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Australasian Journal on Ageing

Characteristics of chiropractors who manage people aged 65 and older: A nationally representative sample of 1903 chiropractors

Journal:	<i>Australasian Journal on Ageing</i>
Manuscript ID	AAJA-2018-108.R2
Manuscript Type:	Research Article
Keywords:	Chiropractic, Ageing, Manual therapy, Prevalence, Practice-based research network
Abstract:	<p>Objectives: To examine the prevalence and profile of chiropractors who frequently manage people aged 65 years and older.</p> <p>Methods: A national cross-sectional survey collected practitioner characteristics, practice settings and clinical management characteristics. Multiple logistic regression was conducted on 1,903 chiropractors to determine the factors associated with the frequent treatment of people 65 years and older.</p> <p>Results: In total, 73.5% of participants report 'often' treating those aged 65 years and older. These chiropractors were associated with treating degenerative spine conditions (OR 2.25; 95%CI 1.72-2.94), working in a non-urban area (OR 1.85; 95%CI 1.35-2.54), treating low back pain (referred/radicular) (OR 1.74; 95%CI 1.26-2.40) and lower limb musculoskeletal disorders (OR 1.50; 95%CI 1.15-1.96).</p> <p>Conclusion: The majority of chiropractors' report often providing treatment to older people. Our findings call for more research to better understand older patient complaints that are common to chiropractic practice and the care provided by chiropractors for this patient group.</p>

1 ABSTRACT

2 **Objectives:** To examine the prevalence and profile of chiropractors who frequently manage
3 people aged 65 years and older.

4
5 **Methods:** A national cross-sectional survey collected practitioner characteristics, practice
6 settings and clinical management characteristics. Multiple logistic regression was conducted
7 on 1,903 chiropractors to determine the factors associated with the frequent treatment of
8 people 65 years and older.

9
10 **Results:** In total, 73.5% of participants report 'often' treating those aged 65 years and older.
11 These chiropractors were associated with treating degenerative spine conditions (OR 2.25;
12 95%CI 1.72-2.94), working in a non-urban area (OR 1.85; 95%CI 1.35-2.54), treating low back
13 pain (referred/radicular) (OR 1.74; 95%CI 1.26-2.40) and lower limb musculoskeletal
14 disorders (OR 1.50; 95%CI 1.15-1.96).

15
16 **Conclusion:** The majority of chiropractors' report often providing treatment to older people.

17 ~~Our findings The association with the treatment of complex spine conditions and lower limb~~
18 ~~musculoskeletal disorders calls for more research to better understand older the patient~~
19 ~~complaints that are common to chiropractic practice and the care provided by chiropractors~~
20 ~~for this patient group. effectiveness of chiropractic management of older people with these~~
21 ~~conditions.~~

22
23 **Policy Impact:** Treatment guidelines recognise the need for non-pharmacological and non-
24 surgical treatment interventions for many musculoskeletal conditions. The growing role of
25 the chiropractic profession in managing older patients with musculoskeletal pain is an
26 emerging health services delivery topic.

27
28 **Practice Impact:** A substantial number of chiropractors are engaged in elderly patient
29 management and these chiropractors are more likely to treat musculoskeletal health
30 burdens common to this patient population. Health professionals working with older
31 Australians should consider the role of chiropractors within elderly care multidisciplinary
32 management.

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5 2 **Key words:** Aging; Chiropractic; Practice-based research network; Older patients; Manual
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7 3 therapy
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10 5 **BACKGROUND**
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14

15 7 In 2016, more than 1 in 7 Australians (15%) were aged 65 years and over and this
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17 8 percentage is projected to more than double by 2057 [1]. The burden of disease and
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19 9 disability increases with age with musculoskeletal conditions now contributing to 9% of total
20
21 10 Disability Adjusted Life Years (DALYs) for Australians aged over 65 years [1] and 7.5% of total
22
23 11 disease burden globally for those aged over 60 years [2].
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25 12

26 13 Arthritis is one musculoskeletal condition that causes activity limitations in nearly one third
27
28 14 of mostly older Australians [3]. The most common form of arthritis, osteoarthritis,
29
30 15 contributes to aging hip and knee joints [4] while age related degeneration contributes to
31
32 16 the progression of painful lumbar spinal stenosis [5]. The prevalence of low back pain is
33
34 17 reported to peak in those aged over 60 years while declining again in the oldest people [6].
35
36 18 Chronic back problems affect approximately 27% of people aged between 65 and 74 years
37
38 19 in Australia [7].
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42 21 While the burden of musculoskeletal conditions in older adults is substantial, there is limited
43
44 22 information about the characteristics of the providers often associated with their healthcare
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46 23 management. For instance, there is now a growing body of research that has examined the
47
48 24 effects of chiropractic management for older populations with musculoskeletal complaints
49
50 25 such as neck pain [8,] low back pain, with and without spinal stenosis [9, 10], and lower limb
51
52 26 conditions [11]. The advancement of this research has also been accompanied by the
53
54 27 development of practice guidelines for the chiropractic management of older adults [12].
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56 28

