UTS UNIVERSITY OF TECHNOLOGY SYDNEY

Dental health services in Australia: the impact of the Chronic Disease Dental Scheme

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Thesis submitted in fulfilment of the requirements for the degree of Doctor of Philosophy under the supervision of Distinguished Professor Jane Hall, Professor Kees Van Gool, Dr Maryam Naghsh Nejad

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24 March 2023

Certificate of Original Authorship

I, Siobhan Kathleen Dickinson declare that this thesis is submitted in fulfilment of the requirements for the award of Doctor of Philosophy in the Faculty of Health at the University of Technology Sydney.

This thesis is wholly my own work unless otherwise referenced 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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Ethics approval

Ethics approval was sought and obtained under the University of Technology Sydney Ethics Committee (UTS HREC REF No. ETH18-2507).

Acknowledgements

I was working in the Commonwealth Department of the Treasury when in 2011 I was given the task of leading dental health policy. The result of that work was to close the Chronic Disease Dental Scheme (CDDS). Its closure meant the cessation of comprehensive adult dental services for a segment of the community. I began to wonder whether the CDDS's closure was good policy and whether the program had been effective at all. Thus, this PhD on dental health policy grew out of this long-standing question. Many years later, I can say that I have answered some of my questions. I have the privilege of presenting my findings to the Department of Health and at the Health Services Research Australia and New Zealand conference. I know this work has also answered questions other have had.

The journey to completing this PhD has not been easy and there have been multiple humps along the way. I know it takes a village to do a PhD and I am grateful for the kindness of the many who are in my village. Most important is my husband. He is the King of my village, and I am thankful to be his Queen. I also wish to thank my supervisors: Jane, Kees and Maryam – oh my, we did have fun! The support staff at CHERE and UTS deserves special mention. Thank you to Vanessa, Lili, Ashleigh, the IT staff, particularly Jim F; and of course, the librarians without whom no person would ever get any sort of degree. I'd also like to thank my friends: Shellie, Rob and Kim, Allison ('Clarke'), Merrillee and my daughter and parents. A special thank you also goes to my husband's boss, Tarryn. She has been a silent supporter of my career in making sure that my husband's roster can accommodate the needs of my PhD.

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Abbreviations list

ABS	Australian Bureau of Statistics
ACA	Patient Protection Affordable Care Act
AIHW	Australian Institute of Health and Welfare
ALSWH	Australian Longitudinal Study on Women's Health
APRA	Australian Prudential Regulation Authority
ARCPOH	Australian Research Centre on Population Oral Health
CDDS	Chronic Disease Dental Scheme
CHERE	Centre for Health Economics Research and Evaluation
DHS	Dental health status
DiD	Difference-in-difference
DHA	Department of Health
DOHA	Department of Health and Ageing
DVA	Department of Veteran's Affairs
EMSN	Extended Medicare Safety Net
OMSN	Original Medicare Safety Net
FE	Fixed effect
IRSAD	Index of Relative Socio-economic Advantage and Disadvantage
ITT	Intention to treat
GP	General practitioner
LPM	Linear probability model
MBS	Medicare Benefits Schedule
N/a	Not applicable
NSAOH	National Adult Survey on Oral Health
OMSN	Original Medicare Safety Net
RAND HIE	RAND corporation Health Insurance Experiment
SEIFA	Socioeconomic indexes for area
USA	United States of America
UTS	University of Technology Sydney

Abstract

Background

A notable omission of Australia's Medicare program is universal adult dental services. While some dental services are provided through state-based public dental services for low-income groups and concession card holders (Biggs 2008), for most Australians dental services are covered by either supplementary private health insurance (PHI), which can be limited, or they are paid for by individuals out of their own pockets (Hopkins, Kidd & Ulker 2013). However, in 2007, Medicare was expanded to cover dental services for those with a chronic condition or complex care needs through the Chronic Disease Dental Scheme (CDDS). This program provided subsidised services covering diagnostic, preventive, restorative services, oral surgery, orthodontics and dentures through the Medicare Benefits Schedule (MBS) with a value of up to $4,250 per patient over two calendar years (Department of Health and Ageing (DOHA) 2009b).

The cost of the CDDS to the Commonwealth Government exceeded initial estimates, with claims it was costing in the vicinity of $80 million per month as opposed to $90 million per year (Plibersek 2012). It was also criticised on multiple fronts. There were claims it was misused and it was poorly targeted (Plibersek 2012), including not addressing those on public dental waiting lists (Akers et al. 2017). Claims that the services provided did not adequately reach those most in need such as those in regional and rural areas (Crocombe et al. 2015; Kraatz et al. 2014). Others argued there were poor governance arrangements (Crocombe et al. 2015; Lam, Kruger & Tennant 2013a; Palfreeman & Zoellner 2012; Weerakoon, Fitzgerald & Porter 2014). There were concerns that there was an overconsumption of more expensive services and an underconsumption of services with longer term benefits such as preventive services (Lam, Kruger & Tennant 2012) as well as claims that some received services that they might not have purchased if they had to pay for them (Lam, Kruger & Tennant 2013a). Finally, the Government claimed some dentists were rorting the program (Biggs 2012; Plibersek 2012). It was subsequently closed in 2012.

Previous literature, research gaps and research motivation

While the CDDS was time-limited, it was an important program as it represented an expansion of public health insurance through Medicare to a select group. Yet to date research regarding the CDDS has been limited, primarily due to the use of MBS

administration data and the techniques employed. No identified studies have sought to determine whether there was an increase in dental use for those who were targeted by the CDDS. Further, no studies to date have provided analysis of the characteristics of a known cohort of CDDS users.

The thesis addresses these gaps. There are four empirical studies in this thesis. Studies one to three use quasi-experimental analyses to provide causal insights into the program that have not previously been available. Study one uses a difference-in-difference (DiD) methodology to assess whether there was an increase in the probability of a dental visit in the previous 12 months following the introduction of the CDDS for the those who were eligible. Study two builds on study one and uses a heterogeneity analysis methodology to assess whether there was an increase in the probability of a dental visit for those who were eligible and vulnerable. Study three uses both DiD and heterogeneity analysis methodologies to assess whether there was an increase in the probability of a dental visit for those who were not covered by PHI. Alternative techniques are used in study four. This study uses survey data linked to Medicare data to provide insights into a known cohort of CDDS recipients to identify their characteristics. The underlying data source for this thesis is the Australian Longitudinal Study on Women's Health.

Results

In studies one and two there was no increase in the probability of a dental visit for those who were eligible as compared to those who were not eligible. In study three there was no increase in the probability of a dental visit for those who were not covered by PHI as compared to those who were. The analysis into the characteristics of those who received a CDDS service found there was a positive association between those who were concessional or experiencing financial hardship or with poorer overall dental health status and a CDDS service, suggesting services went to those who could be considered in need. Further, this final study also found there those living in inner regional and outer regional, rural and remote areas received fewer CDDS MBS benefits.

Conclusion

This absence of any increase in the probability of a dental visit in any of the quasi-experimental analyses undertaken in this thesis are surprising (and one could suspect disappointing for policy makers), especially given the large budgetary overspend by the Commonwealth Government. The results of the linked data study show that as opposed to

criticisms that the CDDS was not targeting those in need, those who were more likely to have received a service could be considered to be in need of subsidised dental services. Further, an overview of the costs of CDDS services show most costs went toward higher cost restorative services, which may be needed to improve dental health status. Overall, the conclusion of this thesis is that the benefit of the CDDS, while not necessarily increasing a dental visit in non-attendees, may have been to allow recipients, particularly those with poorer dental health status and those with financial difficulties or concessional patients, to receive dental benefits that they previously may not have been able to afford.

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Chapter 1 – Introduction

Good dental health is a key component of having good general health. There is a growing literature outlining the link between poor dental health and multiple chronic conditions (Australian Research Centre for Population Oral Health (ARCPOH) 2011; Cheng et al. 2018; Iwasaki et al. 2014; Kisely, Lalloo & Ford 2018; Kuo, Polson & Kang 2007; Pokrajac-Zirojevic, Slack-Smith & Booth 2002; Sheiham & Watt 2000; Simpson et al. 2019). Many Australians report good dental health (Brennan et al. 2020), and just over half of the population report regular dental visiting (Brennan, Luzzi & Chrisopoulos 2020). The problem is that some Australians are missing out. Those who report poorer dental health are generally older, from lower socioeconomic areas and/or those without private health insurance (PHI) (Brennan et al. 2020; Ha et al. 2020; Peres & Lalloo 2020; Slade, Spencer & Roberts-Thomson 2007). The cost of dental services is often cited as a barrier to receiving adequate and timely dental treatment especially as dental services are generally not covered through Australia's health insurance program Medicare, and coverage through PHI can be limited (Australian Institute of Health and Welfare (AIHW) 2021; AIHW et al. 2016). The introduction of the Chronic Disease Dental Scheme (CDDS) in 2007 represented an expansion of Australia's Medicare program to include dental services for those with a chronic disease. To date there has been limited research into the impacts of the CDDS. This thesis uses a health economics framework to assess the impact of the CDDS to fill this literature gap.

Dental health - background

Good dental health enables individuals to "eat, speak and socialise without active disease, discomfort or embarrassment" (DOHA 2015, p. 6). An adequate level of dentition is defined as having more than 21 teeth (Abt, Carr & Worthington 2012; National Advisory Council on Dental Health 2012). Good dental health is an absence of the two most common dental conditions: tooth decay (or dental caries) and periodontal disease (or gum disease). The prevalence of these conditions differs according to age, with caries primarily impacting younger persons and periodontal disease primarily affecting those in middle and older ages (AIHW 2016b; Papapanou 2012). Both caries and periodontal disease conditions are the result of an accumulation of bacteria and risk factors including ineffective personal dental hygiene habits, poor dietary habits and limited dental practitioner treatments (ARCPOH 2009; Hayashi et al. 2014; Selwitz, Ismail & Pitts 2007).

Dental caries is the destruction of hard dental tissue and is one of the leading causes of tooth loss (Selwitz, Ismail & Pitts 2007). Caries is the result of several interacting factors including the host tissue, the plaque and bacteria and the consumption of dietary sugars (Cummins 2010). Biologically, a tooth's surface integrity comes under attack from bacteria, a process known as demineralisation (Peres, Ha & Christofis 2020). Remineralisation occurs in the presence of adequate saliva and is aided by preventive factors such as daily topical fluoride and antibacterial treatments (Cummins 2010). Caries are the result of destruction to the tooth's structure and the formation of a cavity due to a period of sustained ongoing demineralisation with inadequate plaque removal and inadequate fluoride intake (Peres, Ha & Christofis 2020).

Periodontal disease or gum disease is an inflammation of the gum as a result of plaque (Chestnutt 2016). There are two types of periodontal disease: gingivitis, inflammation of the gums without loss of structure, and periodontitis in which the tissues surrounding the teeth and gums that can lead to loss of bone support and result in tooth loss if severe enough (Abt, Carr & Worthington 2012; ARCPOH 2009; Chestnutt 2016; Hayashi et al. 2014).

Dental treatment is important for the promotion of good dental health. Dental treatment can prevent and, in some cases, reverse dental disease (Hayashi et al. 2014; Selwitz, Ismail & Pitts 2007). The types of treatments undertaken by dental professionals are broadly classified as follows: Diagnostic treatments include dental examinations, radiography and other treatments used in the diagnosis of dental disease or management. Preventive treatments include prophylactic and bleaching services such as scaling and cleaning to remove plaque and prevent gum disease; the application of remineralising agents and fissure sealants, which are recommended to protect teeth with deep grooves by providing a physical barrier from decay; and dietary and oral hygiene advice. Restorative services include treatments such as dental fillings and dental restorations for damaged teeth through bonding, which uses a resin to correct damage or discoloured teeth; veneers, which uses a veneer glued to teeth improve the appearance of a damaged tooth; and crowns, which are caps that are permanently bonded to a tooth. Endodontic services include treatments such as root canal treatments, which involve the removal of damage or infection from the internal tooth structure and insertion of packing into the tooth and an artificial surface to protect the tooth. Prosthodontic services replace missing teeth either through

fixed treatments such as crown and bridge treatments or through removable prostheses such as dentures. Oral surgery includes extractions for badly decayed or damaged teeth and the removal of wisdom teeth. Orthodontic treatment aims to correct misalignment of teeth or overcrowded teeth (Australian Dental Association 2017; Department of Health (DHA) 2018a).

Dental health status in Australia – an overview

Despite improvements in dental health over time, a substantial proportion of the population do not report good dental health. The latest National Study of Adult Oral Health (NSAOH) 2017-18, found 35.2% of the population reported being uncomfortable with their dental appearance (Brennan et al. 2020), 23.9% rated their dental health as poor or fair (Brennan et al. 2020), 23.7% reported avoiding food due to dental problems (Brennan et al. 2020), 20.2% reported a toothache in the 12 months prior to being surveyed (Brennan et al. 2020), one in six people reported being either edentulous (an absence of natural teeth) or lacking functional dentition (defined as having fewer than 21 teeth) (Peres & Lalloo 2020), around a third of the population had untreated (coronal) dental caries (or dental decay) (Peres, Ha & Christofis 2020) and around 30% had moderate to severe periodontitis (Ha et al. 2020). The prevalence of poor dental health confers a burden of disease (an aggregate measure of the impact of illness and injury and premature death attributable to a disease or condition) (AIHW 2018a))[1] of 2.2% (in 2011), which is similar to the estimated burden of disease associated with endocrine disorders or hearing and vision disorders (AIHW 2016b, p. 159).

