GPs, more than one in five stated that they would not refer to a chiropractor under any circumstances (Wardle, Sibbritt & Adams 2013). Another survey of 630 Australian GPs found that 70% believed chiropractic education was not evidence-based and 60% had never referred a patient to a chiropractor (Engel, Beirman & Grace 2016). Another study of 4464 Australian chiropractic clinical encounters found only 4% of patient treatment encounters were the result of a GP referral (French, Charity, et al. 2013). In contrast, research suggests Australian GPs often refer headache patients to physiotherapists (Charles & Britt 2005), who provide similar headache treatment to chiropractors (Grant & Niere 2000; Jull 2002). Such findings could therefore suggest a greater GP trust in physiotherapists as MT providers for headache.

While the subject of GP attitudes towards chiropractors for headache management requires further research scrutiny, the substantial headache caseload within chiropractic clinical settings appears to suggest chiropractors may be meeting some of the healthcare needs of this patient population. While the role of chiropractors within coordinated mainstream headache management remains an emerging health services topic, it remains important for all headache-related health professionals to be aware that they may not be the only provider that headache patients utilise, and that the healthcare needs of those with headache are often multidimensional and multidisciplinary. GPs may therefore need to keep an open mind when discussing patients' use of chiropractors for headache and the potential role chiropractors within multidisciplinary headache management landscape.

8.3 Implications of the findings

This research has important implications for Australian headache patients, chiropractors, GPs, providers of chiropractic education and policymakers. Its key implications are outlined in detail below.

8.3.1 Implications for patients

A key thesis finding is chiropractors' substantial use of MTs, including spinal manipulation, for the treatment of headaches. Those with headache who seek help from chiropractors must therefore seek to understand the effectiveness of MTs for headache by their chiropractors and GPs, as well as from non-professional sources, including internet information made available by recognised headache societies and organisations (Headache Australia 2018; National Headache Foundation 2018). In addition, those with headache should seek to understand the comparative

effectiveness of chiropractic and other available headache treatments to make informed decisions.

Patients should also be aware of the need for further high-quality research to assess the safety of spinal manipulation for headache management. While research is ongoing, those with headache should inquire into what is known about the safety of spinal manipulation based on currently available information. Since health risks are also associated with conventional pharmaceutical approaches to headache management (Jackson et al. 2017; Lipton et al. 2019), those with headache should seek to understand the comparative risks of MT to other available headache treatments to make informed decisions about the safety of treatment options available. It is therefore essential that headache patients seek to discuss any direct risks that may be associated with chiropractic MTs for headache with their chiropractor and/or GP when considering this approach for headache management.

8.3.2 Implications for chiropractors

As nationally registered healthcare providers, chiropractors have a responsibility to evaluate the research literature and to provide care based upon evidence-informed information (Chiropractic Board of Australia 2019). It is therefore vital for chiropractors to assist headache patients in understanding the quality of the evidence for the various headache treatments and use a patient-centred approach in their decision-making. Patient centred care has been described as that which “fully involves the individual patient as a person at all stages with unique needs, concerns and preferences” that will “lead to more efficacious and satisfying outcomes” (Australian Commission on Safety and Quality in healthcare 2011). However, while patient centred

care does not always mean the highest level of evidence is essential before considering a treatment intervention, it remains vital for chiropractors to fully discuss the current evidence to support the effectiveness of chiropractic treatment options for headache while taking a patient centred approach.

It is also important for all chiropractors to use headache diagnosis in decision-making about the most effective headache treatments or to exclude secondary headaches associated with serious underlying pathology (Carolei & Ripa 2015). Chiropractors must remain up to date on the criteria for the diagnosis of headache disorders and use appropriate diagnostic tools, such as headache diaries, to improve the reliability of their diagnoses.

8.3.3 Implications for GPs

The substantial proportion of headache within chiropractic clinical practice reported herein has significance for GPs, whose patient medical records may contain contraindications to chiropractic MTs, such as rheumatoid arthritis, osteoporosis, spondylosis, active cancer and acute myelopathy (Puentedura et al. 2012). GPs may therefore have access to additional clinical knowledge about potential contraindications to chiropractic MTs that may not be known to the patient's chiropractor. Given some headache patients do not inform GPs of their use of MT providers for headache (see Chapter 2), it is important for GPs to be active in their inquiries about the issue and to assess patient medical records for any contraindications to any MT treatment.

GP awareness about the use of chiropractors for headache may also assist GPs to better coordinate different aspects of headache patient management between

different healthcare providers. While the role of chiropractors within multidisciplinary headache care remains an emerging area of research investigation, there may be particular circumstances that influence the use and preference of particular healthcare providers, such as chiropractors, for headache. While there is some evidence that MTs are helpful for the prevention of recurrent headaches (preventative care), there is no evidence MTs are effective in reducing the severity or duration of an acute headache episodes (acute care). Accordingly, there may be circumstances where GPs need to coordinate the role of chiropractors in helping to manage particular aspects of headache-related pain.

8.3.4 Implications for chiropractic educators

Many findings of this research reinforce the importance of chiropractic headache training. This includes the need for chiropractors to be adequately trained to provide headache patients with a reliable diagnosis of their headache type. It is therefore vital for chiropractors to have sufficient knowledge and skills in all aspects of headache diagnosis. This includes the need for chiropractors to be familiar with secondary headache classification criteria, and advocate patient headache diaries to improve the reliability of headache diagnosis within chiropractic clinical settings

The substantial level of chronic headaches and increased headache disability within chiropractic settings identified herein has additional implications for providers of chiropractic education where chiropractors need to be aware of the likely increased need for coordinated interdisciplinary headache patient care (Gaul, Visscher, et al. 2011; Sahai-Srivastava et al. 2017). It is therefore vital that chiropractors utilise headache disability instruments to better understand the wider impact of headaches

on patient well-being (Jacobson et al. 1994; Min et al. 2010; Stewart, Lipton & Kolodner 2003) and the potential need for psycho-behavioural headache management for those with increased headache disability (Gunreben-Stempfle et al. 2009; Harpole et al. 2003). The low level of headache patient referral between chiropractors and psychologists calls for providers of chiropractic education to also ensure chiropractors recognise the particular role of psychologists, and other healthcare providers, in assisting those with comorbid psychiatric disabilities, such as anxiety and depression (Baskin & Smitherman 2009; da Silva Jr et al. 2010).

8.3.5 Implications for policymakers

The substantial headache management within chiropractic clinical settings identified in this research underlines the importance of chiropractors in the management of headache within the Australian healthcare system. It also highlights the potential need for future healthcare policy aimed at addressing this significant public health challenge to consider the role of chiropractors as important providers within the field of headache management.

For example, the inclusion of chiropractors in stakeholder consultation aimed at addressing the public health burden of chronic and disabling headaches is of particular significance. As with previous work (Gaul et al. 2009; Kristoffersen et al. 2012; Rossi et al. 2006), the findings herein suggest that increased headache chronicity and disability are common in those seeking help from chiropractors. Greater headache burden is associated with increased utilisation of healthcare resources (Lanteri-Minet 2014; Stokes et al. 2011) and healthcare providers (Barton et al. 2014). Should future, large population, epidemiological studies confirm high levels of headache burden are

common within chiropractic patient populations, healthcare policymakers may need to consider the role of chiropractors in initiatives that aim at improving the coordination and management of those with increased headache chronicity and disability.

Public health determinations are needed to improve outcomes for those with disabling headache disorders. The WHO 'Lifting the Burden' campaign has highlighted the need for improved interdisciplinary professional care in order to deal with all dimensions of headache (World Health Organization 2011). Effective policy planning is needed to facilitate the coordination of headache patient care across healthcare providers to reduce the high cost of headache to the community (Dodick et al. 2016; Linde et al. 2012). The multidimensional and multidisciplinary healthcare needs of those with headache adds weight to the need to evaluate the role of a range of healthcare providers within healthcare policy planning, including those outside of conventional healthcare settings. While uncertainty about the interdisciplinary role of chiropractors within the wider field of headache management remains, findings presented herein show that headache constitutes a substantial proportion of chiropractic caseload and appear to suggest that chiropractors may be meeting some of the healthcare needs of headache sufferers. Accordingly, the role of chiropractors in reducing the burden of headache disorders is a topic worthy of inclusion in future healthcare policy and planning.

8.4 Research limitations

This research utilised a nationally representative cohort of chiropractors to investigate their headache patient management. It also constitutes the most extensive investigation of the clinical features of those with headache who seek help from this

provider group to date. Nevertheless, as with all research, limitations of the study design must be acknowledged.

Sampling bias can occur when the study sample is not representative of the larger population it seeks to measure (Althubaiti 2016). In addressing this concern, this thesis study draws upon a large, random sample of practitioners that has been verified as nationally representative (Adams, Peng, Steel, et al. 2017). The sub-study sample of chiropractors utilised for Phase 2 of the study were compared to the wider ACORN sample and were shown to be similar for gender and place of practice while slightly more experienced (for years in practice). However, a non-random (consecutive) sampling method was utilised for the recruitment of headache patients for this thesis. While this sampling method is commonly chosen for practical reasons, including ease of recruitment across multiple practice sites (Clark et al. 2003), such a sampling approach and the lower response rate for patients reduces the external validity of this component of the work.

Retrospective recall bias occurs when study participants provide an erroneous response based on incorrect recall of a past activity or event (Althubaiti 2016), and is a common limitation of cross-sectional survey research. As such, direct observation, including of patient treatment records, would provide a more accurate understanding of the clinical practice behaviours of chiropractors managing people with headache. Accordingly, while practitioners in Phase Two were asked to review patient records over the previous two weeks to assess the prevalence of headache patients to reduce recall bias, there is greater the risk of practitioner recall bias regarding their approaches to headache management. In addition, there was a risk of patient recall

bias in Phase Three, depending on how long patients delayed completing the survey after being invited to participate (Fadnes, Taube & Tylleskär 2009).

Self-selection bias is the result of respondents selecting themselves into a study and biasing the sample (Hernán, Hernández-Díaz & Robins 2004). Similarly, non-response bias occurs when non-respondents are likely to be different to respondents (Grimes & Schulz 2002). There would be a risk of self-selection bias and non-response bias in the findings of this thesis if participants, both practitioners and patients, were unrepresentative of the broader chiropractic practitioner and headache patient population. This includes in circumstances where chiropractors have control over the selection of the headache patients invited to participate in the study. However, the practitioner participants were compared to the broader ACORN sample and shown to be similar across gender and place of practice, suggesting they were generally representative of the ACORN database. It was not possible to compare the headache patient sample to any equivalent clinical population, and the risks associated with self-selection bias and non-response bias for headache patients in observational research is largely unknown.

The internal validity of research suffers if the study fails to measure what it aims to measure (Grimes & Schulz 2002). Accordingly, there is a risk in using non-validated self-report instruments in observational research. For example, the questionnaire utilised in Phase Three did not provide a definition for patient satisfaction when asking respondents how satisfied they were with headache management by chiropractors. Since the nature of patient satisfaction can be complex and influenced by different experiences (Bjertnaes, Sjetne & Iversen 2012; Jenkinson et al. 2002), interpretation of

this finding should be treated with caution. The HIT-6 instrument used in Phase three of the thesis to assess patient headache disability was validated (Kosinski et al. 2003), but the section of the patient survey utilised to identify patient headache groups in Phase Three was not. To increase the rigour of the methods, this section of the patient survey followed ICHD headache classification criteria for headache diagnosis (Chapter 7) and was informed by survey questions utilised in similar surveys and settings (Andree et al. 2010; Steiner, Gururaj, et al. 2014). While face-to-face consultation with a neurologist is the gold standard for headache diagnosis, high reliability of self-report headache instruments utilising ICHD criteria has been documented within large population studies (Lipton et al. 2003; Lipton et al. 2015).

To further increase the rigour of this section, the decision was also made to avoid the inclusion of 'probable' headache classification categories, as provided within ICHD (Headache Classification Committee of the International Headache Society 2018), due to the greater risk of misclassification in those with overlapping headache features when using survey instruments. While this decision may have increased the percentage of those identified as 'Other headache' (unclassified), this decision was made to limit headache groupings only to those who met *all* of the diagnostic criteria necessary for each classification. Furthermore, pilot testing was conducted prior to survey distribution in Phases Two and Three of this thesis to assess participant understanding of survey wording and content to improve the internal validity of the survey design for both the practitioner and patient surveys.

8.5 Research strengths

Headache-related healthcare delivery outside of conventional medical settings is under-reported in nationally collected data (Becker et al. 2008; Bloudek et al. 2012; Brandes 2002). This research is the first to investigate chiropractic headache management using a nationally representative cross-sectional analysis. A key strength of this research lies in its ability to enable critical insights into chiropractic headache patient care using a long-established, well-designed PBRN cohort. The ACORN database and practitioner membership has strong external validity and, correspondingly, the findings reported herein are generally representative of the wider Australian chiropractic population. Overall, this study has generated extensive and novel information on the delivery and utilisation of chiropractic health services for headache, using observational cross-sectional designs, descriptive statistics and logistic regression analysis.

8.6 Future research directions

Several areas worthy of future research examination emerge from the findings of this body of work. This includes health services and clinical research designs that will progress and expand upon the findings drawn from this work in order to strengthen the informative value of these findings within the field of chiropractic headache patient care. While some areas for future research have briefly been highlighted within this Discussion chapter, this section provides specific insights for future research designs and methodologies that emerge from the findings of this thesis study.

8.6.1 Health services research

Safety and side effects of chiropractic spinal manipulation for headache

It is essential to understand the safety and side effects that may be associated with manual therapies for the management of headache disorders. To date, the quality of the published literature examining the relationship between spinal manipulation and stroke is low, making it difficult for strong conclusions to be made about the safety of this type of therapy (Church et al. 2016). The substantial use of spinal manipulation by chiropractors for headache highlights the need for large scale, well designed, epidemiological studies, with suitable comparison groups to further evaluate this critical issue.

Interdisciplinary headache management

It is important that chiropractors can identify patient circumstances where interdisciplinary headache management is needed for optimal patient care. More detailed information is therefore needed to understand the factors that influence the collaboration between chiropractors and other healthcare providers for headache. This includes the need to better understand the extent to which patient clinical findings influences headache patient referral and whether chiropractic headache patient referral is influenced by factors external to headache patient findings. This may include factors that are related to the philosophical, cultural and professional positioning of chiropractors within healthcare and the effects this may have on their collaborative relationships with conventional, allied health and other CAM providers. Knowledge about the factors that influence collaboration between chiropractors and other healthcare providers may lead to strategies, where necessary, to improve

knowledge translation and implementation for chiropractors in order to improve the quality and safety of headache patient management.

Critically, there is a need to particularly understand the factors that influence collaborative headache patient management between GPs and chiropractors. GPs have an essential role in the coordination of patient care as gatekeepers with Australian healthcare. As such, a better understanding of the collaborative relationship between GPs and chiropractors regarding headache patients deserves closer scrutiny. This includes research that investigates GP knowledge, attitudes and beliefs about the role of chiropractors within the field of headache management. Since headache is substantial within chiropractic caseload, this information may improve understanding of any barriers and facilitators to collaboration between these providers that may improve overall care of those with headache.

Epidemiology of chiropractic headache patient populations

The substantial caseload of headache within chiropractic clinical practice identified in the findings of this thesis also calls for large, well-designed clinical population studies to improve knowledge about the headache types, level of headache chronicity and disability found within chiropractic patient populations. This research will add further weight to the epidemiological knowledge about this clinical population and further understanding of the healthcare needs of this patient population. For example, migraine is one of the most common and disabling neurological disorders (Feigin et al. 2017) and one of the top 10 causes of years lived with disability globally (Vos et al. 2015). If future clinical population studies confirm that migraine is common within chiropractic patient populations, there is an urgent need to prioritise high-quality

clinical research to examine the role and effectiveness of chiropractic patient care in managing the substantial burden of migraine.

The substantial proportion of chronic and disabling headaches in those seeking help from chiropractors identified from this thesis also calls for further examination of the comorbid level of psychiatric disability found within this patient population. Findings from this research will improve understanding of the healthcare needs of this subgroup of headache patients seeking help from this provider. In addition, this knowledge may have important implications for providers of chiropractic education to ensure chiropractors are sufficiently skilled in screening those with disabling headaches for commonly associated psychiatric disabilities. Such knowledge can help to ensure chiropractors recognise the clinical circumstances where appropriate patient referral and co-management is required for those with increased headache-related psychiatric disability.

8.6.2 Clinical research

Multimodal effects of chiropractic headache management

Given thesis findings identifying the substantial prevalence of headache within chiropractic clinical practice and the range of therapeutic approaches utilised within chiropractic headache patient care, there is a critical need to prioritise high-quality clinical research to assess the efficacy of all aspects of headache patient management by chiropractors. This will require sufficiently powered, pragmatic, randomised trial designs to evaluate the effectiveness and cost-effectiveness of the therapeutic approaches employed by chiropractors, both unimodally and multimodally, for

headache. Such clinical research is needed across primary and secondary recurrent headache disorders.

Findings from this thesis also suggest that a significant proportion of those with headache who seek help from chiropractors may also experience high levels of headache chronicity and disability. If this finding is further confirmed by rigorous, large scale patient population studies, there is a need to examine the effectiveness of chiropractic management for those who experience chronic and disabling headaches. Increased headache disability has a significant impact on the quality of life of those with headache disorders, including their personal life, work productivity, leisure time and social activities (Blumenfeld et al. 2011). As such, there is a need for clinical research designs to include investigation of the effectiveness of chiropractic management in reducing other headache-related health outcomes, including those related to patient quality of life and headache-related disability using validated instruments.

The role of chiropractors in interdisciplinary care

Future empirical research is also needed to identify the potential role for chiropractors within coordinated mainstream headache management. With uncertainty about the role of chiropractors within coordinated headache patient care, there are important research opportunities to assess the potential role of chiropractors within the multidisciplinary field of headache management. This knowledge may be particularly important for those with chronic and disabling primary headache disorders that are often more difficult to treat and where improved multimodal, multidisciplinary treatment strategies are more often needed (Nicol, Hammond & Doran 2013; Sahai-

Srivastava et al. 2017). The substantial use of patient education, stress management and physical approaches utilised by chiropractors for headache provide an important opportunity for future research designs to evaluate the contribution of these multimodal approaches within the integrated management of this patient population.

9 Conclusions

The research described in this thesis involved application of HSR methodology to examine headache management by Australian chiropractors and the profile and features of those with headache seeking help from chiropractors. In doing so, it produced multiple valuable findings.

First, the research shows headache management is substantial within Australian chiropractic clinical practice. One in five new patients present with a chief complaint of headaches, and one in three patients present with headache as a secondary complaint. The substantial level of chiropractic headache management has not been empirically identified previously, and challenges commonly held views about the role of chiropractic within healthcare. The substantial level of headache patient management within chiropractic should be acknowledged in current debates about the place of chiropractic within healthcare.

Second, this thesis identifies that contemporary chiropractic headache care incorporates therapeutic approaches that go beyond spinal manipulation. The thesis identifies chiropractic headache management as multimodal and incorporating aspects of patient education, lifestyle advice, stress management and MTs. This finding is of particular significance given popular assertions about chiropractic patient care, and suggests chiropractors can play a wider role in headache management and the wider biopsychosocial aspects of headache patient care. However, the use of spinal manipulation within chiropractic headache management also raises issues around the safety and effectiveness of a key aspect chiropractic headache management.

Third, the research showed that most chiropractors use headache classification in headache patient assessment. However, while this suggests many chiropractors embrace mainstream approaches to headache diagnosis, findings also identified problems with the reliability of headache classification within chiropractic clinical settings, including variable use of headache diaries and lack of familiarity with secondary headache classification criteria. These findings – along with knowledge that some chiropractors omit the use of headache classification – have potential implications for the quality and safety of chiropractic headache management.

Fourth, thesis findings show chiropractors are selective in their collaboration with other healthcare providers for headache management, including more frequent collaboration with CAM providers and GPs and less frequent collaboration with psychologists. This finding may have potential implications for the quality of chiropractic headache patient management and the wider role of chiropractors within multidisciplinary headache patient care. This finding also highlights the need for further empirical research to understand the factors that influence chiropractors collaborating with other healthcare providers for headache.

This thesis study has provided new health services knowledge about the topic of headache patient management by chiropractors and the profile of those with headache within a chiropractic clinical population. This knowledge furthers understanding of health services provision for headache that can impact on the quality and safety of the care provided for this substantial chiropractic patient population. Further, the findings of this thesis identify a number of areas for future research enquiry necessary to substantiate, contextualise and advance the study findings,

providing a valuable foundation to help further knowledge regarding health services delivery for this significant public health challenge. As such, the work presented in this thesis adds new knowledge to an emergent research topic by utilising a practitioner sample, study design and research methods needed to underpin further research enquiry within the field.

10 References

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Appendix 1: 'A critical review of manual therapy use for headache disorders: prevalence, profiles, motivations, communication and self-reported effectiveness' (published version)

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RESEARCH ARTICLE

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A critical review of manual therapy use for headache disorders: prevalence, profiles, motivations, communication and self-reported effectiveness



Craig S. Moore*, David W. Sibbritt and Jon Adams

Abstract

Background: Despite the expansion of conventional medical treatments for headache, many sufferers of common recurrent headache disorders seek help outside of medical settings. The aim of this paper is to evaluate research studies on the prevalence of patient use of manual therapies for the treatment of headache and the key factors associated with this patient population.

Methods: This critical review of the peer-reviewed literature identified 35 papers reporting findings from new empirical research regarding the prevalence, profiles, motivations, communication and self-reported effectiveness of manual therapy use amongst those with headache disorders.

Results: While available data was limited and studies had considerable methodological limitations, the use of manual therapy appears to be the most common non-medical treatment utilized for the management of common recurrent headaches. The most common reason for choosing this type of treatment was seeking pain relief. While a high percentage of these patients likely continue with concurrent medical care, around half may not be disclosing the use of this treatment to their medical doctor.

Conclusions: There is a need for more rigorous public health and health services research in order to assess the role, safety, utilization and financial costs associated with manual therapy treatment for headache. Primary healthcare providers should be mindful of the use of this highly popular approach to headache management in order to help facilitate safe, effective and coordinated care.

Keywords: Headache, Migraine, Tension headache, Cervicogenic headache, Manual therapy, Physical therapy, Chiropractic, Osteopathy, Massage

Background

The co-occurrence of tension headache and migraine is very high [1]. Respectively, they are the second and third most common disorders worldwide with migraine ranking as the seventh highest specific cause of disability globally [2] and the sixteenth most commonly diagnosed condition in the US [3]. These common recurrent headache disorders place a considerable burden upon the personal health, finances and work productivity of sufferers [3–5]

with migraine further complicated by an association with cardiovascular and psychiatric co-morbidities [6, 7].

Preventative migraine drug treatments include analgesics, anticonvulsants, antidepressants and beta-blockers. Preventative drug treatments for tension-type headaches can include analgesics, NSAIDs, muscle relaxants and botulinum toxin as well as anticonvulsants and antidepressants. While preventative drug treatments are successful for a significant proportion of sufferers, headache disorders are still reported as under-diagnosed and under-treated within medical settings [8–16] with other studies reporting sufferers can cease continuing with preventative headache medications long-term [9, 17].

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There is a number of non-drug approaches also utilized for the prevention of headaches. These include psychological therapies such as cognitive behavioral therapy, relaxation training and EMG (electromyography) biofeedback. In addition, there is acupuncture, nutritional supplementation (including magnesium, B12, B6, and Coenzyme Q10) and physical therapies. The use of physical therapies is significant, with one recent global survey reporting physical therapy as the most frequently used 'alternative or complementary treatment' for headache disorders across many countries [18]. One of the most common physical therapy interventions for headache management is manual therapy (MT), [19–21] which we define here as treatments including 'spinal manipulation (as commonly performed by chiropractors, osteopaths, and physical therapists), joint and spinal mobilization, therapeutic massage, and other manipulative and body-based therapies' [22].

Positive results have been reported in many clinical trials comparing MT to controls [23–27], other physical therapies [28–30] and aspects of medical care [31–34]. More high quality research is needed however to assess the efficacy of MT as a treatment for common recurrent headaches. Recent systematic reviews of randomized clinical trials of MT for the prevention of migraine report a number of significant methodological shortcomings and the need for more high quality research before any firm conclusions can be made [35, 36]. Recent reviews of MT trials for tension-type headache and cervicogenic headache are cautious in reporting positive outcomes and the strong need for further robust research [37–41]. Despite the limited clinical evidence there has been no critical review of the significant use of MT by headache populations.

Methods

The aim of this study is to report from the peer-reviewed literature; 1) the prevalence of MT use for the treatment of common recurrent headaches and 2) factors associated with this use across several key themes. The review further identifies key areas worthy of further research in order to better inform clinical practice, educators and healthcare policy within this area.

Design

A comprehensive search of peer-reviewed articles published in English between 2000 and 2015 reporting new empirical research findings of key aspects of MT use among patients with migraine and non-migraine headache disorders was undertaken. Databases searched were MEDLINE, AMED, CINAHL, EMBASE and EBSCO. The key words and phrases used were: 'headache', 'migraine', 'primary headache', 'cephalgia', 'chronic headache' AND 'manual therapy', 'spinal manipulation', 'manipulative therapy',

'spinal mobilization', 'chiropractic', 'osteopathy', 'massage', 'physical therapy' or 'physiotherapy' AND then 'prevalence', 'utilization' or 'profile' was used for additional searches against the previous terms. The database search was accompanied by a hand search of prominent peer-reviewed journals. All authors accessed the reviewed literature (data) and provided input to analysis.

Due to the focus of the review, literature reporting randomized control trials and similar clinical research designs were excluded as were articles identified as letters, correspondence, editorials, case reports and commentaries. Further searches were undertaken of the bibliographies in the identified publications. All identified articles were screened and only those reporting new empirical findings on MT use for headache in adults were included in the review. Articles identified and selected for the review were research manuscripts mostly within epidemiological and health economics studies. The review includes papers reporting MT use pooled with the use of other therapies, but only where MT patients comprised a large proportion (as stated) of the included study population. Results were imported into Endnote X7 and duplicates removed.