57
58 29 Musculoskeletal complaints account for a substantial proportion of patients seeking help
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1 from chiropractors [13]. A recent US longitudinal study found the average annual prevalence
2 rate of chiropractic use by older people was approximately 4.8% [14]. In Australia, a patient
3 population study reports 16.5% of chiropractic patients were older than 65 years [15].
4 Despite the substantial levels of chiropractic use by older adults, no research has yet
5 examined the prevalence and characteristics of chiropractors who frequently provide care
6 for this growing sub-population. Such information is essential to helping guide more
7 effective, coordinated healthcare delivery for older adults. In direct response to this
8 research gap, the study reported here examines the proportion of Australian chiropractors
9 who frequently manage older people and describes their practitioner characteristics,
10 practice settings and approaches to clinical management.

11 12 **METHODS**

13
14 The analyses reported in this paper are drawn from responses to a questionnaire distributed
15 during the recruitment of chiropractors for a national practice-based research network
16 (PBRN) titled the Australian Chiropractic Research Network (ACORN) project [16].

17 18 **Recruitment and Sample**

19 The recruitment of ACORN PBRN participants (March to July 2015) was focused upon all
20 registered chiropractors across Australia. The ACORN questionnaire and recruitment
21 invitation was distributed through national chiropractic professional associations,
22 professional conferences, profession-wide emails and was also made available via the
23 ACORN website (<http://www.acorn-arccim.com/>). Further details of the ACORN PBRN
24 project recruitment can be found elsewhere [17]. A total of 2,005 chiropractors participated
25 in the ACORN cohort (43% response rate) resulting in a nationally representative sample of
26 Australian chiropractors [16]. The ACORN PBRN project was approved by the Human
27 Research Ethics Committee at the University of Technology Sydney (Approval number
28 2014000027).

29 30 **Questionnaire items**

1 The 21-item ACORN questionnaire collected information across three key areas –
2 practitioner characteristics, practice characteristics and approaches to clinical management
3 (Additional file 1). Information collected on practitioner characteristics included age,
4 gender, chiropractic professional qualifications, years in private practice, and memberships
5 of professional associations. Information collected on practice characteristics included the
6 average number of patient care hours and patient visits per week, the number of practices,
7 referral relationships with other health professionals, practice location(s), whether the
8 chiropractor was in single or multi-practitioner practice and the use of diagnostic imaging.
9 With regards to clinical management, this section of the questionnaire was divided into five
10 sub-sections. This included the frequency with which chiropractors discuss identified
11 aspects of health promotion; the frequency with which they treat patients with identified
12 conditions; the frequency with which they treat identified patient subgroups; and the
13 frequency with which they employ a range of chiropractic and musculoskeletal
14 interventions. The ACORN PBRN chiropractors recruited for this sub-study were those who
15 answered the question regarding the frequency with which they treat 'older people (65
16 years and over)'.
17

18 **Statistical analyses**

19 The dependent variable was the frequency of providing treatment to older people which
20 was merged into two categories: "often" and "less often" ('never', 'rarely' and sometimes)
21 with the other variables of clinical management with same response options (never, rarely,
22 sometimes, and often) applied with the same format. The practitioner characteristics,
23 practice characteristics and approaches to clinical management of chiropractors who
24 reported often treating older people were compared to those who reporting less often
25 treating older people.
26

27 The bivariate associations between all survey items and the outcome variables were firstly
28 explored using Student's t-test or chi-square tests [with Yates' correction](#), where applicable,
29 and analysis of variance (ANOVA) were used to perform the statistical analyses via the
30 statistical software STATA 13, version 1. The characteristics of chiropractors who 'often'
31 treat older people were identified via a backward stepwise logistic regression. All variables
32 associated with the chiropractic treatment of older people across the t-tests, χ^2 tests and

1 ANOVA at a p-value of ≤ 0.25 were entered into the regression model. Statistical significance
2 was set at $p < 0.05$. Adjusted odds ratios were reported with 95% confidence intervals for
3 each factor.

4 5 **RESULTS**

6
7 Of the 2,005 ACORN participants, 1,903 (94.9%) chiropractors answered the question
8 regarding frequency of treating people aged 65 years or over. The majority of chiropractors,
9 1,398 (73.5%), reported that they treat older people 'often'.

10 11 **Practitioner characteristics**

12 When compared to chiropractors who treat older people less often, the average age of
13 chiropractors who often treat older people was greater, 43.9 years (SD: 12.2) versus 37.7
14 years (10.4) ($p < 0.001$), reported a higher average number of years in practice, 17.5 years
15 (SD: 11.5) versus 11.4 years (SD: 9.5) ($p < 0.001$), and were more often male, 65.4% versus
16 54.4% ($p < 0.001$). In addition, these chiropractors less often had a Master's degree, 30.2%
17 versus 35.1%, more often had a Bachelor's degree, 37.4% versus 28.8%, as their professional
18 qualification when compared to those who did not often treat older people ($p = 0.0192$)
19 (Table 1).