Importantly, this burden is unevenly distributed across the population. Differences in dental health are observed across socioeconomic groups. In 2017-18, 25.2% of those in the lowest income group reported a toothache as compared to only 14.8% of those in the highest income group (Brennan et al. 2020) and around 35% in the lowest income group reported their dental health as poor or fair compared to 15.8% in the highest income group (Brennan et al. 2020). One reason for poorer dental health status in lower socioeconomic groups is that the determinants of poor dental health are more likely to affect those in lower socioeconomic groups and are the same as those that contribute to poor general health (Crocombe et al. 2014).

[1] The burden of oral disease includes dental caries, pulpitis and failed restorations, periodontal disease and severe tooth loss (defined as fewer than 10 teeth).

Intergenerational differences are also observed in dental health status. Moderate or severe periodontitis (gum disease) is more prevalent in older age groups than younger age groups. In 2017-18, periodontitis was found in 12.2% of younger adults compared to nearly 70% of those aged 75 years and older (Ha et al. 2020). A lack of functional dentition is evident in half of those aged 75 years and over but is only evident in 0.7% of those aged between 15 and 34 years (Peres & Lalloo 2020). These differences are the result of both the ageing processes that affect dental status and the improvements in dental health treatments and practices over time (Slade, Spencer & Roberts-Thomson 2007). The rate of edentulism has reduced from 14.4% of the population in 1987-88 to 6.4% in 2004-06 and to 4% in 2017-18 (Peres & Lalloo 2020). These improvements are the result of increased access to fluoride and improvements in dental hygiene practices as well as developments in dental treatments (AIHW 2016a; Brennan, Balasubramanian & Spencer 2015; Leake & Birch 2008). Whereas full mouth extractions were common between the 1920s and 1940s (Crocombe & Slade 2007), dentist now seek to restore teeth rather than extract them (Selwitz, Ismail & Pitts 2007). These improvements in dental health have benefited those in younger generations, particularly those born after 1970 (Slade, Spencer & Roberts-Thomson 2007).

Dental health and dental attendance

Dental attendance can be linked to increased dental health status (Brennan, Spencer & Roberts-Thomson 2012). Yet, just over half (56.4%) of the population report having had a dental visit in the last 12 months (Brennan, Luzzi & Chrisopoulos 2020). Further, dental visiting is associated with a socioeconomic gradient, which may contribute to this socioeconomic gradient in dental health status. Those living in the most advantaged socioeconomic area are more likely to visit a dentist that those living the in lowest socioeconomic area (59.4% in the least disadvantaged areas as compared to 36.9% in the most disadvantaged areas) (Australian Bureau of Statistics (ABS) 2017). Additionally, inequitable utilisation of dental services is consistent with socioeconomic gradients observed between those with higher education and higher incomes compared to those with lower education and in lower income groups (Ju et al. 2022).

Financial barriers to dental visiting can prevent individuals from receiving regular or timely dental treatment. In 2017-18, 39% of the population reported avoiding or delaying dental care due to cost and of those who did visit a dentist, 23% reported not receiving

recommended treatment due to cost (AIHW 2021). Again, there are socioeconomic disparities, with those in the lowest two socioeconomic groups being more likely to report not receiving recommended services due to cost (27.6% and 24.5% respectively) as compared to those in the highest two socioeconomic groups (17% and 11.4% respectively) (AIHW 2016). There are also links between greater dental health, dental attendance, increased wealth and being covered with private health insurance (Teusner, Brennan & Spencer 2015), which may be partly drive by the positive association between PHI and higher income (Yusuf & Leeder 2020). (See Chapter 2 for a discussion.)

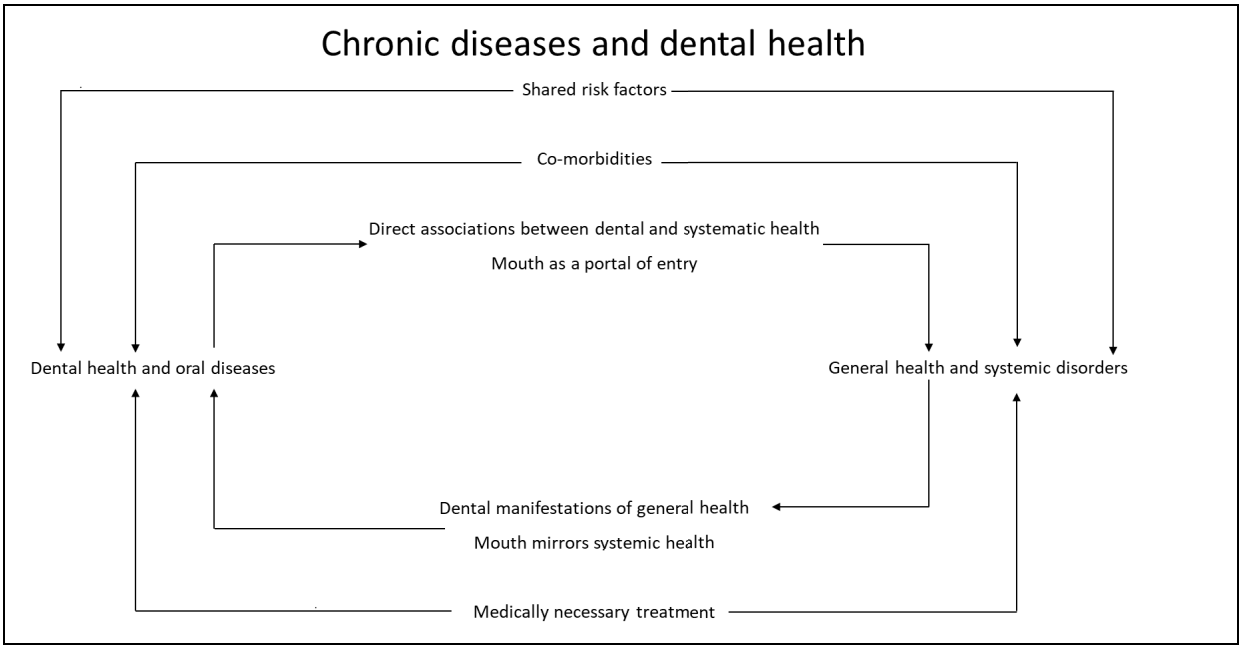
The link between chronic disease and dental health

There is a growing literature on the link between dental health and general (systemic) health as identified in

Figure ***1*** (ARCPOH 2011). As can be seen from the diagram, there are common risk factors such as diet, alcohol and smoking use, which cause both chronic diseases (systemic disease) and which also impact on dental health status (Crocombe et al. 2014; Sheiham & Watt 2000). The association between dental health and general health may be direct as the mouth is a 'portal of entry' for infections or it may be indirect (ARCPOH 2011, p. 336 & 8). As identified by the US Surgeon General (US Department of Health and Human Services 2000), indirect associations of the link between dental health and general health means the mouth can reflect the status of general health and wellbeing. For example, signs of nutritional deficiencies can be reflected through the mouth as can signs of stress and general infection. In this way the mouth can mirror one's systemic health status.

Poor dental health can create difficulties with speaking or can lead to social withdrawal and poor self-esteem (Kisely, Lalloo & Ford 2018). Periodontal disease is a known complication of diabetes (Kuo, Polson & Kang 2007) and glycaemic control can be improved with periodontal treatments (Simpson et al. 2019). Inflammation resulting from autoimmune diseases including arthritis can increase periodontal diseases (Pokrajac-Zirojevic, Slack-Smith & Booth 2002). Tooth loss is associated with a higher risk of cardiovascular disease and stroke (Cheng et al. 2018). Finally, in older people, poor dental health (defined as having missing teeth or poorly fitted dentures) has been shown to have an impact on nutrition levels in part driven by reduced vegetable consumption (Iwasaki et al. 2014).

Figure 1 - Chronic disease and dental health



Source: (ARCPOH 2011)

The Australian health system – a brief overview

Medicare, Australia's government-backed (tax-financed) public insurance program, was introduced in 1984 to provide universal health services for eligible persons (Biggs 2004, 2016). Responsibility for funding and provision of services is shared between the Commonwealth Government and state and territory governments. Public hospitals provide free services and treatments to patients and are funded jointly by the Commonwealth Government and state and territory governments (Biggs 2004). The Commonwealth Government's primary area of responsible is to subsidise medical (including allied health services) through Medicare (Biggs 2004). This includes subsidies for medical services provided to private hospital patients in either a public or a private hospital (AIHW 2016a).

Health insurance coverage through Medicare has evolved over time. Initially Medicare covered medical services provided mostly by doctors. Over time, there has been recognition of the value of more holistic or complete care. This is exemplified by the expansion of Medicare subsidies in 2004 to cover allied health services for those with chronic conditions or complex care needs (DOHA 2007a; Lam, Kruger & Tennant 2013b), which although

restricted to covering only a limited number of conditions and limited by number of subsidised visits, are now available through Medicare.

Services that are covered by Medicare are listed on the Medicare Benefits Schedule (MBS) (Department of Health 2021b). Each MBS item (or service) has its own separate identifier number, description and explanatory information, which includes clinical information and financial information (Biggs 2016; Western Australian Primary Health Alliance 2020). The MBS pays on a fee per service arrangement. A schedule fee attached to each item is set by the Commonwealth Government. The Commonwealth Government then provides an MBS benefit (also called a rebate) to the patient as a proportion of this schedule fee depending on where the service item was performed. As opposed to public hospitals, where the majority of services are provided free of charges (DHA 2018b), medical services that are provided in a private hospital attract a charge (DHA 2021a). The Commonwealth Government provides a benefit to (rebates) the patient of 75% of the schedule fee for these medical services[2]. For services that are provided outside of hospital (such as CDDS services provided at the dentist), the government provides a benefit to (rebates) the patient equal to 85% of the schedule fee and for GP services the MBS benefit paid is 100% of the schedule fee (DHA 2018b).

Providers of services may be public, private or not-for-profit (AIHW 2016a). Health professionals can choose to 'bulk-bill' the patient in which case the health provider receives the MBS benefit (or rebated amount) directly from the government and the patient faces zero costs for the service (Biggs 2016). Alternatively, they may choose the amount they wish to charge the patient, in which case any cost in excess of the MBS benefit amount are borne by the patient out-of-pocket (Van Doorslaer et al. 2008). To protect against high costs for out-of-hospital services, the Commonwealth Government provides patients with a higher reimbursement amount for out-of-hospital services once a threshold is reached through the Medicare financial safety nets. There are two Medicare safety nets: the Original Medicare Safety Net (OMSN), which provides a benefit paid (or rebate) of 100% of the schedule fee once its threshold is met and the Extended Medicare Safety Net (EMSN), which provides up

[2] Other charges in hospitals can be covered by PHI, through other Commonwealth Government programs (for example, pharmaceuticals can be covered through the Pharmaceutical Benefits Schedule), and in some cases are covered by the patient themselves.

to 80% of the total out-of-pocket amount once its threshold is met[3] (Department of Human Services 2018). Both the OMSN and EMSN work on a calendar year basis which means that each year, households have to qualify by reaching the thresholds amounts.

In addition to Medicare coverage, individuals can choose to purchase additional insurance through private health insurance (PHI). There are two components to PHI: hospital cover and ancillary (or 'extras') cover. In 2021, 45% of the Australian population had PHI hospital coverage and 55% had ancillary coverage (Australian Prudential Regulation Authority (APRA) 2022) (APRA 2022). Hospital PHI covers patients who may wish to be a private patient in either a public or private hospital and therefore have the benefit of choosing their own doctor or of having less waiting time for some procedures than public patients. Private health insurance covers the costs associated with the hospital stay and treatment (AIHW 2022a). Ancillary PHI covers services such as dental, physiotherapy or optical services and, in some cases, covers ambulance services (DHA 2021a).

Dental services in Australia

The dental health workforce

The dental workforce consists of dentists and other dental allied health staff. Dentists comprise the majority, at 75.5% of the dental workforce population (in 2012) (AIHW 2014). Ninety per cent of dentists are general dentists and 10% belong to one of 13 dental specialities (AIHW 2014). Approximately 85% of dentists in Australia work in the private sector (AIHW 2016).The supply of dentists differs according to geography and distribution is uneven. Higher densities of dentists are found in major cities as compared to remote and very remote areas. In 2013, 63.1 dentists per 100,000 population work in major cities, while 25.7 per 100,000 were employed in remote and very remote areas (AIHW 2016). The allied dental health workforce includes dental prosthetists who work independently to provide dentures and mouthguards *(AIHW 2014)*. The auxiliary dental workforce includes dental hygienists, dental therapists and oral health therapists who work with dentists to provide a limited range services *(AIHW 2014)*. Dental hygienists provide treatments for periodontal disease and preventative services for all ages; while dental therapists generally work with

[3] The Original Medicare Safety Net has a lower threshold and is $495.60 in 2022. In 2022, the Extended Medicare Safety Net (EMSN) threshold is $717.90 for concessional individuals and families (and families on Family Tax Benefit part A) and $2,249.80 for non-concessional individuals and families.

children providing hygiene, restorative and preventive services and extractions; and oral health therapists can provide hygiene and restorative services depending on their training (Australian Dental Association 2016).