Search outcomes, analyses and quality appraisal

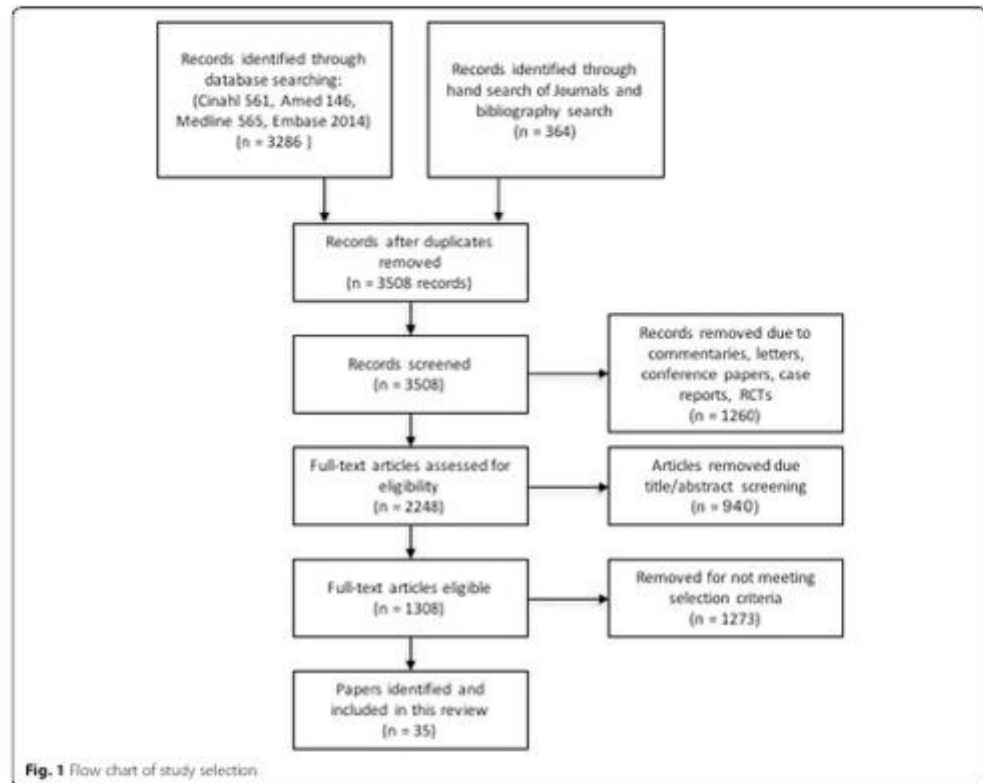
Figure 1 outlines the literature search process. The initial search identified 3286 articles, 35 of which met the inclusion criteria. Information from each article was organized into a review table (Table 1) to summarise the findings of the included papers. Information is reported under two selected headache groups and within each individual MT profession - chiropractic, physiotherapy, osteopathy and massage therapy - where sufficient detail was available.

An appraisal of the quality of the articles identified for review was conducted using a quality scoring system (Table 2) developed for the critical appraisal of health literature used for prevalence and incidence of health problems [42] adapted from similar studies [43–45]. This scoring system was applicable to the majority of study designs involving surveys and survey-based structured interviews (29 of the 35 papers) but was not applicable to a small number of included studies based upon clinical records, secondary analysis or practitioner characteristics.

Two separate authors (CM and JA) independently searched and scored the articles. Score results were compared and any differences were further discussed and resolved by all the authors. The quality score of each relevant article is reported in Table 3.

Results

The key findings of the 35 articles were grouped and evaluated using a critical review approach adapted from



previous research [46, 47]. Based on the limited information available for other headache types, prevalence findings are reported within one of two categories - either as 'migraine' for papers reporting studies where the population was predominately or entirely made up of migraine patients or as 'headache' for papers where the study population was predominately other headache types (including tension-type headaches, cluster headaches, cervicogenic headache) and/or where the headache type was not clearly stated. Ten papers reported findings examining prevalence rates for the 'migraine' category alone, 18 papers reported findings examining prevalence for the 'headache' category alone and 3 papers reported findings for both categories. Based on the nature of the information available, prevalence use was categorised by manual therapy providers. The extracted data was then analysed and synthesized into four thematic categories: *prevalence; profile and motivations for MT use; concurrent use and order of use of headache providers; and self-reported evaluation of MT treatment outcomes.*

Prevalence of MT use

Thirty-one of the reviewed articles with a minimum sample size (>100) reported findings regarding prevalence of MT use. The prevalence of chiropractic use for those with migraine ranged from 1.0 to 36.2% (mean: 14.4%) within the general population [19–21, 48–52] and from 8.9 to 27.1% (mean: 18.0%) within headache-clinic patient populations [53, 54]. The prevalence of chiropractic use for those reported as headache ranged from 4 to 28.0% (mean: 12.9%) within the general population [20, 48, 51, 55–57]; ranged from 12.0 to 22.0% (mean: 18.6%) within headache/pain clinic patient populations [58–60] and from 1.9 to 45.5% (mean: 9.8%) within chiropractic patient populations [61–69].

The prevalence use of physiotherapy for those with migraine ranged from 9.0 to 57.0% (mean: 24.7%) within the general population [19, 20, 48, 52] and from 4.9 to 18.7% (mean: 11.8%) within headache-clinic patient populations [54, 70]. The prevalence use of physiotherapy for those reported as headache ranged from 12.2 to 52.0% (mean:

Table 1 Research-based studies of manual therapy use for headache disorders

Authors Year	Country/ Region	Population/ Profession	Study Method	Sample size	Themes †	Prevalence use based on Headache Groupings
Atties et al 2010 [63]	Europe (Belgium)	Manual Therapy population/ Chiropractic	Postal questionnaire by chiropractors	517 patients	1	Headache; Chiropractic 1.9%
Bethel et al 2013 [76]	North America	General population	Secondary analysis of national survey	2011	2	
Bipal et al 2008 [19]	North America	General population	Longitudinal study following a cohort of headache sufferers	Chronic migraine 520, Episodic migraine (942)	1	Chronic migraine: Chiropractic 36.2%, Physiotherapy 13.3% Episodic migraine: Chiropractic 25.7%, Physiotherapy 4.2%
Brown et al 2014 [63]	Australia	Manual Therapy population/ Chiropractic	Cross-sectional survey completed by patients	488	1	Headaches: Chiropractic 5.5%
Chewkin et al 2002 [62]	North America	Manual Therapy population/ Chiropractic	Practitioner completed questionnaire	2550	1	Headaches: Chiropractic Massachusetts 4.6%, Arizona 6.4%
Coole et al 2010 [49]	North America	General population	Telephone survey to public	1210	1	Migraine: Chiropractic 6%, Massage 2%, Osteopathy 1%
Coulter et al 2002 [66]	North America	Manual Therapy population/ Chiropractic	Patient questionnaires	1275	1	Headaches: Chiropractic 4.0%
Brown et al 2013 [66]	Australia	Manual Therapy population/ Chiropractic	Cross-sectional general population survey questionnaire	757	1	Headache: Chiropractic 45.5%
French et al 2013 [64]	Australia	Manual Therapy population/ Chiropractic	Cross-sectional observational practitioner survey	4664	1	Headaches: Chiropractic 4%
Gaul et al 2009 [70]	Europe (Germany/Austria)	Headache clinic population	Questionnaire based patient survey	432	1,2,3,4	Mixed primary headaches: Massage 46.1%, Physiotherapy 27.8%
Gaul et al 2011 [72]	Europe (Germany/Austria)	Headache clinic population	Questionnaire based survey	448	1,2	Migraine (78.5%): Physiotherapy 18.7%, Massage 36.4%
Gaumer G 2006 [56]	North America	General population	Random telephone survey	800	1	Headaches: Chiropractic 5.3%
Godsil et al 2014 [73]	Europe (Turkey)	Headache clinic population	Patient questionnaire through interview	110	1,2,4	Migraine (64.6%): Massage 5.1%
Hansjosten et al 2003 [68]	Europe (Denmark)	Manual Therapy/Chiropractic	Questionnaire data collected by practitioners	1887 patients	1	Headache: Chiropractic 4%
Jackson P 2001 [63]	North America	Manual Therapy population/ Chiropractic	Postal questionnaire to chiropractors	1500	1	Headaches: Chiropractic 15.4%
Kristoffersen et al 2012 [20]	Europe (Norway)	General population	Cross-sectional epidemiological survey	405	1,2	All Primary Headaches: Chiropractic 2.8% Physiotherapy 52%
Kristoffersen et al 2013 [19]	Europe (Norway)	General population	Cross-sectional epidemiological postal survey and clinical interview	253 primary 82 secondary	4	
Lambert et al 2010 [77]	Europe (UK)	Headache clinic population	Self-administered questionnaire	92	2,3	
Lyngherg et al 2005 [1, 32]	Europe (Denmark)	General population	Medical doctor interviews	740	1	Mostly migraine: Chiropractic 9% Physiotherapy 5%

Table 1 Research-based studies of manual therapy use for headache disorders (Continued)

Author et al. [ref.]	Location	General population	Study design	Sample size	Intervention	Findings
Malone et al. 2012 [71]	North America	General population	On-line survey via migraine website	2735		Migraine: Massage 26.7%
Minen et al. 2014	North America	Headache clinic population	Secondary analysis of baseline questionnaire data	225		Migraine with/without aura: Chiropractic 27.1%, Massage 18.2%, Physiotherapy 4.0%
Morin et al. 2014 [54]	North America (Quebec)	Manual Therapy population	Prospective survey	1402		Migraine: Osteopathy 1.7%, Headaches: Osteopathy 2.7%
Nadeau et al. 2009 [57]	North America	General population	Secondary Survey analysis	31248		Headache: Chiropractic 15.1%
Orrock P. 2009 [75]	Australia	Manual Therapy population/ Osteopathy	Mailed practitioner questionnaire	2238 patient records		Headache: Osteopathy 10%
Ossendorf et al. 2009 [50]	Europe (Germany)	Pain clinic population	Physician administered structured interview and questionnaires	288 (136 with Headache)		Headache: Chiropractic 22%, Physiotherapy 35%, Osteopathy 9%, Massage 5%
Rossi et al. 2005 [53]	Europe (Italy)	Headache clinic population	Physician administered structured interview	481		Migraine: Massage 16.1%, Chiropractic 8.9%, Osteopathy 2.7%
Rossi et al. 2006 [58]	Italy	Headache clinic population	Physician administered structured interview	110		Headache (ICHD): Chiropractic 21.9%, Massage 17.8%
Rossi et al. 2008 [59]	Europe (Italy)	Headache clinic population	Physician administered structured interview	100		Headache (IHS): Chiropractic 1.2%, Acupuncture 1.2%
Rubinstein et al. 2000 [67]	Europe (Netherlands)	Manual Therapy population/ Chiropractic	Retrospective patient questionnaires	833		Headache: Chiropractic 7%
Sanderson et al. 2013 [21]	USA, Canada, UK, Germany, France and Australia	General population	Web-based screening questionnaire	16663		Chronic migraine: 10% USA, Canada 10%, France/UK 6%, Germany 1%, Australia 3%
S. van Peeter et al. 2002 [78]	North America	Headache clinic population	Patient interview using a standardized questionnaire	73		Epidemic Migraine: USA 7%, Canada 4%, France/UK 1%, Germany 6%, Australia 3%
Vukovic et al. 2010 [85]	Europe (Croatia)	General population	Random cross-sectional survey questionnaire	616		Tension, Migraine (27%) and other Headaches: Chiropractic 15.1%, Massage 42.5%
Wells et al. 2010 [51]	North America	General population	National cross-sectional survey sample	23,393		Migraine: Chiropractic 9.5%, Physiotherapy 19.1%, Tension Headache: Chiropractic 40%, Physiotherapy 12.2%
Wells et al. 2011 [50]	North America	General population	National cross-sectional survey sample	23,393		Migraine 18.5% and Headaches 15.7%; Chiropractic/massage pooled
Xue et al. 2006 [55]	Australia	General population	Cross-sectional telephone survey	1867		Migraine: Chiropractic 15.4%, Massage 15.1%, Headaches: Chiropractic 9.3%

Themes: 1 = MF prevalence use, 2 = Profile and motivations, 3 = Concurrent use, 4 = Self-reported effectiveness

Table 2 Description of quality criteria and scoring for selected studies

Dimensions of Quality Assessment	Points Awarded†
Methodology	
A. Sampling strategy reported/ appropriate to study design	1
B. Sample size >100	1
C. Response rate >75%	1
D. Low recall bias (prospective data collection or retrospective data collection within past 12 months)	1
Reporting of Participants characteristics	
E. Classification of migraine or headache type(s) reported	1
F. Age and sex	1
G. Ethnicity	1
H. Indicator of socioeconomic status (income, education)	1
Reporting of relevant MT factors	
I. Reporting of MT use for headache	1
J. Reporting of MT financial costs	1

†Maximum score of 10 points for studies applicable to this scoring system with each item weighted equally with 0 (criterion not fulfilled) or 1 (criterion fulfilled) point

32.1%) within the general population [20, 48] and from 27.8 to 35.0% (mean: 31.4%) within headache/pain clinic populations [60, 70].

Massage therapy use for those with migraine ranged from 2.0 to 29.7% (mean: 15.6%) within the general population [49, 50, 71] and from 10.1 to 56.4% (mean: 33.9%) within headache-clinic populations [53, 54, 72, 73]. Massage/acupressure use for those reported as headache within headache/pain clinic patient populations ranged from 12.0 to 54.0% (mean: 32.5%) [58–60, 70].

Osteopathy use for those with migraine was reported as 1% within the general population [49]; as 2.7% within a headache-clinic patient population [53] and as 1.7% within an osteopathy patient population [74]. For headache the prevalence was 9% within a headache/pain clinic population [60] and ranged from 2.7 to 10.0% (mean: 6.4%) within osteopathy patient populations [74, 75].

The combined prevalence rate of MT use across all MT professions for those with migraine ranged from 1.0 to 57.0% (mean: 15.9%) within the general population; ranged from 2.7 to 56.4% (mean: 18.4%) within headache-clinic patient populations and was reported as 1.7% in one MT patient population. The combined prevalence rate of MT use across all MT professions for those reported as headache ranged from 4.0 to 52.0% (mean: 17.7%) within the general population; ranged from 9.0 to 54.0% (mean: 32.3%) within headache-clinic patient populations and from 1.9 to 45.5% (mean: 9.25%) within MT patient populations.

Profile and motivations for MT use

While patient socio-demographic profiles were not reported within headache populations that were exclusively using MT, several studies report these findings where MT users made up a significant percentage of the non-medical headache treatments utilized by the study population (range 40% – 86%: mean 63%). While findings varied for level of income [58, 70] and level of education, [70, 72, 73] this patient group were more likely to be older [70, 72], female [20], have a higher rate of comorbid conditions [58, 70, 76] and a higher rate of previous medical visits [20, 58, 70] when compared to the non-user group. Overall, this group were reported to have a higher level of headache chronicity or headache disability than non-users [20, 54, 58, 70, 72, 77].

Several studies within headache-clinic populations report patient motivations for the use of complementary and alternative headache treatments where MT users made up a significant proportion of the study population (range 40% – 86%: mean 63%) [58, 70, 72, 78]. From these studies the most common motivation reported by study patients was 'seeking pain relief' for headache which accounted for 45.4% – 84.0% (mean: 60.5%) of responses. The second most common motivation was patient concerns regarding the 'safety or side effects' of medical headache treatment, accounting for 27.2% – 53.0% (mean: 43.8%) of responses [58, 70, 72]. 'Dissatisfaction with medical care' accounted for 9.2% – 35.0% (mean: 26.1%) of responses [58, 70, 72].

A limited number of reviewed papers (all from Italy) report on the source of either the referral or recommendation to MT for headache treatment [53, 58, 59]. From these studies, referral from a GP to a chiropractor ranged from 50.0 to 60.8% (mean: 55.7%), while referral from friends/relatives ranged from 33.0 to 43.8% (mean: 38.7%) and self-recommendation ranged from 0 to 16.7% (mean: 5.6%). For massage therapy, referral from a GP ranged from 23.2 to 50.0% (mean: 36.6%), while referral from friends/relatives ranged from 38.4 to 42.3% (mean: 40.4%) and self-recommendation ranged from 7.7 to 38.4% (mean: 23.1%). For acupressure, referral from a GP ranged from 33.0 to 50.0% (mean: 41.5%), while referral from friends/relatives was reported as 50% and self-recommendation ranged from 0 to 16.6% (mean: 8.3%). One study reported findings for osteopathy where referral from both GPs and friends/relatives was reported as 42.8% and self-recommendation was reported as 14.4%. Overall, the highest proportion of referrals within these studies was from GPs to chiropractors for chronic tension-type headache (56.2%), cluster headache (50%) and migraine (60.8%).

Concurrent use and order of use of headache providers and related communication of MT users

Several studies report on the concurrent use of medical headache management with complementary and alternative

Table 3 Quality score for selected studies

Dimensions of Quality Assessment				
Authors/Year	Methodology	Participant characteristics	Reporting of MT use	Total score
Alliet et al. 2010 [65]	A, B, C	F, H	I	6
Bigal et al. 2008 [19]	A, B, C, D	E, F, G, H		8
Brown et al. 2013 [69]	A, B, C, D	F, H		6
Brown et al. 2014 [61]	A, B, C, D	F, G, H	I	8
Cherkin et al. 2002 [62]	A, B, C, D	F, G	I	7
Cooke et al. 2010 [49]	A, B, D	E, F		5
Coulter et al. 2002 [66]	A, B, D	F, G, H		6
French et al. 2013 [64]	A, B, D	F, G, H	I	7
Gaul et al. 2009 [70]	A, B, D	E, F, G, H	I	8
Gaul et al. 2011 [72]	A, B, D	E, F, H	I	7
Gaumer G. 2006 [56]	A, B, D	F, H		5
Goksel et al. 2014 [73]	A, B, D	E, F, H	I	7
Hartvigsen et al. 2003 [68]	A, B, C, D			4
Kristofferson et al. 2012 [20]	A, B	E, F, G	I	6
Kristofferson et al. 2013 [79]	A, B, D	E, F	I	6
Lambert et al. 2010 [77]	A, D	F, G, H	I	6
Lynberg et al. 2005 [1, 52]	A, B, C, D	E, F		6
Malone et al. 2015 [71]	B, C, D	F ₁		4
Ossendorf et al. 2009 [60]	A, B, C, D	F, H	I	7
Rossi et al. 2005 [55]	A, B, D	E, F, H	I	7
Rossi et al. 2006 [58]	A, B, D, E, F, H		I	7
Rossi et al. 2008 [59]	A, B, C, D	E, F, H		7
Rubinstein et al. 2000 [67]	A, B, C, D	F, H		6
Sanderson et al. 2013 [21]	A, B, C, D	E, F, G, H		8
S von Peter et al. 2002 [78]	C, D	E, F, G, H	I	7
Vukovic et al. 2010 [48]	A, B, C, D	E, F		6
Wells et al. 2010 [51]	A, B, D	F, G, H		6
Wells et al. 2011 [50]	A, B, D	F, G, H	I	7
Xue et al. 2008 [53]	A, B, D	F, G, H		6

Key: A-Sampling reported, B-Sample size >100, C-Response rate >75%, D-Low recall bias, E-Classification of headache type, F-Age and sex, G-Ethnicity, H-Socioeconomic status. Scoring: 1-4 poor quality, 5-6 low quality, 7-8 moderate quality, 9-10 high quality

therapies. In those studies where the largest percentage of the patient population were users of MT's (range 57.0% – 86.4%; mean 62.8%), [58, 70, 78] concurrent use of medical care ranged between 29.5% and 79.0% (mean: 60.0%) of the headache patient population.

These studies further report on the level of patient non-disclosure to medical providers regarding the use of MT for headache. Non-disclosure ranged between 25.5 and 72.0% (mean: 52.6%) of the patient population, with the most common reason for non-disclosure reported as the doctor 'never asking' ranging from 37.0 to 80.0% (mean: 58.5%). This was followed by a patient belief that 'it was not important for the doctor to know' or 'none of the

doctor's business', ranging from 10.0 to 49.8% (mean: 30.0%). This was followed by a belief that either 'the doctor would not understand' or 'would discourage' these treatments, ranging from 10.0 to 13.0% (mean: 11.5%) [53, 77].

One large international study reported the ordering of the typical provider of headache care by comparing findings between several countries for migraine patients [21]. Primary care providers followed by neurologists were reported as the first and second providers for migraine treatment for nearly all countries examined. The only exception was Australia, where those with chronic migraine selected chiropractors as typical providers at equal frequency to neurologists (14% for both) while

those with episodic migraine selected chiropractors at a greater frequency to neurologists (13% versus 5%). Comparatively, chiropractors were selected as the typical provider for those with chronic migraine by 10% in USA and Canada, 1% in Germany and 0% for UK and France. Chiropractors were selected as the typical provider for those with episodic migraine by 7% in USA, 6% in Germany, 4% in Canada and by 1% in both the UK and France.

Self-reported effectiveness of MT treatment outcomes

Several headache and pain-clinic population studies provide findings for the self-reported effectiveness of MT headache treatment. For chiropractic, patient self-reporting of partially effective or fully effective headache relief ranged from 27.0 to 82.0% (mean: 45.0%) [53, 58–60, 78]. For massage therapy, patient self-reporting of partially effective or fully effective headache relief ranged from 33.0 to 64.5% (mean: 45.2%) [53, 58, 60, 73, 78], and for acupressure this ranged from 33.4 to 50.0% (mean: 44.5%) [53, 58, 59]. For osteopathy and physiotherapy, one study reported effectiveness as 17 and 36% respectively [60].

When results are combined across all MT professions the reporting of MT as either partially or fully effective ranged from 17.0 to 82.0% (mean 42.5%) [53, 58–60, 73, 78]. In addition, one general population study provides findings for the self-reported effectiveness for chiropractic and physiotherapy at 25.6 and 25.1% respectively for those with primary chronic headache and 38 and 38% respectively for those with secondary chronic headache [79].

Discussion

This paper provides the first critical integrative review on the prevalence and key factors associated with the use of MT treatment for headaches within the peer-reviewed literature. While study methodological limitations and lack of data prevent making strong conclusions, these findings raise awareness of issues of importance to policy-makers, educators, headache providers and future research.

Our review found that MT use was generally higher within medical headache-clinic populations when compared to general populations. However, the use of individual MT providers does vary between different regions and this is likely due to a number of factors including variation in public access, healthcare funding and availability of MT providers. For example, the use of physiotherapy for some headache types may be relatively higher in parts of Europe [20, 60] while the use of chiropractors for some headache types may be relatively higher in Australia and the USA [19, 21]. Overall, the prevalence use of MT for headache appears to be substantial and likely to be the most common type of physical therapy utilized for headache in many countries [19–21, 49]. More high quality epidemiological studies

are needed to measure the prevalence of MT use across different headache types and sub-types, both within the general population and clinical populations.

Beyond prevalence, data is more limited regarding who, how and why headache patients seek MT. From the information available however, the healthcare needs of MT headache patients may be more complex and multi-disciplinary in nature compared to those under usual medical care alone. Socio-demographic findings suggest that users of MT and other complementary and alternative therapies have a higher level of headache disability and chronicity compared to non-users. This finding may correlate with the higher prevalence of MT users within headache-clinic populations and a history of more medical appointments. This may also have implications for future MT trial designs both in terms of the selection of trial subjects from inside versus outside MT clinical settings and the decision to test singular MT interventions versus MT in combination with other interventions.

Limited information suggests that a pluralistic approach toward the use of medical and non-medical headache treatments such as MT is common. While findings suggest MT is sought most often for reasons of seeking headache relief, the evidence to support the efficacy of MT for headache relief is still limited. MT providers must remain mindful of the quality of the evidence for a given intervention for a given headache disorder and to inform patients where more effective or safer treatment interventions are available. More research is needed to assess these therapies individually and through multimodal approaches and for studies to include long-term follow-up.

Information limited to Italy, suggests referral from GPs for MT headache treatment can be common in some regions, while this is less likely to be widespread given the issue of patient non-disclosure to medical doctors regarding the use of this treatment in other studies. High quality healthcare requires open and transparent communication between patients and providers and between the providers themselves. Non-disclosure may adversely influence medical management should unresponsive patients require further diagnostic investigations [80] or the implementation of more effective approaches to headache management [81] or prevents discussion in circumstances where MT may be contraindicated [82]. Primary headache providers may benefit from paying particular attention to the possibility of non-disclosure of non-medical headache treatments. Open discussion between providers and patients about the use of MT for headache and the associated outcomes may improve overall patient care.

Future research

Despite the strong need for more high quality research to assess the efficacy of MT as a treatment for headache,

the substantial use of MT brings attention to the need for more public health and health services research within this area of headache management. The need for this type of research was identified in a recent global report on the use of headache-related healthcare resources [18]. Furthering this information can lead to improvements in healthcare policy and the delivery of healthcare services.

The substantial use of physical therapies such as MT has been under-reported within many of the national surveys reporting headache-related healthcare utilization [3, 5, 83–85]. Regardless, the role of physical therapies in headache management continues to be assessed, often within mainstream and integrated headache management settings [86–89]. Continuing this research may further our understanding of the efficacy and outcomes associated with a more multidisciplinary approach to headache management.

Further to this is the need for more research to understand the healthcare utilization pathways associated with those patients who use MT in their headache management. Little is known about the sociodemographic background, types of headaches, level of headache disability and comorbidities more common to this patient population. In turn, such information can provide insights that may be valuable to provider clinical decision-making and provider education.

Limitations

The design and findings of our review has a number of limitations. The design of the review was limited by a search within English language journals only. As a result, some research on this topic may have been missed. While the quality scoring system adopted for this review requires further validation, the data we collected was limited by the low to moderate quality of available papers which averaged 6.4 out of 10 points (Table 3). The low scoring was largely due to significant methodological issues and the small sample size associated with much of the collected papers. Much of the data on this topic was heterogeneous in nature (telephone, postal surveys and face-to-face interviews). There was a lack of validated practitioner and patient questionnaires to report findings, such as for questions on prevalence, where the time frames utilized varied between 'currently', 'last 12 months' and 'ever'.

Data on the prevalence of MT use for headache was limited particularly within individual MT provider populations when compared to data found within the general population and headache-clinic populations. Many studies assessed the use of MT for headache without identifying headache types. Only one study inside an MT population had reported the percentage of patients attending for reasons of migraine alone (osteopathy). The prevalence of MT use for headache was reported

most within chiropractic patient population studies, however information was limited on the types of headache. We found no studies reporting the prevalence of headache patients within physiotherapy or massage therapy patient populations using our search terms.

A lack of data for some themes necessitated providing findings pooled with users of other non-medical headache providers. Data within many geographical regions was very limited with the most limited data was on the source of referral to MT headache providers (three papers from Italy only). These limitations support the call for more research to be focused exclusively within MT populations and different regional areas before stronger conclusions can be drawn.

Conclusion

The needs of those with headache disorders can be complex and multi-disciplinary in nature. Beyond clinical research, more high quality public health and health services research is needed to measure and examine a number of issues of significance to the delivery and use of MTs within headache management. With unmet needs still remaining for many who suffer recurrent headaches, clinicians should remain cognizant of the use of MTs and remain open to discussing this approach to headache management in order to ensure greater safety, effectiveness and coordination of headache care.

Abbreviations

MT: Manual therapy; EMG: Electromyography

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Authors' contributions

CM, JA and DS designed the paper. CM carried out the literature search, data collection and selection. CM and DS provided the analysis and interpretation. CM and JA wrote the drafts. All authors contributed to the critical review and intellectual content. All authors read and approved the final manuscript.

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The authors declare that they have no competing interests.