20 21 **Practice characteristics**

22 Compared to chiropractors who less often treat older people, chiropractors who often treat
23 older people report more patient care hours per week ($p = 0.009$) and more patient
24 treatment visits per week ($p < 0.001$). They are also more likely to report working with a
25 medical specialist ($p = 0.0364$) and a physiotherapist ($p = 0.0495$) in the same practice
26 location, and are less likely to report working with another chiropractor ($p = 0.009$) in the
27 same practice location. Chiropractors often treating older people are also more likely to
28 both send and/or receive referrals to/from a general practitioner (GP) ($p < 0.001$), to/from a
29 podiatrist ($p < 0.001$) and to/from medical specialist ($p = 0.0384$) as well as use diagnostic
30 imaging as part of their practice when than those who treat older people less often
31 ($p < 0.001$). Chiropractors who often treat older people are more likely to work in a non-

1 urban area (including rural and remote areas) ($p < 0.001$) compared to chiropractors who less
2 often treat older people (Table 2).

3 4 **Clinical management characteristics**

5 With regards to clinical management (Table 3), chiropractors often treating older people are
6 more likely to discuss occupational health and safety, pain counselling, and medications as
7 part of their patient care than those chiropractors who less often treat older people (all
8 $p < 0.05$). It is worth noting chiropractors often treating older people are more likely to report
9 treating a wide range of musculoskeletal conditions including neck pain (axial and
10 referred/radicular), thoracic pain (axial and referred/radicular), low back pain (axial and
11 referred/radicular), lower limb musculoskeletal disorders, upper limb musculoskeletal
12 disorders, postural disorders, degenerative spine conditions, headache disorders, migraine
13 disorders, and provide spinal health maintenance/prevention than those chiropractors less
14 frequently treating older people (all $p < 0.001$). In addition, chiropractors often treating older
15 people were more likely to use a wider range of treatment techniques/methods in their
16 patient management including the use of biomechanical pelvic blocking/sacro-occipital
17 technique, instrument adjusting, flexion-distraction, and extremity manipulation, as well as
18 three types of general musculoskeletal interventions/approaches in their patient
19 management including the use of soft tissue therapy/trigger point therapy/massage
20 therapy/stretching, heat/cryotherapy, and orthotics than those chiropractors less frequently
21 treating older people (all $p < 0.05$).

22
23 Logistic regression analysis identified a range of factors independently associated with the
24 likelihood of a chiropractor often treating older people (Table 4). Factors with a significant
25 association include treating degenerative spine conditions (OR 2.25; 95%CI 1.72-2.94),
26 working in a non-urban area (OR 1.85; 95%CI 1.35-2.54), treating patients with low back
27 pain (referred/radicular) (OR 1.74; 95%CI 1.26-2.40), treating patients with lower limb
28 musculoskeletal disorders (OR 1.50; 95%CI 1.15-1.96), chiropractor being of older age (OR
29 per 10 years 1.59; 95%CI 1.41-1.80), increased average number of patient treatment visits
30 per week (OR per 10 patients 1.05; 95%CI 1.02-1.08), having a professional referral
31 relationship with a GP (OR 1.47; 95%CI 1.14-1.90), the use of soft tissue therapy, trigger
32 point therapy, massage therapy, stretching (OR 1.37; 95%CI 1.04-1.80) and treating patients

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3 1 with thoracic pain (axial and referred/radicular) (OR 1.37-1.47; 95%CI 1.02-2.09) and not
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5 2 having a professional referral relationship with an occupational therapist (OR 0.57; 95%CI
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7 3 0.37-0.87).
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10 5 **DISCUSSION**

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14 7 Our analysis of a large nationally representative sample of Australian chiropractors
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16 8 identified that nearly three in four Australian chiropractors report often providing treatment
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18 9 to people aged 65 and older. Compared to chiropractors who less often treat older people,
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20 10 these chiropractors were more likely to have a greater patient caseload, work in a non-
21
22 11 urban area, have a referral relationship with GPs, use soft tissue therapies, and be more
23
24 12 likely to manage spinal pain (including degenerative spine conditions) and lower limb
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26 13 musculoskeletal disorders. The substantial level of chiropractic older patient care reported
27
28 14 in our study and the high proportion of older chiropractic patients reported previously raises
29
30 15 questions regarding how chiropractors manage this patient population and the
31
32 16 effectiveness of the care they provide. With an ageing population, our findings also suggest
33
34 17 significant attention needs to be given to the geriatric training of chiropractors and highlight
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36 18 the need for further investigation and evaluation of current educational standards within
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38 19 this area.
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41 21 Our study identified chiropractors who frequently treat older people as more likely to report
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43 22 a referral relationship with a GP. This finding may relate to the increased comorbidity
44
45 23 associated with age, particularly for those with low back pain [18] and the greater utilisation
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47 24 of healthcare services and providers that results. There is limited information regarding the
48
49 25 clinical circumstances associated with older patient referrals between chiropractors and
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51 26 GPs. However, while some evidence suggests a stronger referral relationship may occur
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53 27 between chiropractors and GPs in rural areas [19], a recent survey of Australian GPs
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55 28 reported an unwillingness by many GPs to refer patients to chiropractors with many
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57 29 questioning the efficacy of chiropractic treatment and the current level of chiropractic
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59 30 education [20]. These findings likely reflect the need for more research to assess the role,
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31 31 safety and effectiveness of chiropractic older patient management, findings which are likely

1 to improve provider awareness of the role of chiropractors within the elderly
2 multidisciplinary care.