Private dental services and private health insurance

The majority of dental services are provided by private practitioners with the costs of services borne mostly by individuals (AIHW 2016a). Individuals can choose to either self-insure, which means they pay for the cost of dental services themselves out-of-pocket, or they may choose to purchase ancillary PHI to assist with some of the costs of dental services (DHA 2021a). Ancillary PHI to cover dental services can be purchased as a stand-alone product or in conjunction with private hospital coverage to provide comprehensive PHI cover. In 2017-18, just over 50% of the Australian population aged 5 years and over reported being covered with PHI that covered dental expenses (AIHW 2022b).

The range of policies available for ancillary PHI is varied and the extent of coverage is usually capped so additional costs are borne by the individual out-of-pocket (AIHW 2020). This can mean that those with ancillary PHI are left underinsured. Further, there can be heterogeneity in the extent of insurance coverage offered by different insurance companies (Teusner, Brennan & Spencer 2015). Of those who attended a dental visit in 2013, only 8.5% reported that their PHI paid all of their dental visiting expenses while 77% reported the cost of a dental visit was shared between their PHI and themselves. The costs of visiting the dentist can be high. In 2017-18, the median out-of-pocket payment for a preventive service was $16, with a range of between $0 to $82; for a restorative service the median out-of-pocket was $60, with a range of between $0 to $199 and for a full crown, the median out-of-pocket cost was $786, with a range of between $26 to $1,989 (AIHW 2021).

Public dental provision and funding

Dental services are subsidised by the Commonwealth Government for Veterans and there are a limited number of specific services, for example, cleft lip or cleft palate treatment subsidised through the MBS (Biggs 2008). The Commonwealth Government also subsidises

services for children in receipt of certain government benefits[4] through the Child Dental Benefits Schedule (DHA 2022).

State and territory governments can provide public dental services directly. These public services act as a safety net particularly for low-income groups and concession card holders. However, they are subject to long waiting times. For example, in 2015-16, median waiting time for a first visit was between one and two years for most states, with only residents in Western Australian and the Australian Capital Territory having a median wait time of under one year (AIHW 2018b). Further, public dental services can be limited (National Advisory Council on Dental Health 2012). For example, private dental patients treated in the private system are more likely to have their teeth restored, while those who access public services or Aboriginal Medical Services are more likely to have their teeth extracted (Dudko, Kruger & Tennant 2015).

Provision of dental services and funding in Australia – an historical perspective

The provision of dental services and who should fund services has been the subject of multiple reviews and inquiries. In 1986, just after the introduction of Medicare, the Layton inquiry examined whether the MBS should be extended to non-medical services, including dental services. This inquiry noted there was unmet need in the community and that dental services met the criteria for inclusion for public funding; however, the high cost associated with comprehensive service provision, estimated at $600 million (in 1986), was deemed unrealistic (Medicare Benefits Review Committee 1986, p. 204). Additionally, this review also noted that the Australian Dental Association was not in favour of a publicly funded scheme for dental services on the basis that "imposed controls and political conflict go hand in hand with government money" (Medicare Benefits Review Committee 1986, p. 202).

Multiple subsequent reviews and inquires have reported that government-backed dental services are inadequate and that individuals miss out on treatment (National Health and Hospitals Reform Commission 2009; Select Committee on Medicare 2003; Senate Community Affairs Reference Committee 1998). The Senate Community Affairs Reference Committee (1998) concluded there is a need for the Commonwealth and states and

[4] These benefits include Family Tax Benefit, Parenting Payment, Carer Payment, Youth Allowance, Disability Support Pension, Double Orphan Pension, a Special Benefit payment and ABSTUDY.

territory governments to work together to improve dental health status through various arrangements. The Select Committee on Medicare (2003) viewed dental care as a shared responsibility between commonwealth, state and territory governments, and recommended the Commonwealth Government commit to funding and working with the state and territory governments to target services. A further inquiry into health in 2006 also concluded that dental services should be an area of shared responsibility between state and territory governments and the Commonwealth Government and noted that the disagreement between the jurisdictions on responsibility led to long waiting lists and declining dental health status of the population. It recommended the Commonwealth Government should supplement funding for disadvantaged groups (House of Representatives Standing Committee on Health and Ageing 2006). In contrast to these previous reviews the National Health and Hospitals Reform Commission (2009) proposed that the Commonwealth Government assume responsibility for dental care through a '*Denticare*' scheme. Through this universal dental scheme basic dental services would be provided through either a private insurance or public insurance plan. Finally, the National Advisory Council on Dental Health (2012) noted that there was a need for engagement between governments to clearly define responsibilities and that this definition would assist with policy and planning and funding of services. It too proposed a universal scheme although it argued this should be a longer-term proposal.

A persistent problem with providing a universal dental scheme is the high per annum cost. In 1998, a Medicare-based dental scheme was estimated to cost around $1 billion (Senate Community Affairs Reference Committee 1998). In 2003, the Australian Dental Association estimated a scheme for universal public dental coverage could cost between $2.5 and $4.5 billion (Select Committee on Medicare 2003, p. 128). The proposal for *Denticare* from the National Health and Hospitals Reform Commission (2009) was estimated to cost the Commonwealth Government around $3.9 billion, with the suggestion that this could be funded by an increase in the Medicare Levy by 0.75% of taxable income. Again, the issue of the expense associated with a comprehensive dental program was highlighted as a barrier to an immediate universal scheme by the National Advisory Council on Dental Health (2012). Despite these reviews, there is no universal dental coverage for dental services in Australia and it remains an area of shared responsibility between the Commonwealth and state and

territory governments (as described above), with the majority of services provided through private dental practitioners and costs borne mostly by individuals.

Dental services on Medicare - Chronic Disease Dental Scheme

MedicarePlus: the Allied Health and Dental Care Initiative – a precursor program

In the 2004-05 Budget, the Commonwealth (Coalition) Government introduced several measures to subsidise allied health professionals on the basis that patients with chronic and complex health needs may require additional health services and a multidisciplinary approach to care (Lam, Kruger & Tennant 2013b). The *MedicarePlus* program (under the *Allied Health and Dental Care Initiative*[5]) covered both allied health professionals, such as physiotherapy and psychology, as well as providing for dentist services for those whose dental health was impacting their chronic disease (Commonwealth Treasury 2004). Under this dental program a limited number of dental services, up to three dental consultations per year to a value of $220, could be claimed (Abbott 2004; Biggs 2007). This was the first time subsidised dental services had been available through the MBS. The Commonwealth Government sought to limit the scope of this program highlighting the program was primarily a "health care measure not a dental care scheme" (Abbott 2004).

The program was undersubscribed. A total of 16,000 dental services were provided to eligible patients over the first three years of operation, which was less than the estimated 23,000 consultations that were expected (Abbott 2004; Biggs 2007) and only $1.8 million in benefits were paid (Lam, Kruger & Tennant 2012). The lack of uptake of the program was blamed on concerns regarding the limited MBS benefit available for services (Biggs 2008; Smith 2007) and the underutilisation of the program gave rise to concerns that the administration costs of the program were likely to outweigh the program's benefits (Lam, Kruger & Tennant 2012). In 2007, the *MedicarePlus* program was closed.

The Chronic Disease Dental Scheme

In place of the *MedicarePlus* program was the CDDS. Announced in August 2007 and commencing in November 2007, the CDDS saw an expansion of dental service coverage available through Medicare for those whose "oral health is impacting on, is likely to impact

[5] This program was introduced under the measure *MedicarePlus – new Medicare Benefits Schedule items for certain health professionals and dentists.*

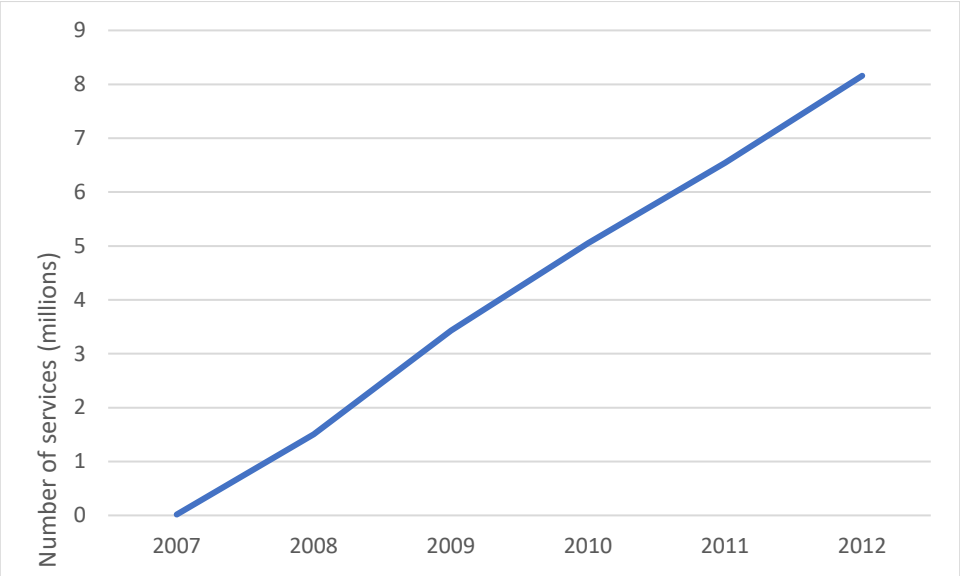
on, their chronic condition" (Abbott 2007; Commonwealth Treasury 2007). It was a more generous program than its predecessor, providing coverage to general dentists, specialists and prosthetists for a range of services totalling up to $4,250 over two calendar years. Any costs over this value were to be paid directly by the patient (DOHA 2009b). Consistent with other services on Medicare, providers were able to set their own charges for each individual MBS item. The provider could choose to charge the CDDS MBS schedule fee or charge additional costs for each MBS item and therefore leave the patient with out-of-pocket expenses (DOHA 2009c). As the CDDS was provided in an out of hospital setting, out-of-pocket costs contributed to the safety nets thresholds, which allowed for additional MBS benefits to be paid once the threshold was met. The safety net threshold amounts in November 2007 was $519.50 for concessional persons (including concessional families) and $1,039.00 for other individuals and families (DOHA 2007b). Costs in excess of the $4,250 threshold were borne by the individual as safety net arrangements did not apply once this limit was reached (DOHA 2007b).

To receive benefits, patients were required to have their chronic disease or complex condition managed by their general practitioner (GP) through a GP Management Plan[6] and Team Care Arrangement[7]. In aged care facilities, patients required a multidisciplinary care plan[8] (DOHA 2009a). A chronic condition meant one that was present for six months or more and complex care was defined as needing ongoing care from a multidisciplinary team, defined as a GP and at least two other health care providers (DOHA 2009c). The schedule of dental services covered diagnostic, preventive, restorative services, oral surgery, orthodontics and dentures (although there was a limit of one set of dentures every 8 years, except for in exceptional circumstances (DOHA 2007b)) as long as the primary purpose of the program was to improve oral health or functioning (DOHA 2009a). Participating dentists, oral and maxillofacial surgeons and dental prosthetists were required to receive a Medicare provider number in order to participate in the program (DOHA 2009c). While the CDDS provided subsidised services for dental specialists, GPs could not refer directly to a dental specialist. The GP was required to refer to a dentist or, where necessary, a dental

[6] MBS item number 721 or 725 for a review
[7] MBS item number 723 or 727 for a review
[8] MBS item number 731

prosthetist. After the initial referral to a dentist, the patient could be referred to the dental specialist including by the dentist themselves (DOHA 2007b).

Figure 2 - MBS CDDS services 2007-2012

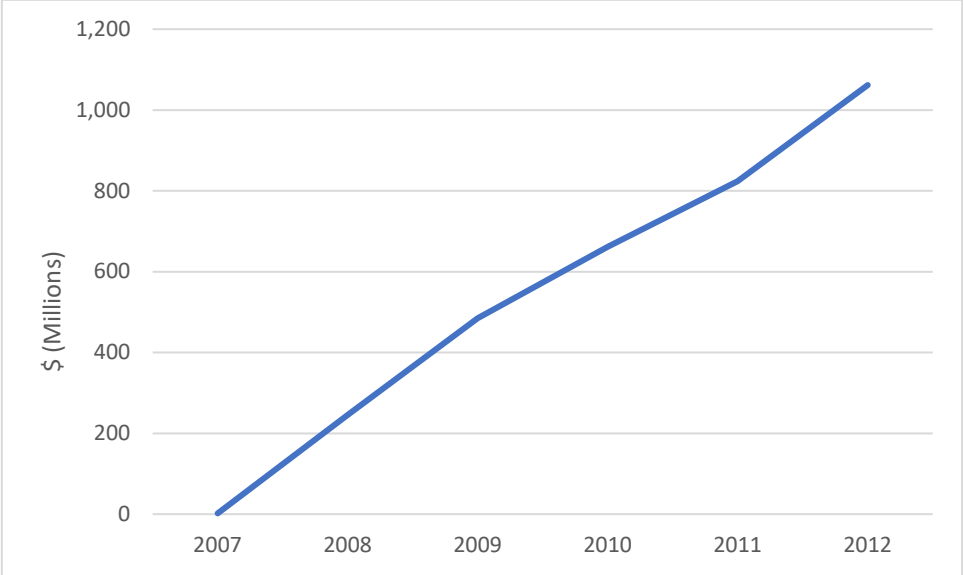


Source: MBS data online

As opposed to its precursor program, there was strong uptake of the program as shown in Figure 2. When first proposed, the CDDS was estimated to cost the Commonwealth Government $384.6 million over the forward estimates period[9] (Abbott 2007). However, this cost grew rapidly (Figure 3), and these costs were soon a source of concern for the then (Labor) Commonwealth Government who closed the program to new entrants in September 2012 and terminated it completely in November 2012. The reasons for closing the program included cost to the Commonwealth Government, claims of rorting by dentists and that the program was poorly targeted (Plibersek 2012). To date comprehensive dental health services for adults are not available through the MBS.