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Appendix 2: ACORN baseline questionnaire

ACORN PRACTITIONER QUESTIONNAIRE

00001

Chiropractic practitioner characteristics

- 1) What is your age in years?
- 2) What is your gender? Male Female
- 3) Are you currently in private chiropractic practice? No Yes, how many years?
- 4) What is the highest level of chiropractic professional qualification that you hold?
 Diploma Advanced Diploma Bachelor (or Double Bachelor) degree
 Masters degree Doctor of Chiropractic PhD
- 5) Are you a member of any of the following professional chiropractic organisations? (please indicate all that apply)
 CAA COCA CAA and COCA None Other(s) (please specify) _____
- 6) As a chiropractor, please indicate all the roles in which you are or have been involved over the last 12 months:
 University teaching Clinical supervision Professional organisations
 Private practice Research Chiropractic volunteer work
- 7) Do you routinely consult patients in a language other than English? No Yes (please specify): _____

Practice characteristics

- 8) How many of the following would you provide, on average, per week:
 a) Patient care hours b) Patient visits
- 9) Do you practice in more than one location? No Yes, how many in total
- 10) Indicate all other health professionals located within the same practice?
 Another Chiropractor GP Medical Specialist Podiatrist Physiotherapist
 Exercise Physiologist Occupational Therapist Psychologist/Counsellor Other(s): _____ None
- 11) Do you have a professional referral relationship (sending and/or receiving referrals) with any of the following practitioners: (tick all that apply)
 GP Medical Specialist Podiatrist Physiotherapist Exercise Physiologist Occupational Therapist
 Psychologist/Counsellor Other(s) (please specify): _____
- 12) In which state/territory do you practice? (tick all that apply) NSW VIC QLD WA SA TAS NT ACT
- 13) Which of the following best describes your practice location(s) (tick all that apply)
 Urban Rural Remote
- 14) How frequently do you use diagnostic imaging as part of your practice?
 Never Rarely Sometimes Often
- 15) Indicate all imaging facilities or scanning tools you have on site:
 X-ray Diagnostic Ultrasound MRI SEMG Thermography Other (please specify) _____ None
- 16) Indicate when you use electronic records: Initial History Examination findings Subsequent patient visits Never

Clinical management

- 17) Please indicate the frequency with which you discuss the following as part of your care/management plans:

	Never	Rarely	Sometimes	Often
Diet/Nutrition	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Smoking/Drugs/Alcohol	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Physical Activity/Fitness	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Occupational Health and Safety	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Pain Counselling	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Nutritional Supplements (including vitamins, minerals, herbs)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Medication (including for pain/inflammation)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Other (please specify): _____	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

ACORN PRACTITIONER QUESTIONNAIRE

00001

18) Indicate the frequency with which you treat patients that present with the following conditions:

	Never	Rarely	Sometimes	Often
Neck pain - axial	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Neck pain – referred/radicular	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Thoracic pain - axial	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Thoracic pain – referred/radicular	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Low back pain - axial	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Low back pain – referred/radicular	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Lower limb musculoskeletal disorders (hip, knee, ankle, foot)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Upper limb musculoskeletal disorders (shoulder, elbow, wrist, hand)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Postural disorders (including lordosis, thoracic kyphosis, scoliosis)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Degenerative spine conditions (including spondylolisthesis)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Headache disorders (including cervicogenic, tension)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Migraine disorders	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Spinal health maintenance/prevention	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Non-musculoskeletal disorders (please specify): _____	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Other (please specify): _____	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

19) Indicate the frequency with which you treat the following patient subgroups:

	Never	Rarely	Sometimes	Often
Children (up to 3 years)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Children (4 to 18 years)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Older people (65 years or over)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Aboriginal and Torres Strait Islander people	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Pregnant women	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Athletes or sports people	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Work-related injuries	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Traffic-related injuries	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Post-surgical rehabilitation	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Non-English speaking ethnic group(s) (please specify): _____	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Other (please specify): _____	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

20) Please indicate the frequency with which you employ the following Techniques/Methods in your patient management:

	Never	Rarely	Sometimes	Often
Drop-piece techniques / Thompson® or similar	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Biomechanical pelvic blocking / Sacro-Occipital Technique®	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Instrument adjusting	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Chiropractic BioPhysics®	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
High velocity, low amplitude adjustment /manipulation/mobilisation	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Applied Kinesiology® (AK)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Flexion-distraction	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Functional Neurology	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Extremity manipulation	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Other technique or intervention (please specify): _____	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

21) Please indicate the frequency with which you employ the following Musculoskeletal interventions in your patient management:

	Never	Rarely	Sometimes	Often
Dry needling or Acupuncture	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Soft -tissue, trigger point, massage /stretching	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Electro-modalities (TENS, laser, interferential/ultrasound therapy)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Heat / cryotherapy	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Orthotics (foot care)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Specific exercise therapy/rehabilitation/injury taping	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Other (please specify): _____	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Appendix 3: Practitioner sub-study invitational email

Subject: Invitation to participate in new ACORN Project



Invitation to participate in new ACORN Project

Dear valued ACORN member,

We are pleased to announce the launch of a new ACORN research project.

This research is focussed on your management of headache disorders. Your help in this research will provide essential information in understanding the role of chiropractic and your specific practice in headache management. You have been invited to participate in this study because you are a member of the ACORN database and have been selected based on the responses you provided in the initial ACORN questionnaire.

This is your opportunity to provide your opinion and voice on this important practice topic.

To start the questionnaire please click on the link here: <https://www.surveymonkey.com/r/6KTSR5N>

Regards

Dr Craig Moore - Chiropractor
PhD candidate
Faculty of Health UTS

UTS CRICOS Provider Code: 00099F DISCLAIMER: This email message and any accompanying attachments may contain confidential information. If you are not the intended recipient, do not read, use, disseminate, distribute or copy this message or attachments. If you have received this message in error, please notify the sender immediately and delete this message. Any views expressed in this message are those of the individual sender, except where the sender expressly, and with authority, states them to be the views of the University of Technology Sydney. Before opening any attachments, please check them for viruses and defects. Think. Green. Do. Please consider the environment before printing this email.

Appendix 4: Practitioner sub-study survey questionnaire



Exit

The management of headache disorders by Australian chiropractors

INFORMATION SHEET AND CONSENT FORM

Approval number: UTS HREC ETH16-0639

I am delighted to invite you to participate in this ACORN research sub-study. My name is Dr Craig Moore (Chiropractor) and I am a PhD candidate at the University of Technology Sydney. My principal supervisor is Professor Jon Adams (co-supervisors Professor David Sibbritt and Dr Andrew Leaver). This research is an opportunity for you to contribute to the evidence-base for chiropractic.

The purpose of this research is to find out more information about the management provided by Australian chiropractors for those with headache disorders. This online questionnaire will first ask a few questions about you, including your place of education, years in practice, followed by questions about your headache patient caseload and finishes with asking how you manage those with headaches, including your approach to diagnosis, collaboration and treatment.

Completing this questionnaire is voluntary. The information you provide will be anonymous and will only be accessed by the research team and stored in a fully secured software management system. This should take less than 15 minutes to complete. Your completion of the questionnaire implies consent. You may change your mind at any time and stop completing the questionnaire without consequence. If you stop and later return back to the survey your completed answers will be saved.

With the understanding that the information gathered can only be published in a form that does not identify you, please continue with answering the survey questions.

If you would like to talk to someone who is not connected with the research, you may contact the Research Ethics Officer on 02 9514 2478 or Research.ethics@uts.edu.au and quote this ethics approval number UTS HREC ETH16-0639

If you have concerns about the research that you think I or my supervisor can help you with, please feel free to contact the projects research assistant on 02-95148050 or email Jon.Adams@uts.edu.au

The management of headache disorders by Australian chiropractors

Practitioner Demographics

This section is about you.

*** 1. What is your gender?**

- Male
 Female
 Other

*** 2. How many years have you been in practice?**

*** 3. Please identify where you received your chiropractic education.**

*** 4. Where do you currently practice? (You may select more than one response)**

- NSW
 VIC
 WA
 QLD
 TAS
 SA
 NT

Headache Prevalence

This section is about the number of patients you consulted in the LAST TWO WEEKS.

- * 5. In the last two weeks, how many NEW patients did you consult?

- * 6. In the last two weeks, how many NEW patients did you consult who had a chief complaint of headache?

- * 7. In the last two weeks, how many NEW patients did you consult who had a secondary complaint of headache (i.e. headache present but not their chief complaint)?

- * 8. In the last two weeks, how many consultations did you undertake in TOTAL?

- * 9. In the last two weeks, how many consultations did you undertake where the chief complaint was headache?

- * 10. In the last two weeks, how many consultations did you undertake where the secondary complaint was headache (i.e headache present but not the chief complaint)?

The management of headache disorders by Australian chiropractors

Headache Classification

This section is about the diagnostic criteria you use for headaches.

Questions 11-13 relate to the diagnostic criteria provided below for **primary headache types** as recommended by the International Classification of Headache Disorders (ICHD) as per [ichs-classification.org](https://www.ichd-classification.org)

Tension-type headache

Episodes of headache, typically bilateral, pressing or tightening in quality and of mild to moderate intensity, lasting minutes to days. The pain does not worsen with routine physical activity and is not associated with nausea, but photophobia or phonophobia may be present.

Migraine type headache

Recurrent headache disorder manifesting in attacks lasting 4-72 hours. Typical characteristics of the headache are unilateral location, pulsating quality, moderate or severe intensity, aggravation by routine physical activity and association with nausea and/or photophobia and phonophobia.

Cluster headache

Attacks of severe, strictly unilateral pain which is orbital, supraorbital, temporal or in any combination of these sites, lasting 15–180 minutes and occurring from once every other day to eight times a day. The pain is associated with ipsilateral conjunctival injection, lacrimation, nasal congestion, rhinorrhoea, forehead and facial sweating, miosis, ptosis and/or eyelid oedema, and/or with restlessness or agitation.

* 11. Are you familiar with these diagnostic criteria for these primary headaches?

- Yes
 No

The management of headache disorders by Australian chiropractors

Headache Classification

Primary Headaches

* 12. Do you use these diagnostic criteria for primary headache types such as migraine, tension-type headache or cluster headache?

- Yes
 No

* 13. To what extent do you agree with the following statements about these criteria for the diagnosis of PRIMARY headaches.

	Strongly disagree	Disagree	Neutral	Agree	Strongly agree
These are distinct headache criteria for the diagnoses of primary headache types.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
These diagnostic criteria for primary headache types are easy for me to follow.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
My patients with primary headache easily fit into these diagnostic criteria.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
These diagnostic criteria influence my management of patients with primary headaches.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Using these diagnostic criteria for primary headaches helps my communication with other healthcare professionals.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Using these diagnostic criteria improves my decision-making about patient referral or co-management for those with primary headaches.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

The management of headache disorders by Australian chiropractors

Headache Classification

Secondary Headaches

Questions 14-16 relate to the diagnostic criteria provided below for **secondary headache types** as recommended by the International Classification of Headache Disorders (ICHD) as per <https://www.ichd.org/>

Cervicogenic headache

Headache caused by a disorder of the cervical spine and its component bony, disc and/or soft tissue elements, usually but not invariably accompanied by neck pain.

Medication overuse headache

Headache occurring on 15 or more days per month developing as a consequence of regular overuse of acute or symptomatic headache medication (on 10 or more, or 15 or more days per month, depending on the medication) for more than 3 months. It usually, but not invariably, resolves after the overuse is stopped.

* 14. Are you familiar with these diagnostic criteria for these secondary headaches?

- Yes
 No

The management of headache disorders by Australian chiropractors

Headache Classification

Secondary Headaches

* 15. Do you use these diagnostic criteria for secondary headache types such as cervicogenic or medication-overuse headache?

- Yes
 No

* 16. To what extent do you agree with the following statements about these headache diagnostic criteria for the diagnosis of **SECONDARY** headaches.

	Strongly disagree	Disagree	Neutral	Agree	Strongly agree
These are distinct headache criteria for the diagnoses of secondary headache types.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
These diagnostic criteria for secondary headache types are easy for me to follow.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
My patients with headache easily fit into these secondary headache categories.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
These diagnostic criteria influence my management of patients with secondary headaches.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Using these diagnostic criteria for secondary headaches helps my communication with other healthcare professionals.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Using these diagnostic criteria improves my decision-making about patient referral or co-management for those with secondary headaches	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

The management of headache disorders by Australian chiropractors

Headache Classification

Other labels

* 17. Do you use other labels or words to diagnose headache types other than those recommended by the ICHD classification (primary or secondary)?

- Yes
 No

The management of headache disorders by Australian chiropractors

Headache Classification

Other labels

18. If so please list these labels/descriptions below:

1.	<input type="text"/>
2.	<input type="text"/>
3.	<input type="text"/>
4.	<input type="text"/>
5.	<input type="text"/>

The management of headache disorders by Australian chiropractors

Treatment Outcome Measures

This section is about outcome measures you may use for monitoring headaches.

*** 19. How often do you use the following outcome measures to monitor new patients who present with a chief complaint of headache?**

	Never	Rarely	Often	Every new patient with headache
Migraine Disability Assessment Test (MIDAS)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Headache Disability Inventory (HDI)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Headache Diary	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

The management of headache disorders by Australian chiropractors

Multidisciplinary care

These questions are about your collaboration with other health providers.

*** 20. How often do you RECEIVE a patient referral from the following healthcare professionals for the management of headache?**

	Never	Rarely	Sometimes	Often
General medical practitioner	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Medical Specialist (eg neurologist, rheumatologist, orthopaedic, psychiatrist)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Psychologist	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Dentist	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Physiotherapist	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Osteopath	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
CAM practitioners (including acupuncturist, herbalist, naturopath, massage therapist, counsellor)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

*** 21. How often do you REFER a patient to the following healthcare professionals for the management of headache?**

	Never	Rarely	Sometimes	Often
General medical practitioner	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Medical Specialist (via the GP) e.g neurologist, rheumatologist, orthopaedic, psychiatrist	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Psychologist	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Dentist	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Physiotherapist	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Osteopath	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
CAM practitioners (including acupuncturist, herbalist, naturopath, massage therapist, counsellor)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

*** 22. How often would you refer a patient with headache to another healthcare professional based on the following reasons?**

	Never	Rarely	Sometimes	Often
To seek or confirm the headache classification/diagnosis	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
To improve the patient's coping skills and management of headache-related disability	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
To investigate a headache red-flag	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
To provide pain relief for acute headache attacks	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
To help provide headache prevention	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

The management of headache disorders by Australian chiropractors

Multidisciplinary care

* 23. To what extent are you aware of the following indications for urgent medical attention in patients with headache (red-flags)?

	Not at all aware	Somewhat aware	Highly aware
Sudden onset of headache following head or neck injury	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Worsening pattern of existing headaches	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Abrupt or split second onset of severe headache	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Headache triggered by valsalva, cough or exertion	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Headaches developing during pregnancy	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Headaches first beginning after the age of 50 years	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Headaches associated with neurological signs (seizures, confusion, weakness papilledema)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Child with headaches associated with systemic fever and neck stiffness	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

The management of headache disorders by Australian chiropractors

Chiropractic Headache Management

These questions are about your management of headaches.

* 24. How important are the following treatment outcomes to your management of patients with headache?

	Very unimportant	Somewhat unimportant	Neutral	Somewhat important	Very important
Prevent headache episodes	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Improve recovery from an episode of headaches	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Pain relief during the headache episode	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Improve headache-related coping skills	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Improve overall health and well-being	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

The management of headache disorders by Australian chiropractors

Chiropractic Headache Management

*** 25. How frequently do you use the following treatment options in your management of patients with MIGRAINE?**

	Never	Rarely	Often	Almost every migraine patient
Manual adjusting/ manipulation (including Diversified, Gonstead)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Non-thrust spinal mobilisations	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Instrument adjusting	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Drop piece, Thompson or similar	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Massage, myofascial technique, stretching or trigger-points to neck/shoulder area	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Electro-physical therapies (TENS, ultrasound etc)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Soft tissue or exercise therapy to temporo-mandibular region	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Prescriptive exercises for the neck/shoulder region	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Advice on stress management	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Advice on diet or fitness	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Advice on Headache triggers	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Other therapies used for migraine (please specify):

*** 26. How frequently do you use the following treatment options in your management of patients with TENSION HEADACHE?**

	Never	Rarely	Often	Almost every patient with tension headache
Manual adjusting/manipulation (including Diversified, Gonstead)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Non-thrust spinal mobilisations	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Instrument adjusting	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Drop piece, Thompson or similar	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Massage, myofascial technique, stretching or trigger-points to neck/shoulder area	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Electro-physical therapies (TENS, ultrasound etc)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Soft tissue or exercise therapy to temporo-mandibular region	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Prescriptive exercises for the neck/shoulder region	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Headache triggers advice	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Stress management advice	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Diet or fitness advice	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Other therapies used for tension headache (please specify):

The management of headache disorders by Australian chiropractors

Chiropractic Headache Management

*** 27. How frequently do you use the following treatment options in your management of patients with CERVICOGENIC HEADACHE?**

	Never	Rarely	Often	Almost every patient with cervicogenic headache
Manual adjusting/manipulation (including Diversified, Gonstead)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Non-thrust spinal mobilisations	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Instrument adjusting	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Drop piece, Thompson or similar	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Massage, myofascial technique, stretching or trigger-points to neck/shoulder area.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Electro-physical therapies (TENS, ultrasound etc)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Soft tissue or exercise therapy to temporo-mandibular region	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Prescriptive exercises for the neck/shoulder region	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Stress management advice	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Diet or fitness advice	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Headache triggers advice	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Other therapies used for cervicogenic headache (please specify):

The management of headache disorders by Australian chiropractors

Chiropractic Headache Management

The following questions are about your headache treatment plan.

*** 28. Indicate the average NUMBER of visits you provide during the initial period of care for a new patient presenting with a chief complaint of headache as listed below.**

	Less than 5 treatments	5 to 10 treatments	More than 10 treatments
Migraine (<u>less</u> than 3 months duration)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Tension-type headache (<u>less</u> than 3 months duration)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Cervicogenic headache (<u>less</u> than 3 months duration)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Migraine (<u>more</u> than 3 months duration)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Tension headache (<u>more</u> than 3 months duration)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Cervicogenic headache (<u>more</u> than 3 months duration)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

* 29. Indicate the average DURATION of the initial period of care for a new patient presenting with a chief complaint of headache as listed below.

	Less than 2 weeks	2-4 weeks	4-8 weeks	More than 8 weeks
Migraine, Tension-type headache or Cervicogenic headache (<u>less</u> than 3 months duration)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Migraine, Tension-type headache or Cervicogenic headache (<u>more</u> than 3 months duration)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

* 30. Indicate the average FREQUENCY of visits for the initial period of care for a new patient presenting with a chief complaint of headache as listed below.

	Once per week	Twice per week	Three times per week	More than three times per week
Migraine, Tension-type headache or Cervicogenic headache (<u>less</u> than 3 months duration)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Migraine, Tension-type headache or Cervicogenic headache (<u>more</u> than 3 months duration)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

The management of headache disorders by Australian chiropractors

Chiropractic Headache Management

This final question is about your treatment results.

* 31. How effective do you perceive your chiropractic management to be for each of the following headache types?

	Never helps	Rarely helps	Sometimes helps	Often helps	Difficult to say
Migraine (<u>less</u> than 3 months duration)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Tension headache (<u>less</u> than 3 months duration)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Cervicogenic headache (<u>less</u> than 3 months duration)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Migraine (<u>more</u> than 3 months duration)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Tension headache (<u>more</u> than 3 months duration)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Cervicogenic headache (<u>more</u> than 3 months duration)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Appendix 5: Headache patient background leaflet with online link



PARTICIPANT INFORMATION SHEET **The Headache Features of Chiropractic Headache Patients** (Ethics approval number ETH18-2196)

Dear chiropractic patient

WHO IS DOING THE RESEARCH?

My name is Dr Craig Moore and I am a PhD student at the University of Technology Sydney and my supervisor is Distinguished Professor Jon Adams.

WHAT IS THIS RESEARCH ABOUT?

I am conducting research into the characteristics of headache patients who seek help from chiropractors.

WHY HAVE I BEEN ASKED?

You have been asked to participate because your chiropractor recently treated you for headache related symptoms and this research is examining the burden and characteristics of headaches in patients seeking help from chiropractors.

IF I SAY YES, WHAT WILL IT INVOLVE?

If you decide to participate you will be invited to complete an online questionnaire that will take approximately 8-10 minutes.

ARE THERE ANY RISKS/INCONVENIENCE?

We do not envisage any risk to you in participating. There is only the inconvenience of your time in completing this survey.

DO I HAVE TO SAY YES?

Participation in this study is voluntary. It is completely up to you whether or not you decide to take part.

WHAT WILL HAPPEN IF I SAY NO?

If you decide not to participate, it will not affect your relationship with your chiropractor or have any bearing upon your ongoing care or treatment. Not participating will also not affect your relationship with the researchers or the University of Technology Sydney. If you wish to withdraw from the study after having started the questionnaire online, you are free to do so at any time without having to give a reason and with no consequence for you or your care.

(Please turn over)

CONFIDENTIALITY

By starting the survey you consent to the research team collecting this information from you for the research project. All information will be treated confidentially and you are not personally identifiable. All information will be kept under a security password at the University of Technology Sydney and only the researchers will have access to the data. In all instances your information will be treated confidentially.

We plan to publish the study results in peer-reviewed journals of interest to chiropractors, researchers and others interested in headache research and to published the results on ACORN project website (<http://www.acorn-arccim.com/>). In any publication, information will be provided in such a way that you cannot be identified.

WHAT IF I HAVE CONCERNS OR A COMPLAINT?

If you have concerns about the research that you think I or my supervisor can help you with, please feel free to contact us further.

Dr Craig Moore (Chiropractor)

Email: [\[REDACTED\]@student.uts.edu.au](mailto: [REDACTED]@student.uts.edu.au)

Phone: [REDACTED]

Distinguished Professor Jon Adams

Email: Jon.Adams@uts.edu.au

Phone: (02) 95148050

To participate in this important headache research please start the online survey by typing this link into your URL or by scanning this QR code with your smart phone.

sgiz.mobi/s3/headache



Yours sincerely,

Dr Craig Moore (chiropractor) and Distinguished Professor Jon Adams PhD

University of Technology Sydney, Level 8, Building 10, 235-253 Jones Street, Ultimo NSW Australia, 2007 Phone: 02-95148050 Fax: +61 2 95144835

NOTE: This study has been approved by the University of Technology Sydney Human Research Ethics Committee [UTS HREC]. If you have any concerns or complaints about any aspect of the conduct of this research, please contact the Ethics Secretariat on ph.: +61 2 9514 2478 or email: Research.Ethics@uts.edu.au), and quote the UTS HREC reference number. Any matter raised will be treated confidentially, investigated and you will be informed of the outcome.

The patient profile and headache features of chiropractic headache patients

Ethics approval number: UTS HREC ETH 18-2196

I am delighted to invite you to participate in this headache research project. My name is Dr Craig Moore (Chiropractor) and I am a PhD candidate at the University of Technology Sydney. My principal supervisor is Distinguished Professor Jon Adams. This research is an opportunity for you to contribute to headache healthcare research.

The purpose of this research/online survey is to find out more information about the headaches managed by Australian chiropractors.

This survey should take less than 10 minutes to complete. The survey will start with questions about the characteristics of your headaches and the impact headaches can have on your routine activities. This will be followed by a few questions about you, including your gender, age and education. Your participation in this study is appreciated and may help to improve the care provided to headache patients.

Completing this survey is entirely elective. Your chiropractor does not know and does not need to know if you have agreed to participate. Your completed survey results are anonymous. Your recorded survey answers are sent to the researchers and stored in a fully secured software management system that only the researchers can access. When you start the survey you have consented to

participate. You can change your mind at any time and stop completing the survey without consequences.

If you agree to be part of this research with the understanding that the research information gathered from this survey can only be published in a form that does not identify you, please continue with answering the survey questions. If you would like to talk to someone who is not connected with the research, you may contact the Research Ethics Officer on 02 9514 2478 or Research.ethics@uts.edu.au and quote this ethics approval number ETH 18-2196. If you have concerns about the research that you think I or my supervisor can help you with, please feel free to contact the projects research assistant on 02 95148050 or email Jon.Adams@uts.edu.au

HEADACHE CHARACTERISTICS

Page description:

Some people have more than one type of headache . The following questions are only about the headache type that you presented to the chiropractor with.

1. Approximately how many headaches of this type have you had in your entire lifetime? *

- Just this current headache
- 2 to 5
- 6 to 10
- 11 to 20
- More than 20

2. Do you experience this headache type on more than 14 days per month over the last 3 months on average? *

- Yes
- No

3. How long does this type of headache usually last? (Please provide a number beside **one** option only) *

- Minutes OR
- Hours OR
- Days

4. Is the location of this headache usually on: *

- One side of the head only
- Both sides of the head

5. If so is it always on the same side of the head? *

- Yes
- No
- Not sure

6. Is the location of this headache type usually (more than one option may apply): *

- Back/base of the head
- Front of the head
- Top of the head
- Not sure

7. Remembering these questions are only about the headache type that you presented to the chiropractor with, would you describe the character of this headache as: *

- Throbbing or pulsating
- Pressing, squeezing or tightening
- Neither

8. Would you best describe the intensity of this headache as: *

- Mild
- Moderate
- Severe

9. Please provide a number in the box below to describe the severity of this type of headache when it is at its worse (providing a number between 1 and 10 where 0=no pain and 10=worse pain imaginable). *

10. Is this headache type aggravated by routine physical activity (e.g. walking or climbing stairs)?

*

- Yes
- No
- Not sure

11. Remembering to focus only on the headache type that you have presented to the chiropractor for help with, do you experience any of these symptoms with this type of headache? (Please tick all that apply)

*

- Nausea
- Vomiting
- Sensitivity to light or need to avoid light
- Sensitivity to sound or need to avoid sound
- None of the above

12. **Aura** is a word used to describe some of the symptoms that accompany certain types of headaches. Aura symptoms can be blind spots, tunnel vision, flashing, zig-zag lines, sparkling or stars in your vision OR feeling weakness on one side, prickling, numbness or tingling sensations OR difficulty with speech. Aura symptoms usually develop over a 5 to 20 minute period lasting less than 1 hour.

Does this headache involve any of the aura symptoms described above? *

Yes, please describe:

No

Not sure

13. Is this headache type related to a neck injury or pain occurring in your neck? *

Yes

No

Not sure

14. Does this headache decrease or disappear with improvement in neck pain? *

Yes

No

Not sure

15. Do you have restricted neck movement associated with this headache type e.g. turning your head or looking up and down? *

- Yes
- No
- Not sure

16. Is this headache made worse by bad or uncomfortable neck positions? *

- Yes
- No
- Not sure

17. Is this headache made worse by pressing on the base (back) of your skull or neck? *

- Yes
- No
- Not sure

18. Has this type of headache been successfully treated in the past with pain-based injections into your neck? *

- Yes
- No

19. Is this headache associated with any of the following? (tick all that apply) *

- Shoulder pain
- Arm pain
- Not sure

20. Does this headache pain start at the back of the head and move to the front of the head? *

- Yes
- No
- Not sure

21. Has a medical doctor ever given you a diagnosis for the headache type that you have presented to the chiropractor for help with? *

- Yes
- No

22. Please select the diagnosis given for this type of headache from the list provided: *

- Write headache name:

- I cannot remember

LEVEL OF HEADACHE IMPACT

Page description:

The next few questions are about the impact headaches can have on your daily routine.