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10 Our research suggests the practitioner characteristics of chiropractors who often manage
11 older adults are themselves more likely to be older, to be working in non-urban settings,
12 working longer hours and consulting more patients per week. An older chiropractic provider
13 population might explain why our study found a higher percentage of chiropractors who
14 often treat older people have a comparatively lower level of tertiary education than those
15 who less often treat older people as education standards have improved overtime. Such
16 findings can raise questions regarding the current level of education and knowledge within
17 chiropractic geriatric patient care. A greater understanding of the potential barriers to
18 younger chiropractors engaging in older patient management (more often associated with
19 non-urban settings) is warranted. The higher work-load of chiropractors working in non-
20 urban areas may be additionally explained by a higher percentage of older people living in
21 rural areas [21], where there is a relative lack of conventional providers and a higher use of
22 complementary health providers [22].

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Our study reveals that chiropractors who frequently treat older people are more likely to
manage spinal conditions including thoracic and low back pain (referred/radicular) and
degenerative spine conditions. The association with the management of these spinal
presentations is not surprising given the prevalence of these conditions in older populations.
For example, in a cohort of older community dwelling Australian women, 55.8% reported
spinal pain in the last month [23]. The 3-month prevalence of thoracic pain in older people
has been reported to be as high as 15% [24]. In addition, approximately 47% of those over
60 years suffer lumbar spinal stenosis, a degenerative spinal condition which causes
compression of the spinal cord or nerve roots, producing radicular leg pain [25]. With this
condition one of the most common reasons for spine surgery in older people there is an
urgent need for further high-quality research to further assess the effectiveness of
chiropractic manual therapies for both spinal stenosis [10] and other chronic spine
conditions commonly found in older adults.

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3 1 Compared to those chiropractors who less frequently treat older people, those often-
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5 2 treating older people are more likely to manage lower limb musculoskeletal disorders.
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7 3 Symptomatic lower limb pain and related OA are highly prevalent health burdens in older
8
9 4 people that are associated with pain, severe disability and suboptimal quality of life [26].
10
11 5 While limited evidence appears to support some benefit from chiropractic manipulative
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13 6 therapies for the management of lower extremity disorders [11] more high-quality clinical
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15 7 research is needed to assess the range of therapeutic approaches utilised by chiropractors
16
17 8 for these complaints. In addition, further examination is needed to assess the current levels
18
19 9 of chiropractic education, including ongoing professional training, for the management of
20
21 10 these conditions and to assess the clinical circumstances whereby chiropractors engage with
22
23 11 other healthcare providers in managing these complaints.
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25 12

25 13 Chiropractors who frequently treat older people are more likely to use soft tissue therapies,
26
27 14 including trigger point therapy, massage therapy and muscle stretching. While a recent
28
29 15 clinical trial reported no serious adverse events from the use of chiropractic spinal
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31 16 manipulative therapy for those aged over 65 years with low back pain [27] the higher use of
32
33 17 more gentle soft tissue therapies for this patient group may relate to practitioner safety
34
35 18 concerns when selecting manual therapy methods regarding patient age and related frailty
36
37 19 [12]. Aging is associated with multiple comorbidities and musculoskeletal changes including
38
39 20 increased loss of hip, spine and ankle joint flexibility and osteoporosis [28]. As such,
40
41 21 chiropractic treatment methods that aim to address stiffening soft tissues may be helpful
42
43 22 for the safer treatment of musculoskeletal complaints common to older patients. While
44
45 23 research has examined the use of soft tissue management for a range of conditions
46
47 24 including low back [29], neck and shoulder pain [30], there remains a paucity of research
48
49 25 examining the benefit of these soft tissue therapies within older populations.
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51 26

51 27 **LIMITATIONS**

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53 28

54 29 A key strength of our study is that it draws upon a large representative sample of
55
56 30 chiropractors, reducing the risk of selection bias. However, limitations include the
57
58 31 subjectivity of Likert categories provided in the questionnaire for frequency ('never', 'rarely',
59
60 32 'sometimes', 'often') which are subject to practitioner interpretation of these terms. In

1 addition, our findings rely on the retrospective recall of practitioners, and drawing strong
2 conclusions from our research is also limited due to our analysis being secondary - relying
3 upon the quality and fit of the existing data to help analyse a topic which the survey was not
4 primarily designed to facilitate. Although causal relationships cannot be explored via our
5 study design, the ACORN cross-sectional survey provides an excellent first platform for
6 investigating this neglected area of research in order to explore and identify key questions
7 for further enquiry regarding chiropractic management of older populations. This includes
8 the need for more primary survey data to more closely examine current chiropractic
9 geriatric practice and to assess the efficacy of the care provided as well as broader health
10 services research to examine issues associated with the integration of chiropractic within
11 multidisciplinary older patient management.