[9] The forward estimates period covers the proposed expenditure over the first four years of a program's operation based on projected demographics, uptake and other assumptions (Department of Finance 2016).

Figure 3 -MBS CDDS benefits ($) 2007-2012



Source: MBS data online[10]

Thesis overview

As Australia's Medicare does not include universal comprehensive adult dental services, inequities in dental health outcomes remain. The CDDS represented an important evolution of Medicare in which comprehensive dental services were subsidised for a (limited) population. The costs associated with this program far exceeded initial expectations, yet to date the literature on the CDDS is limited. To inform future dental policy it is important the effects of this program are known. This thesis answers two very pertinent yet unanswered questions:

1) Did the CDDS result in an increase in dental utilisation for those who were eligible?
2) What were the characteristics of CDDS recipients?

Chapter 2 provides the conceptual basis for this thesis and the literature review. This literature seeks to provide a guide to the potential outcomes that might be expected from the CDDS and clearly shows the research gaps and the motivation for this thesis. Chapter 3 provides an overview of the data used in this thesis giving a background for the empirical chapters. The data in this thesis comes from the Australian Longitudinal Study on Women's Health (ALSWH). Chapters 4,5 6 and 7 are the empirical chapters that address the questions

[10] MBS item numbers used are those in Appendix A. Author's own calculations.

above. Chapter 8 is the final chapter that summarises the key findings from this thesis and concludes with the policy indications and future research options.

Chapter 2 – Health Insurance – conceptual underpinnings and literature review

Introduction

As this thesis is about what happens when publicly funded dental insurance is expanded, an understanding of the theory of insurance is presented in this chapter. It commences with a discussion on insurance and then provides a rationale for such strong government intervention in health insurance markets as opposed to other insurance markets. In the second half a discussion of the most relevant literature on the consequences of expansions to publicly funded dental health insurance is presented. This chapter also provides the relevant literature on the CDDS. It concludes by identifying the gaps in the literature which provides the rational for the studies in this thesis.

Insurance

Uncertainty and risk associated with loss are present throughout life. Risk is the central concept of insurance (Atkins & Bates 2008; Morris, Devlin & Parkin 2007). While risk can be mitigated, it cannot be eliminated. As individuals do not know whether they are going to be affected by a loss-inducing event or not, they can increase their welfare by limiting the financial consequences associated with risk and loss through insurance (Pauly 1968; Santerre & Neun 2013). The value of insurance is that rather than pay the full cost for rectifying any loss, which can in some cases be prohibitive, insurance coverage means individuals pay a smaller amount (known as a premium), to indemnify themselves and return them to their financial position should a loss inducing event occur (Rejda 2011).

Insurable risk means the probability associated with a loss inducing occurrence can be calculated (Borch 1990). While an individual's probability of experiencing a loss, or their risk is important, insurance is valuable as it pools each individual's risk into one (Pauly 1968; Rejda 2011; Santerre & Neun 2013). Pooled arrangements mean the insurance company is able to more accurately predict the actual loss associated with an event due to the *law of large numbers*[11] (Atkins & Bates 2008; Rejda 2011). These pooled arrangements reduce the total risk (Pauly 1968). This allows companies calculate a risk per insured upon which they

[11] The law of large numbers is a statistical/ probability law that as more people enter the insurance pool the probability of a loss-inducing event occurring becomes closer to the population average.

are able to set the price (or premium) to cover the expected losses from the pool (that is the amount they will need to pay out to individuals) as well as an administration and a profit component (Borch 1990). Consumers will purchase a premium that they consider 'fair', which covers the individual's expected loss (which is a may be depended on how risk averse they are) as well as a risk component and an additional cost to cover the costs of administration (Nyman 2004). Important for the insurance company's viability is the need for premiums to be set accurately. There are two problems which affect the efficiency of the insurance market: adverse selection and moral hazard.

Problems with insurance markets - adverse selection

According to Rothschild & Stiglitz (1976), adverse selection is a problem of a pooling equilibria where higher risk individuals imposed additional costs on those who are lower risk. This is because it is difficult for the insurance company to set one premium that covers both higher risk individuals (who are likely to purchase more generous insurance premiums consistent with their higher expected losses) as well as the lower risk individual (who seek to minimise their premiums consistent with their lower risk profiles. Insurance companies) in setting a fair premium, need to balance the needs of the higher and lower risk individuals. If the insurance company sets the premium too high, accounting for higher-risk individuals, lower-risk individuals may find insurance unattractive and drop their coverage. However, setting premiums too low impacts the company's ability to cover their expected costs.

Adverse selection occurs due to information asymmetries (Akerlof 1970). This is because individuals know more about their risk profile than the insurance company does, which inhibits the insurance company's ability to adequately assess the risk profile of those in their insurance pool (Santerre & Neun 2013). The problem with adverse selection is that as those with lower risks drop out, the insurance pool becomes full of high risk individuals who are such poor risks that insurance coverage becomes unfeasible at any price (Akerlof 1970). This ultimately makes insurance unsustainable and can induce the insurance 'death spiral' (Duckett & Sobart 19 May 2021).

Moral hazard

Moral hazard occurs when the insured, owing to their insurance status, undertakes activities that directly impacts their likelihood of experiencing loss (Nicholson & Snyder 2012). This occurs because the insurance company cannot adequately observe the actions of the

insured and complete monitoring would be price prohibitive (Nicholson & Snyder 2012). There are two types of moral hazard that occur in insurance markets: ex-ante moral hazard and ex-post moral hazard. Ex-ante moral hazard occurs when the insured does not take due care thus impacting on the likelihood of a loss-inducing event or the increasing the size of that loss (Nguyen & Worthington 2023; Nicholson & Snyder 2012). For example, having car insurance may increase the likelihood of leaving one's car unlocked and ungaraged. This behaviour could be considered careless and could impact on the likelihood of the car being stolen. Ex-post moral hazard refers to instances where the insured, because of the insurance, is more likely to demand additional purchases that they might not otherwise have bought themselves (Zweifel & Manning 2000). Moral hazard is a problem because it impacts on the costs outlaid by the insurance company (Nyman 2004; Zeckhauser 1970). The outcome of moral hazard is to increase to the expected payments that the insurance company needs to make, thereby increasing company costs, which, consequently, increases premiums (Zweifel & Manning 2000).

Health Insurance

Health insurance is purchased to protect individuals from the very large expenses associated with health care (Cronin et al. 2009; Cutler & Zeckhauser 2000). Health insurance allows those who are risk averse to cover themselves against the potential of requiring high cost health care (Cutler & Zeckhauser 1999). The rise in health insurance has been driven by the increasing effectiveness of medical care since the 1940s and the improvements in health technologies that offer increasingly effective but costly health treatments (Cutler & Zeckhauser 2000; Productivity Commission 2018).

Across many countries, governments intervene in the health insurance market to the point of directly providing health insurance, such as is the case in Australia, where Medicare provides health insurance for eligible persons. In the USA government backed health insurance is provided through Medicaid, which covers poorer adults and families, and Medicare, which covers older aged persons. A question that may be posed is why health insurance is different from other insurance markets that prompts such an investment from government?

A primary concern is that when the health insurance market is left to the private market, gaps in market coverage emerge from adverse selection (Akerlof 1970). This was highlighted

by Akerlof (1970) who observed an absence of medical insurance available for purchase for those aged over 65 years in the USA (at the time). The absence of available insurance occurred despite those aged over 65 being more likely to need health services and demand insurance. Thus, he concluded the provision of government backed insurance through Medicare[12] (for those aged over 65 years in the US) was deemed to be welfare enhancing.

While other insurance markets also experience gaps leading to welfare losses for those who are unable to obtain insurance[13], the consequence of inadequate health insurance coverage mean that individuals may face significant or catastrophic costs to obtain healthcare (Morris, Devlin & Parkin 2007) that may result in financial ruin (Cutler & Zeckhauser 2000). This leaves those without the ability to pay possibly missing out on treatment (Deeble & Scotton 1968), which is considered unacceptable due to the high value placed on people's health care consumption. Further, as opposed to other goods and service, health is seen as a fundamental human right (World Health Organization 2017) that has important social welfare implications (Scotton 1968) as it is a necessary input for individuals to maximise their potential in life (Wagstaff & Van Doorslaer 2000). There are also equity concerns regarding the provision of health care that mean health should be distributed on the basis of need (Mooney 2003) and there is a value placed on other people's ability to consume healthcare when they need it. This is termed a 'caring externality' (Culyer 1971). Further, within health markets an option value externality exists as consumers wish to ensure there is sufficient supply of health care interventions that are needed infrequently[14] (Hurley 2000).

In his seminal paper, Arrow (1963) articulated how the medical (health) care market differs from the assumptions of the classical competitive market and the special features of the health insurance markets. These features include that the demand for health care can be considered a derived demand as the demand is not for health care itself, rather the consumption of health care is to promote health (Getzen 2004; Hurley 2000). This demand can occur when an individual has experienced some significant event that has resulted in an 'assault' on the person (Arrow 1963) and, in some cases, consumers may not realise there is

[12] Medicare was introduced in 1965.
[13] For example, flood insurance in some parts of Australia.
[14] An example of this type of externality might be in relation to heart transplants.

a need for health care treatment at all[15] (Culyer 1971). Further, this demand for health care is not steady in nature, rather it is unpredictable and irregular, with uncertainty related to both the demand for health care, due to the inability to clearly predict illness, when it might occur and how severe an illness might be; and uncertainty related to the treatment of illness, including a limited ability to predict the outcomes of treatments such as whether they will be effective, or whether treatment itself might result in further ill health.

Arrow (1963) argued that consumers are unable to have full information regarding the health products or treatments that they purchase, as would be assumed in the perfectly competitive model. This arises due to the unpredictability of the health care needs and treatments and, because consumers do not tend to repeatedly purchase many health care services, thus they are unable to obtain this information. This results in information gaps that give rise to the unique relationship between doctors and their patients. The doctor is largely considered the expert and is considered to have more knowledge about ill health and treatments than the patient, resulting in doctors guiding or deciding the best course of action and the allocation of resources (Cutler & Zeckhauser 2000). This type of arrangement results in the doctor acting as the patient's agent and violates assumptions of consumer sovereignty and the consumer's ability to judge the quality of care (Culyer 1971) and the independence of the supply and demand curves (Hurley 2000). In addition, consistent with the view that doctors act as the patient's agent, there is an expectation regarding the behaviour of medical providers (doctors and other health care providers), which is different from other profit maximising agents (Arrow 1963). As the doctor is relied upon to provide advice for treatment, it is expected this advice is based on the best interests of their patients as opposed to either financial considerations or customer's wants.

While there is an assumption of no barriers to entry for suppliers under the perfectly competitive market, Arrow (1963) observed regulations such as licenses are deliberate barriers to restrict the practice of medicine to ensure a level of quality for medical practitioners. Both the quality and quantity of the supply of medical practitioners is restricted.

[15] Patients who are unconscious can need health care but may be are unaware due to their altered consciousness.

Economic theory notes that price acts as a rationing mechanism. In the case of health care, Arrow (1963) observed that the distinct pricing practices are a feature of the health care market. In some cases, treatment may not be based on price, rather even when the consumer is unable to afford the price, treatment can still be provided. For example, even prior to Medicare's commencement, those who required life-saving treatments could access hospitals based on their need irrespective of their financial status (Finkelstein & McKnight 2005). Finally, externalities, for example communicable diseases, impact on the efficiency of the market (Arrow 1963).

Based on the above observations, Arrow's article provided an argument for governments to provide insurance where the private market has failed to do so adequately as this improves efficiency (Pauly 2001; Productivity Commission 2018). Similarly, Akerlof (1970), identified that due to the presence of adverse selection in health insurance markets higher risk individuals can have difficulty obtaining insurance where insurance operates in a free market (Akerlof 1970; Chestnutt 2016). These arguments provided a basis for government provision of health insurance.