23. When you have headaches how often is the pain severe? *

- Never
- Rarely
- Sometimes
- Very often
- Always

24. How often do headaches limit your ability to do usual daily activities including household work, work, school or social activities? *

- Never
- Rarely
- Sometimes
- Very often
- Always

25. When you have a headache how often do you wish you could lie down? *

- Never
- Rarely
- Sometimes
- Very often
- Always

26. In the past 4 weeks, how often have you felt tired to do work or daily activities because of your headaches? *

- Never
- Rarely
- Sometimes
- Very often
- Always

27. In the past 4 weeks, how often have you felt fed up or irritated because of your headaches? *

- Never
- Rarely
- Sometimes
- Very often
- Always

28. In the last 4 weeks, how often did headaches limit your ability to concentrate on work or daily activities? *

- Never
- Rarely
- Sometimes
- Very often
- Always

29. Please indicate from the list below the level of importance for **why** you seek help from the chiropractor for your headaches: *

	Not important	Low importance	Slightly important	Moderately important	Important	Very important
Headache prevention	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Headache relief during a headache	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Help with headache related stress	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Feeling more in control of my headache	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Reduce the effect of headaches on my relationships	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Reduce the effect of headaches on my ability to work	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

30. Please select which option best describes your level of satisfaction with chiropractic management of your headaches? *

- Very unsatisfied
- Unsatisfied
- Neutral
- Satisfied
- Very satisfied

BACKGROUND INFORMATION

Page description:

These final questions are about general background information.

31. What is your age? *

- 18 - 30
- 31- 40
- 41- 50
- 51 - 65
- 66 or older

32. What is your gender? *

- Male
- Female
- Other

33. Do you have private health insurance? *

- No
- Yes, hospital only
- Yes, hospital and extras cover

34. Which of the following best describes the highest degree or level of education that you have completed? *

- No high school completion (year 12)
- High school completion
- TAFE/Private/Technical college
- University under graduate
- University post graduate

35. Please describe your current employment status: *

- Salary worker
- Self employed
- Not working or part-time worker or casual worker
- Home duties
- Student
- Retired
- Unable to work

36. Please specify your ethnic background: *

- Anglo European
- Asian
- Pacific Islander
- Aboriginal or Torres Strait islander
- African
- Middle Eastern

37. **Last question.** What is your relationship status? *

- Single, never married
- Married or de facto relationship
- Widowed
- Divorced or separated

Thank You!

Page description:

Please be aware that headache can be a symptom of more serious conditions. Medical attention may be needed if you are experiencing any new, unresolved or worsening of headache related symptoms.

Thank you for taking our survey.

Appendix 7: Practitioner invitational email



Dear valued ACORN member,

We are pleased to announce the launch of a new ACORN research project. My name is Dr Craig Moore and I am a PhD student at the University of Technology Sydney and my supervisor is Distinguished Professor Jon Adams.

You have been invited to participate in this study because you are a member of the ACORN Practice-Based Research Network (PBRN) database. This research is aimed at understanding the headache features of those who seek help from chiropractors. It involves your practice distributing a leaflet containing background information and a link to an online survey questionnaire to 10 consecutive patients who have presented with a chief complaint of headache.

Before you decide to confirm your participation in this study, please read the study participation information below. **Once you have read these instructions please indicate your willingness to participate in the study by replying to this email by writing the word CONFIRM in the subject bar. If you confirm your participation in the study, you will soon receive further information about the recruitment period and survey distribution.**

Conditions of Participation

To participate in this important headache study please read the following:

- You are willing to inform 10 consecutive adult patients (>18years) who have presented with a chief complaint of headache of their study eligibility (avoiding new patients) at the end of the consultation and will provide each with a sealed envelope containing the study leaflet and link to the survey.
- You will participate only if your clinic privacy policy allows you to provide patients with information related to research.
- You are willing to display an A4 size advertisement in your reception area informing patients about the study during the recruitment period (this will be sent to you for display).

- You will follow guidelines regarding how to inform patients of their study eligibility to avoid the risk of coercing patients to participate. A short script will be sent to you for how to introduce the study. This short script will take less than 2 minutes to read out for each patient you inform.
- You and your staff will avoid asking patients if they have completed the study survey questionnaire and will direct patients to email or phone the research team if they have further questions.

Could you please indicate your willingness to participate in this study by writing the word CONFIRM in the subject bar in a return email.

If you have concerns about the research please feel free to contact us further.

With sincere thanks,

Dr Craig Moore (Chiropractor)

Email: [\[REDACTED\]@student.uts.edu.au](mailto: [REDACTED]@student.uts.edu.au)

Phone: [REDACTED]

Distinguished Professor Jon Adams

Email: Jon.Adams@uts.edu.au

Phone: (02) 95148050

University of Technology Sydney. Level 8, Building 10, 235-253 Jones Street. Ultimo NSW Australia, 2007 Phone: 02-95148050 Fax: +61 2 95144835

Appendix 8: Practitioner headache patient interview script

Dear Practitioner

Please follow the script provided below at the conclusion of your consultation with adult patients (aged between 18-65 years) who have presented on a routine visit (avoid new patients) with a primary complaint (or co-complaint) of headache and who you believe have an adequate understanding of English to complete a questionnaire.

Please follow this script for 10 consecutive individual headache patients (not to repeat patients).

Please provide these patients with the sealed envelope containing the study background information and link to the online survey when following this practitioner script.

PRACTITIONER SCRIPT

I wish to inform you that you are eligible to participate in a research study. This would involve completing an online questionnaire that would normally take up to 10 minutes to complete. The questionnaire asks questions about the characteristics and impact of headaches in chiropractic patients.

Completing the questionnaire is voluntary and the information you provide is anonymous. Participating in the survey will have no effect on your care or relationship with us here. I will not know and do not need to know if you have participated in the study or your answers to the survey questions.

Inside this sealed envelope is a leaflet fully explaining the survey along with a link to the online questionnaire should you decide to participate. The findings of this research may help to improve the management of those with headaches in the future.

Appendix 9: Ethics approval secondary analysis of ACORN baseline survey



July 21, 2016

Prof Jon Adams
Health
CB10.08.225, UTS
Ultimo NSW 2007

Research & Innovation
Building 1, Level 14
PO Box 123 Broadway
NSW 2007 Australia
T: +61 2 9514 9681
F: +61 2 9514 1244
Research.Ethics@uts.edu.au
www.uts.edu.au

UTS DRODS-PROVIDER CODE 0000F

Dear Jon,

RE: HREC Approval Granted – UTS HREC ETH16-0474

The Faculty has considered your Nil/Negligible Risk Declaration Form for your project titled, "Characteristics of Australian chiropractors treating migraine within a practice-based research network (PBRN)", and agree your research does not require review from the UTS Human Research Ethics Committee. Please keep a copy of your Declaration form on file to show you have considered risk.

For tracking purposes, you have been provided with an ethics application number, which is UTS HREC ETH16-0474.

I also refer you to the AVCC guidelines relating to the storage of data, which require that data be kept for a minimum of 5 years after publication of research. However, in NSW, longer retention requirements are required for research on human subjects with potential long-term effects, research with long-term environmental effects, or research considered of national or international significance, importance, or controversy. If the data from this research project falls into one of these categories, contact University Records for advice on long-term retention.

Yours sincerely,

Production Note:

Signature removed
prior to publication.

Professor Marion Haas
Chairperson
UTS Human Research Ethics Committee
C/- Research & Innovation Office
University of Technology, Sydney
E: Research.Ethics@uts.edu.au

Appendix 10: Ethics approval ACORN practitioner sub-study survey

From: Research Ethics research.ethics@uts.edu.au
Subject: UTS HREC Letter of Noting - ETH16-0639
Date: 7 July 2016 at 3:51 pm
To: Craig Moore [redacted]@student.uts.edu.au, David Sibbritt David.Sibbritt@uts.edu.au, Jon Adams Jon.Adams@uts.edu.au, Research Ethics research.ethics@uts.edu.au, andrew.leaver@sydney.edu.au



Dear Applicant,

The Faculty has considered your Nil/Negligible Risk Declaration Form for your project titled, "A survey on the management of headache disorders by Australian chiropractors", and agree your research does not require review from the UTS Human Research Ethics Committee. Please keep a copy of your Declaration form on file to show you have considered risk.

For tracking purposes, you have been provided with an ethics application number, which is UTS HREC ETH16-0639.

I also refer you to the AVCC guidelines relating to the storage of data, which require that data be kept for a minimum of 5 years after publication of research. However, in NSW, longer retention requirements are required for research on human subjects with potential long-term effects, research with long-term environmental effects, or research considered of national or international significance, importance, or controversy. If the data from this research project falls into one of these categories, contact University Records for advice on long-term retention.

You should consider this your official letter of noting.

Instructions for saving the declaration form can be downloaded from:
<https://staff.uts.edu.au/howdoi/Pages/Researching/Research%20ethics/Human%20research%20ethics/submit-my-human-research-ethics-application.aspx>

To access this application, please follow the URLs below:

* if accessing within the UTS network: <https://rm.uts.edu.au>

* if accessing outside of UTS network: <https://remote.uts.edu.au>, and click on "RM6 - Research Master Enterprise" after logging in.

If you or anyone connected with this research have any queries please do not hesitate to contact Research.Ethics@uts.edu.au

Yours sincerely,

Professor Marion Haas
Chairperson
UTS Human Research Ethics Committee
C/- Research & Innovation Office
University of Technology, Sydney
E: Research.Ethics@uts.edu.au
<https://staff.uts.edu.au/topichub/Pages/Researching/Research%20ethics/Human%20research%20ethics/human-research-ethics.aspx>
PO Box 123, BROADWAY NSW 2007
[Level 14, Building 1, Broadway Campus]

REF: E28

Appendix 11: Ethics approval ACORN headache patient sub-study

From: Research.Ethics@uts.edu.au
Subject: HREC Approval Granted - ETH18-2196
Date: 14 May 2018 at 2:08 pm
To: Jon.Adams@uts.edu.au, [REDACTED]@student.uts.edu.au, Research.Ethics@uts.edu.au

UE

Dear Applicant

Thank you for your response to the Committee's comments for your project titled, "The headache features of chiropractic headache patients". Your response satisfactorily addresses the concerns and questions raised by the Committee who agreed that the application now meets the requirements of the NHMRC National Statement on Ethical Conduct in Human Research (2007). I am pleased to inform you that ethics approval is now granted.

Your approval number is UTS HREC REF NO. ETH18-2196.

Approval will be for a period of five (5) years from the date of this correspondence subject to the provision of annual reports.

Your approval number must be included in all participant material and advertisements. Any advertisements on the UTS Staff Connect without an approval number will be removed.

Please note that the ethical conduct of research is an on-going process. The National Statement on Ethical Conduct in Research Involving Humans requires us to obtain a report about the progress of the research, and in particular about any changes to the research which may have ethical implications. This report form must be completed at least annually from the date of approval, and at the end of the project (if it takes more than a year). The Ethics Secretariat will contact you when it is time to complete your first report.

I also refer you to the AVCC guidelines relating to the storage of data, which require that data be kept for a minimum of 5 years after publication of research. However, in NSW, longer retention requirements are required for research on human subjects with potential long-term effects, research with long-term environmental effects, or research considered of national or international significance, importance, or controversy. If the data from this research project falls into one of these categories, contact University Records for advice on long-term retention.

You should consider this your official letter of approval. If you require a hardcopy please contact Research.Ethics@uts.edu.au.

To access this application, please follow the URLs below:

* if accessing within the UTS network: <https://rm.uts.edu.au>

* if accessing outside of UTS network: <https://remote.uts.edu.au>, and click on "RM6 - ResearchMaster Enterprise" after logging in.

If you have any queries about your ethics approval, or require any amendments to your research in the future, please do not hesitate to contact Research.Ethics@uts.edu.au.

Yours sincerely,

Associate Professor Beata Bajorek
Chairperson
UTS Human Research Ethics Committee
C/- Research & Innovation Office
University of Technology, Sydney
E: Research.Ethics@uts.edu.au

REF: E38

Appendix 12: 'The treatment of migraine patients within chiropractic: analysis of a nationally representative survey of 1869 chiropractors' (published version)

Moore et al. *BMC Complementary and Alternative Medicine* (2017) 17:519
DOI 10.1186/s12906-017-2026-3

BMC Complementary and
Alternative Medicine

RESEARCH ARTICLE

Open Access

The treatment of migraine patients within chiropractic: analysis of a nationally representative survey of 1869 chiropractors



Craig Moore^{1*}, Jon Adams¹, Andrew Leaver², Romy Lauche¹ and David Sibbritt¹

Abstract

Background: While the clinical role of manual therapies in migraine management is unclear, the use of chiropractors for this condition is considerable. The aim of this study is to evaluate the prevalence and characteristics of chiropractors who frequently manage patients with migraine.

Methods: A national cross-sectional survey of chiropractors collected information on practitioner characteristics, clinical management characteristics and practice settings. A secondary analysis was conducted on 1869 respondents who reported on their migraine caseload to determine the predictors associated with the frequent management of patients with migraine.

Results: A large proportion of chiropractors report having a high migraine caseload (HMC) ($n = 990$; 53.0%). The strongest factors predicting a chiropractor having a HMC include the frequent treatment of patients with axial neck pain (OR = 2.89; 95%CI: 1.18, 7.07), thoracic pain (referred/radicular) (OR = 2.52; 95%CI: 1.58, 3.21) and non-musculoskeletal disorders (OR = 3.06; 95%CI: 2.13, 4.39).

Conclusions: Several practice-setting and clinical management characteristics are associated with chiropractors managing a HMC. These findings raise key questions about the therapeutic approach to chiropractic migraine management that deserves further examination. There is a need for more primary research to assess the approach to headache and migraine management provided by chiropractors and to understand the prevalence, burden and comorbidities associated with migraine found within chiropractic patient populations. This information is vital in helping to inform safe, effective and coordinated care for migraine sufferers within the wider health system.

Keywords: Chiropractic, Migraine, Headaches, Practice-based research network, Utilisation, Manual therapy, Prevalence

Background

Migraine is the seventh leading cause of years lived with disability (YLDs) and a common neurological disorder [1]. During an attack, migraine symptoms are characterised by severe, throbbing, unilateral headaches associated with nausea, vomiting, photophobia and/or phonophobia and aggravation from physical activity and while less common, a migraine with aura is further associated with visual, sensory or speech related symptoms [2]. A variety of precipitating factors have been associated with triggering a

migraine attack. Triggers reported include weather, stress, poor or over-sleeping, odours, missing meals and certain foods, menses and neck pain [3, 4].

Uncertainty remains regarding the mechanisms associated with the initiation of migraine pain. Evidence suggests migraine pain has a central origin involving the cortex and brainstem [5, 6]. Indirect evidence also suggests migraine pain has a peripheral origin whereby peripheral input from within cervical spine structures causes sensitization of trigeminal nociceptive pathways [7–9]. This may be more common in sufferers with neck pain and may involve convergent nociceptive input via the trigeminal nerve and the upper cervical afferents to the trigeminal cervical complex [10–12]. Interpretation of this indirect evidence may have implications for the role of manual therapies in the

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treatment of migraine [13, 14]. To date however, clinical trials to support the effectiveness of manual therapies, including soft tissue therapies, spinal manipulation and spinal mobilisation, for the prevention of migraine remains limited, of poor quality and sometimes conflicting [15–17]. Despite this clinical uncertainty, physical therapies, which may include manual therapies, are reported as the most frequently used complementary and alternative therapies for the management of headaches worldwide [18].

Chiropractors are one of the most common complementary and alternative medicine (CAM) providers globally [19–21]. The use of chiropractic for the treatment of headaches appears to be substantial [22–24] with migraine likely to be one of the most common headache types chiropractors manage [25–27]. Consequently, there is a need to better understand how many chiropractors have a high migraine caseload and whether this is more common to a particular type of chiropractor. While the treatment of migraine by chiropractors may be substantial, no research to date has reported on how prevalent such treatment is within the profession or the features of those chiropractors who provide it. In response, this study aimed to investigate the proportion of Australian chiropractors with a high migraine caseload; and the practitioner characteristics, practice characteristics and clinical management factors associated with frequent management of patients with migraine by chiropractors.

Methods

The analyses presented in this paper were drawn from a questionnaire distributed during recruitment for a national practice-based research network (PBRN) titled the Australian Chiropractic Research Network (ACORN) project. This national project is independently designed and conducted by senior researchers at the Australian Research Centre in Complementary and Integrative Medicine (ARCCIM), University of Technology Sydney. The ACORN 21-item questionnaire examining practitioner, practice and clinical management characteristics was distributed to all registered chiropractors across Australia (approval # 2014000027) [28]. The secondary analyses sub-study reported in this paper were undertaken following ethical approval from the Human Research Ethics Committee of the University of Technology Sydney (approval # ETH16–0474).

Recruitment and sample

Recruitment for the ACORN PBRN occurred through a profession-wide recruitment strategy conducted from March through to June 2015. An invitation pack was distributed to all registered Australian chiropractors who were invited to both complete the baseline ACORN questionnaire and to consent to participate in the ACORN PBRN project. Distribution was via post (hard copy), email (survey link) and at several regional

profession-based conferences and was also made available through the official ACORN website (Survey-Gizmo™). The invitation pack was similarly re-distributed with four reminders starting 4 weeks after the initial invitation [28].

A total of 2005 chiropractors (43% of the 4684 Australian chiropractors registered at time of recruitment) completed the baseline ACORN practitioner questionnaire. Participants were generally representative of the wider profession with regards to a number of key indicators when compared to registered chiropractors identified by AHPRA (Australian Health Practitioner Regulation Agency) at the time of recruitment [29] including age ($p = 0.065$) and gender ($p = 0.634$). While the ACORN baseline sample is also generally representative of the wider chiropractic population regarding practice location, we found slight differences in terms of the distribution by location with the questionnaire sample slightly over-represented by chiropractors from South Australia, the Australian Capital Territory, Tasmania and the Northern Territory ($p < 0.01$) [28].

Instrument

The ACORN questionnaire collected information across three key domains (see Additional file 1). The first was practitioner characteristics (age, gender, education, professional qualifications and memberships in professional associations, years in private practice and professional roles in education, research and other professional areas). The second domain was practice characteristics (average patient care hours, number of weekly patient visits, place, number and type of practice location(s), types of health professionals working in the chiropractor's practice location, professional referral relationships and use of diagnostic imaging and electronic records). The third domain was clinical management characteristics where all response categories were on a four-point Likert frequency scale ('never', 'rarely', 'sometimes' or 'often'). This domain was divided into five sub-sections including frequency with which chiropractors discuss listed aspects of health promotion in their care plans; treat patients presenting with a range of listed conditions; treat patient subgroups and utilise listed treatment methods and interventions.

Statistical analyses

Statistical analyses were conducted using statistical software Stata 13.1 and SPSS 22.0 on those chiropractors who provided an answer to the question on how often they treat patients with migraine ($n = 1869$; 93.2% of all questionnaire respondents). The dependent variable was the frequency of treatment of patients with migraine; 'never', 'rarely', 'sometimes' or 'often', which was dichotomized into those who treat patients with migraine 'often'

and those who treat patients with migraine 'less often' (represented by the 'never', 'rarely' and 'sometimes' responses). Data are presented as means and standard deviations, or absolute and relative frequencies.

The bivariate associations between all survey items and the outcome variables were firstly explored using Student's t-test or chi-square tests, where applicable. Independent predictors of frequency of treating patients with migraine were identified using multiple logistic regression analysis. ACORN survey items with associations from the bivariate analyses ($p \leq 0.25$) were included in the regression model. A backward stepwise procedure employing a likelihood ratio test was chosen to determine the independent predictors of chiropractors who treat patients with migraine 'often'. Statistical significance was set at $p < 0.05$. Odds ratios were reported with 95% confidence intervals.

Results

Of the 1869 chiropractors, 62% were male with a mean (SD) age of 42.1 (12.1) years and most had a Bachelor or Master's degree qualifications (96%). Participants had worked for an average of 15.8 (11.3) years in practice and worked an average of 27.3 (12.6) patient care hours each week. The majority of chiropractors reported managing patients with migraine 'often' ($n = 990$; 53.0%). Fewer participants reported managing patients with migraine 'sometimes' ($n = 765$; 40.9%) and only a small percentage reported managing patients with migraine 'rarely' ($n = 106$; 5.7%) or 'never' ($n = 8$; 0.4%).

Chiropractors with a high migraine caseload ('often' group) were more often older ($p = 0.001$), had more

years in practice ($p < 0.001$), worked a greater number of patient-care hours per week ($p < 0.001$) and reported a greater number of patient visits per week ($p < 0.001$) than those chiropractors with a lower migraine caseload (Table 1). The practice setting of chiropractors with a high migraine caseload was more often rural ($p = 0.017$) and they less often shared their practice location with a GP ($p = 0.046$) or psychologist/counsellor ($p = 0.043$) while more often had a referral relationship with an occupational therapist ($p = 0.016$), podiatrist ($p = 0.016$) and/or exercise physiologist ($p = 0.031$). Additionally, these chiropractors more often used imaging in their practice ($p < 0.001$) but less often had diagnostic ultrasound on site ($p = 0.008$) than those chiropractors with a lower migraine caseload (Table 2).

Table 3 displays the clinical management characteristics of chiropractors with a high migraine caseload. The clinical management plans of chiropractors with a high migraine caseload more often included advice on diet/nutrition ($p < 0.001$), smoking/drugs/alcohol ($p < 0.001$), physical activity ($p = 0.005$), occupational health and safety ($p < 0.001$), pain counselling ($p < 0.001$), nutritional supplements ($p < 0.001$) and medications (including for pain/inflammation) ($p < 0.001$) than those chiropractors who less often managed patients with migraine. In addition, those chiropractors with a high migraine caseload more often treated patients presenting with neck, thoracic and low back pain, upper and lower limb disorders, postural disorders, degenerative conditions (all $p < 0.001$), non-musculoskeletal conditions ($p < 0.001$), other headache disorders (excluding migraine) including cervicogenic and tension type headaches ($p < 0.001$) and spine health maintenance/prevention

Table 1 Distribution of practitioner characteristics across frequency of practitioner treating patients with migraine

Characteristic	Treat patients with migraine		p-value
	Never/rarely/sometimes ($n = 879$)	Often ($n = 990$)	
Age in years (mean \pm sd)	41.3 \pm 11.7	43.1 \pm 12.3	0.001
Gender			
male n (%)	531 (60.7)	624 (63.4)	0.237
female n (%)	344 (39.3)	361 (36.6)	
Qualification n (%)			
Diploma n (%)	20 (2.3)	21 (2.1)	0.718
Advanced diploma n (%)	6 (0.7)	8 (0.8)	
Bachelor n (%)	304 (34.9)	344 (35.0)	
Doctor of Chiropractic n (%)	245 (28.1)	296 (30.1)	
Masters n (%)	288 (33.0)	308 (31.4)	
PhD n (%)	9 (1.0)	5 (0.5)	
Years in practice (mean \pm sd)	14.9 \pm 11.0	16.8 \pm 11.6	< 0.001
Patient care hours/week (mean \pm sd)	26.0 \pm 11.2	28.0 \pm 10.4	< 0.001
Patient visits/week (mean \pm sd)	78.1 \pm 53.8	95.5 \pm 59.2	< 0.001

Table 2 Distribution of practice characteristics across frequency of practitioner treating patients with migraine

Characteristic	Treat patients with migraine		p-value
	Never/rarely/sometimes (n = 879)	Often (n = 990)	
Location			
Urban n (%)	685 (79.6)	727 (74.9)	0.017
One location only	214 (24.5)	257 (26.0)	0.441
Other health professionals in practice location			
General practitioner	66 (7.7)	54 (5.5)	0.046
Podiatrist	93 (10.6)	86 (8.7)	0.165
Medical specialist	26 (3.0)	25 (2.5)	0.567
Physiotherapist	85 (9.7)	91 (9.2)	0.724
Chiropractor	504 (57.3)	595 (60.1)	0.226
Exercise physiologist	56 (6.4)	69 (7.0)	0.605
Psychologist	126 (14.3)	111 (11.2)	0.043
Occupational therapist	17 (1.9)	31 (3.1)	0.102
Referral relationships			
General practitioner	483 (54.9)	581 (58.7)	0.103
Psychologist	119 (13.5)	147 (14.8)	0.418
Physiotherapist	259 (29.5)	329 (33.2)	0.080
Occupational therapist	59 (6.7)	97 (9.8)	0.016
Podiatrist	323 (36.7)	418 (42.2)	0.016
Medical specialist	129 (14.7)	168 (17.0)	0.176
Exercise physiologist	120 (13.7)	171 (17.3)	0.031
Using imaging at least often	332 (38.1)	549 (55.7)	< 0.001
Having imaging on site			
X-ray	138 (15.7)	144 (14.5)	0.487
Magnetic resonance imaging (MRI)	36 (4.1)	26 (2.6)	0.077
Surface electromyography (SEMG)	30 (3.4)	50 (5.1)	0.081
Diagnostic ultrasound	35 (4.0)	19 (1.9)	0.008
Thermography	33 (3.8)	55 (5.6)	0.067

($p < 0.001$) than chiropractors with a lower migraine caseload. In addition, they were more likely to treat pregnant women ($p < 0.001$), athletes/sports people ($p < 0.001$), Aboriginal and Torres Strait Islander people (ATSI) ($p < 0.012$), patients with work injuries ($p < 0.001$) and traffic injuries ($p < 0.001$), patients from non-English speaking ethnic groups ($p < 0.035$), people receiving post-surgical rehabilitation ($p < 0.001$), and younger and older patients (all $p < 0.001$) than those chiropractors with a lower migraine caseload. The treatment techniques/methods more often used by chiropractors with a high migraine caseload were high velocity, low amplitude (HVLA) spinal manipulation ($p = 0.023$), drop-piece techniques ($p = 0.015$), sacro-occipital techniques ($p < 0.001$), instrument adjusting ($p = 0.001$), biophysics ($p = 0.040$), applied kinesiology ($p = 0.001$), functional neurology ($p < 0.001$), dry needling ($p = 0.006$),

heat/cryotherapy ($p = 0.002$), orthotics ($p < 0.001$) and extremity joint manipulation methods ($p < 0.001$).