12 13 **CONCLUSIONS**

14
15 A high proportion of Australian chiropractors often treat people aged 65 years and older
16 and it would appear chiropractors are likely to occupy an important role in the healthcare
17 management of this patient population. There is a need for more high-quality research to
18 better understand the prevalence, disease burden and comorbidities commonly associated
19 with older patients seeking help from chiropractors and to better understand the
20 approaches and effectiveness of chiropractic management of older people. In addition,
21 closer examination of the current level of chiropractic education may be warranted to
22 assess and improve the capacity of the profession in meeting the healthcare needs of older
23 people within multidisciplinary patient settings.

24 **Additional file 1: ACORN national survey questionnaire**

25 26 **References:**

- 27
28 1 Australian Institute for Health and Family Welfare (AIHFW). *Older Australia at a glance*. 2017
29 [cited November 9 2017]; Available from: [https://www.aihw.gov.au/reports/older-
30 people/older-australia-at-a-glance/contents/summary](https://www.aihw.gov.au/reports/older-people/older-australia-at-a-glance/contents/summary).
31 2 Prince MJ, Wu F, Guo Y et al. The burden of disease in older people and implications for
32 health policy and practice. *The Lancet* 2015; 385: 549-62.

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- 1 3 Australian Institute of Health and Welfare (AIHW). *A snapshot of arthritis in Australia 2010. Arthritis series Number 13* 2010 [cited November 9 2017]; Available from: <https://www.aihw.gov.au/reports/arthritis-other-musculoskeletal-conditions/snapshot-arthritis-australia-2010/contents/summary>.
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- Felson DT. Osteoarthritis as a disease of mechanics. *Osteoarthritis and Cartilage* 2013; 21: 10-5.
- Genevay S, Atlas SJ. Lumbar Spinal Stenosis. *Best Practice & Research Clinical Rheumatology* 2010; 24: 253-65.
- Fejer R, Leboeuf-Yde C. Does back and neck pain become more common as you get older? A systematic literature review. *Chiropractic & Manual Therapies* 2012; 20: 24-.
- Australian Institute of Health and Welfare (AIHW). *Impacts of chronic back problems*. 2016 [cited November 11 2017]; Available from: <https://www.aihw.gov.au/reports/arthritis-other-musculoskeletal-conditions/impacts-of-chronic-back-problems/contents/summary>.
- Maiers M, Bronfort G, Evans R et al. Spinal manipulative therapy and exercise for seniors with chronic neck pain. *Spine Journal* 2014; 14: 1879 - 89.
- Dougherty PE, Karuza J, Dunn AS, Savino D, Katz P. Spinal manipulative therapy for chronic lower back pain in older veterans: a prospective, randomized, placebo-controlled trial. *Geriatric orthopaedic surgery & rehabilitation* 2014; 5: 154-64.
- Ammendolia C, Stuber KJ, Rok E et al. Nonoperative treatment for lumbar spinal stenosis with neurogenic claudication. *Cochrane Database of Systematic Reviews* 2013.
- Brantingham JW, Globe G, Pollard H et al. Manipulative therapy for lower extremity conditions: expansion of literature review. *Journal of Manipulative and Physiological Therapeutics* 2009; 32: 53-71.
- Hawk C, Schneider MJ, Haas M et al. Best Practices for Chiropractic Care for Older Adults: A Systematic Review and Consensus Update. *Journal of Manipulative and Physiological Therapeutics* 2017; 40: 217-29.
- Adams J, Lauche R, Peng W et al. 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* 2017; 17: 14.
- Weigel P, Hockenberry JM, Bentler SE et al. A longitudinal study of chiropractic use among older adults in the United States. *Chiropractic & Osteopathy* 2010; 18.
- Brown BT, Bonello R, Fernandez-Caamano R et al. Consumer Characteristics and Perceptions of Chiropractic and Chiropractic Services in Australia: Results From a Cross-Sectional Survey. *Journal of Manipulative and Physiological Therapeutics* 2014; 37: 219-29.
- Adams J, Steel A, Moore C, Amorin-Woods L, Sibbritt D. Establishing the ACORN National Practitioner Database: Strategies to Recruit Practitioners to a National Practice-Based Research Network. *Journal of Manipulative and Physiological Therapeutics* 2016; 39: 594-602.
- Adams J, Peng W, Steel A et al. 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* 2017; 7: 1-8.
- Manchikanti L, Singh V, Falco FJE, Benyamin RM, Hirsch JA. Epidemiology of Low Back Pain in Adults. *Neuromodulation: Technology at the Neural Interface* 2014; 17: 3-10.
- Wardle JL, Sibbritt DW, Adams J. Referrals to chiropractors and osteopaths: a survey of general practitioners in rural and regional New South Wales, Australia. *Chiropractic & Manual Therapies* 2013; 21: 1.
- Engel RM, Beirman R, Grace S. An indication of current views of Australian general practitioners towards chiropractic and osteopathy: a cross-sectional study. *Chiropractic & Manual Therapies* 2016; 24: 37.
- Australian Government. Department of Health. *2.5.2 Trends in population ageing. Report on the audit of health workforce in rural and regional Australia* 2008 [cited November 26