Arguments for and against government-backed health insurance, implementation of health insurance and developments over time

Not everyone was convinced by Arrow's argument that the government should increase the provision of health insurance. In response to Arrow's argument, Pauly (1968) cautioned government to consider the impact (negative welfare impacts) of moral hazard arguing moral hazard is inefficient. According to economic theory, individuals will choose consumption where marginal benefit equals marginal costs (Pauly 2011), but as health insurance reduces the price of medical care at the point of sale by rotating the individual consumer's budget constraint (Manning & Marquis 2001), the provision of insurance can result in a change in the insured individual's behaviour (Santerre & Neun 2013; Zweifel & Manning 2000) resulting in an incentive to overconsume medical care. Pauly (1968) argued moral hazard occurred, not due to bad behaviour, but as the result of individual's acting rationally because of insurance lowering the cost of health care to the individual (to near zero).

This has led to health insurance policies that seek to mitigate concerns about overconsumption of health care (moral hazard) while maximising the insured's benefits

(Cutler & Zeckhauser 2000). To reduce this moral hazard health insurance policies include a risk sharing (or cost sharing) arrangement into the health insurance contracts (Nicholson & Snyder 2012). These arrangements include a deductible, which is the amount a person pays prior to accessing any form of health insurance benefit; and a co-insurance (or co-payment) amount, which is considered a co-contribution for accessing care (Cutler & Zeckhauser 2000). The purpose of deductibles and co-payments are to reduce the moral hazard impacts from health insurance by reducing the costs of health care (Pauly 1968). A stop-loss amount can be included as an additional financial protective mechanism. The stop-loss is the maximum amount a person needs to pay to access treatment (Cutler & Zeckhauser 2000).

However, others have argued that the moral hazard concerns associated with moral hazard have been overstated (Nyman 1999). Nyman (1999, 2004) noted that health insurance provides a transfer of income from healthy individuals to those who become ill. He states that as opposed to insurance leading to an overconsumption of healthcare, the purchase of health insurance is reflective of the increased willingness to pay for health care due to insurance (Nyman 2004). The welfare benefits of insurance identified by Nyman (1999) result because insurance coverage (which itself is welfare enhancing) increases income allowing consumption of more medical care whilst in an ill state and the ability for consumers to receive medical care they would otherwise not have been able to. Blomqvist (2001) also argued that the absence of any insurance results in welfare losses because of unaffordable health care. As a result of these criticisms of the theory of moral hazard, Nyman (1999) argued that if moral hazard is less of a concern and insurance is welfare enhancing, then there is less of a need for cost sharing of health care services.

Implementation of the Medicare in Australia has seen features that include a risk sharing component, consistent with thinking at the time. This explains why the Medicare benefit paid (or rebate) is less than what is determined through the schedule fee to ensure the consumer of the health care has a price signal, that is, they are required to share some of the costs of health treatments. (Chapter 1 provides further explanation on the MBS benefits paid or rebate amount for MBS services.) While cost sharing does reduce the concerns of possible overconsumption, and despite the introduction of the Medicare safety nets, there are concerns in Australia about the out-of-pocket costs associated with health care that are faced by individuals (Yusuf & Leeder 2020).

Arguments in favour of health insurance in Australia at the time of Medicare's inception identified that the strongest case for health insurance is to cover expensive and unpredictable services, such as cancer treatment, heart conditions and alike, with a less strong case for cheaper and regular services, such as some preventive check-up services (Deeble & Scotton 1968). (Arrow (1963) also made such arguments.) Since its introduction, the scope of service provided through Medicare has increased. Most notably there has been the introduction of preventive health items on the MBS. An example of this is the *45 and up health check*, which is a specific health item to identify those who are at risk of developing a chronic disease (Department of Health and Aged Care 2014). The inclusion of subsidised preventive checks is in contradiction to views that there are less of an insurance argument for lower cost preventive services articulated above. Additionally, Medicare has evolved to include allied health services in addition to high cost medical services, consistent with a more holistic view of health insurance. (See also Chapter 1 for an overview of the *Medicare Plus: Allied Health and Dental Care Initiative* in the 2004-05 Budget.) Australia's Medicare does provide Australians with some financial protections, despite the concerns around the high out of pocket costs, for various health care needs across a range of medical and allied health services. Although, as highlighted in Chapter 1, these protections are limited when it comes to dental health. The comprehensiveness of general health services on Medicare, consistent with a holistic view of health, raises more questions regarding the absence of coverage for dental services.

Dental health – an extra special case of insurance

While generally health is viewed differently to other commodities and this has provided an argument for government intervention, this does not extend to coverage of dental health insurance. Basing arguments on Arrow's 1963 framework, Sintonen & Linnosmaa (2000) argue that dental health services are different from other general health services and this reduces the argument for government intervention.

One argument for providing government backed health insurance care is that the nature of demand for medical care is unpredictable and irregular (Arrow 1963). While it is shown that there is a degree of risk (or probability) associated with dental illness (Burt 2005), the question is whether dental services experience the same degree of uncertainty and

unpredictability as do general health services? Those opposing government backed dental health coverage argue that dental diseases occur slowly and provide many opportunities to halt or reverse the ill effects with adequate treatment (Selwitz, Ismail & Pitts 2007). Therefore, with adequate knowledge and access to preventive treatment there is reduced risk of dental disease development. Further, as opposed to general health conditions in which the diagnoses of health conditions can be more uncertain, Sintonen & Linnosmaa (2000) note that dental diseases are easier to diagnose and most of the information for diagnosis can be obtained easily through X-rays and rarely is dental care an emergency service. While Arrow (1963) noted that ill health can result in death or impairment, poor dental health is unlikely to result in death excepting some extreme cases. Overall, dental disease does not suffer the same levels of uncertainty that are present in general health conditions.

It is also argued there are externalities that impact on health and provides a strong rationale for government intervention. However, dental disease and its impacts may be thought of as a solo experience or, as argued by Sintonen & Linnosmaa (2000), dental disease is a non-communicable disease or independent condition. Thus, dental disease does not appear to confer an externality in the same way that illnesses such as communicable diseases, which impact on the efficient allocation of resources.

Information asymmetries are a known issue in the field of health care and provide a source of market failure. In the case of general health, patients often have limited information upon which to base their decisions, thus they often refer to the doctor which acts as the patient's agent. In regard to dental care however, Sintonen & Linnosmaa (2000) argue that as dental services are purchased on a regular basis, there is capacity for consumers to learn from experience, which makes it easier to judge the quality of the product over time.

One area that is consistent between general health and the dental health system are the supply side restrictions due to the high barriers to entry. In a divergence from the perfectly competitive model, Arrow (1963) noted that there are licensing requirement that prevent entry into the market for dentists. Dentists, like doctors and all other health practitioners, are regulated to ensure quality standards.

While it could be argued that overall the dental care market does not contain the same quantity of market failures as general health services, it could still be argued that in the

absence of adequate insurance there are welfare losses (Chetty & Finkelstein 2013) and this can provide a sufficient economic argument for the provision of government backed services. There may also be equity concerns arising from the inequitable use of dental health services or from inequitable dental health outcomes that would further provide sufficient argument for government backed health services.

Finally, it may be argued that as with general health care, a 'caring externality' may be present, in that individuals may derive a marginal external benefit from knowing that others are consuming the dental health care they require (Morris, Devlin & Parkin 2007). Yet despite these arguments dental health insurance coverage remains excluded from Australia's Medicare. As a result, much of Australia's dental insurance coverage is left to the private health insurance market.

For policy makers in Australia the decision whether to expand dental insurance also depends on the consequences of such a policy. Notwithstanding the cost, a central question is what the increase in dental utilisation may be as a result of an expansion in dental health insurance coverage. As health insurance coverage reduces the price of health care at the point of sale (Manning & Marquis 2001), the provision of insurance can result in a change in the insured individual's behaviour (Santerre & Neun 2013; Zweifel & Manning 2000), as a result there should be an increase in utilisation. A possible problem with dental insurance as opposed to other forms of health insurance may the issue of moral hazard. While it is unlikely that individuals will overconsume some treatments, for example chemotherapy, it may be difficult to disentangle the cosmetic and dental health benefits of some dental services (e.g., tooth-coloured restorative services) (Lam, Kruger & Tennant 2013a). The next section provides the empirical literature on the effects of insurance on health and dental health utilisation and also covers the CDDS literature.

Literature Review - Measuring the impact of health insurance

The literature is divided into two parts. The first part sources international literature and the second part of the literature review is sourced from Australia. The first part commences with an overview of the RAND Health Insurance Experiment (HIE) as it is the seminal study into the effect of health insurance and utilisation and outcomes. The literature review then covers more recent literature. This literature is chosen as the methods used in these studies align with the methods in this thesis. This international literature shows there is generally an

increase in dental utilisation following dental health insurance expansions. Literature from Australia is the focus of the second part of the literature review. This commences with a discussion of PHI and dental utilisation and then covers the literature on the CDDS. Overall, this shows there are few studies into the outcomes of the CDDS and the studies that do exist are limited in multiple ways, including in terms of underlying data source used and the conclusions that are drawn. This shows the gap in the current CDDS literature and provides the motivation for this thesis.

International literature - health insurance and utilisation

RAND Health Insurance Experiment

The concern regarding moral hazard and the use of health services, ultimately became an empirical question. The early studies into the effect of insurance on (general health insurance as opposed to specifically dental health insurance) health services utilisation suffered from multiple measurement issues (Mueller & Monheit 1988). Observational studies into the effect of insurance coverage on health care utilisation were biased due to endogeneity from adverse selection as those who are more likely to demand more health services are more likely to also purchase more generous health insurance (Gnanamanickam & Teusner 2018; Manning et al. 1985; Manning et al. 1987). The RAND HIE sought to overcome these methodological problems by using randomisation to provide causal evidence of insurance coverage, or cost sharing, on health utilisation thus making insurance exogenous (Mueller & Monheit 1988; Sintonen & Linnosmaa 2000). It proved to be one of the most important and seminal studies into the impact of health insurance and health services usage and costs (Aron-Dine, Einav & Finkelstein 2013; Blomqvist 2001; Gnanamanickam & Teusner 2018).

The RAND HIE occurred between 1974 and 1981 when around 2,000[16] households were enrolled into the experiment (Nicholson & Snyder 2012). Families[17] were randomised into

[16] Seventy percent of households were enrolled for three years and 30 percent for five years.
[17] Ineligible participants were those aged 62 years and older, those with high incomes (excluding 3 percent of families), those eligible for the Medicare disability program, institutionalised or incarcerated individuals, military families and veterans with service-connected disabilities (Newhouse & the Insurance Experiment Group 1993).

one of 14 different fee-for-service plans[18] across six sites across America[19]. The insurance product had two parts: the coinsurance amount and the upper limit amount. The variable coinsurance amounts were 0, 25, 50 or 95 percent of the cost of the health product and the variable upper limit, or maximum dollar expenditure, was 5, 10 or 15 percent of family income up to a maximum of $1,000. There were additional differential coinsurance rates across inpatient and outpatient services, mental and dental health[20]. Sub-experiments were also run, including testing for the transitory effects of insurance. All families received a lump sum payment to ensure no household was worse off for participating.

Overall, the RAND HIE found that for general health care services usage responded to out-of-pocket costs faced by the consumer (or the amount of cost sharing of the insurance plan). The mean predicted expenditure was 46 percent higher on the free plan than those on the plan with a 95 percent coinsurance rate (Manning et al. 1987). Comparisons of income groups found those with higher incomes had a higher probability of medical services use, although the authors noted the magnitude was small and other factors were likely influential (Manning et al. 1987; Newhouse & the Insurance Experiment Group 1993). Comparisons between healthy and unhealthy participants showed that there was no difference between the groups' responses, although they found that those who were sicker were more responsive to price than the healthy (Manning et al. 1987; Newhouse & the Insurance Experiment Group 1993). There was little differential impact on inappropriate care versus appropriate care (Zweifel & Manning 2000), meaning all care is responsive to price. Seeking to understand whether there was an economic argument for 'free' care, some beneficial effects of free care were found where treatments were for relatively common conditions, where diagnostic tests were relatively inexpensive and the treatment was well-known, inexpensive and efficacious relative to the treatment of many medical conditions.(Newhouse & the Insurance Experiment Group 1993, p. 351). Importantly, health improvements were noted for those who were poorer including: a modest improvement in

[18] Or they were enrolled into a prepaid group practice. The fee-for-service insurance plans were the focus of this article.

[19] The six sites were: Dayton, Ohio; Seattle, Washington; Fitchburg, Massachusetts; Franklin County, Massachusetts; Charleston, South Carolina; and Georgetown, South Carolina.

[20] Additionally, one plan had a different coinsurance rate for inpatient and ambulatory medical services (25 percent) than for mental health and dental services (50 percent). Another plan meant that families had a 95 percent coinsurance rate for outpatient services, but inpatient services were free.

vision with correctable eyeglasses; improvements in dental status (for those aged 12 to 35 years) through caries reduction and filled teeth and improvement in gums; and those with high blood pressure in the free plan experienced a clinically significant reduction in blood pressure (Manning et al. 1987; Newhouse & the Insurance Experiment Group 1993).