Logistic regression analysis identified a range of factors independently associated with the likelihood of a chiropractor having a high migraine caseload. These factors included the chiropractor often discussing medications with their patients (including for pain/inflammation) (OR = 1.55; 95%CI: 1.09, 2.21), treating patients with neck pain (axial) (OR = 2.89; 95%CI: 1.18, 7.07), neck pain (referred/radicular) (OR = 1.88; 95%CI: 1.28, 2.77), thoracic pain (referred/radicular) (OR = 2.52; 95%CI: 1.58, 3.21), low back pain (referred/radicular) (OR = 1.78; 95%CI: 1.11, 2.85), upper limb musculoskeletal disorders (shoulder, elbow, wrist, hand) (OR = 1.67; 95%CI: 1.20, 2.31), providing spinal health maintenance/prevention (OR = 1.59; 95%CI: 1.12, 2.25), treating non-

Table 3 Distribution of clinical management characteristics across frequency of practitioner treating patients with migraine

Characteristic	Treat patients with migraine		p-value
	Never/rarely/ sometimes (n = 879)	Often (n = 990)	
Care plan includes (discussed often)			
Diet/nutrition	379 (43.2)	565 (57.4)	< 0.001
Smoking/drugs/alcohol	171 (19.5)	295 (30.1)	< 0.001
Physical activity/fitness	724 (82.8)	861 (87.5)	0.005
Occupational health and safety	325 (37.4)	439 (44.8)	0.001
Pain counselling	175 (20.2)	285 (29.3)	< 0.001
Nutritional supplements	261 (29.8)	435 (44.1)	< 0.001
Medications (including pain/inflammation)	165 (19.1)	264 (27.0)	< 0.001
Conditions (treated often)			
Neck pain: Axial	780 (88.8)	967 (97.8)	< 0.001
Neck pain: Referred/radicular	374 (42.5)	799 (80.7)	< 0.001
Thoracic pain: Axial	654 (74.8)	922 (93.4)	< 0.001
Thoracic pain: Referred/radicular	227 (26.1)	632 (64.4)	< 0.001
Low back pain: Axial	793 (90.5)	968 (98.2)	< 0.001
Low back pain: Referred/radicular	600 (68.5)	910 (92.2)	< 0.001
Lower limb musculoskeletal disorders	395 (45.0)	729 (73.8)	< 0.001
Upper limb musculoskeletal disorders	416 (47.4)	748 (76.1)	< 0.001
Postural disorders	442 (50.5)	765 (77.7)	< 0.001
Degenerative spine conditions	642 (73.1)	986 (99.7)	< 0.001
Headaches (tension, cervicogenic)	642 (73.0)	986 (100.0)	< 0.001
Migraine disorders			
Spine health maintenance/prevention	529 (60.3)	834 (84.8)	< 0.001
Non-Musculoskeletal conditions	106 (16.8)	306 (41.2)	< 0.001
Patient groups (treated often)			
Child: <4 years	198 (22.7)	362 (36.8)	< 0.001
4–18 years	363 (41.6)	627 (63.6)	< 0.001
Older: >65 years	574 (65.8)	794 (80.6)	< 0.001
Aboriginal and Torres Strait Islander	8 (0.9)	24 (2.5)	0.012
Pregnant women	233 (26.8)	448 (45.7)	< 0.001
Athletes/sports people	339 (39.1)	572 (58.5)	< 0.001
Work injuries	250 (28.9)	418 (42.8)	< 0.001
Traffic injuries	58 (6.7)	196 (20.1)	< 0.001
Post-Surgical Rehabilitation	32 (3.7)	88 (9.0)	< 0.001
Non-English Speaking ethnic groups	43 (5.1)	72 (7.5)	0.035
Techniques/methods (used often)			
Drop-piece	443 (51.0)	549 (56.7)	0.015
Pelvic blocking/sacro-occipital	343 (39.7)	465 (48.1)	< 0.001
Instrument Adjusting	420 (48.4)	545 (56.0)	0.001
Chiropractic Biophysics	28 (3.3)	49 (5.0)	0.040
HVLA manipulation/mobilisation	694 (80.0)	821 (84.1)	0.023
Applied kinesiology	113 (13.1)	182 (19.1)	0.001
Flexion-Distraction	65 (7.6)	81 (8.5)	0.472

Table 3 Distribution of clinical management characteristics across frequency of practitioner treating patients with migraine (Continued)

Characteristic	Treat patients with migraine		p-value
	Never/rarely/sometimes (n = 879)	Often (n = 990)	
Functional Neurology	71 (8.4)	168 (17.8)	< 0.001
Extremity Manipulation	443 (50.9)	648 (66.5)	< 0.001
Musculoskeletal Interventions (used often)			
Dry Needle or acupuncture	98 (11.3)	153 (15.7)	0.006
Soft tissue therapies	573 (65.9)	650 (66.1)	0.905
Electro-modalities	71 (8.6)	103 (10.6)	0.147
Heat/cryotherapy	118 (13.7)	184 (18.9)	0.002
Orthotics	55 (6.4)	134 (13.8)	< 0.001
Exercise therapy/rehabilitation	411 (47.7)	497 (51.1)	0.140

musculoskeletal disorders (OR = 3.06; 95%CI: 2.13, 4.39), treating athletes/sports people (OR = 1.65; 95%CI: 1.22, 2.23), employing functional neurology methods in their patient management (OR = 1.63; 95%CI: 1.02, 2.61) and less often having a psychologist/counsellor located in the same practice as the chiropractor (OR = 0.53; 95%CI: 0.34, 0.86) (Table 4).

Discussion

Prevalence of migraine management

Our study found a large proportion of Australian chiropractors report managing a high migraine caseload. This appears to support previous studies which have identified a high prevalence of headache in chiropractic patient populations (4.6% - 15.4%) [30–32] and a high prevalence of chiropractic use within the general migraine population (10%–29%) [23, 25, 26, 33]. The high use of chiropractors by those with migraine would suggest these providers are likely to be addressing some of the healthcare needs of this

population and raises several questions for further research enquiry.

For instance, there is a need to better understand all of the relevant patient management approaches included within chiropractic migraine management and whether these approaches vary from those reported in routine Australian chiropractic practice which favours spinal manipulation, soft tissue therapy and exercise prescription [34]. For instance, while management of public health and lifestyle factors, have been captured in recent chiropractic workforce data [35, 36] there has been no detailed examination on how these aspects of patient management are utilised in the management of migraine. For example, little is known about the role chiropractors play in patient education regarding migraine triggers associated with diet, fatigue and stress or improving headache-related coping skills and pain management. While more high quality research is still needed to assess the effectiveness of individual manual therapies for the treatment of migraine, understanding

Table 4 Logistic regression output for chiropractors that treat migraine often compared to never/rarely/sometimes

Factors	Odds Ratio	95% CI	p-value
Non-musculoskeletal disorders	3.058	2.132, 4.388	< 0.001
Neck pain (Axial)	2.889	1.181, 7.068	0.020
Thoracic pain (Referred/radicular)	2.252	1.580, 3.210	< 0.001
Neck pain (Referred/radicular)	1.881	1.280, 2.764	0.001
Low back pain (Referred/radicular)	1.783	1.115, 2.851	0.016
Upper limb Musculoskeletal disorders	1.668	1.206, 2.308	0.002
Athletes or Sports people	1.653	1.225, 2.231	0.001
Functional Neurology	1.632	1.020, 2.610	0.041
Spinal health maintenance/prevention	1.586	1.116, 2.252	0.010
Discussing medication (Including pain/inflammation)	1.555	1.093, 2.213	0.014
Psychologist/counsellor in same practice	0.543	0.342, 0.862	0.010

the use of these management approaches by chiropractors and their influence on migraine health outcomes, both individually and synergistically, may prove helpful in the design of future clinical trials that aim to assess the overall effectiveness of chiropractic migraine management. Chiropractic clinical trials have yet to incorporate any multimodal aspects of chiropractic care that may influence underlying migraine mechanisms and have been limited to the assessment of unimodal manual therapy interventions for which headache treatment guidelines report only weak evidence or level III recommendations [37, 38].

Factors associated with high migraine caseload

Our analyses did not identify any practitioner characteristics (practitioner age, gender or place of education) that were associated with a high migraine caseload, suggesting that a broad cross-section of the Australian chiropractors are frequently managing those with migraine. However, our research highlights several practice-setting and clinical management characteristics associated with chiropractors managing a high migraine caseload and which raise valuable questions about the therapeutic or philosophical approaches that may be common to chiropractic migraine management.

Our study found chiropractors with a high migraine caseload were associated with treating spine regions (cervical, thoracic and lumbar) including referred and radicular spine symptoms associated with noxious stimulation of nerve endings and direct nerve root compression respectively [39], as well as treating upper limb disorders. Previous studies report manual therapies, particularly manipulative therapies, to be the most common therapies utilised by chiropractors when treating the spine and upper limb [34, 40–43]. Spinal manipulation in particular is reported to be the most popular treatment modality utilised by Australian chiropractors [35] and the only therapeutic modality to be evaluated by the profession for the treatment of migraine [15]. While unclear from our findings directly, these associations may suggest a greater preference for the use of manual therapies when compared to the use of other therapies amongst chiropractors with a high migraine caseload. More research is needed to assess the use of other therapeutic approaches that may also fall within the scope of chiropractors in their management of migraine. This could include the use of relaxation methods, herbs, minerals, supplements and physical therapies as identified within non-pharmaceutical migraine treatment guidelines [37, 44–46]. More research is also needed to understand the clinical circumstances within which chiropractors decide to refer patients with migraine to other healthcare providers for management and treatment that is outside their scope of practice.

Our analyses identified chiropractors with a high migraine caseload as more likely to provide treatment of patients with non-musculoskeletal conditions. While migraine itself is classified as a neurological disorder, the classification of migraine as a non-musculoskeletal condition is less straight forward when considering evidence of an association with neck pain and the potential role of neck pain in migraine pathophysiology [10, 11, 47, 48]. However, the treatment of a number of non-musculoskeletal conditions with manual therapies by chiropractors is controversial, [49, 50] not least because of the significant methodological limitations in related clinical trials [51, 52] and concerns raised about the lack of biological plausibility to support how manual therapies, such as spinal manipulative therapy (SMT), might influence the underlying pathophysiology of these conditions [53]. On the other hand, higher headache disability and chronicity is more common amongst those who seek complementary medicine including chiropractic [23, 54] and this is associated with greater levels of anxiety and depression [55, 56]. With the interest by some chiropractors toward improving overall patient health, including mental and emotional well-being [35, 57, 58], more research is needed to understand whether the association with treatment of patients with non-musculoskeletal conditions may relate to care that is aimed to assist in the management of common migraine comorbidities, such as anxiety and depression, or toward the management of non-musculoskeletal conditions unrelated to migraine.

Our study also found chiropractors with a high migraine caseload are associated with providing spinal health maintenance and prevention. While there is limited research to identify a universal evidence-based definition of chiropractic maintenance care [59, 60], the role of preventative care is well recognised within healthcare settings including for the prevention of migraine [61], which often presents as a chronic or recurring condition [62, 63]. As such, the need to help sufferers through ongoing support, advice or treatment may be clinically indicated under a prevention paradigm. While ongoing SMT may be a popular component of chiropractic prevention [64, 65], more research is needed to understand all of the therapeutic modalities and approaches utilised under this therapeutic paradigm. With few clinical trials having included sufficient long-term follow-up to assess the benefits of chiropractic spinal health maintenance and prevention, no robust conclusions can be yet made about the long-term outcomes associated with this approach to care both for the management of conditions associated with the spine or the effect this type of care may have on those with migraine.

Our analyses identified chiropractors with a high migraine caseload as more likely to not have a psychologist/counsellor practicing at the same practice location. While

psychologists can be a key healthcare provider for those with headache [38, 66, 67] it may be difficult to explain why chiropractors with a high migraine caseload are less likely to practice alongside psychologists. Possible explanations may be the potential influence of existing incentives for greater collaboration and therefore proximity between psychologists and other healthcare providers [68] or the possibility that chiropractors who often manage migraine may have a more independent therapeutic approach to the management of psychological aspects of patient health [69] suggesting less proximity reflects less inter-disciplinary collaboration with psychologists when managing this patient population. Alternatively, this could simply reflect a more general trend for Australian psychologists to work in independent private practice settings [70].

The association with discussing medications (including for pain/inflammation) by chiropractors who often manage migraine raises valuable questions about the nature of these patient discussions. These discussions may reflect the practitioners aim to assist migraine patients to manage their health 'without the use of drugs or surgery,' a defining therapeutic and philosophical approach to patient care encouraged by chiropractic political bodies [71, 72] promoting better health without an unnecessary dependence on medications. These discussions may also reflect patient's raising concerns or dissatisfaction with migraine medications, a finding that has been reported as a key predictor for the use of complementary medicine including chiropractic for this patient population [73, 74]. As a result, discussing current and previous migraine medications may be more common place inside consultations with migraine patients. More research is needed to understand the nature of discussions regarding migraine medications and whether these discussions extend beyond the normal documentation of current and previous treatments for a presenting complaint as expected for registered chiropractors under regulatory guidelines [75].

Limitations

Our secondary analysis of the ACORN cross-sectional survey provides an opportunity to answer a number of questions and identify further pertinent questions for future enquiry regarding chiropractic migraine management. Drawing strong conclusions from our research may be limited due to our analysis being secondary and the quality and fit of existing data to our research. As such, it cannot be concluded that the associations drawn from this secondary analysis are unique to the management of migraine patients. Our findings rely on practitioners understanding the classification criteria for migraine headache and the retrospective recall of practitioners when answering the original ACORN questionnaire. The Likert categories provided in the ACORN questionnaire ('never', 'rarely', 'sometimes',

'often') for the frequency of migraine management are also subject to practitioner interpretation of these terms. There would also be a risk of selection bias if the features of the practitioners responding to the ACORN survey are less than representative of the wider profession. While the associations reported from our secondary analysis of the ACORN cross-sectional survey are preliminary, the findings nevertheless are valuable in helping to generate hypotheses to further explore the management and effectiveness of headache and migraine management by chiropractors.

Conclusions

Migraine appears to be a significant component of chiropractic caseload. There is a need for more high-quality research to better understand how chiropractors manage this patient population and to understand the prevalence, burden and comorbidities associated with migraine patients who seek help from these providers. Such information is important in helping to inform safe, effective and coordinated care for migraine sufferers within the wider health system.

Additional file

Additional file 1: ACORN national survey questionnaire (PDF 78 kb)

Abbreviations

ACORN: Australian Chiropractic Research Network; ARCCIM: Australian Research Centre in Complementary and Integrative Medicine; ATS: Aboriginal and Torres Strait Islander; HVA: High Velocity Low Amplitude; MRI: Magnetic Resonance Imaging; PBRN: Practice-Based Research Network; SEMG: Surface Electromyography; SMT: Spinal Manipulative Therapy; YLDs: Years Lived with Disability

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Availability of data and materials

The datasets generated during and/or analysed during the current study are available from the corresponding author on reasonable request.

Authors' contributions

Designed the study: JA, DS; Collected the data: JA, DS; Analyzed the data: RL, CM; Interpreted the data: CM, JA, DS, AL, RL; Wrote the first draft: CM; Critically revised the manuscript, and approved the final version: CM, JA, DS, AL, RL.

Ethics approval and consent to participate

The ACORN RBRN has been approved by the UTS Human Ethics Committee (approval #201400027). All participants provided written informed consent.

Consent for publication

Not applicable

Competing interests

The authors declare that they have no competing interests.

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Appendix 13: 'The management of common recurrent headaches by chiropractors: a descriptive analysis of a nationally representative survey' (published version)

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RESEARCH ARTICLE

Open Access



The management of common recurrent headaches by chiropractors: a descriptive analysis of a nationally representative survey

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Abstract

Background: Headache management is common within chiropractic clinical settings; however, little is yet known about how this provider group manage headache sufferers. The aim of this study is to report on the prevalence of headache patients found within routine chiropractic practice and to assess how chiropractors approach key aspects of headache management applicable to primary care settings.

Methods: A 31-item cross-sectional survey was distributed to a national sample of chiropractors ($n = 1050$) to report on practitioner approach to headache diagnosis, interdisciplinary collaboration, treatment and outcome assessment of headache patients who present with recurrent headache disorders.

Results: The survey attracted a response rate of 36% ($n = 381$). One in five new patients present to chiropractors with a chief complaint of headache. The majority of chiropractors provide headache diagnosis for common primary (84.6%) and secondary (90.4%) headaches using formal headache classification criteria. Interdisciplinary referral for headache management was most often with CAM providers followed by GPs. Advice on headache triggers, stress management, spinal manipulation, soft tissue therapies and prescriptive neck exercises were the most common therapeutic approaches to headache management.

Conclusion: Headache patients make up a substantial proportion of chiropractic caseload. The majority of chiropractors managing headache engage in headache diagnosis and interdisciplinary patient management. More research information is needed to understand the headache types and level of headache chronicity and disability common to chiropractic patient populations to further assess the healthcare needs of this patient population.

Keywords: Chiropractic, Migraine, Tension headache, Cervicogenic headache, Manual therapy, Practice-based research network, Spinal manipulation

Background

Tension headache and migraine are the most common recurrent primary headaches globally [1] and cervicogenic headache is one of the most common recurrent secondary headaches [2, 3]. While less information is available regarding the burden and economic impact associated with cervicogenic headache [4, 5], the societal impact of tension

headache and migraine are significant and well documented [6–8].

In the collaborative study between the World Health Organisation (WHO) and the 'Lifting The Burden' campaign, survey information was collected from neurologists and general practitioners in order to better understand how these providers approach headache diagnosis and management [9]. The findings of the report provided important insights into the use of headache diagnostic criteria, headache assessment tools, headache treatment and interdisciplinary collaboration.

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While headache is most often managed by general practitioners and neurologists, the report also found headache patients report a clear preference for the use of complementary and alternative treatments for headaches including physical based therapies and acupuncture.

The use of chiropractors for headache management appears to be significant. In a recent national US study, manipulative-based physical therapies were reported to be the most frequently used complementary and alternative treatments for migraine and headache patients [10]. In North America, a general population study reported between 25.7–36.2% of migraine headache patients had sought help from chiropractors at some time [11]. In Australia, chiropractic utilisation by those with headache was reported to be 9.3% in the preceding 12 months [12]. Notably, one international study found chiropractors to be the second and third most common health care provider by those with migraine in Australia and the United States respectively [13].

While the use of chiropractors for the management of headache disorders appears to be significant, little is understood about how this provider group manage this substantial patient population. With increasing research examination on interdisciplinary headache management [14, 15], more information is needed to understand the role of chiropractors within the interdisciplinary headache management landscape. Gathering this information can offer important insights that may help to guide more effective and coordinated healthcare delivery between providers and improve the management of headache patients. In direct response to this important research gap, this paper reports on a) the prevalence of patients who present to chiropractors with headache and b) how chiropractors approach key aspects of headache patient management appropriate to primary care settings including the use of headache diagnostic criteria, headache assessment tools, approach to headache treatment and interdisciplinary engagement with other headache providers.

Methods

The study collected data via an online cross-sectional survey (Additional file 1) distributed to Australian practicing chiropractors who were recruited members of the Australian Chiropractic Research Network (ACORN) - a national practice-based research network (PBRN) [16]. Those recruited to the ACORN PBRN database are broadly representative of the wider national population of Australian chiropractors in terms of the key indicators of gender distribution, age distribution and practice location [17]. Full details of the original recruitment of chiropractors to join the national-based ACORN PBRN has been reported elsewhere [16]. This ACORN PBRN sub-study was approved by the Human Research Ethics Committee at the University of Technology Sydney (Approval number: ETH16-0639).

Recruitment and participants

Practitioner recruitment for the sub-study was a random sample of chiropractors taken from the nationally representative ACORN database. A sample of 1050 participants was selected using the random number generator function in Microsoft Excel 2016. Recruitment was conducted between August and November 2016 with participants invited to complete a 31-item online headache questionnaire using the SurveyMonkey™ platform. An embedded link to the headache questionnaire was emailed to invited participants who received three reminders during the recruitment period.

Instrument

The questionnaire introduction explained the approximate duration, purpose and contents of the study and that survey completion was voluntary, and that respondent information was anonymous. Consent was implied by completing the survey and no incentives were offered to participate in the study. As there are no previously validated instruments for the assessment of provider headache management across several clinical areas, the key themes and questions adopted for our study questionnaire were developed after consideration of the 'WHO: Lifting the Burden' report [9] and other surveys examining primary care management of headache patients [18, 19]. The headache disorders selected for the study were based upon headache types previously reported as common to chiropractic headache patient populations [20–22].

The questionnaire collected information on practitioner characteristics (i.e. gender, years in practice, place of education and practice location). Practitioner reporting of headache patient prevalence were based on practitioner consultations over the previous two weeks. Questions about the use of headache diagnostic criteria were based on the International Classification of Headache Disorders (ICHD-3 Beta) criteria for primary and secondary recurrent headaches [23]. Preceding the questions on primary headaches, the online questionnaire provided a direct link to ICHD-3 Beta diagnostic criteria. Preceding the questions on secondary headaches, a direct link was similarly provided to the ICHD-3 Beta diagnostic criteria. Questions regarding the use of headache assessment instruments were based on the use of the Migraine Disability Assessment questionnaire (MIDAS) [24], Headache Disability Inventory (HDI) [25] and the use of patient headache diaries [26]. For headache management, the questionnaire included questions on multi-disciplinary engagement with other providers (sending and receiving headache patient referrals) and questions on chiropractor's approach to headache management including treatment aims, therapeutic methods and treatment volume. For questions regarding headache management by chiropractors, headaches were divided into headaches of

less than 3 months' duration and headaches of more than 3 months' duration.

The questionnaire was pilot tested with 10 chiropractors in private clinical practice from different socio-demographic backgrounds who provided feedback on content, wording and survey length. Feedback from pilot testing resulted in further changes to the length and wording of the instrument. The final version of the on-line survey was estimated to take around 15 min to complete. All questionnaire items were either dichotomous (yes/no) or reported as ratings on a 4-point or 5-point Likert scale.

Statistical analyses

Participant perceptions regarding the role of ICHD diagnostic criteria for primary and secondary headaches are re-categorized into 3 groups: strongly disagree/disagree; neutral and agree/strongly agree and the reporting of participant collaboration with other healthcare providers for the management of headache are re-categorised into 2 groups: never/rarely; and sometimes/often. This was due to the very low number of responses reported within some of the Likert categories provided for these questions. A minimum mean agreement score is used to report participant headache treatment aims (very unimportant/somewhat unimportant/neutral/somewhat important/very important). The reporting of chiropractic headache management provided by chiropractors are categorized as: often/almost every headache patient compared to never/rarely. Descriptive statistics are used to describe responses by participants. Continuous descriptive data are presented using means and standard deviations and categorical data presented using numbers and percentages. Statistical analysis was based upon the total number of completed surveys ($n = 321$) and conducted using software Stata 14.2.

Results

Practitioner characteristics

The questionnaire was completed by 381 practitioners, giving a response rate of 36.2%. This number represents 12.1% of the total number of practicing chiropractors in Australia at the time of recruitment. Participants mean number of years in practice was 18.1 years ($SD = 10.9$). When comparing survey participants to the ACORN data-base, survey respondents are generally representative for gender (64% male vs 63%) ($p = 0.379$), and place of practice: New South Wales (35.1% vs 34%), Victoria (23.2% vs 25%), Queensland (15.2% vs 15.0%), Western Australia (14.7% vs 13%), South Australia (8.5% vs 9.0%), Australian Capital Territory (1.6% vs 2%), Tasmania (0.9% vs 1%) and Northern Territory (0.5% vs 1%) ($p = 0.916$) [16]. These non-significant p values show no difference in distributions between samples for gender

and place of practice, suggesting survey respondents are generally representative of the ACORN database participants. The distribution of these participant demographic characteristics are consistent with national registration records reported by the Chiropractic Board of Australia [27].

Headache prevalence

In the previous two-week period the mean total number of new consultations reported by participants was 7.1 ($SD = 4.8$) where a chief complaint of headaches accounted for 1.5 ($SD = 1.7$) new consultations and a secondary complaint of headaches accounted for 2.5 ($SD = 2.3$) new consultations. In the previous two-week period the mean number of total patient consultations (new and routine treatment visits) was 170.9 ($SD = 107.3$) where a chief complaint of headaches accounted for 21.5 ($SD = 28.6$) total consultations and a secondary complaint of headaches accounted for 28.2 (33.8) total consultations.

Headache treatment plans

In terms of the number of initial treatment visits normally provided for a new patient presenting with headaches of less than 3 months duration for each of migraine, tension headache and cervicogenic headache, between 28 and 29.6% of participants reported providing less than 5 treatments, 54.2–55.5% provided between 5 and 10 visits and 14.9–16.5% reported providing more than 10 visits across all 3 headache types. For the duration of an initial headache treatment plan for a new patient presenting with headaches of less than 3 months duration - migraine, tension headache and cervicogenic headache (grouped); 11.8% of participants reported providing treatment for less than 2 weeks, 50.3% reported 2–4 weeks, 33.0% reported 4–8 weeks and 4.4% reported treatment for more than 8 weeks. With regards to the frequency of treatment during an initial headache treatment plan for a new patient presenting with headaches of less than 3 months duration (i.e. migraine, tension headache and cervicogenic), 16.0% of participants reported providing one treatment per week, 72.5% two treatments per week, 11.0% three treatments per week and 0.5% reported providing more than three visits per week. In terms of the number of initial treatment visits for a new patient presenting with headaches for more than 3 months duration for each of migraine, tension headache and cervicogenic headache, between 10.7–12.0% of participants reported providing less than 5 treatments, 46.3–50.3% provided between 5 and 10 visits and between 38.0–43.0% reported providing more than 10 visits across all 3 headache types. For the duration of an initial headache treatment plan for a patient presenting with headaches for more than 3 months duration - migraine, tension headache and cervicogenic

headache (grouped), 4.7% of participants reported providing treatment for less than 2 weeks, 32.2% reported 2–4 weeks, 46.9% reported 4–8 weeks and 16.2% reported an initial treatment period of more than 8 weeks.

Headache classification

The majority of participants reported being familiar with ICHD headache criteria for primary (98.3%; $n = 411$) and secondary (81.2%; $n = 324$) headaches and using these criteria for classifying primary (84.6%; $n = 334$) and secondary (90.4%; $n = 291$) headaches. Figure 1 provides the mean score for participants' perceptions regarding ICHD criteria for the diagnosis and management of primary and secondary headaches independently. The mean scores (0 = no agreement, 5 = high agreement) across all domains were high for participant agreement on the clinical utility of ICHD classification for a range of listed clinical purposes. There was a strong agreement amongst participants that ICHD criteria were easy to follow for primary (mean = 4.00; SD = 0.76) and secondary headaches (mean = 3.88; SD = 0.76) and represent distinct criteria for primary (mean = 3.92; SD = 0.76) and secondary headaches (mean = 3.89; SD = 0.76) and helps communication with other providers for primary (mean = 3.95; SD = 0.76) and secondary headaches (mean = 3.96; SD = 0.76). There was relatively less agreement amongst participants that patients easily fit into ICHD criteria for primary (mean = 3.29; SD = 0.76) and secondary headaches (mean = 3.39; SD = 0.76).

Multidisciplinary care

The level of interdisciplinary collaboration between chiropractors and other healthcare providers in managing patients with headaches is reported in Table 1. The most frequent collaboration between chiropractors and other providers for headache management was reported to be with other Complementary and Alternative Medicine (CAM) providers, followed by GPs for both referring and receiving headache patient referrals. The frequency of chiropractors referring headache patients to GPs was reported as substantially higher than the frequency of chiropractors receiving headache patient referrals from GPs.

The reasons chiropractors 'sometimes' or 'often' refer headache patients to other providers was to: investigate headache red-flags (83.4%; $n = 324$); assist with acute headache pain (57.1%; $n = 224$); assist with headache-related coping skills (53.8%; $n = 211$); assist with headache prevention (44.9%; $n = 176$); and confirm headache diagnosis (32.9%; $n = 129$).