2017]; Available from:

<http://www.health.gov.au/internet/publications/publishing.nsf/Content/work-res-ruraud-toc~work-res-ruraud-2~work-res-ruraud-2-5~work-res-ruraud-2-5-2>.

- 22 Robinson A, Chesters J. Rural diversity in CAM usage: The relationship between rural diversity and the use of complementary and alternative medicine modalities. *Rural Society* 2008; 18.
- 23 de Luca KE, Parkinson L, Haldeman S, Byles JE, Blyth F. The Relationship Between Spinal Pain and Comorbidity: A Cross-sectional Analysis of 579 Community-Dwelling, Older Australian Women. *Journal of Manipulative and Physiological Therapeutics* 2017; 40: 459-66.
- 24 Fejer R, Ruhe A. What is the prevalence of musculoskeletal problems in the elderly population in developed countries? A systematic critical literature review. *Chiropractic & Manual Therapies* 2012; 20: 31.
- 25 Kalichman L, Cole R, Kim DH et al. Spinal stenosis prevalence and association with symptoms: the Framingham Study. *The Spine Journal* 2009; 9: 545-50.
- 26 March L, Smith EU, Hoy DG et al. Burden of disability due to musculoskeletal (MSK) disorders. *Best Practice & Research: Clinical Rheumatology* 2014; 28: 353-66.
- 27 Dougherty PE, Karuza J, Dunn AS, Savino D, Katz P. Spinal Manipulative Therapy for Chronic Lower Back Pain in Older Veterans: A Prospective, Randomized, Placebo-Controlled Trial. *Geriatric orthopaedic surgery & rehabilitation* 2014; 5: 154-64.
- 28 Chodzko-Zajko WJ, Proctor DN, Singh MAF et al. Exercise and physical activity for older adults. *Medicine and Science in Sports and Exercise* 2009; 41: 1510-30.
- 29 Furlan AD, Imamura M, Dryden T, Irvin E. Massage for low back pain: an updated systematic review within the framework of the Cochrane Back Review Group. *Spine* 2009; 34: 1669-84.
- 30 Kong LJ, Zhan HS, Cheng YW et al. Massage therapy for neck and shoulder pain: a systematic review and meta-analysis. *Evidence-Based Complementary and Alternative Medicine* 2013.

Table 1: Practitioner characteristics across frequency of chiropractors treating older people

	Never/rarely/ sometimes (n=505)	Often (n=1398)	p-value
Age in years, mean±sd	37.7 (10.4)	43.9 (12.2)	<0.001*
Gender			<0.001†
Male n (%)	274 (54.4)	909 (65.4)	
Female n (%)	230 (45.6)	481 (34.6)	
Qualification			0.0192†
Diploma n (%)	13 (2.6)	43 (3.1)	
Bachelor n (%)	144 (28.8)	519 (37.4)	
Doctor of Chiropractic n (%)	164 (32.7)	397 (28.6)	
Masters degree n (%)	176 (35.1)	418 (30.2)	
PhD n (%)	4 (0.8)	10 (0.7)	
Private chiropractic practice in years, mean±sd	11.4 (9.5)	17.5 (11.5)	<0.001*

* t-test and analysis of variance were used to determine the statistical significance of the differences between groups.

† chi-square test was used to determine the statistical significance of the differences between groups.

Table 2: Practice characteristics across frequency of chiropractors treating older people