In regard to the effect of dental health insurance and dental services utilisation, Manning et al. (1985) found utilisation increased with increasing generosity of coverage, consistent with economic theory. They also found those on the free plan had a greater use of dental services. Those on the free plan had a statistically significant higher expenditure as compared to those on the 95% plan. In terms of the types of services used, they found prosthodontic, periodontic and endodontic services were received by few in the population, yet they accounted for three quarters of the expenditure. Comparing those on the upper third of income with those on the lower third of income, higher incomes led to higher use of services. The authors note those on higher incomes had lower expenses per user as higher income individuals use the more common but less expensive services: diagnostic, preventive and restorative. The authors note the effects of expensive services; prosthodontic, endodontic and periodontic services may be bidirectional. For example, dentures may be used by lower income individuals and fixed dentures (implants) may be used by those on higher income individuals; however, the authors noted the lack of users affected the precision of the estimates. There was a greater response to cost sharing for those on low incomes than on higher incomes. Importantly, a transient surge in demand was observed, with a substantially greater use of dental services in the first year of coverage than in the second year of coverage was observed on most plans.

Bailit et al. (1985) studied the effects of health insurance and dental health outcomes for 4,815 dentate people aged 6 to 61 who received an oral examination at the end of the experiment. For those under 35 years there were statistically significant fewer decayed teeth for those in the free health insurance plan as compared to those in the 95% coverage plan. The largest difference was observed in the 12 to 17 years age group in which those in the free plan had 82% less decay than those in the 95% plan. Overall, the authors noted the effect of insurance was on the treatment of diseased teeth, not on the prevention of disease itself and the effect is greatest on teenagers and young adults. Additionally, those with the

poorest initial dental health and those with the least education showed improvements in their dental health status (dental decay and periodontal disease).

The limitations to the study included a higher attrition rate and refusal to participate for those in the cost sharing plans than the free plan (Zweifel & Manning 2000). A further problem with the RAND HIE is that it is now over 40 years old. There have been significant changes in dental health since then, particularly because of fluoridation and increased awareness of dental protections. The RAND HIE has not been replicated, mostly due to cost and possibly there would be ethical concerns. None-the-less the experiment is worthy of consideration in the context of discussion of outcomes associated with health insurance expansion and the lessons learnt provide an important basis for hypothesizing the effect of health insurance on demand. On the basis of the RAND HIE, it could be expected that the introduction of the CDDS will increase dental health services utilisation. As with the RAND HIE, which showed a transient surge in demand at the commencement of the experiment, it is possible the CDDS too might elicit this sort of response. The next sections focus on more recent literature regarding insurance expansions.

Medicaid dental insurance in the USA

The literature on the impacts of insurance expansion from the USA is growing. Much of the literature reports on the effects of differential insurance coverage across populations through Medicaid[21]. In the USA, the provision of dental coverage through Medicaid is determined individually by states. The literature presented in this section is consistent with the methodology undertaken in the first three empirical chapters of this thesis[22], which are difference-in-difference (DiD) and heterogeneity analyses. This literature search was conducted in Econolit, Business Source Complete and Pubmed as these provide coverage of both the economics and health literature. The search strategy is in Table 1. The search criterion focused on identifying the effects of dental insurance coverage. Studies focusing on other types of health services, such as optometry and general insurance, were excluded. In terms of outcomes, the primary outcome of interest in most studies and for the purposes of

[21] America's low-income public health insurance program

[22] For example, several studies were excluded as they used alternative methodologies that were not consistent with those used in this thesis (Singhal et al. 2021; Singhal, Damiano & Sabik 2017) or were excluded as it focused on a younger dependent cohort (Shane & Wehby 2017).

this thesis is defined as a dental visit in the last 12 months, with a few exceptions. Other insurance outcomes that could be explored such as the impact on financial protections, defined as reductions in out-of-pocket costs, and the impact on health outcomes are also important. However, as the motivation for the CDDS was to reduce costs thereby improving the affordability of the CDDS, and by extension increasing utilisation, this literature review focusses on the effect of utilisation only. As this thesis is concerned with an adult dental population the literature on the impact for children is excluded. It covers literature commencing 2011 until current. The underlying data sources for all studies are cross-sectional survey data.

Table 1 - Search strategy for literature review on insurance expansion

Search number	**Search terms**
1	dental insurance OR 'oral health' insurance OR public health insurance OR health insurance
2	dental health outcomes OR 'oral health' outcomes OR dental health status OR 'oral health' status OR dental health OR 'oral health'
3	dental health utili?ation OR 'oral health' utili?ation OR dental health services OR 'oral health services
4	medicare OR medicaid OR affordable care act
5	S1 Or S4
6	S2 And S5
7	S3 And S5

Choi (2011) used the *Behavioral Risk Factor Surveillance System* (BRFSS), a cross sectional telephone survey, data to undertake a DiD methodology to assess the impact of Medicaid dental coverage by comparing dental visits for Medicaid eligible persons (typically low-income parents) in states with dental coverage to those who were not eligible in states

without dental coverage[23]. Alternative comparison groups, such as wealthier parents and low-income childless adults in the same states, are also used to provide estimates. This study concluded that Medicaid coverage increased the likelihood of a dental visit by between 7.4 and 9.9 percentage points, depending on the assumptions and comparison group used. Due to heterogeneity in eligibility of across States, parental status was used as a proxy for Medicaid eligibility, which is a limitation of this study. The authors note some Medicaid-ineligible individuals are in the treatment groups, which suggests the estimates may be an underestimate of the effect. The study's strength is using multiple comparison groups to provide more robust estimates. A limitation is that this study does not rely on any policy change to motivate the study.

Nasseh & Vujicic (2013) also used the BRFSS data to undertake a DiD to examine the effect of the 2006 Medicaid reform in Massachusetts where dental benefits were expanded to include low-income adults. They compared outcomes, a dental visit in the last 12 months, in the pre-reform period (2004) to the post reform period (in 2008 and 2010) as compared to eight comparison states. They found no increase in the probability of a dental visit in 2008 but a significant increase of 2.9 percentage points in the probability of a dental visit in 2010. A key strength of this study was the use of a heterogeneity analysis methodology to assess the impact of the reforms on the poor as compared to the non-poor. In splitting the effect by socioeconomic status, a statistically significant increase in the post implementation period of 7.2 percentage points in 2008 and 11 percentage points in 2010 for those who were poor is found. An additional strength of this study is the inclusion of a probit model sensitivity analysis to assess the model specification. These results for the coefficients of interest showed similar magnitudes and the same significance level. It is unclear why the eight comparison states are chosen, although the study provides robustness tests using different comparison states.

Decker & Lipton (2015) used cross sectional survey data (from the *National Health Interview Survey* and *National Health and Nutrition Examination Survey*) to assess changes to dental coverage in 15 states (expansions to include dental coverage or contractions to exclude dental coverage) over a long time period, from 2002 to 2012 to motivate this study. As

[23] In most states at the time childless adults were not eligible for Medicaid, those states that expanded their coverage (between 2002 and 2004) did not have their post expansion information included.

opposed to Choi (2011) who used parental status as a proxy of Medicaid eligibility, this study used actual Medicaid status in the analysis. The methodology in this study is a heterogeneity analysis to account for individuals within states who were eligible for Medicaid, to account for availability of dental benefits between states and to account for changes in availability across time. This is a key strength of this paper as further refinement highlights differential impacts. They found Medicaid dental coverage results in a statistically significant increase in the probability of a dental visit in the past year of 12.9 percentage points. Additional findings are that having Medicaid decreases the probability of having unmet dental needs and dental health problems, statistically significant. Decker & Lipton (2015) also found that supply side conditions impact noting that the fee ratio paid to dentists can impact on the utilisation as those with fee ratios at the lowest rates may experience little increase in the likelihood of a utilisation by Medicaid beneficiaries. This study uses alternative control groups to account for robustness. A further strength of this paper is the inclusion of an explanatory variable that accounts for the supply of dentists per 1,000 population.

With the introduction of the *Patient Protection and Affordable Care Act* (ACA) in the USA, states opted to expand their Medicaid health insurance coverage to low-income adults, including childless adults, who were previously not eligible for coverage in most states. Some states also opted to also expand dental insurance coverage (Elani, Kawachi & Sommers 2021; Singhal, Damiano & Sabik 2017; Wehby, Lyu & Shane 2019). Those states that did expand their Medicaid programs introduced the changes in or around January 2014[24] (Kosali, Soni & Cawley 2017; Singhal, Damiano & Sabik 2017).

Kosali, Soni & Cawley (2017) also used BRFSS data to assess the impact of the ACA expansion by comparing states that expanded Medicaid insurance with states that did not. Outcomes were assessed for the first two years following the ACA's introduction (2014 and 2015). This study was not focused exclusively on dental health insurance effects as it covered a range of preventive care behaviours including a dental visit. The methodology employed was a DiD. Results showed that there was no statistically significant increase in the probability of a dental visit for all adults, but for childless adults, who were a new group

[24] Some states partially expanded their programs prior to 2014, as early as 2011 and some expanded after 2014 (Kosali, Soni & Cawley 2017).

eligible for Medicaid under the ACA, there was a statistically significant increase in the probability of a dental visit of 4.1 percentage points. This study used a logit model to test model specification. This study was limited in terms of time period as it provided the short run effects accounting for only two years since the majority of the states expanded their Medicaid programs.

Nasseh & Vujicic (2017a) used the Gallup Wellbeing Index Survey data to undertake an early assessment of the impact of the ACA on dental utilisation using a DiD methodology. They compared states that did expand Medicaid to include dental services against three comparison groups. Comparison group one was states that did not expand Medicaid and do not provide dental. Comparison group two was states that did not expand Medicaid but do provide dental. Comparison group three was states that did expand Medicaid but do not provide dental coverage[25]. Results of this study showed individuals in states that expanded adult dental coverage as compared to states who did not expand Medicaid and do not provide dental coverage (comparison group 2) had a 6.2 percentage point increase in the probability of a dental visit, statistically significant. As with Kosali, Soni & Cawley (2017) the post intervention time period was limited to only one year (2014, the year of expansion). Therefore, a follow up study was undertaken by Nasseh & Vujicic (2017b) using the same data source and methodology, with a post time period that included the immediate year of expansion, 2014, and two years after expansion (to 2016). Results showed there was a 3-6 percentage point increase in the probability of a dental visit for states that expanded Medicaid to include dental coverage as compared to all three comparison groups and this result was mostly statistically significant. Further, they found the result was strengthened in the outer years. The strength of this study was the controlling for states based on whether they provided adult dental and whether they expanded Medicaid. This separately accounted for the effect of Medicaid expansion as well as the expansion of Medicaid dental benefits and may capture any spill-over effects of Medicaid only expansions.

[25] There are four categories of states: those with adult dental benefits and who did expand Medicaid (18 states), those with adult dental benefits and who did not expand Medicaid (9 states), those without adult dental benefits and who did expand Medicaid (7 states), and without adult dental benefits and who did not expand Medicaid (16 states).

Wehby, Lyu & Shane (2019) assessed the impact of the ACA expansion comparing states that expanded Medicaid coverage to those that did not using the BFSS survey. A DiD methodology was employed. The post intervention time period was the immediate year of expansion, 2014, and two years after expansion in 2016. A strength of this study was that it separated states on the basis of generosity of coverage, with states classified as having extensive dental coverage, limited dental coverage and emergency only coverage. Similar to Nasseh & Vujicic (2017a), they found no effect in the immediate post intervention year, 2014. For the year 2016, they found individuals in states with extensive coverage had a 5.8 percentage point increase in the probability of a dental visit, statistically significant. They found there was no statistically significant increase for individuals in states with limited dental coverage and for individuals in states with emergency only coverage there was a decline, although the pre-trends chart for emergency only states show a differential pre-intervention trend. This study further examined the effects on individuals with varying characteristics and found for states with extensive benefits the effect was larger for non-white persons, females and parents. The finding of a greater effect for parents is in contrast with Kosali, Soni & Cawley (2017) who found the effect was greater on childless low-income adults. Explanations for this difference may be that the study by Kosali, Soni & Cawley (2017) aimed to capture the effect of the ACA on health behaviours and prevention using a broad range of outcome variables, whereas in this study, the effect was differentiated by generosity of coverage. Supply side effects were also noted as they found there was a statistically significant increase in the likelihood of a dental visit in states with extensive dental coverage and with a high supply of dentists while in states that had a low supply of dentists the effect was smaller and insignificant. Thus, the authors conclude that improving dental visiting for those in need requires both demand-side and supply-side interventions. This finding was similar to Decker & Lipton (2015) who also noted a differential effect on the basis of dentist remuneration.