Chiropractic headache management

The mean scores (0 = no agreement, 5 = high agreement) across all domains were high for participant agreement

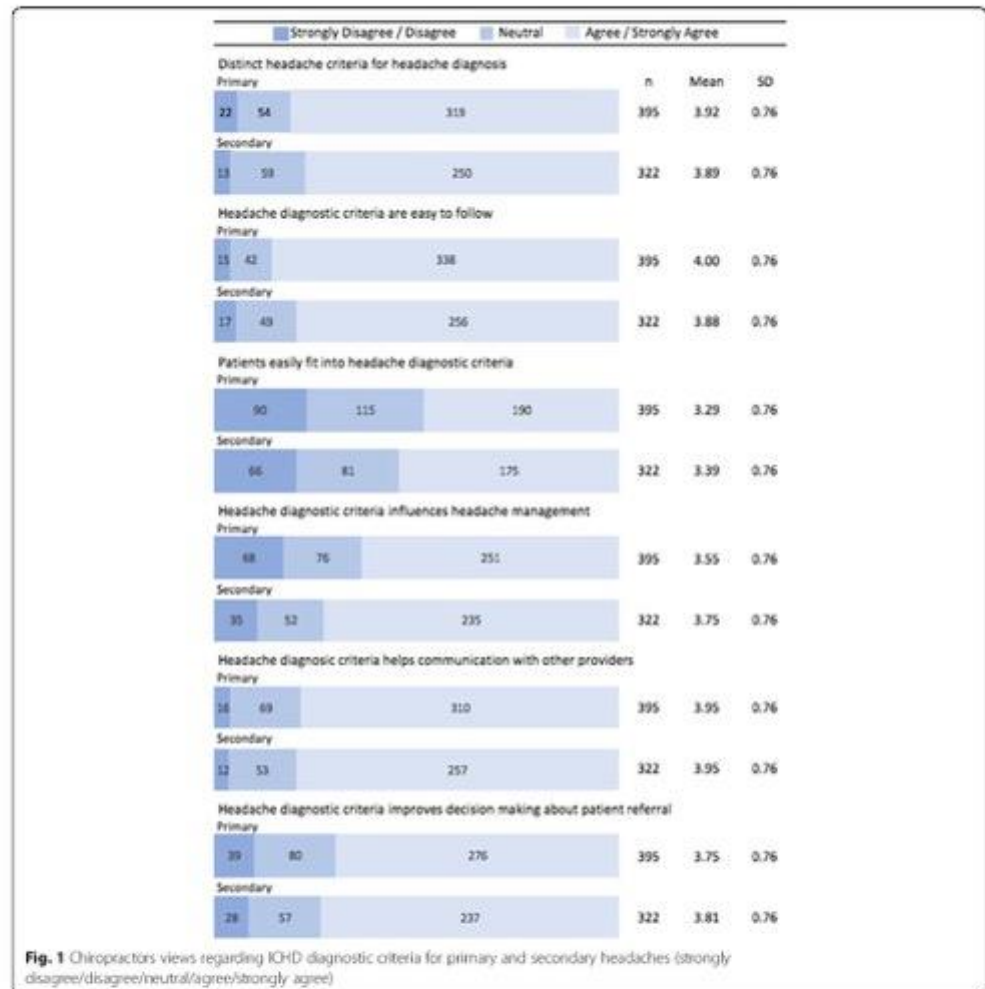
on the importance of a range of headache treatment outcomes. There was a minimum mean agreement score of 4.23 out of 5 for: the importance of treatment providing headache prevention; improving headache recovery and headache pain relief; improving headache-related coping skills; and patient health and well-being.

The most frequent therapeutic approach by participants for migraine management was advice on headache triggers (94.1%), stress management (89.4%) and non-thrust spinal mobilisation (88.4%). The most frequent therapeutic approach by participants for tension headache management was advice on headache triggers (90.9%), stress management (90.1%) and soft tissue therapies (massage, myofascial, stretching or trigger point therapy) to the neck/shoulder area (88.1%). The most frequent therapeutic approach by participants for cervicogenic headache management was prescription exercises for the neck/shoulders (91.7%), spinal manipulation (90.6%) and soft tissue therapies (massage, myofascial, stretching or trigger point therapy) to the neck/shoulder area (88.3%) (Table 2).

When asked about the use of headache assessment instruments, a significant percentage of participants reported 'never' or 'rarely' using MIDAS (96.2%) and HDI (87.3%) headache instruments. The use of headache diaries was reported as 'sometimes' or 'almost every headache patient' by 41% of the chiropractors (data not shown).

Discussion

Results from our study suggest that a large percentage of new and routine chiropractic patient consultations are related to headache management with around one in five new patients presenting to chiropractors with a chief complaint of headache and more than one in three presenting with a secondary complaint of headache. This substantial level of headache caseload within chiropractic clinical settings raises questions about the factors that influence the preference and use of chiropractors for the management of headache compared to the use of other headache providers and treatments. Previous evidence suggests that patient dissatisfaction with preventative headache drug treatments are likely to be an important predictor for headache patient use of manual therapy providers [21]. However, there is a need for more robust research to assess the effectiveness of manual therapies for the prevention of recurrent headaches. To date, systematic reviews report significant methodological short-comings for clinical trials that aim to assess the prevention of migraine with manual therapies [28, 29], while limited, moderate quality evidence appears to support the potential role of manual therapies for the prevention of tension-type headache [30, 31] and cervicogenic headache [32, 33].



Our study results suggest some aspects of headache patient management by chiropractors are consistent with that of medical providers. For example, the proportion of chiropractors reporting the use of primary and secondary headache diagnostic criteria in our study (84.6% and 90.4% respectively) compares favourably with the use of headache diagnosis found within medical care [9, 18]. While headache diagnosis is likely to improve clinical decision-making when managing the healthcare needs of headache sufferers [34], there is currently limited, poor quality information reporting on the proportion of migraine [13], tension headache [22], and

cervicogenic headache within chiropractic clinical settings. As such, more information is needed to better understand the types of headaches and level of headache burden more common to chiropractic clinical settings and how the management of headache patients is influenced by headache diagnosis including approaches to patient examination, education, referral and treatment.

Of note, practitioner use of secondary headache criteria for cervicogenic and medication over-use headache was reported slightly more often than practitioner familiarity with these secondary headache criteria. Poor familiarity with secondary headache criteria raises concerns

Table 1 Interdisciplinary collaboration by chiropractors with other healthcare providers for headache management (sometimes/often compared to never/rarely)

Provider	Receiving (sometimes/often) n = 392	Referring (sometimes/often) n = 392
CAM practitioner	66.1% (n = 259)	66.3% (n = 260)
General practitioner	29.6% (n = 116)	59.9% (n = 235)
Medical specialist (via GP)	3.8% (n = 15)	42.6% (n = 167)
Dentist	25% (n = 98)	40.3% (n = 158)
Psychologist	10.9% (n = 43)	16.6% (n = 65)
Physiotherapist	11.7% (n = 46)	13.3% (n = 52)
Osteopath	5.3% (n = 21)	3.8% (n = 15)

Survey key: Medical specialist (via GP) e.g. neurologist, psychiatrist. CAM practitioner e.g. acupuncturist, herbalist, naturopath, massage therapist, counselor

about the risk to patient outcomes should chiropractors fail to appropriately diagnose secondary headaches. Such concerns could have serious consequences for secondary headaches needing urgent medical management [35]. While fully understanding this finding requires further empirical investigation, another explanation may be that some chiropractors are less familiar with at least some secondary headache diagnostic criteria listed, a finding that may relate to medication overuse headache, a secondary headache condition that can go unrecognized in clinical settings [36]. Additionally, this finding may also relate to practitioner concerns regarding the clinical utility of the diagnostic criteria associated with cervicogenic headache, an issue that has been reported elsewhere [3, 37, 38]. If so, these results may add weight to the need for further research examination into provider understanding, use and acceptance of cervicogenic headache criteria within primary care clinical settings.

The high rate of headache referral (receiving/referring) between chiropractors and other CAM providers in our study is consistent with findings from previous research in Australia and the US [39, 40]. The pattern of high referral between chiropractors and other CAM providers may be influenced by a number of factors including the influence of chiropractic organisations who sometimes promote a drugless approach to patient care [41, 42] or the higher percentage of chiropractors working at the same practice location as other CAM providers when compared to those practicing alongside other healthcare providers [40].

Our study identified that less than one in three chiropractors sometimes or often receive headache referrals from GPs. While the implication of these findings requires further empirical inquiry, this low rate of headache referral from GPs may be due to factors including GP concerns about the current level of evidence to

Table 2 Headache management characteristics by chiropractors (often/almost every headache patient compared to never/rarely)

Treatment approach	Migraine (often/almost all) (n = 387)	Tension headache (often/almost all) (n = 382)	Cervicogenic headache (often/almost all) (n = 382)
Joint-based manipulative therapies			
Spinal manipulation	318(82.2%)	337(87.5%)	349(90.6%)
Non-thrust spinal mobilisations	264(68.4%)	252(65.5%)	252(65.5%)
Instrument adjusting	279(72.1%)	270(70.1%)	273(70.9%)
Drop-piece methods	133(34.4%)	148(38.4%)	153(39.7%)
Soft-tissue based and exercise therapies			
Soft tissue to neck/shoulders	331(85.3%)	339(88.1%)	340(88.3%)
Electro-physical therapies	30(7.8%)	30(7.8%)	30(7.8%)
Soft-tissue/exercise to temporomandibular	252(65.1%)	249(64.7%)	233(60.5%)
Exercises - neck/shoulders	311(81.6%)	337(87.5%)	353(91.7%)
Patient advice and education			
Advice on headache triggers	364(94.1%)	350(90.9%)	338(87.8%)
Advice on diet and fitness	331(85.6%)	336(87.3%)	327(84.9%)
Stress management	346(89.4%)	347(90.1%)	337(87.5%)

Survey key: Spinal manipulation (manual adjusting/manipulation (including Diversified, Gonstead); Drop piece methods (drop-piece/Thompson or similar); Soft tissue - neck/shoulders (massage, myofascial, stretching or trigger points to neck/shoulders); Electro-physical therapies (including TENS, ultrasound)

support the effectiveness of manual therapies for the management of headache or a less favourable GP attitude toward chiropractors as reported in a recent survey which found that 60% of Australian GPs never referred patients to a chiropractor [43]. With systematic reviews reporting evidence to support the potential role of manual therapies for some headache types [31, 32, 44], further research may be needed to better understand the current barriers to collaborative headache management that may exist between these providers. This research priority would seem important given the unmet needs remaining for some headache sufferers under medical care [45–48] and the high use of manipulative therapy providers by headache patients [10, 13, 21].

While the low frequency of headache patient referral between chiropractors and physiotherapy and osteopathic providers in our study may be partly explained by the use of similar approaches to headache treatment [49, 50], the low frequency of headache patient referral between chiropractors and psychologists deserves further consideration. Psychologists are a significant healthcare provider for the management of headache pain [51, 52] and for the management of headache-related comorbidities such as anxiety and depression. [53, 54]. As such, this finding raises questions about whether chiropractors managing headache are fully aware of the psycho-behavioural approaches available to assist in the management of headache. In comparison, the higher frequency of headache patient referral to GPs and medical specialists (via the GP) by chiropractors appears to suggest there are circumstances where chiropractors are working together with medical providers for the management of headache, a finding further supported by the high frequency of referral for the investigation of headache red-flags reported in our study. More information reporting on the types of headaches, level of headache chronicity and disability found within chiropractic headache populations would further help researchers and clinicians to better comprehend the related healthcare needs of this patient population and the clinical circumstances where greater interdisciplinary collaboration is warranted between chiropractors and other headache-related healthcare providers.

The most common therapeutic approaches reported by chiropractors in our study for the management of headache was providing advice on headache triggers, stress management, spinal manipulation, soft tissue therapies and prescriptive neck exercises. Helping patients both identify and manage headache triggers is recognised as an important aspect of headache patient management for those who present with migraine and tension headache within primary care settings [55]. However, the role of manual and exercise therapies for the management of those with recurrent headaches remains less certain with systematic reviews reporting stronger evidence for manual

therapies for the prevention of cervicogenic and tension headache [31, 32] and limited and conflicting evidence for the prevention of migraine [29]. As such, more robust research is needed to assess the effectiveness of both uni-modal and multi-modal approaches to headache management by chiropractors, including for the management of both acute and chronic headache sub-types.

The chiropractors in our study most often provided between 5 and 10 treatments during an initial headache treatment plan while a slightly higher average number of treatments were provided for those with headaches of longer duration (more than 3 months). This number of treatments is similar to the number of treatments associated with significant improvement in headache outcomes for spinal mobilisation and manipulation reported in previous tension headache and cervicogenic headache studies [56, 57]. While information is limited regarding the relative costs associated with chiropractic headache management, one recent US study compared the cost of headache care using risk-adjusted scores that would otherwise affect the level of healthcare utilization [58]. This study found headache treatment costs were significantly higher both for medical doctor-only care when compared to chiropractic-only care and for medical doctor care combined with physical therapy care compared to medical doctor care combined with chiropractic care.

Our study found chiropractors more frequently engage the use of patient headache diaries, an approach to headache assessment that can help to reduce patient difficulty in recalling headache characteristics and their response to headache treatment [59]. However, the use of formal headache instruments such as MIDAS and HDI was comparatively low, a finding reported within other primary care settings [9, 60]. These validated headache instruments can assist health care providers to better understand headache disability, exacerbations and remissions and circumstances that indicate the need for specialty care [25, 61, 62]. As such, the low use of validated headache instruments reported in our study raises questions about best practice with regards to chiropractors more fully assessing headache patients to better understand clinical findings associated with more complex headache patient presentations.

A key strength of our study is the nationally representative cross-sectional sample of chiropractors in order to provide important preliminary information on the current state of chiropractic headache practice. It is however important to acknowledge several limitations to our study. While the online survey provided a direct reference and link to the ICHD-3 classification criteria for primary and secondary headaches, a comprehensive list of the headache criteria was not provided within the survey prior to asking respondents if they were familiar with the diagnostic criteria for the primary and secondary headaches listed.

Furthermore, the survey has not aimed to explore diagnosis and management of chronic headache types (15 or more days per month over a 3-month period). The response rate for our sample (36%), while similar to other studies of this type, is limited to 12% of the total practitioner population nationally. As a result, there may be important differences in the headache management characteristics between survey respondents and non-respondents. This would include the risk of selection bias that may result from the random selection of chiropractors within a PBRN compared to outside the PBRN. The Likert categories utilized in parts of the survey questionnaire are open to practitioner interpretation and findings are based upon self-report and retrospective recall and subject to recall bias. In addition, our study did not provide any assessment of adverse events that may result from manual therapies for the management of headaches. However, these findings draw upon a national sample of chiropractors in order to provide valuable insights for future investigation to further our understanding of the management of headache patients by this provider group.

Conclusions

Our national-based sample suggests headache is a substantial proportion of chiropractic caseload. While some aspects of chiropractic headache management, including the acceptance and use of headache diagnostic criteria, appears to be consistent with good clinical practice, other aspects of chiropractic headache management raise questions worthy of further research enquiry. Critically, there is a need for more detailed information on the proportion of headache types and level of headache chronicity and disability found within chiropractic headache patient populations. This information will help practitioners, researchers and policy-makers to better understand the healthcare needs associated with headache patients who seek help from this common provider of headache management.

Additional file

Additional file 1: Survey questionnaire. (PDF 2893 kb)

Abbreviations

ACORN: Australian chiropractic research network; CAM: Complementary and alternative medicine; HDI: Headache disability inventory; ICHD: International classification of headache disorders; MIDAS: Migraine disability assessment questionnaire; PBRN: Practice-based research network

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Availability of data and materials

The datasets used and/or analysed during the current study are available from the corresponding author on reasonable request.

Authors' contributions

CM, AL, DS and JA designed the paper. CM and DS carried out the data collection, analysis and interpretation. CM wrote the drafts with revisions made by AL, DS and JA. All authors contributed to the intellectual content. All authors read and approved the final manuscript.

Ethics approval and consent to participate

This study was approved by the Human Research Ethics Committee at the University of Technology Sydney (Approval number: ETH16-0638). Consent was implied by completing the survey.

Consent for publication

Not applicable.

Competing interests

All the authors declare that they have no competing interests related to the contents of this manuscript. Furthermore, all authors declare that they have received no direct or indirect payment in preparation of this manuscript.

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Appendix 14: 'The prevalence and factors associated with the use of primary headache diagnostic criteria by chiropractors' (published version)

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RESEARCH

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Prevalence and factors associated with the use of primary headache diagnostic criteria by chiropractors



Craig Moore^{1*}, Andrew Leaver², David Sibbritt¹ and Jon Adams¹

Abstract

Background: The diagnosis of primary headaches assists health care providers in their decision-making regarding patient treatment, co-management and further evaluation. Chiropractors are popular health care providers for those with primary headaches. The aim of this study is to examine the clinical management factors associated with chiropractors who report the use of primary headache diagnostic criteria.

Methods: A cross-sectional survey was distributed between August and November 2016 to a random sample of Australian chiropractors who are members of a practice-based research network ($n = 1050$) who had reported 'often' providing treatment for patients with headache disorders to report on practitioner approaches to headache diagnosis, management, outcome measures and multidisciplinary collaboration. Multiple logistic regression was conducted to assess the factors that are associated with chiropractors who report using International Classification of Headache Disorders (ICHD) primary headache diagnostic criteria.

Results: With a response rate of 36% ($n = 381$), the majority of chiropractors report utilising ICHD primary headache diagnostic criteria (84.6%). The factors associated with chiropractors who use ICHD primary headache diagnostic criteria resulting from the regression analysis include a belief that the use of ICHD primary headache criteria influences the management of patients with primary headaches (OR = 7.86; 95%CI: 3.15, 19.60); the use of soft tissue therapies to the neck/shoulders for tension headache management (OR = 4.33; 95%CI: 1.67, 11.19); a belief that primary headache diagnostic criteria are distinct for the diagnosis of primary headaches (OR = 3.64; 95%CI: 1.58, 8.39); the use of headache diaries (OR = 3.52; 95%CI: 1.41, 8.77); the use of ICHD criteria improves decision-making regarding primary headache patient referral/co-management (OR = 2.35; 95%CI: 1.01, 5.47); referral to investigate a headache red-flag (OR = 2.67; 95%CI: 1.02, 6.96) and not referring headache patients to assist headache prevention (OR = 0.16; 95%CI: 0.03, 0.80).

Conclusion: Four out of five chiropractors managing headache are engaged in the use of primary headache diagnostic criteria. This practice is likely to influence practitioner clinical decision-making around headache patient management including their co-management with other health care providers. These findings call for a closer assessment of headache characteristics of chiropractic patient populations and for further enquiry to explore the role of chiropractors within interdisciplinary primary headache management.

Keywords: Chiropractic, Headache diagnosis, Migraine, Tension headache, Cluster headache, Manual therapy, Practice-based research network (PBRN)

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Background

The global adult prevalence of tension-type headache and migraine is reported to be approximately 40 and 10%, respectively [1–3]. These headaches constitute a substantial burden on the personal health and productivity of sufferers [4, 5] and cause a significant drain on healthcare resources [6, 7]. While those with chronic tension headache can sometimes report greater headache pain than those with migraine [8], migraine is one of the top 10 causes of years lived with disability [9] and the third leading cause of disability for those under the age of fifty [10].

Significant challenges remain regarding the management of headache patients. Headache patients are often poorly or under diagnosed [11], under treated [12, 13] or can fail to receive effective interdisciplinary management [14, 15]. Such challenges have led international headache organisations [16–18] and headache researchers [19, 20] to call for more effective health care service delivery for this significant patient population. While general practitioners (GPs) are typically the first point of contact for those with primary headaches [7, 21], sufferers can enter the healthcare system via a range of health care providers [22–24]. The use of chiropractors for headache management is likely most often for primary headaches, with studies reporting substantial use in the North America [25, 26], Australia [27] and parts of Europe [24, 28]. Despite the substantial use of chiropractors by those with primary headaches, little is known about how these practitioners manage this patient population. Such information can improve our understanding of headache-related health care delivery services and the role of these providers within the wider landscape of headache patient management.

The 3rd edition of International Classification of Headache Disorders (ICHD) outlines the current criteria utilised for headache diagnosis [29]. Headache diagnosis is a key determinant that will influence practitioner decision-making around headache patient care. While a recent study reported the high use of headache diagnosis by chiropractors [30], there is little information regarding how primary headache diagnosis influences the clinical management of headaches by these providers. In direct response, the aim of this study was to draw upon a national sample of chiropractors to identify the headache patient management factors associated with those practitioners who utilise.

Methods

The data analysed in this study was drawn from a questionnaire distributed to members (chiropractors) of a national practice-based research network (PBRN) titled the Australian Chiropractic Research Network (ACORN) project [31]. This study was approved by the Human

Research Ethics Committee at the University of Technology Sydney (Approval number ETH16–0639).

Recruitment and sample

Detailed information about the ACORN PBRN recruitment and data base has been previously reported [31, 32], but briefly, ACORN recruitment was conducted via an invitation pack that included a baseline questionnaire disseminated between March and June 2015 to all registered Australian chiropractors. Invitation pack distribution was via email (with an embedded link to online questionnaire), postal distribution (hard copy questionnaire), regional chiropractic conferences (hard copy questionnaire) and the official ACORN website (with an embedded link to the online questionnaire). Forty-three percent ($n = 1680$) of all registered Australian chiropractors joined the ACORN network database. The socio-demographic profile of the ACORN database is representative of the wider chiropractic profession across Australia in terms of gender, age and practice location [32].

Participants for this PBRN sub-study were randomly selected from the ACORN practitioners who had reported that they 'often' provided treatment for patients with headache disorders in the ACORN PBRN invitation pack questionnaire. Participants were asked to complete a 31-item cross-sectional online survey between August and November 2016. An embedded link to the questionnaire was emailed to chiropractors. Three further reminders to complete the survey were sent out during the recruitment period. Participation in the survey was further promoted within routine email newsletters sent out by the Australian Chiropractors Association during that period.

Questionnaire

The introduction to the questionnaire explained the purpose, contents and approximate duration of the study and that respondent information was anonymous and survey completion voluntary. No incentives were offered to participate, and consent was implied by completing the survey. Questionnaire items specifically developed for this study aimed to examine chiropractic headache management across several clinical themes considered important to frontline headache management practice. With no validated instruments available, the key themes adopted for our study questionnaire were developed after consideration of past surveys examining the management of headache patients in primary care settings [11, 33, 34]. The survey collected information on practitioner characteristics, including gender, place of education, practice location and years in practice. Prevalence of headache in chiropractic practice was based on self-report on patient consultations over the previous two weeks. The use of formal diagnostic criteria for

headaches was based on International Classification of Headache Disorders (ICHD-3 Beta) criteria [35]. The survey design included descriptions of primary headache criteria for migraine, tension-type headache and cluster headache and for secondary headache criteria for cervicogenic and medication overuse headache. The use of headache treatment outcome instruments was based on the use of the Headache Disability Index (HDI) [36], Migraine Disability Index (MIDAS) [37] and standard patient headache diaries [38]. Patient management included questions on collaboration with other healthcare providers associated with headache management (sending and receiving) and questions on the basis for patient referral. The questions on headache management provided a list of therapeutic approaches for headache including patient education on headache triggers, physical therapies and manual therapies utilised for headache (e.g. spinal manipulation, mobilisation, massage therapy).

The primary headache management questions included in the questionnaire were based upon primary headaches previously reported as most often treated by chiropractors [24, 39, 40] and after consultation with 10 practicing Australian chiropractors during survey pilot testing. The pilot testing findings were discussed between all members of the research team to assist decisions about survey duration and the selection of the survey themes and item options. This included the selection of headache treatment outcome measures, where we considered practitioner familiarity and understanding of the nature and purpose of select outcome instruments as well as treatment terminology and their views on relevance to headache management. All questionnaire items were either reported as ratings on a 4-point or 5-point Likert scale or as dichotomous (yes/no).

Statistical analyses

Summary statistics were presented by number (percentage), mean (SD) as appropriate. In-order to test the differences in continuous and categorical variables by group, we have used Student's t-test and chi-square test or Fishers exact test respectively (Table 1). Bivariate comparison of clinical management characteristics, headache referral characteristics, importance of headache treatment outcomes and headache management characteristics were made between chiropractors who indicated the use ICHD headache classification criteria for the diagnosis of primary headaches (i.e. yes/no) using chi-square/Fishers exact test as appropriate (Tables 2, 3, 4, 5).

Multiple logistic regression modelling was then performed to identify independent predictors associated with those chiropractors who use ICHD primary headache criteria (presented in Table 6). Questionnaire response items are dichotomized into "Strongly disagree/

Disagree/Neutral" versus "Agree/Strongly agree" with bivariate associations of $p < 0.2$ included in the regression model. The independent survey variables were dichotomized after consideration of previous research [41, 42] and the distribution of the data. A backward stepwise procedure was chosen to determine the most parsimonious model that predicts those chiropractors who use primary headache diagnostic criteria. Statistical significance was set at $p < 0.05$. Odds ratios were reported with 95% confidence intervals. All statistical analyses were conducted using the statistical software Stata 13.1.