	Never/rarely/ sometimes (n=505)	Often (n=1398)	p-value
Patient care hours per week, mean±sd	25.9 (16.8)	28.1 (15.4)	0.009*
Patient visits per week, mean±sd	71.8 (52.1)	93.3 (58.3)	<0.001*
Practice in more than one location			0.494 [†]
No	382 (76.1)	1040 (74.5)	
Yes	120 (23.9)	355 (25.5)	
Other health professionals working in the practice location n (%)			
GP	32 (6.3)	88 (6.3)	0.973 [†]
Podiatrist	44 (8.7)	136 (9.7)	0.504 [†]
Medical specialist	7 (1.4)	44 (3.2)	0.0364 [†]
Physiotherapist	58 (11.5)	119 (8.5)	0.0495 [†]
Another chiropractor	321 (63.6)	795 (56.9)	0.009 [†]
Exercise physiologist	39 (7.7)	85 (6.1)	0.200 [†]
Psychologist/counsellor	57 (11.3)	182 (13.0)	0.314 [†]
Occupational therapist	11 (2.2)	37 (2.7)	0.5765 [†]
Referral relationships n (%)			
GP	236 (46.7)	844 (60.4)	<0.001 [†]
Psychologist/counsellor	65 (12.9)	208 (14.9)	0.270 [†]
Physiotherapist	155 (30.7)	450 (32.2)	0.5436 [†]
Occupational therapist	52 (10.3)	107 (7.7)	0.0766 [†]
Podiatrist	165 (32.7)	595 (42.6)	<0.001 [†]
Medical specialist	66 (13.1)	238 (17.0)	0.0438 [†]
Exercise physiologist	82 (16.2)	215 (15.4)	0.6549 [†]
Practice location			<0.001 [†]
Urban	404 (82.3)	957 (69.7)	
Non-urban	69 (14.0)	359 (26.1)	
Both urban and non-urban	18 (3.7)	58 (4.2)	
Using imaging (used often) n (%)	191 (38.1)	706 (50.8)	<0.001 [†]
Having imaging facilities on site n (%)			
X-rays	73 (14.5)	209 (15.0)	0.789 [†]
MRI	16 (3.2)	46 (3.3)	0.8950 [†]
SEMG	18 (3.6)	64 (4.6)	0.3364 [†]

Diagnostic ultrasound	15 (3.0)	39 (2.8)	0.834 [†]
Thermography	18 (3.6)	70 (5.0)	0.1869 [†]

* t-test and analysis of variance were used to determine the statistical significance of the differences between groups.

† chi-square test was used to determine the statistical significance of the differences between groups.

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Table 3: Clinical management characteristics across frequency of chiropractors treating older people

	Never/rarely/ sometimes (n=505)	Often (n=1398)	p-value [†]
Discussed as part of the care/management plan (used often)			
Diet/Nutrition	264 (52.5)	699 (50.2)	0.383
Smoking/Drugs/Alcohol	113 (22.5)	358 (25.9)	0.1394
Physical activity/Fitness	420 (83.7)	1197 (86.1)	0.182
Occupational health and safety	180 (35.9)	596 (43.2)	0.004
Pain counselling	107 (21.4)	358 (26.1)	0.0354
Nutritional supplements (Including vitamins, minerals, herbs)	187 (37.3)	522 (37.5)	0.930
Medication (Including for pain/inflammation)	99 (19.7)	335 (24.4)	0.034
Treating patients with the following conditions (used often)			
Neck pain (Axial)	433 (85.9)	1348 (96.6)	<0.001
Neck pain (Referred/radicular)	240 (47.6)	954 (68.2)	<0.001
Thoracic pain (Axial)	362 (72.3)	1242 (89.3)	<0.001
Thoracic pain (Referred/radicular)	152 (30.5)	722 (52.2)	<0.001
Low back pain (Axial)	439 (87.5)	1355 (97.3)	<0.001
Low back pain (Referred/radicular)	338 (67.3)	1197 (85.9)	<0.001
Lower Limb musculoskeletal disorders (Hip, knee, ankle, foot)	212 (42.3)	937 (67.1)	<0.001
Upper Limb musculoskeletal disorders (Shoulder, elbow, wrist, hand)	224 (44.8)	964 (69.3)	<0.001
Postural disorders (Including lordosis, thoracic kyphosis, scoliosis)	251 (51.4)	888 (65.1)	<0.001
Degenerative spine conditions	198 (40.7)	1006 (73.8)	<0.001
Headache disorders (Including cervicogenic, tension)	364 (74.3)	1256 (91.9)	<0.001
Migraine disorders	191 (39.1)	794 (58.0)	<0.001
Spinal health maintenance/prevention	309 (63.5)	1048 (76.8)	<0.001
Non-musculoskeletal disorders	99 (27.1)	311 (31.1)	0.156
Using the following techniques/management (used often)			
Drop-piece techniques/Thompson or similar	251 (50.3)	756 (55.0)	0.072
Biomechanical pelvic blocking/Sacro- Occipital technique	198 (39.8)	628 (45.7)	0.024

Instrument adjusting	219 (44.2)	765 (55.3)	<0.001
Chiropractic BioPhysics	14 (2.9)	64 (4.9)	0.074 [†]
High velocity, low amplitude adjustment/manipulation/mobilisation	403 (80.9)	1144 (82.7)	0.3697 [†]
Applied kinesiology	73 (14.8)	227 (16.7)	0.322 [†]
Flexion-distraction	25 (5.1)	121 (9.0)	0.006
Functional neurology	61 (12.5)	181 (13.5)	0.573 [†]
Extremity manipulation	255 (51.2)	853 (61.7)	<0.001
Musculoskeletal Interventions (used often)			
Dry needling or Acupuncture	68 (13.6)	190 (13.8)	0.884
Soft tissue therapy, trigger point therapy, massage therapy, stretching	309 (61.3)	944 (68.0)	0.007
Electro-modalities (TENS, laser, interferential/ultrasound therapy)	45 (9.0)	138 (10.0)	0.5071 [†]
Heat/Cryotherapy	63 (12.6)	249 (18.1)	0.004
Orthotics (foot care)	29 (5.8)	161 (11.7)	<0.001
Specific exercise therapy/rehabilitation/injury taping	225 (45.6)	698 (50.5)	0.062 [†]

[†] chi-square test was used to determine the statistical significance of the differences between groups.