Lyu, Shane & Wehby (2020) used the Medical Expenditure Panel Survey data, a self-reported survey dataset, to assess the impact of ACA expansion of dental services for the years 2014, 2015 and 2016, also using a DiD methodology. The strength of this study stems from the use of a data source that collected information on individual's dental services use and divided services into preventive and treatment, with treatment services further divided

into major and minor services. As with Wehby, Lyu & Shane (2019), states were grouped according to the generosity of their dental insurance coverage. A further strength of this study was that the population who were previously eligible for Medicaid were excluded from this study. This means the results reflect the insurance effect for those who were newly eligible only. For states that expanded services to provide extensive benefits there was a statistically significant increase in the likelihood of a dental visit of 5.6 to 7.9 percentage points[26]. This effect was greater in 2014 and 2015. Further, there was an increase in the likelihood of any preventive visit of over 5 percentage points in each post implementation year, and 'any dental treatment' of 3.5 to 5.2 percentage points, significant only in 2014 and 2015. For individuals in states that provided limited benefits there was a statistically significant increase in the likelihood of 'any dental treatment' of 4.8 to 8.2 percentage points, with the greatest increase in 2014 and a lower increase in 2016. For preventive services there was a 7.7 percentage point increase in 2014 and a 6.7 percentage point increase in 2015. For major treatments there was a 3.2 to 4.9 percentage point increase in all three post intervention years. For states that expanded emergency treatment only, there are concerns regarding the pre-trends test, suggesting the DiD estimate may be biased, except for the 'any treatment' and the minor treatment categories. This found a 5.4 percentage points increase 2015 and 5.9 percentage points increase in 2016, statistically significant. The findings in this study imply the effect of the ACA expansion was a greater increase in the immediate post-period (2014 and 2015) leading the authors to suggest there is some evidence of unmet demand being fulfilled as a result of the Medicaid dental insurance coverage expansion or a transitory surge similar to that observed in the RAND HIE. This is inconsistent with other studies, specifically Nasseh & Vujicic (2017a) and Wehby, Lyu & Shane (2019) neither of whom found any effect in 2014 and Nasseh & Vujicic (2017b) who found a greater effect in the outer years. The explanation for differences may relate to the construction of the studies comparing aggregate effects with the effects disaggregated by generosity of dental coverage.

Elani, Kawachi & Sommers (2021) used the National Health and Nutrition Examination Survey (NHNES) data and compared states that expanded Medicaid to those that did not

[26] Results reported are without sampling weights.

expand Medicaid dental coverage. This study used a DiD methodology. This study initially compared outcomes across all states, then assessed outcomes separately by states that did and did not offer dental benefits. For example, they compared states that expanded Medicaid that offered dental services with states that did not expand Medicaid that also provided dental services. This study used a range of outcome variables, and the strength of the data source was that it included dental visits and clinical dental measures. As opposed to previous studies, this study examined the longer-term impacts of Medicaid's expansion as it covered up until 2018, which is four years following the ACA's expansion. This study found that for those states that had dental benefits there was a statistically significant increase in the probability of a dental visit of 11.4 percentage points. In regard to the states that expanded but did not include dental benefits the results were omitted in this review as the placebo test showed a statistically significant difference in the pre-intervention trends.

The literature from the USA comparing states that provided Medicaid dental benefits to states that did not, finds there was an increase in the likelihood of a dental visit in those states that provided Medicare coverage. Multiple studies assessed the impact on dental visiting (and for some studies other outcomes that are not included in this review). In terms of magnitude the results vary considerably from 2.9 to 12.9 percentage points depending on the underlying methodological assumptions and the comparison groups. Early studies in the expansion of the ACA assessed the short-term effects but later studies were able to include additional post time periods. While the RAND HIE found evidence of a transitory surge as a result of a reduced price, these studies find inconsistent effects. Lyu, Shane & Wehby (2020) found a greater effect in the initial years following the expansion of the ACA whereas Nasseh & Vujicic (2017b) found a greater effect in the later years, in 2016 compared to 2014.

The studies exploited differences between states in the USA and used quasi-experimental approaches, specifically DiD approaches to compare utilisation outcomes in states that provide coverage and states that do not provide coverage. A limited number of studies have sought to identify differential effects using heterogeneity analysis techniques. In all studies the preferred model is the linear probability model, with some studies also undertaking logit (Kosali, Soni & Cawley 2017) and probit models (Nasseh & Vujicic 2013) to test the model's specifications. The underlying data sources for all studies are cross-sectional survey data.

The limitation, therefore, is that as the data is not panel data individual fixed effects cannot be used to capture individual heterogeneity nor can any change in individual's dental visiting behaviour be captured. The use of fixed effects technique is to control for state and time fixed effects. None of the studies include dental health status explanatory variables, although two studies use data that does include dental health and clinical dental health information (Decker & Lipton 2015; Elani, Kawachi & Sommers 2021). Despite the limitations, the studies provide valuable insight into the effect of the differential expansion of Medicaid under the ACA. On the basis of this literature review, there is an expectation that the expansion of the CDDS would result in an increase in dental utilisation following the implementation of the CDDS for eligible persons. However, it should be noted that there may be a concern regarding the generalisability of these studies to the Australian context. This is because Medicaid in the USA provides coverage for lower income individuals while the CDDS was targeted to those with a chronic disease.

Other international studies on dental health reforms - Korean reforms

Between 2012 and 2018 Korea implemented two dental health reform policies. The first was in 2013 when public dental insurance was expanded to cover preventive cleaning dental services by reducing the costs of annual dental scaling for all Koreans aged 20 years and over. This policy was aimed at reducing inequality in oral health and improving access to dental care (Jang, Kim & Kim 2017).

Using cross sectional data from a health department survey of eligible Koreans (20-64 years of age), Park et al. (2016) undertook a pre/ post study to assess outcomes of two binary dental health variables: self-reported unmet need; and a preventive dental health visit in the last 12 months. The results showed that the probability of unmet need decreased by a statistically significant 6.1% and there was an increase of 14% (statistically significant) in the probability of a preventive dental care visit (in the last 12 months) in the post reform period. Further, analysis by subgroups found those in the higher income group had a significant decrease in the probability of reporting unmet need of 7.6% and a significant increase of 12.8% in the probability of a preventive dental visit whereas there was no statistically significant change for those in the lower income group. When analysed by education level, those in the higher income groups reported a significant decrease in the probability of unmet need of 8.1%. There was an 18.3% increase (significant) in the probability of a

preventive dental visit for those in the higher education group as compared to 9.6% (significant) in the lower education group. These results suggest those in higher socioeconomic groups (higher income and higher education level) benefited from the expansion to of dental health insurance covering preventive dental health services.

Assessing the outcomes of the same reforms, Jang, Kim & Kim (2017) also used cross sectional data from a community health survey to observe the rates of dental cleaning (scaling) for all adults between 2009 and 2014. Using descriptive analysis to assess the rates of dental cleaning over time, they found an increase in dental scaling rates for Korean adults across all years, with a greater increase following the reforms (between 2013 and 2014) of 4.1%. They also compared the rates of dental scaling by subgroups including socioeconomic status. These results also show that those in higher socioeconomic groups saw higher increases in their receipt of dental scaling as compared to those in lower socioeconomic groups.

The primary limitation of these studies is that they are unable provide causal outcomes related to the policy change. An additional limitation to these studies relates to the use of cross-sectional data. As different individuals are surveyed in each time period, it limits the ability of the researcher to identify changes in the same individual's behaviours following the policy change. These studies are also early assessments of the policy change, as such they are unable to account for the longer-term effects. Further, neither study was able to account for the dental health status of the participants. Nonetheless these studies do provide insight into the increases in scaling attendance over time and by subgroups. These studies both show that those in higher socioeconomic groups were more likely to benefit from a preventive dental health policy than those in lower socioeconomic groups. This response may be consistent with the findings of the RAND HIE which showed that higher socioeconomic individuals were more likely to receive preventive dental health services while restorative dental health services are used by those in lower socioeconomic groups.

In the second set of reforms, between 2012 and 2018 Korea expanded dental coverage to older Koreans to include dentures and dental implants[27]. Using a national panel data set,

[27] These reforms expanded coverage for those aged 65 years and over to cover prosthetics: dentures and dental implants. These reforms were implemented in a staged manner. In 2012 dentures were covered with a

Choi & Jung (2020) undertook descriptive analyses to assess the impact of the reforms on outpatient dental care utilisation, dentures and dental implant use. They found between 2012 and 2015 there was an increase in utilisation for dental care of 5.7 percent, for dentures an increase of 1.4 percent and for dental implants an increase of 2.8 percent. However, using multivariate analysis this study did not find any increase in services usage for those for whom the policy might have been intended, such as those with lower incomes or education levels. The authors observed that in the post policy period dentures were associated more with those in lower income groups while dental implants were associated with those in higher incomes, highlighting a difference in services provision between higher and lower income individuals The strength of this study was its use of panel data, which tracks the same population over time thus allowing for dynamic change by the same individual before and after the policy change. This study was limited in its ability to provide causal outcomes due to the study's methodology.

Kim, Elani & Kawachi (2021) assessed the reforms for older Koreans, providing causal outcomes using a DiD methodology. They compared a range of dental health outcomes (unmet need; dental visits for oral examinations, periodontal treatments preventive care; clinical health outcomes; and perceived oral health outcomes and quality of life) for those aged 50-64 years compared to those aged 65-80 years. In an extension they undertook a heterogeneity analysis to compare the outcomes for those with lower and higher incomes. Overall, the DiD study found there was an increase in unmet need following the expansion of dental insurance for older Koreans. The authors suggested this might be due to individuals identifying their dental needs following initial treatment as a result of the policy change. There was also an increase in dental wearing, dental implants and a decrease in denture needs for those who were eligible compared to those who were not. The results of the DiD, however, are interpreted with caution as they are not robust to assumptions regarding the comparison group. The heterogeneity analysis found that for the lower income groups, there was a lower increase in unmet need as compared to the higher

30% co-payment for those aged 75 years and over, then expanded to those aged 70 and over in 2015, and those aged 65 and over in 2016. In 2014 dental implants were covered, to a maximum limit of two in a lifetime, with a 50% co-payment in 2014 for those aged 75 years and over, then expanded to those aged 70 years and over in 2015, and those aged 65 years in 2016 and in 2018 this co-payment was reduced to 30% (Kim, Jung & Kawachi 2021).

income group. There was also an increase in the number of teeth removed and an increase in the prevalence of denture wearing compared to those in the higher income group. This suggested the expansion of insurance may have had an impact on those with lower incomes having a 'pro poor impact', contrasting with the results from (Choi & Jung 2020)

The studies from reforms in Korea align with the other findings presented here, which show there is an increase in dental utilisation following in the expansion of dental health insurance. As opposed to policy from the USA, which expanded dental insurance coverage to those on lower incomes only (through Medicaid), the Korean reforms were universally applied to certain cohorts, irrespective of income level. This is similar to the implementation of the CDDS, in which eligibility was universally applied for all with a chronic disease. The results of the various studies from Korea show that even when insurance is expanded universally, there are differential effects for those in lower income groups as compared to those in higher incomes. The findings from these studies, particularly the different needs by different income groups might yield insight into what may be expected from the studies on the CDDS. This could be expected given there are differences in dental health status and, therefore, differences in needs between higher and lower socioeconomic groups.

Private health insurance and utilisation in Australia

In Australia, the primary form of dental health insurance is through voluntary PHI. The CDDS, on the other hand, was a form of public insurance (as it was taxpayer funded through Medicare and available to all who are eligible). It is unclear whether the CDDS is likely to be a complement or substitute to PHI coverage in Australia. This section provides the literature on PHI and utilisation in Australia to provide understanding of the status quo on the effect of insurance on dental health utilisation. The studies in this section primarily use cross-sectional data and are studies of association rather than causal (Anikeeva, Brennan & Teusner 2013; Brennan, Anikeeva & Teusner 2013; Teusner, Brennan & Spencer 2015). One study is a systematic review (Gnanamanickam & Teusner 2018). As with many studies into voluntary health insurance there are issues of self-selection into insurance (endogeneity), (Gnanamanickam & Teusner 2018; Kettlewell 2019), which can cause bias and thus hinder causal inferences. This endogeneity is accounted for in three studies (Hopkins, Kidd & Ulker 2013; Kettlewell 2019; Srivastava, Chen & Harris 2017).

Gnanamanickam & Teusner (2018) undertook a systematic review to gather the Australian literature on the effect of dental insurance and utilisation or dental insurance and health outcomes. Using a publish date of 1986 (consistent with the publication of the RAND HIE), and following a process of shifting through tiles, abstracts and the full text, the list of relevant publications included a final list of 36 studies. These studies were observational with only around two thirds of the studies presenting results adjusted for confounders. Overall, these studies showed a positive association between dental insurance and dental visiting although the effect on dental health outcomes was mixed. It did show those with insurance were more likely to receive diagnostic, preventive and crown and bridge services and less likely to receive extractions.

While the relationship overall between insurance and utilisation is positive, studies have sought to explore this relationship by sub-populations. Anikeeva, Brennan & Teusner (2013) use a national survey of 30 to 61-year-old Australians to assess the relationship between dental insurance and household income. Stratifying the population into three income groups: low, middle and high, they found those who were insured had a higher prevalence of dental visiting at least once every two years, but this effect was modified by household income. There was a greater association on dental visiting for those who were insured in the lower income group than those who were insured and on higher income groups. The authors concluded insurance enabled a dental visit by reducing the financial barriers for those in the lower income group more than those in the higher income group, suggesting the financial barriers are less onerous for those in higher household income groups.

Brennan, Anikeeva & Teusner (2013) used the same data source to assess whether dental health status impacted the relationship between dental insurance and dental visiting. By dividing the population into those with poorer dental health status and those with higher dental health status they found those with insurance had a higher prevalence of visiting the dentist and this relationship was not modified by oral health status. However, they did find that those with poorer dental health status were more likely to report visiting the dentist for a dental problem as compared to those with higher dental health status and this effect was not modified by health status and dental insurance did not modify this relationship.