Results

A total of 1050 chiropractors were invited to participate of which 381 (36.2%) completed the questionnaire. As shown in Table 1, the sub-study sample of participants was compared to the wider ACORN sample and was shown to be similar across gender ($p = 0.379$), place of practice ($p = 0.916$) suggesting survey respondents are generally representative (non-significant p values) of the ACORN database participants while our sample was slightly more experienced than the ACORN database members for years in practice ($p = 0.003$). The majority of questionnaire respondents were male (64%) and the

Table 1 Comparison of survey population with ACORN membership based on demographic characteristics

Characteristic	Survey Population	ACORN Database	<i>p</i> -value
Gender (%)			
Male	64	63	$p = 0.379$
Female	36	37	
Place of Practice (%)			
New South Wales	35.1	34	$p = 0.916$
Victoria	23.2	25	
Queensland	15.2	15	
Western Australia	14.7	13	
South Australia	8.5	9	
Australian Capital Territory	1.6	2	
Tasmania	0.9	1	
Northern Territory	0.5	1	
Place of Education (%)			
New South Wales	38.6	N. A.	
Victoria	35.6	N. A.	
Queensland	0.8	N. A.	
Western Australia	9.7	N. A.	
Other	15.3	N. A.	
Years in Practice (mean \pm sd)	18.1 \pm 10.9	15.6 \pm 11.2	$p = 0.003$

N. A. denotes comparative data not available for place of education

Table 2 Clinical management characteristics across the use of ICHD primary headache diagnostic criteria

Chiropractic headache classification/assessment		Used diagnostic criteria for primary headache types		p-value
		No (n = 61)	Yes (n = 334)	
Headache classification criteria (views)		%	%	
ICHD primary headache diagnostic criteria are distinct for the diagnosis of primary headaches	Strongly disagree	3	1	< 0.001
	Disagree	10	4	
	Neutral	34	10	
	Agree	46	66	
	Strongly agree	7	19	
ICHD primary headache diagnostic criteria are easy to follow	Strongly disagree	5	1	< 0.001
	Disagree	5	2	
	Neutral	23	8	
	Agree	62	67	
	Strongly agree	5	22	
Patients with primary headache easily fit into ICHD primary headache diagnostic criteria	Strongly disagree	6	1	< 0.001
	Disagree	43	17	
	Neutral	25	29	
	Agree	23	46	
	Strongly agree	3	5	
ICHD primary headache diagnostic criteria influences headache management	Strongly disagree	13	2	< 0.001
	Disagree	41	9	
	Neutral	28	17	
	Agree	18	58	
	Strongly agree	0	14	
ICHD primary headache diagnostic criteria helps communication with other healthcare professionals	Strongly disagree	5	0	< 0.001
	Disagree	13	1	
	Neutral	36	14	
	Agree	41	60	
	Strongly agree	5	25	
ICHD primary headache diagnostic criteria improves decision-making about patient referral or co-management	Strongly disagree	10	1	< 0.001
	Disagree	29	4	
	Neutral	36	17	
	Agree	23	58	
	Strongly agree	2	20	
Headache outcome criteria				
Use of Migraine Disability Assessment Test (MDAS)	Never	97	69	< 0.001
	Rarely	3	27	
	Often	0	4	
	Every new headache patient	0	1	
	Use of Headache Disability Inventory (HDI)	91	60	
Rarely	9	24		
Often	0	12		
Every new headache patient	0	3		

Table 2 Clinical management characteristics across the use of ICHD primary headache diagnostic criteria (Continued)

Chiropractic headache classification/assessment		Used diagnostic criteria for primary headache types		p-value
		No (n = 61)	Yes (n = 334)	
Use of Headache Diary	Never	43	18	< 0.001
	Rarely	40	37	
	Often	14	42	
	Every new headache patient	3	4	

average number of years in practice was 18.1 (SD = 10.9) years. Most participants were educated in Australia including New South Wales (38.6%), Victoria (35.6%), Western Australia (9.7%) and Queensland (0.8%). Place of practice amongst the participants was greatest in New South Wales (35.1%), followed by Victoria (23.2%), Queensland (15.2%), Western Australia (14.7%), South Australia (8.5%), Australian Capital Territory (1.6%), Tasmania (0.9%) and Northern Territory (0.5%). Participant demographic characteristics were consistent with national chiropractic registration records [43].

Factors associated with ICHD use for primary headaches

The majority of chiropractors reported utilising ICHD criteria for the diagnosis of primary headaches (84.6%). The clinical management characteristics of chiropractors who use or do not use the ICHD primary headache classification criteria are presented in Table 2. Chiropractors who use ICHD diagnostic criteria for primary headaches were more likely to believe that: ICHD criteria are distinct for the diagnoses of primary headache types; believe ICHD criteria are easy to follow; believe primary headaches easily fit into ICHD diagnostic criteria; believe ICHD criteria influences management of patients with primary headaches; ICHD criteria helps communication with other healthcare professionals; and improves decision-making about patient referral or co-management for those with primary headaches (all $p < 0.001$). In addition, those chiropractors who use primary headache diagnostic criteria were also more likely to use a Migraine Disability Assessment Test (MIDAS); the Headache Disability Inventory (HDI); and patient headache diaries (all $p < 0.001$).

Table 3 shows the referral characteristics of chiropractors who use or do not use the ICHD primary headache classification criteria. Chiropractors who used the ICHD primary headache diagnostic criteria were more likely to receive a headache referral from a general practitioner, medical specialist (including neurologist, rheumatologist, orthopaedic, psychiatrist), psychologist, CAM practitioners (including acupuncturist, herbalist, naturopath, massage therapist, counsellor) (all $p < 0.001$) and dentist ($p = 0.002$), compared to chiropractors who do not use

the ICHD primary headache diagnostic criteria and less likely to receive headache referrals from a physiotherapist ($p = 0.684$) or osteopath ($p = 0.154$) although these associations were not statistically significant. Further, chiropractors who use the ICHD primary headache diagnostic criteria were also more likely to refer headache patients for further management to general practitioners ($p < 0.001$), medical specialists ($p < 0.001$), psychologist ($p = 0.004$), dentist ($p = 0.001$), and CAM practitioners (including acupuncturist, herbalist, naturopath, massage therapist, counsellor) ($p = 0.001$), compared to chiropractors do not use the ICHD primary headache diagnostic criteria and were less likely to refer a headache patient to a physiotherapist ($p = 0.106$) although these associations were not statistically significant. Chiropractors who use ICHD primary headache criteria were more likely to refer patients for reasons of confirming headache diagnosis ($p < 0.001$), improve coping skills ($p < 0.001$), investigate headache red-flags ($p < 0.001$), provide pain relief for acute headache attacks ($p = 0.004$) and to provide headache prevention ($p = 0.004$), compared to chiropractors do not use the ICHD primary headache diagnostic criteria.

The importance of headache treatment outcomes of chiropractors who use or do not use the ICHD primary headache classification criteria are presented in Table 4. Chiropractors who use ICHD primary headache criteria are more likely to aim their treatment toward improving the recovery from an episode of headaches i.e. postdromal headache period ($p = 0.043$), to provide pain relief during headache episode ($p = 0.049$) and improve headache related coping skills ($p = 0.001$) and less likely to aim treatment toward headache prevention ($p = 0.317$) or to improve headache patient overall health and well-being ($p = 0.411$) although these associations were not statistically significant.

Table 5 shows the approaches to primary headache management of chiropractors who use or do not use the ICHD primary headache classification criteria. For patients with migraine, chiropractors who use primary headache diagnostic criteria were also more likely to: provide non-thrust spinal mobilisations ($p = 0.001$); provide massage, myofascial technique, stretching or trigger-points to neck/shoulder area ($p < 0.001$); use soft

Table 3 Headache referral characteristics across the use of ICHD primary headache diagnostic criteria

Chiropractic headache referral		Used diagnostic criteria for primary headache types		p-value	
		No (n = 61)	Yes (n = 334)		
	Headache referral (receiving)	%	%		
Headache referral from GP	Never	42	27	< 0.001	
	Rarely	46	40		
	Sometimes	7	29		
	Often	5	4		
Headache referral from medical specialist (neurologist, rheumatologist, orthopaedic, psychiatrist)	Never	89	77	< 0.001	
	Rarely	9	19		
	Sometimes	2	4		
	Often	0	1		
Headache referral from Psychologist	Never	89	68	< 0.001	
	Rarely	9	19		
	Sometimes	2	11		
	Often	0	2		
Headache referral from Dentist	Never	67	40	0.002	
	Rarely	21	33		
	Sometimes	9	23		
	Often	4	5		
Headache referral from Physiotherapist	Never	74	67	0.684	
	Rarely	19	21		
	Sometimes	7	10		
	Often	0	2		
Headache referral from Osteopath	Never	89	78	0.154	
	Rarely	11	16		
	Sometimes	0	5		
	Often	0	1		
Headache referral from CAM practitioners (inc. acupuncturist, herbalist, naturopath, massage therapist, counsellor)	Never	28	11	< 0.001	
	Rarely	28	19		
	Sometimes	35	47		
	Often	9	23		
Headache referral (sending)					
	Headache referral to GP	Never	19	7	< 0.001
		Rarely	46	29	
		Sometimes	33	55	
Often		2	9		
Headache referral to medical specialist (neurologist, rheumatologist, orthopaedic, psychiatrist) via GP	Never	25	17	< 0.001	
	Rarely	58	36		
	Sometimes	18	42		
	Often	0	4		
Headache referral to Psychologist	Never	74	47	0.004	
	Rarely	19	34		
	Sometimes	7	16		
	Often	0	2		

Table 3 Headache referral characteristics across the use of ICHD primary headache diagnostic criteria (Continued)

Chiropractic headache referral		Used diagnostic criteria for primary headache types		p-value
		No (n = 61)	Yes (n = 334)	
Headache referral to Dentist	Never	39	15	0.001
	Rarely	32	42	
	Sometimes	26	37	
	Often	4	5	
Headache referral to Physiotherapist	Never	72	54	0.106
	Rarely	21	31	
	Sometimes	7	13	
	Often	0	2	
Headache referral to Osteopath	Never	91	74	0.025
	Rarely	7	21	
	Sometimes	2	4	
	Often	0	0	
Headache referral to CAM practitioners (eg. acupuncturist, naturopath, massage therapist, counsellor)	Never	23	7	0.001
	Rarely	28	23	
	Sometimes	33	50	
	Often	16	20	
Headache referral (reasons)				
Headache referral to confirm headache diagnosis	Never	54	21	< 0.001
	Rarely	32	43	
	Sometimes	12	32	
	Often	2	4	
Headache referral to improve coping skills and headache disability management	Never	39	11	< 0.001
	Rarely	26	31	
	Sometimes	33	47	
	Often	2	10	
Headache referral to investigate headache red-flag	Never	0	1	< 0.001
	Rarely	42	12	
	Sometimes	42	51	
	Often	16	36	
Headache referral to provide pain relief for acute headache attacks	Never	26	10	0.004
	Rarely	33	29	
	Sometimes	33	48	
	Often	7	12	
Headache referral to help provide headache prevention	Never	37	17	0.004
	Rarely	33	35	
	Sometimes	25	39	
	Often	5	9	

tissue or exercise therapy to temporo-mandibular region ($p < 0.001$); prescribe exercises for the neck and shoulder region ($p < 0.001$); provide advice on stress management ($p = 0.019$) and headache triggers ($p = 0.005$), compared to chiropractors do not use the ICHD primary

headache diagnostic criteria. They were less likely to provide manual manipulation ($p = 0.751$), instrument adjusting ($p = 0.407$), drop piece adjusting (0.944), electro-physical therapies ($p = 0.236$) and advice on diet or fitness ($p = 0.057$) although these associations

Table 4 Importance of headache treatment outcomes across the use of ICHD primary headache diagnostic criteria

Chiropractic headache management/treatment		Used diagnostic criteria for primary headache types		p-value
		No (n = 61)	Yes (n = 334)	
Importance of treatment outcomes		%	%	
Treatment aimed to prevent headache episodes	Very unimportant	11	5	0.317
	Somewhat unimportant	0	0	
	Neutral	0	1	
	Somewhat important	13	10	
	Very important	77	84	
Treatment aimed to improve recovery from episode of headaches	Very unimportant	9	4	0.043
	Somewhat unimportant	2	1	
	Neutral	0	1	
	Somewhat important	27	16	
	Very important	62	78	
Treatment aimed at pain relief during headache episode	Very unimportant	9	3	0.019
	Somewhat unimportant	0	1	
	Neutral	5	3	
	Somewhat important	41	32	
	Very important	45	61	
Treatment aimed to improve headache coping skills	Very unimportant	7	2	0.001
	Somewhat unimportant	11	3	
	Neutral	16	8	
	Somewhat important	32	35	
	Very important	34	52	
Treatment aimed to improve overall health and well-being	Very unimportant	9	4	0.411
	Somewhat unimportant	0	2	
	Neutral	2	3	
	Somewhat important	12	16	
	Very important	77	75	

were not statistically significant. For patients with tension headache, chiropractors who use primary headache diagnostic criteria were more likely to: provide non-thrust spinal mobilisations ($p = 0.003$); use massage, myofascial technique, stretching or trigger-points to neck/shoulder area ($p < 0.001$); use soft tissue or exercise therapy to temporomandibular region ($p = 0.017$); prescribe exercises for the neck/shoulder region ($p < 0.001$); provide advice on stress management ($p = 0.002$) and headache triggers ($p < 0.001$), compared to chiropractors do not use the ICHD primary headache diagnostic criteria. They were less likely to provide manual manipulation ($p = 0.291$), instrument adjusting ($p = 0.810$), drop piece adjusting ($p = 0.662$), electro-physical therapies ($p = 0.374$), and advice on diet and fitness ($p = 0.480$) although these associations were not statistically significant.

The results of the multiple logistic regression modeling used to identify the important independent factors associated with chiropractors who use ICHD primary headache diagnostic criteria compared to those chiropractors who do not use ICHD primary headache diagnostic criteria are presented in Table 6. These factors include a belief that: the use of ICHD primary headache criteria will influence their management of patients with primary headaches (OR = 7.86; 95%CI: 3.15, 19.6); improve decision-making about primary headache patient referral/co-management (OR = 2.35; 95%CI: 1.01, 5.47); and not referring headache patients to assist with headache prevention (OR = 0.16; 95%CI: 0.03, 0.80). Chiropractors who use ICHD criteria for the diagnosis of primary headaches are also associated with: believing ICHD criteria are distinct criteria for the diagnoses of primary headache types (OR = 3.64; 95%CI: 1.58, 8.39);

Table 5 Headache management characteristics across the use of ICHD primary headache diagnostic criteria

Chiropractic headache management		Used diagnostic criteria for primary headache types		p-value
		No (n = 61)	Yes (n = 334)	
Chiropractic headache management - migraine		%	%	
Manual adjusting/manipulation (including Diversified, Gonstead)	Never	7	5	0.751
	Rarely	14	12	
	Often	45	51	
	Almost every migraine patient	34	32	
Non-thrust spinal mobilisations	Never	18	9	0.001
	Rarely	37	19	
	Often	34	58	
	Almost every migraine patient	11	14	
Instrument adjusting	Never	14	9	0.407
	Rarely	18	18	
	Often	48	58	
	Almost every migraine patient	20	14	
Drop piece, Thompson or similar	Never	29	29	0.944
	Rarely	34	37	
	Often	22	28	
	Almost every migraine patient	5	6	
Massage, myofascial technique, stretching or trigger-points to neck/shoulder area	Never	9	2	< 0.001
	Rarely	25	9	
	Often	48	42	
	Almost every migraine patient	18	47	
Electro-physical therapies (TENS, ultrasound etc)	Never	89	77	0.236
	Rarely	9	15	
	Often	2	7	
	Almost every migraine patient	0	2	
Soft tissue or exercise therapy to temporomandibular region	Never	29	5	< 0.001
	Rarely	20	27	
	Often	41	54	
	Almost every migraine patient	11	14	
Prescriptive exercises for the neck/shoulder region	Never	14	2	< 0.001
	Rarely	20	14	
	Often	46	52	
	Almost every migraine patient	20	33	
Advice on stress management	Never	2	0	0.019
	Rarely	16	9	
	Often	59	51	
	Almost every migraine patient	23	41	
Advice on diet or fitness	Never	2	1	0.057
	Rarely	12	14	
	Often	64	49	
	Almost every migraine patient	21	37	
Advice on Headache triggers	Never	0	0	0.005

Table 5 Headache management characteristics across the use of ICHD primary headache diagnostic criteria (Continued)

Chiropractic headache management		Used diagnostic criteria for primary headache types		p-value
		No (n = 61)	Yes (n = 334)	
	Rarely	14	5	
	Often	52	45	
	Almost every migraine patient	34	50	
Chiropractic headache management - tension headache				
Manual adjusting/manipulation (including Diversified, Gonstead)	Never	9	4	0.291
	Rarely	11	7	
	Often	36	42	
	Almost every tension headache patient	45	47	
Non-thrust spinal mobilisations	Never	27	11	0.003
	Rarely	27	21	
	Often	38	52	
	Almost every tension headache patient	9	16	
Instrument adjusting	Never	14	11	0.810
	Rarely	20	18	
	Often	48	55	
	Almost every tension headache patient	18	16	
Drop piece, Thompson or similar	Never	32	35	0.662
	Rarely	25	27	
	Often	38	30	
	Almost every tension headache patient	5	8	
Massage, myofascial technique, stretching or trigger-points to neck/shoulder area	Never	5	3	< 0.001
	Rarely	27	6	
	Often	43	40	
	Almost every tension headache patient	25	51	
Electro-physical therapies (TENS, ultrasound etc)	Never	89	79	0.374
	Rarely	9	13	
	Often	2	6	
	Almost every tension headache patient	0	2	
Soft tissue or exercise therapy to temporo-mandibular region	Never	18	8	0.017
	Rarely	32	25	
	Often	43	50	
	Almost every tension headache patient	7	18	
Prescriptive exercises for the neck/shoulder region	Never	11	1	< 0.001
	Rarely	20	8	
	Often	45	45	
	Almost every tension headache patient	25	46	
Advice on stress management	Never	2	0	0.002

Table 5 Headache management characteristics across the use of ICHD primary headache diagnostic criteria (Continued)

Chiropractic headache management		Used diagnostic criteria for primary headache types		p-value
		No (n = 61)	Yes (n = 334)	
Advice on diet or fitness	Rarely	14	9	0.480
	Often	59	42	
	Almost every tension headache patient	25	49	
	Never	2	2	
	Rarely	11	11	
	Often	59	48	
Headache triggers advice	Almost every tension headache patient	29	39	< 0.001
	Never	7	0	
	Rarely	14	7	
	Often	46	47	
	Almost every tension headache patient	32	46	

ICHD primary headache diagnostic criteria influences the use of soft-tissue therapies to neck and shoulder region for tension headache (OR = 4.33; 95%CI: 1.67, 11.19); the use headache diaries as a headache outcome measure (OR = 3.52; 95%CI: 1.41, 8.77) and referral to investigate a headache red-flag (OR = 2.67; 95%CI: 1.02, 6.96).

Discussion

This is the first study to provide detailed information on the patient management features associated with primary headache diagnosis by chiropractors. The majority of chiropractors in our study report utilising ICHD

criteria for the diagnosis of primary headaches, a finding which may suggest that chiropractors are sometimes the first point of provider contact for patients seeking help for the management of primary headache disorders. There are a number of factors that can challenge health care providers delivering an accurate primary headache diagnosis. These include the co-occurrence of migraine with both cervicogenic headache [44] and tension-type headache [45], variations in headache characteristics found within headache types [46] and the high prevalence of co-occurring neck pain associated with common recurrent headaches [47, 48]. With misdiagnosis resulting in

Table 6 Logistic regression analysis identifying associations with chiropractors who use ICHD primary headache diagnostic criteria

Factors		Odds Ratio	95% C.I.	p-value
ICHD primary headache diagnostic criteria influences headache management	Strongly Disagree/Disagree/Neutral	1.00		
	Agree/Strongly Agree	7.86	3.15, 19.60	< 0.001
ICHD primary headache diagnostic criteria improves decision-making about headache patient referral/co-management	Strongly Disagree/Disagree/Neutral	1.00		
	Agree/Strongly Agree	2.35	1.01, 5.47	0.046
Referral to investigate a headache red-flag	Never/Rarely/Sometimes	1.00		
	Often	2.67	1.02, 6.96	0.045
Referral to assist headache prevention	Never/Rarely/Sometimes	1.00		
	Often	0.16	0.03, 0.80	0.026
ICHD primary headache diagnostic criteria are distinct for the diagnosis of primary headaches	Strongly Disagree/Disagree/Neutral	1.00		
	Agree/Strongly Agree	3.64	1.58, 8.39	0.002
Massage, myofascial technique, stretching or trigger-points to neck/shoulder area for tension headache management	Never/rarely	1.00		
	Often/Almost every new patient with tension headache	4.33	1.67, 11.19	0.003
Headache diary	Never/rarely	1.00		
	Often/Every new patient with headache	3.52	1.41, 8.77	0.007

suboptimal headache patient management [49, 50], poor standards of headache diagnosis have raised concerns about the current level of headache education within primary health care curriculums [11, 49, 51]. Our study found almost half of those chiropractors engaged in primary headache diagnosis implement the use of patient headache diaries. The mixed use of headache diaries has been reported in other primary care settings [52]. While this practice is likely to improve diagnostic accuracy [38, 53], further research would be valuable in assessing the reliability of primary headache diagnosis as undertaken by chiropractors, information that can similarly inform chiropractic educational curriculums. Despite the high percentage of chiropractors self-reporting the utilisation of ICHD primary headache diagnostic criteria, uncertainty remains regarding how effectively chiropractors identify headache criteria in order to provide an accurate headache diagnosis.

Our study found several factors that were associated with chiropractors engaged in primary headache diagnosis. These chiropractors include a belief that the use of ICHD primary headache criteria influences their patient management. Previous studies have reported the use of manual therapies, exercise therapies and advice on headache triggers as common to chiropractic headache management [30, 54]. While advice on headache triggers is well recognised as an important aspect of primary headache management [55, 56], the effectiveness of manual and exercise therapies for the prevention of primary headaches requires further evaluation. To date, research evidence supports the role of manual and exercise therapies for the preventative treatment of tension headache [57, 58], while research supporting the role of these therapies for the prevention of migraine remains low quality and inconclusive [59, 60]. In contrast, around 10% of chiropractors who use primary headache diagnosis were not associated with ICHD primary headache diagnostic criteria influencing headache management. While this finding requires further investigation, it may be that providing a diagnosis of the patient's headache type relates more to other motivations for a small number of practitioners. This could include to inform the headache patient or satisfy potential oversight from regulatory authorities. As such, more research is needed to examine how aspects of primary headache patient management are potentially improved through the use of primary headache diagnosis within chiropractic clinical settings.

Our analysis found several factors associated with chiropractors engaged in primary headache diagnosis that were related to specific aspects of practitioner decision-making regarding headache patient management. For example, our study found chiropractors engaged in the use of ICHD primary headache diagnostic criteria are more likely to believe doing so improves decision-making related to

headache patient referral/co-management. The health care needs of primary headache sufferers can sometimes be multifactorial and multidisciplinary in nature, particularly for those who present with more complex and chronic headache conditions where a greater use of pharmaceutical, behavioural and physical approaches to patient care may be needed [61, 62]. Previous research has suggested that those with headaches seeking help from manual therapy providers are more likely have a higher rate of headache chronicity and disability than non-users [40]. As such, the belief that primary headache diagnosis improves decision-making about headache patient referral/co-management associated with chiropractors engaged in primary headache diagnosis may reflect practitioner awareness regarding the multidisciplinary health care needs of many primary headache patients within chiropractic patient populations [14, 63].

An unexpected finding from our results was that chiropractors engaged in primary headache diagnosis are less likely to undertake patient referral to assist with headache prevention. A recent Australian study showed chiropractors refer headache patients to both complementary health care providers (including acupuncturist, herbalist, naturopath, massage therapist, counsellor) and general practitioners [30]. For tension headache, preventative treatment guidelines advise non-drug management first be considered [64] and provide recommendations for behavioural treatments such as electromyography (EMG) biofeedback (level A), cognitive-behavioral therapy and relaxation training (level C), massage therapy (level C) and acupuncture (level C). In contrast, preventative treatment guidelines for migraine provide stronger recommendations for drug treatments (Level A) with additional recommendations also provided for several herbs and supplements such as butterbur (Level A), feverfew and magnesium (Level B) and coenzyme Q10 (level C) [65, 66]. Beyond headache diagnosis, provider referral to assist headache prevention requires careful consideration regarding a range of patient factors and circumstances including headache severity, headache comorbidities, patient treatment preferences and response to current care [15, 67, 68]. While more research is needed to understand this finding, one possible explanation is that engagement with headache diagnosis leads to more practitioner certainty about their own capacity to provide sufficient preventative management for those with primary headaches. With increasing examination of the quality and integration of health services and providers engaged in preventative headache management [20, 69], more research examining the factors that influence headache patient co-management between chiropractors and other headache providers is warranted.

Our findings identified chiropractors engaged in primary headache diagnosis are more likely to refer headache patients to investigate a headache red-flag. This

finding is not unexpected, since the use of headache diagnostic criteria is more likely to result in the identification of headache features associated with headache red-flag findings. The most important diagnostic consideration for frontline clinicians engaged in headache management is to rule out headaches caused by serious and potentially life-threatening underlying pathology. While rare, the underlying causes associated with headache red-flag symptoms can include stroke, sub-arachnoid haemorrhage, tumour, meningitis and artery dissection (carotid or vertebral) [70]. Since headache features in those with an underlying brain tumour can be similar to those of tension headache and migraine [71], and since neck stiffness and headache in those with underlying meningitis and arterial dissection [72, 73], can be similar to those with cervicogenic headache, chiropractors need to be mindful of the possibility of serious underlying pathology when examining those who present with headache.

Our study found that chiropractors engaged in primary headache diagnosis are more likely to use soft tissue therapies such as massage, myofascial technique, stretching or trigger-points to neck/shoulder area for their patients with tension headache. This finding is interesting given a recent systematic review which found manual therapies, including soft tissue therapies, may be more effective than pharmacological care for reducing the short-term frequency, intensity and duration of tension headache [58]. Tenderness of myofascial trigger points of the neck and shoulder muscles are increased in patients with tension-type headache [74, 75]. These active trigger-points appear to cause nociceptive input that contributes to peripheral and central sensitization in patients with chronic tension headache [76]. While further research is needed, these findings appear to support soft tissue treatment approaches that are specifically aimed at addressing these muscular factors.

Limitations

Regression analysis of chiropractors engaged in primary headache diagnosis provides an excellent opportunity to better understand the primary headache management associated with this common headache provider. The self-reported nature of the data collected is a limitation of our study – the data may be subject to recall bias and the use of Likert categories are subject to practitioner interpretation. The headache management characteristics of chiropractors reported in this study may also be influenced by non-respondents to the survey when estimating chiropractors who use of ICHD primary headache criteria and the associations related to their headache management characteristics. Nonetheless, analysis of this cross-sectional survey provides valuable insights into primary headache health management

associated with these popular providers and helps to identify key questions for further enquiry into chiropractic headache management.

Conclusion

Our research found that most chiropractors managing primary headaches are engaged in primary headache diagnosis and that this practice is likely to influence their clinical-decision making toward key aspects of primary headache patient management and co-management. These findings highlight the need for closer examination of the clinical decision-making that underlies chiropractic primary headache management and the role of these providers toward reducing the burden of this significant public health issue. Gathering this information will help to improve our understanding of the role of chiropractors within multimodal, multidisciplinary headache patient management.

Abbreviations

ACORN: Australian Chiropractic Research Network; CAM: Complementary and alternative medicine; HDI: Headache Disability Inventory; ICHD: International Classification of Headache Disorders; MIDAS: Migraine disability assessment questionnaire; PBRN: Practice-based research network

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Availability of data and materials

The data are not publicly available because the participants were not informed about this when they accepted participation but are available from the first author on reasonable request.

Authors' contributions

CM, JA, AL, and DS designed the study. CM and DS carried out the data collection, analysis and interpretation. CM wrote the drafts with revisions made by JA, DS and AL. All authors contributed to the intellectual content and approved the final manuscript.

Ethics approval and consent to participate

This study was approved by the Human Research Ethics Committee at the University of Technology Sydney (Approval number: ETH16-0639).

Consent for publication

Not applicable

Competing interests

All authors declare no competing interests related to the contents of this manuscript and that they have received no direct or indirect payment in preparation of this manuscript.