Table 4: Logistic regression analysis identifying associations with chiropractors who often treat older people

Factor	Odds ratio	95%CI	p-value
Age (increments of 10)	1.589	1.4061, 1.79580	<0.001
Patient visits per week (Increments of 10)	1.050	1.023, 1.0778	<0.001
Having referral relationship with a GP			
Yes	1.470	1.1394, 1.8980	0.003
Having referral relationship with an occupational therapist			
Yes	0.5667	0.367, 0.873	0.010
Practice location			
Non-urban (vs Urban)	1.8495	1.345, 2.543	<0.001
Treating patients with thoracic pain (Axial)			
Often	1.474	1.043, 2.0859	0.0283
Treating patients with thoracic pain (Referred/radicular)			
Often	1.3667	1.020, 1.8293	0.0364
Treating patients with low back pain (Referred/radicular)			
Often	1.7384	1.262, 2.3940	0.001
Treating patients with lower limb musculoskeletal disorders			
Often	1.49950	1.1485, 1.9576	0.003
Treating patients with degenerative spine conditions			
Often	2.245	1.7182, 2.9354	<0.001
Using soft tissue therapy, trigger point therapy, massage therapy, stretching			
Often	1.3697	1.042, 1.800	0.024



ACORN PRACTITIONER QUESTIONNAIRE

Chiropractic practitioner characteristics

Q1 What is your age in years?

Q2 What is your gender?

- Male
 Female

Q3 Are you currently in private chiropractic practice?

- No
 Yes, how many years?

Q4 What is the highest level of chiropractic professional qualification that you hold?

- Diploma Masters degree
 Advanced Diploma PhD
 Bachelor (or Double Bachelor) degree
 Doctor of Chiropractic

Q5 Are you a member of any of the following professional chiropractic organisations? (select all that apply)

- CAA CAA and COCA
 COCA None
 Other(s) (Please specify)

Q6 Indicate all the roles in which you have been involved as a chiropractor over the last 12 months: (select all that apply)

- University teaching
 Research
 Clinical supervision
 Volunteer work
 Private practice
 Professional organisation activities

Q7 Do you routinely consult patients in a language other than English?

- No
 Yes (Please specify)

Practice characteristics

Q8 How many of the following would you provide on average, per week?

- a) Patient care hours
 b) Patient visits

Q9 Do you practice in more than one location?

- No
 Yes, how many in total

Q10 Indicate all other health professionals working in your practice location(s): (select all that apply)

- GP Exercise Physiologist
 Podiatrist Psychologist/Counsellor
 Medical specialist Occupational Therapist
 Physiotherapist None
 Another Chiropractor Other(s) (Please specify)

Q11 Do you have a professional referral relationship (sending and/or receiving referrals) with any of the following practitioners: (select all that apply)

- GP Medical specialist
 Psychologist/Counsellor Exercise Physiologist
 Physiotherapist None
 Occupational Therapist Other(s) (Please specify)
 Podiatrist

Q12 In which state/territory do you practice? (select all that apply)

- NSW VIC QLD WA SA TAS NT ACT

Q13 Which of the following best describes your practice location(s)? (select all that apply)

- Urban Rural Remote

Q14 How frequently do you use diagnostic imaging as part of your practice?

- Never Rarely Sometimes Often

Q15 Indicate all imaging facilities or scanning tools you have on site: (select all that apply)

- X-ray Thermography
 MRI None
 SEMG Other(s) (Please specify)
 Diagnostic Ultrasound

Q16 Indicate when you use electronic records: (select all that apply)

- Initial History Examination findings
 Subsequent patient visits Never

Clinical management

Q17 Indicate the frequency with which you discuss the following as part of your care/management plans:

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



Q18 Indicate the frequency with which you treat patients that present with the following conditions:

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

Q19 Indicate the frequency with which you treat the following patient subgroups:

	Never	Rarely	Sometimes	Often		Never	Rarely	Sometimes	Often
Children (up to 3 years)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	People with work-related injuries	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Children (4 to 18 years)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	People with traffic-related injuries	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Older people (65 years or over)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	People receiving post-surgical rehabilitation	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Aboriginal and Torres Strait Islander people	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Non-English speaking ethnic group(s) (Please specify)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Pregnant women	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Other (Please specify)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Athletes or sports people	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>					

Q20 Indicate the frequency with which you employ the following Techniques/Methods in your patient management:

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

Q21 Indicate the frequency with which you employ the following Musculoskeletal Interventions in your patient management:

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