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Appendix 15: The features and burden of headaches within a chiropractic clinical population: a cross-sectional analysis (under review with Complementary Therapies in Medicine journal)

Manuscript Details

Manuscript number	CTIM_2019_1473
Title	The features and burden of headaches within a chiropractic clinical population: A cross-sectional analysis
Article type	Full Length Article

Abstract

Objectives: The aim of this study is to a) investigate the headache features and level of headache severity, chronicity, and disability found within a chiropractic patient population and b) to ascertain if patient satisfaction with headache management by chiropractors is associated with headache group or reason for consulting a chiropractor. **Design and setting:** Consecutive adult patients with a chief complaint of headache participated in an online cross-sectional survey (n=224). Recruitment was via a randomly selected sample of Australian chiropractors (n=70). Headache features were assessed using International Classification of Headache Disorders criteria and level of headache disability measured using the Headache Impact Test instrument. **Results:** One in four participants (n=57; 25.4%) experienced chronic headaches and 42.0% (n=88) experienced severe headache pain. In terms of headache features, 20.5% (n=46) and 16.5% (n=37) of participants had discrete features of migraine and tension-type headache, respectively, while 33.0% (n=74) had features of more than one headache type. 'Severe' levels of headache impact were most often reported in those with features of mixed headache (n=47; 65.3%) and migraine (n=29; 61.7%). Patients who were satisfied or very satisfied with headache management by a chiropractor were those who were seeking help with headache-related stress or to be more in control of their headaches. **Conclusion:** Many with headache who consult chiropractors have features of recurrent headaches and experience increased levels of headache disability. These findings may be important to other headache-related healthcare providers and policymakers in their endeavours to provide coordinated, safe and effective care for those with headaches.

Keywords	Chiropractic; migraine; tension-type headache; HIT-6; practice-based research network
Taxonomy	Health Profession, Medical Science
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Research Data Related to this Submission

There are no linked research data sets for this submission. The following reason is given:
The authors do not have permission to share data

The features and burden of headaches within a chiropractic clinical population: a cross-sectional analysis

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1 **1. Introduction**

2

3 Collectively, headache disorders, such as tension-type headache, migraine and
4 cervicogenic headache, affect over half of all adults. ¹⁻³ Headache disorders cause
5 substantial personal suffering with adverse impacts on the family life, leisure time,
6 social activities and work productivity of sufferers. ⁴⁻⁶ While medical providers are the
7 most common point of contact for those with headache, ^{7,8} many with headache
8 remain under-diagnosed or refrain from seeking medical help. ⁹⁻¹¹

9

10 The criteria utilised for headache classification are specified in the 3rd edition of
11 International Classification of Headache Disorders (ICHD-3), ¹² with headache
12 classification primarily established via patient self-report of their headache symptom
13 profile. While the 'gold standard' for headache diagnosis is via face-to-face
14 consultation with a neurologist, previous research suggests self-report instruments
15 can be reliable for the screening of headache features within larger populations. ¹³⁻¹⁵

16

17 The epidemiology and burden of headaches found within primary care populations
18 has previously been examined ^{7,16} While much is known about the patient case-mix
19 of those with headache under conventional care, many with headache also consult
20 healthcare providers outside of medical settings. ^{17,18} For example, general
21 population studies have identified chiropractors as popular providers for headache
22 management ¹⁹⁻²¹ and headache has been identified as one of the most common
23 health complaints within chiropractic clinical populations. ^{22,23} However, while

1

24 evidence suggests manual therapies, as commonly utilised by chiropractors, may
25 help in the prevention of tension-type headache and cervicogenic headache,^{24, 25} the
26 role of manual therapies for the prevention of migraine remains less certain,²⁶
27 despite many with migraine also seeking help from chiropractors.^{19, 20}

28

29 The substantial use of chiropractors for headache management highlights the need
30 for more information to understand the headache features within this clinical
31 population. Such information may improve our understanding of the use and role of
32 chiropractors within the field of headache management. As such, the aims of this
33 study were to estimate the headache features and the level of headache severity,
34 chronicity and disability found in those who present to chiropractors for headache
35 management. In addition, this study aims to ascertain if headache type or the
36 reasons for consulting a chiropractor were associated with patient satisfaction with
37 headache management by a chiropractor.

38

39 **2. Methods**

40

41 The study collected data via an online cross-sectional survey from patients with
42 headaches seeking help from Australian practicing chiropractors. This research was
43 a sub-study of the Australian Chiropractic Research Network (ACORN), a national
44 practice-based research network (PBRN) of Australian chiropractors.²⁷ Members of
45 the ACORN network database are representative of the wider national population of

46 Australian chiropractors regarding age and gender and generally representative for
47 practice location (with over-representation of chiropractors in one state).²⁸ The
48 research reported in this paper was approved by the Human Research Ethics
49 Committee, University of Technology Sydney (Approval number: ETH182196).

50

51 *2.1 Recruitment and participants*

52 Invitational emails were limited to a random sample of 900 of the 1680 practitioner
53 members of the ACORN database (31st May to June 15th, 2018) due to the
54 competing demands on the ACORN practitioners. Seventy chiropractors responded
55 to the invitation agreeing to facilitate patient recruitment for the study. Patient
56 recruitment occurred between the 11th July and 15th November 2018. Each
57 participating chiropractor was posted study instructions along with 10 sealed
58 envelopes (700 in total) for patient distribution. Each envelope contained a study
59 background leaflet with a link to the online questionnaire. The survey introduction
60 explained how consent to participate is assumed by starting the survey. Consecutive
61 patients presenting on a regular consultation with a chief complaint of headache
62 were informed of their eligibility to participate (avoiding recruitment of patients on an
63 initial consultation).

64

65 Inclusion criteria for the study were adult patients aged between 18-65 years,
66 presenting with a primary complaint of headache with an adequate understanding of
67 the English language in order to complete the questionnaire. At the close of the
68 consultation, practitioners informed eligible patients of the study and that completing
69 the questionnaire was voluntary and that all information provided was anonymous.

70 Only headache patients who expressed an interest in participating in the study were
71 provided with a sealed envelope and those who did participate completed the online
72 questionnaire after leaving the practice. The researchers did not inform practitioners
73 of patient involvement in the study to protect patient privacy and to avoid patient
74 coercion by practitioners. Practitioners were not asked to collect additional
75 information and no incentives were offered to study practitioners or patients.

76

77 *2.2 Questionnaire*

78 The 35-item study questionnaire included 4 main sections. The first section of the
79 survey collected information on patient headache characteristics based on ICHD-3
80 diagnostic criteria for migraine, tension-type headache and cervicogenic headaches
81 ¹² utilising survey questions similar to previous surveys. ^{15, 29} These headache
82 disorders were selected due to having been previously reported as headache types
83 more common to chiropractic headache patient populations. ^{20, 21, 30, 31} A standard
84 numerical rating scale for pain (NPRS) was used to assess the level of headache
85 pain intensity. ³²

86

87 The second section of the survey questioned participants regarding headache
88 disability using the Headache Impact Test (HIT-6) questionnaire. HIT-6 is reported to
89 be a reliable and validated measure of headache disability. ^{33, 34} This instrument
90 encompasses six questions across six representative categories commonly used to
91 assess headache impact (pain, social functioning, role functioning, vitality, cognitive
92 functioning, and psychological distress). ³³ Summed values for the response to each
93 question produces a total HIT-6 score for the level of patient headache disability
94 using four score categories: Little or no impact (36-49); Moderate impact (50-55);

95 Substantial impact (56-59); and Severe impact (60-78) to indicate the level of
96 headache impact experienced in daily life.³⁵ The survey was pilot tested with 10
97 headache patients to assist decisions about survey duration, survey wording and
98 item options.

99

100 The third questionnaire section explored the reasons patients seek help from
101 chiropractors for their headache (*"Please rank from the list below in order of*
102 *importance the reasons why you seek help from the chiropractor for your*
103 *headache"*). Participants selected from options including: headache prevention, relief
104 during a headache attack, help with headache related stress, feeling more in control
105 of headache, reduce the effects of headaches on relationships and reduce the
106 effects of headaches on ability to work. Participants were also questioned regarding
107 their level of satisfaction with headache management by a chiropractor (*"Please*
108 *select which option best describes your level of satisfaction with chiropractic*
109 *management of your headaches"*). The last section of the survey collected
110 information on patient socio-demographics and related characteristics.

111

112 2.3 Headache classification

113 Not all ICHD-3 criteria for cervicogenic headache can be collected via a survey
114 format. For example, patients were not asked to include clinical and/or imaging
115 evidence of a disorder or lesion within the cervical spine or soft tissues of the neck or
116 to ascertain if abolition of their headache has been demonstrated following a
117 diagnostic blockade of the cervical spine. Classification of cervicogenic headache

118 was provided when subjects met the minimum ICHD-3 diagnostic criteria (as per
119 Criterion C). Patients were considered to have chronic headache if they reported
120 experiencing headaches on at least 15 days per month on average for 3 months.¹²
121 Participants who satisfied the criteria for more than one headache were classified as
122 having 'Mixed headache'. As with other studies, participants who did not meet the
123 minimum ICHD-3 diagnostic criteria (for migraine, tension-type headache or
124 cervicogenic headache) were categorised 'Other headache'.³⁶⁻³⁸

125

126 A scoring algorithm was applied within Microsoft excel for migraine, tension-type
127 headache and cervicogenic headache classification criteria with a conditional logic
128 formula applied to identify patient responses that met ICHD-3 classification for each
129 of these headache types. Two separate authors (CM and AL) reviewed the excel
130 formulae results to assess for accuracy.

131

132 *2.4 Statistical analysis*

133 Characteristics of the study population are reported using descriptive statistics with
134 categorical data presented using frequencies and percentages and continuous
135 descriptive data are presented using means and standard deviations. Chi-square
136 tests or Fishers exact test were used, as applicable, to examine the association
137 between reasons for consulting a chiropractor and the level of satisfaction with
138 headache management by a chiropractor and to see if headache type was
139 associated with patient satisfaction with headache management by a chiropractor.

140 Statistical analyses were conducted using SPSS software (version 25). Statistical
141 significance was set at $p < 0.05$.

142

143 3. Results

144

145 3.1 Study participants

146 Up to 700 eligible headache patients received an invitation to participate. Of those
147 who participated in the study, 224 participants completed the section on headache
148 characteristics and level of headache chronicity (i.e. minimum 32% response). Of
149 these, 207 completed the section on their headache numerical pain score, 206
150 reported their level of satisfaction with headache management by a chiropractor, 205
151 reported their level of headache impact and 203 (29%) completed all sections of the
152 survey including their sociodemographic details.

153

154 Table 1 shows that 55 participants were male (27.1%) and 148 (72.9%) were female.
155 The majority of participants were aged between 51-65 years ($n=65$; 32.0%) and 41-
156 50 years ($n=55$; 27.1%). The largest ethnic group were Anglo-European ($n=185$;
157 91.1%). Nearly a third of participants reported having a technical/private college level
158 of education ($n=64$; 31.5%) as their highest level of education. Salaried workers
159 represented the largest employment group ($n=92$; 45.3%) and the majority of
160 participants were married or in a domestic partnership ($n=143$; 70.4%). Three out of

161 four participants (n=159; 78.3%) reported having health insurance cover that
 162 included both hospital and extra insurance cover inclusive of chiropractic services.

163

164 **Table 1: Study population socio-demographic characteristics (n=203)**

Characteristic	n (%)
Gender	
Male	55 (27.1%)
Female	148 (72.9%)
Age in years	
18-30	34 (16.7%)
31-40	39 (19.2%)
41-50	55 (27.1%)
51-65	65 (32.0%)
>65	10 (4.9%)
Ethnic background	
Anglo-European	185 (91.1%)
Asian	10 (4.9%)
Middle Eastern	7 (3.4%)
African	1 (0.5%)
Highest education	
No high school completion	19 (9.4%)
High school completion	25 (12.3%)
Technical/Private college	64 (31.5%)
University (Undergraduate)	45 (22.2%)
University (Postgraduate)	50 (24.6%)
Employment status	
Salary	92 (45.3%)
Self-employed	45 (22.2%)
Not working/part-time/casual worker	21 (10.3%)
Home duties	14 (6.9%)
Student	14 (6.9%)
Retired	13 (6.4%)
Unable to work	4 (2.0%)
Relationship status	
Single, never married	39 (19.2%)
Married or domestic partnership	143 (70.4%)
Widowed	2 (1.0%)
Divorced or separated	19 (9.4%)
Private health insurance	
No	31 (15.3%)
Yes (hospital and extras cover)	159 (78.3%)

165 Yes (Hospital only) 13 (6.4%)
166

167

168 3.2 Headache characteristics

169 Of those who completed the questionnaire section on headache characteristics
170 (Table 2), 45% were classified as having features of a single headache type (n=101)
171 and 33% were classified as having features of more than one headache type (mixed
172 headache) (n=74) and 21.8% as having 'Other headache' (n=49). Of those with
173 features of a single headache, 20.5% had features of migraine (n=46), 16.5% of
174 tension-type headache (n=37) and 8% of cervicogenic headache (n=18). Of those
175 with migraine, a similar proportion reported features of migraine with aura (n=22;
176 9.8%) and without aura (n=24; 10.7%). Fifty-seven participants (25.4%) reported a
177 headache frequency consistent with chronic headaches. A total of 52 participants
178 (25.1%) reported that their headache type had been previously diagnosed by a
179 medical doctor. Of these, nearly two out of three (n=32; 61.5%) reported a diagnosis
180 of migraine was given by a medical doctor. In terms of level of headache pain
181 intensity, 88 participants (42.5%) provided a numerical pain score of 8 or more out of
182 10 for their headache severity (where 0=no pain and 10= worse pain imaginable).

183

184 **Table 2: Distribution of study participants by headache group (n=224)**

Headache group	n=224 (%)
Mixed headache	74 (33.0)
Migraine	46 (20.5)
Migraine without aura	24 (10.7)
Migraine with aura	22 (9.8)
Tension-type headache	37 (16.5)

Other headache	49 (21.8)
Cervicogenic headache	18 (8.0)
Chronic headache (> 15 days/month)	57 (25.4)
Episodic headaches (<15 days/month)	167 (74.6)

185

186 3.3 Headache Impact

187 The level of headache impact (HIT-6) for each headache group, combining both
 188 episodic with chronic headaches, are presented in Table 3. The average overall level
 189 of headache impact (HIT-6) across all headache groups was 59.0 (SD 6.8). The
 190 headache type with the largest proportion with a score range of severe headache
 191 impact was for those with features of mixed headache (n=47; 65.3%) and migraine
 192 (n=29; 61.7%) In total, 149 participants with episodic and chronic headaches
 193 combined (72.7%) reported substantial or severe levels of headache impact.

194

195 **Table 3: Distribution of study participants level of headache disability for all**
 196 **headaches assessed using the Headache Impact Test (HIT-6) score (n=205)**
 197

Headache Groups	HIT-6 impact levels				Total n (%)
	Little or no impact	Moderate impact	Substanti al impact	Severe impact	
Cervicogenic headache	1 (5.5%)	5 (27.7%)	5 (27.7%)	7 (38.9%)	18 (100%)
Migraine	1 (2.1%)	7 (14.9%)	10 (21.3%)	29 (61.7%)	47 (100%)
Mixed headache	6 (8.3%)	9 (12.5%)	10 (13.9%)	47 (65.3%)	72 (100%)
Tension-type Headache	10 (27.0%)	7 (18.9%)	7 (18.9%)	13 (35.1%)	37 (100%)
Other headache	3 (9.6%)	7 (22.5%)	7 (22.5%)	14 (45.2%)	31 (100%)
Totals	21	35	39	110	205

198 *HIT-6 (Headache Impact test): Little or no impact (36-49); Moderate (50-55); Substantial*
 199 *(56-59); and Severe (60-78)*
 200

201 For those experiencing *less* than 15 headache days per month (episodic
 202 headaches), the average overall level of headache impact (HIT-6) was in the
 203 'substantial' impact range of 58.0 (SD 6.6). The largest proportion of those with
 204 episodic headaches with a score range of severe headache impact on their daily life
 205 was the mixed headache group (n=31; 62.0%), followed by the migraine group
 206 (n=18; 58.1%) (data not shown). For those experiencing *more* than 15 headache
 207 days per month (chronic headaches), the average overall level of headache impact
 208 was in the 'severe' impact range of 62.1 (SD 6.3). The largest proportion of those
 209 with chronic headaches with a score range of severe headache impact on their daily
 210 life was the cervicogenic headache group (n=4; 80.0%). This was followed by those
 211 with mixed headache (n=16; 72.7%) and migraine (n=11; 68.7%) (data not shown).

212

213 3.4 Reasons and satisfaction with headache management

214 Table 4 shows the reasons why participants consulted a chiropractor for the
 215 management of headaches. Participants reported headache prevention (n=190;
 216 92.2%), followed by seeking relief during a headache attack (n=166; 80.6%) and
 217 reducing the effects of headaches on ability to work (n=166; 80.6%) as the highest-
 218 ranking reasons for consulting a chiropractor for help with headaches.

219

220 **Table 4: Level of importance for reasons for consulting a chiropractor for the**
 221 **management of headaches (n=206)**

Questionnaire Item	Important	Not important
Reason for consulting a chiropractor		
Headache prevention	190 (92.2%)	16 (7.8%)

11

Relief during a headache attack	166 (80.6%)	40 (19.4%)
Help with headache related stress	149 (72.3%)	57 (27.6%)
Feeling more in control of headaches	154 (74.7%)	52 (25.2%)
Reducing the effects of headaches on relationships	121 (58.7%)	85 (41.2%)
Reducing the effects of headaches on ability to work	166 (80.6%)	40 (19.4%)

Important=Moderately important, Important, Very Important. Not important=Not important, Low importance, Slightly important

222

223 The majority of participants (90.3%) reported they were either satisfied or very
 224 satisfied with the chiropractic management of their headaches (n=186). Table 5
 225 shows the distribution of levels of satisfaction across the reasons for consulting a
 226 chiropractor. Those patients who were satisfied or very satisfied with headache
 227 management by a chiropractor were more likely to consider consulting a chiropractor
 228 to 'help with headache related stress' (p=0.019) or to be 'more control of their
 229 headaches' (p=0.032) as being important, compared to those who were neutral or
 230 unsatisfied.

231

232 **Table 5: Level of satisfaction with chiropractic headache management based**
 233 **on reason for consulting chiropractor for headache management (n=206)**
 234

Reason for consulting a chiropractor		Level of Satisfaction		p-value
		Very satisfied /Satisfied	Neutral/ Unsatisfied/ Very unsatisfied	
		n (%)	n (%)	
Headache prevention	Not Important	12 (6.5)	4 (20.0)	0.055
	Important	174 (93.5)	16 (80.0)	
Relief during a headache attack	Not Important	34 (18.3)	6 (30.0)	0.234
	Important	152 (81.7)	14 (70.0)	
Help with headache related stress	Not Important	47 (25.3)	10 (50.0)	0.019
	Important	139 (74.7)	10 (50.0)	
More in control of	Not Important	43 (23.1)	9 (45.0)	0.032

12

headaches	Important	143 (76.9)	11 (55.0)	
Reducing effects of headaches on relationships	Not Important	73 (39.2)	12 (60.0)	0.073
	Important	113 (60.7)	8 (40.0)	
Reducing effects of headaches on ability to work	Not Important	33 (17.7)	7 (35.0)	0.076
	Important	153 (82.3)	13 (65.0)	

235

236 The distribution of levels of satisfaction with headache management by a
 237 chiropractor based on patient headache group are presented in Table 6. It can be
 238 seen that there was no statistically significant association between headache type
 239 and patient satisfaction.

240

241
 242 **Table 6: Level of satisfaction with headache management by a chiropractor**
 243 **based on patient headache group (n=206)**

Headache Group	Level of Satisfaction		p-value
	Satisfied/ Very Satisfied	Neutral/ Unsatisfied/ Very unsatisfied	
	n (%)	n (%)	
Cervicogenic	17 (9.1)	1 (5.0)	0.233
Migraine	39 (21.0)	8 (40.0)	
Mixed headache	66 (35.5)	6 (30.0)	
Tension-type headache	28 (15.1)	4 (20.0)	
Other headache	36 (19.3)	1 (5.0)	

245

246

247 **4. Discussion**

248

249 Our study found a substantial proportion of those seeking help from chiropractors for
250 headache management had features of recurrent primary headaches and high levels
251 of headache severity, chronicity and disability. These patients were more often
252 female, were aged between 41-65 and more often had a high level of socioeconomic
253 status.

254

255 Our study found a similar proportion of participants had discrete features of either
256 migraine or tension-type headache. However, while there is emerging good quality
257 clinical evidence for manual therapies for the prevention of tension-type headache,
258 ^{24, 39} level 1 evidence for manual therapies for the prevention of migraine remains
259 limited and preliminary. ^{26, 40} It may, therefore, be that the use of chiropractors by
260 those with migraine could also relate to other aspects of chiropractic headache
261 management beyond the role of manual therapies alone. For example, previous
262 research has identified that chiropractors utilise a multimodal approach when
263 managing those with migraine that incorporates stress management, patient
264 education and advice on lifestyle factors. ⁴¹ While this study found increased patient
265 satisfaction with chiropractic headache management was associated with those
266 motivated by the need to gain 'more control of their headaches', more research is
267 needed to better understand the extent to which particular aspects of chiropractic
268 patient care contribute to patient satisfaction with chiropractic headache
269 management.

270

271 Our study found a substantial proportion of those with headache seeking help from
272 chiropractors had headache features associated with increased headache burden,
273 including those with mixed headaches, increased headache severity and headache

274 chronicity. Those with mixed headaches made up the largest headache group
275 seeking help from chiropractors in our study, a finding that is likely explained by the
276 high co-occurrence of migraine with tension-type headache.^{20, 42} In addition, our
277 study found a substantial proportion of those with headache seeking help from
278 chiropractors scored their headache pain at the level of severe, and one in four
279 reported a headache frequency consistent with a classification of chronic headache.
280 Those with mixed, severe and chronic headaches more likely to experience greater
281 headache burden⁴³⁻⁴⁵ and are more likely to seek professional help, including from
282 healthcare providers outside of medical settings.^{17, 46, 47} More research is therefore
283 needed to understand how chiropractors might assist those with increased headache
284 burden. For example, clinical research evidence for the role of manual therapies for
285 chronic headaches remains limited.^{39, 40} In addition, many with chronic and disabling
286 headaches commonly experience psychiatric comorbidities, such as anxiety and
287 depression.^{48, 49} While this study found those seeking 'help with headache-related
288 stress' were more likely to be satisfied with chiropractic headache management,
289 there is little detailed knowledge regarding how chiropractors seek to assist those
290 with psychiatric disabilities commonly associated with increased headache burden.

291

292 In addition, our study found one in five participants were identified as having a
293 headache features that failed to fulfil the minimum criteria needed to assign a
294 headache classification of either migraine, tension-type headache or cervicogenic
295 headache. While uncertainty remains about the significance of this finding, the true
296 proportion of those with headache who meet all of the required ICHD criteria needed
297 for a distinct headache classification remains unclear^{42, 50} and overlapping headache

298 characteristics are reported as common amongst those with recurrent headaches.⁵¹
299 ⁵² Overlapping headache features may also help to explain why our study found
300 there was no statistically significant association between headache grouping and
301 patient satisfaction with chiropractic management. However, while those failing to
302 fulfil the minimum criteria needed to assign a headache classification may partly be
303 explained by the challenges of classifying headaches into discrete categories, it may
304 also be a limitation of the self-report instrument utilised for the study.

305

306 Our study identified that many with headache seeking help from chiropractors
307 experience increased levels of headache impact. Study participants with the highest
308 level of headache impact were those with features of migraine and mixed
309 headaches, a finding similarly identified in other studies.^{4, 53} High levels of headache
310 burden can adversely impact patient quality of life, including their work, leisure and
311 social activities.⁴ In this regard, it was not surprising that many respondents were
312 motivated to seek help from chiropractors in order to reduce the impact of headaches
313 on their work-life and relationships. The increased levels of headache impact
314 amongst those seeking help from chiropractors, as identified by the findings of this
315 study, highlights the need for chiropractors to monitor and evaluate the level of
316 headache burden in those who are seeking their help. In doing so, it is incumbent
317 upon chiropractors to carefully consider the healthcare needs of those who
318 experience increased headache burden and to consider the role of other healthcare
319 providers in assisting in these circumstances.^{54, 55}

320

321 Our study found nearly three out of every four patients who consult chiropractors with
322 headache were female. A higher proportion of female patients with headache has

323 been reported in those seeking help from Complementary and Alternative Medicine
324 (CAM) ⁵⁶ and medical providers. ⁵⁷ This finding is likely influenced by the higher
325 percentage of women who experience migraine and tension-type headache, the
326 most common recurrent headaches. ^{42, 58, 59} Nearly two thirds of our sample were
327 aged between 41 – 65 years, despite evidence that the peak age of migraine
328 decreases after menopause. ⁶⁰ Since the peak age of those with tension-type
329 headache is reported to be between 30 – 39 years ⁶¹ and between 18 – 45 years for
330 those with migraine (females), ^{53, 62} it may be that headache patients seeking help
331 from chiropractors do so later than the age of peak incidence and later than seeking
332 help from other primary care providers. Our study found the majority of chiropractic
333 headache patients were well educated with nearly half having a university education,
334 with two thirds being salary-workers or self-employed and three quarters reporting
335 health insurance cover inclusive of chiropractic health services. With low employment
336 status and lack of health insurance reported as economic barriers to medical
337 headache treatment, ⁶³ our findings may also suggest similar socioeconomic barriers
338 may exist regarding patient access to non-medical headache providers such as
339 chiropractors.

340

341 Our study has several limitations. The section of the questionnaire using self-report
342 for headache features is unvalidated and this can increase the risk of an incorrect
343 headache classification and the generalisability of the study findings. When
344 considering this concern, we avoided participant grouping into 'probable' headache
345 classification categories, as identified by ICHD, where increased overlap of
346 headache features would increase the risk of misclassification. As such, study
347 participants were only grouped under discrete headache categories when responses

348 met all of the formal ICHD headache classification criteria. While favourable reliability
349 of self-report headache instruments has been previously documented,^{13, 64} future
350 studies are needed to explore the validity of a self-report survey instruments for
351 headache classification against that of face-to-face consultation. The low patient
352 response rate and limited patient sample size may also result in headache groups
353 and headache disability being under or over-represented. As such, our findings call
354 for larger population studies to be conducted before robust conclusions can be made
355 about the external validity of the findings. In addition, there is a need for future
356 research to additionally assess the proportion of those seeking help from
357 chiropractors who also have medication-overuse headache, known to be most
358 common in those with chronic migraine.^{65, 66}

359

360 **5. Conclusion**

361

362 Our study found a high proportion of patients who consult chiropractors for headache
363 management experience features of common recurrent headaches. In addition,
364 many of these patients experience high levels of headache pain, chronicity and
365 headache-related disability. However, these findings highlight the need for larger
366 population studies before robust conclusions can be made about the headache
367 profile of this patient population.

368

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370

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375 **Conflict of interest**

376 All authors declare no competing interests related to the contents of this manuscript

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379

380 **Authors contributions**

381 CM, JA, AL and DS designed the study. CM carried out the data collection and CM

382 and DS provided the analysis and interpretation. CM wrote the drafts with revisions

383 made by JA, AL and DS. All authors contributed to the intellectual content and

384 approved the final manuscript.

385

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