Recognising that the effect of health insurance on utilisation was modified by household income, Teusner, Brennan & Spencer (2015) sought to assess whether a favourable dental

visiting pattern (defined as visiting the same dental practitioner annually for a check-up) is impacted by generosity of insurance coverage. National data were sourced via a survey of adults aged 15 years and over. Insurance generosity was determined based on the maximum benefit paid for a periodic dental examination as documented by each company in their Standard Information Statement. The authors noted heterogeneity between insurance policies. To account for the heterogeneity in the fees charged by dentists, the authors identified the mean rebate charged for a periodic examination in 2007. The authors then converted the maximum benefit paid by insurance companies into a per cent rebate based on this mean fee charged by dentists. Where the rebate (in percentage terms) was less than the median, the insurance coverage was categorised as low generosity. Those who provided a percent rebate higher than the median were categorised as high generosity cover. This study found that irrespective of insurance generosity, higher or lower, those who were insured were more likely to have a favourable dental visiting pattern than adults with no cover but no statistically significant difference in favourable dental visiting pattern between those with high and low generosity coverage was found. Consistent with Anikeeva, Brennan & Teusner (2013) this study also found the effect of insurance on having a favourable dental visiting pattern was significant for those in the lowest income groups while for those in the highest income group insurance was not significantly associated with a favourable dental visiting pattern. This implies insurance coverage may assist those on lower income as opposed to those on higher incomes.

A limitation to the studies above is that they are observational studies. As identified above, the issue with these studies relates to endogeneity. The direction of this endogeneity is bidirectional (Srivastava, Chen & Harris 2017) as those who have poorer health may buy more insurance and those with insurance may increase the health services demanded (Hopkins, Kidd & Ulker 2013). To account for endogeneity Srivastava, Chen & Harris (2017) used a simultaneous equation approach to model dental health, dental insurance and dental utilisation. They used data from the National Survey on Adult Oral 2004-06, which contains a comprehensive survey for dental health in Australia. They found a positive association between insurance and the probability of a dental visit and concluded that the treatment effect of PHI on dental utilisation is large (56 percentage points).

Hopkins, Kidd & Ulker (2013) sought to uncover the causal relationship of the effect of insurance on the frequency of dental visits using an instrumental variable approach. They used National Health Survey data in 1995 and 2001, which straddled PHI reforms that occurred between 1998 and 2000. The authors noted dental attendance had increased in the 2001 cohort as compared to the 1995 cohort as the proportion of people who had visited the dentist in the last 3 months was greater and there were fewer who had not visited the dentist in the last 2 years. The identification strategy was wearing glasses, which was the instrument variable. They noted wearing glasses is associated with the purchase of ancillary PHI, but it is not associated with attending a dental visit. Their results found that the effect of insurance is large as individuals with ancillary coverage make more frequent visits to the dentist relative to those who are not insured. These results are consistent for both 1995, prior to PHI reforms in Australia, and in 2001 post these PHI reforms. Following, Hopkins, Kidd & Ulker (2013) who looked at frequency of visits, Kettlewell (2019) built on the study by expanding it to cover a range of allied health services in addition to dental health. They used glasses as the instrumental variable. As opposed to Hopkins, Kidd & Ulker (2013) who used frequency of visit as the outcome measure, this study used a binary utilisation variable to identify a visit in the last 12 months. It also used a more recent wave of the National Health Survey data, the 2011-12 data. This study found that ancillary PHI increased dental utilisation by 25.8 percentage points. Nguyen & Worthington (2023) also sought to estimate the effect of PHI on dental utilisations similar to (Hopkins, Kidd & Ulker 2013); however, they used physiotherapy as the instrument variable. The data source for this analysis was specific waves of the Household, Income and Labour Dynamics in Australia dataset, which is not linked to administration data. This study found those who were insured through PHI had a statistically higher probability of dental visits than those without. This ranged from 63 percentage points for those insured in all relevant survey waves through to 24 percentage points for those who were infrequently insured as compared to those never insured through PHI.

There is evidence that PHI in Australia increases the probability of a dental visit, as is the expectation. There are descriptive studies showing there are differences in outcomes across populations based on income level. A limitation to the above studies is that all data sources are cross-sectional. The use of panel data would enable these studies to account for any

individual unobserved heterogeneity. It is unclear the effect of the CDDS given the presence of PHI in Australia. The evidence above suggests it is possible the CDDS might have had a differential effect on dental utilisation for those with higher incomes as compared to those in lower income groups.

Literature on the CDDS

A final literature search was undertaken to obtain all the literature on the CDDS program itself. This search was conducted in PubMed, Medline, Econlit and Informit. The search terms included "Chronic Disease Dental Scheme", "CDDS", "Dental" and "Australia". There are a limited number of studies on the CDDS. Using MBS administration data, these studies are primarily descriptive in nature, providing information on which services (CDDS MBS item numbers) were used, the total costs of the different CDDS services, or the regional variation in the services used (Crocombe et al. 2015; Kraatz et al. 2014; Lam, Kruger & Tennant 2012, 2013a, 2013b, 2014; Palfreeman & Zoellner 2012). One study used cross-sectional data obtained through a survey of General Practitioner patients to provide information on the distribution of a range of Medicare services, including the CDDS, by socioeconomic status (Knott et al. 2012). A final study was qualitative in nature. This study provided information on the experiences of individuals who engaged with the CDDS (Weerakoon, Fitzgerald & Porter 2014).

An early study of the services provided by the CDDS, from November 2007 to December 2008, was undertaken by Palfreeman & Zoellner (2012) using MBS administrative data. In addition to providing information on jurisdictional uptake of the CDDS across states and territories, this study found women were more likely to use the CDDS than men and the majority of users were aged over 54 years. In terms of service provision, they found the most common services were direct restorations, preventive and periodontal services, diagnostic services, extractions, dentures and indirect restorations. They concluded that there appeared to be an over-representation of indirect restorations, including bridges, which were costly. However, they note the pattern of service delivery is consistent with a significant burden of disease but that without data on individual patients it is not possible to be confident services were appropriate to need. The limitations to this study include that it is an early estimate of the effect of the CDDS and that there is no patient level data thus limiting the conclusions that can be drawn on the needs of the patients accessing the CDDS.

In a series of papers, Lam, Kruger & Tennant (2012) Lam, Kruger & Tennant (2013a) and Lam, Kruger & Tennant (2013b) used MBS administrative data to provide descriptive analyses of the CDDS. Lam, Kruger & Tennant (2012) used data from 2007 - 2009 to compare the services provided in general dental practice to those provided through the CDDS. For the CDDS, the most common services provided were restorative services, followed by diagnostic services and prosthodontic services. By comparison, private dental service provision (non-CDDS services provided in private dental practices) found the most commonly provided services were diagnostic services, restorative services and preventive services. The authors noted that invasive dentistry is more favourably remunerated than preventive dentistry and argued that this remuneration might have been a driver for utilisation of CDDS services. A potential problem with comparing general dental service provision with services provision under the CDDS is the inability to determine the health status, income status and attendance patterns of participants. Evidence from the RAND HIE, for example, found that those on higher incomes were more likely to consume common but less expensive services: diagnostic, preventive and restorative. Additionally, it is possible that patients may have used the CDDS to access the more expensive dental services after paying directly for the cheaper diagnostic and preventive services.

Extending the time period under review, Lam, Kruger & Tennant (2013a) used MBS administrative data for calendar years 2007 to 2010 to provide descriptive analysis on the patterns of service provision under the CDDS. They found the largest proportion of the costs of the program were for those aged 55 to 64 years and those aged 65 to 74 years, followed by those aged 45-54 years, which they noted was consistent with the progression of chronic diseases. They also found women were more likely to have received a service (54%) than men (46%). Women were more likely to present for review and preventive treatment and required fewer extractions than males. This paper focused on the use of prosthodontic services arguing this was a source of high expenditure under the program. They also noted the higher use of more aesthetically appropriate tooth-coloured crowns as compared to the more functional metallic restorations. The authors further argued there was a need for a greater emphasis on preventive treatments. Again, the use of MBS administrative data is the main limitation of these studies, as without dental health status information no conclusions on the appropriateness of the services provided can be determined.

In a further study and continuing their theme that remuneration incentives may have driven service provision on the CDDS, Lam, Kruger & Tennant (2013b) compared the costs from the CDDS with other allied health programs. Primarily, their concerns centred around the costs, sustainability and appropriateness of service provision under the CDDS, which was a fee-for-service program. In contrast they noted other allied health programs also targeted to those with a chronic disease provided a range of services, such as podiatry, audiology, physiotherapy and dietetics and were remunerated through a limited number of subsidised visits on a fixed fee per visit schedule. Using MBS administrative data for the calendar year 2009 they provided a range of descriptive analysis, including the value of care per person. They found that in both the CDDS and the other allied health programs the majority of services were for those aged 55 years and over. Overall, this paper concluded the remuneration arrangements for the CDDS were responsible for the large costs associated with the program while the limited service provision for the other allied health services meant their costs were contained. In terms of service provision, they noted the CDDS was focused on restorative services while the other allied health professions, due to their limited funding arrangements were unable to provide effective and timely treatment for complex or chronic needs. A primary limitation to this study is whether there is value in comparing the needs of those using the CDDS with those using other 'allied health' services such as audiology and podiatry. A further limitation to this paper and previous papers is that they do not cover the entire period of the CDDS.

Both Kraatz et al. (2014) and Crocombe et al. (2015) used MBS administrative from 2008 to 2013 thus they cover the full length the CDDS was operational. Kraatz et al. (2014) undertook a retrospective analysis of utilisation of the CDDS, including the regional variation in utilisation. They found the majority of services provided through the program were diagnostic (25%), restorative (25%), removable prostheses (dentures) (16%), preventive (13%), oral surgery (6%), crown and bridges (6%), periodontic (4%) and endodontic (4%). In terms of regional variation, they found 79% of services were in provided in major cities, 15.4% of service provided in inner regional, 5.2% provided in outer regional and 0.4% remote or very remote areas. A conclusion of this study was that factors other than dental health drove participation in the scheme. In particular, the authors suggested that the absence of available dentists in remote and very remote areas as well noting that those in

non-urban areas are less likely to have a GP Chronic Disease Management plan, which was a requirement for participation in the CDDS. Both factors were cited as a reason there were limited CDDS services provided in remote areas.

Similarly, Crocombe et al. (2015) used MBS administrative data on MBS benefits claimed to provide retrospective analysis of CDDS utilisation, including the regional variation in utilisation. They found that over 75% of MBS benefits paid were for the following services: crown, bridge and implants (32.4%); removable prostheses (dentures) (22.4%); and restorative services (21.6%). In terms of regional variation, they found that 80% of MBS benefit claims were for services provided in major cities, and MBS benefit claims for services decreased with increasing regionality and remoteness, despite those in regional and remote areas having poorer dental health than those in cities. This led Crocombe et al. (2015) to conclude that the program was poorly targeted to those most in need, that is those in rural and remote areas.

Knott et al. (2012) used a survey of nearly 2,900 patients aged 55 years and over from 322 general practices to assess the socioeconomic distribution (defined according to income) of Medicare benefits paid for chronic conditions. The survey period covered July 2008 to June 2009. Using survey data linked to MBS services data, they found that CDDS services were primarily used by those from lower income groups. This group received more than two and a half times the amount of funding of those in the highest income groups. Knott et al. (2012) also found that those in regional areas were 69% less likely to use the CDDS. Although the use of survey data and linked MBS data is a strength of this paper, the limitation is that this study covers a short time period in the early stages of the program only.

Weerakoon, Fitzgerald & Porter (2014) undertook a qualitative study into the CDDS. They sought views on the CDDS from 31 participants: patients, dentists and doctors through focus groups and semi-structured interviews. Participants stated the eligibility criteria were imprecise and vague and some GPs stated it was difficult to refuse patient requests for a referral even if the GP was not convinced the patient was eligible. Patients admitted to pressuring GPs for a referral. ‘Reverse referrals’, where the dentist prompted their patient to request a GP referral, were noted by the authors. Dentists noted that some patients who were referred were not always eligible as they did not have a chronic disease. Patients, however, stated that the program was not well promoted and felt doctors should have

informed their patients of the program. Dentists identified the MBS benefit paid (or rebate) was less than standard consultation fees and there were administrative burdens from Medicare. Despite these concerns, these dentists chose to accept the Medicare reimbursement. Dentists found that patients stopped treatment once their allocation was exhausted leaving dentists to complete work at no cost or patients chose to cease treatment leaving them with incomplete treatment. Overall, the authors concluded the program's lack of clarity over eligibility resulted in tensions between doctors, patients and dentists. A limitation to this study is the geographic representation of the participants as the study notes focus groups were only held in two places: the Sunshine Coast in Queensland and inner Sydney in New South Wales.

The literature on the CDDS presented above provides informative descriptions of the CDDS usage and patterns of use. Limitations to the studies that use MBS administrative data are that they do not provide information on dental health status and other patient characteristics of those who received a CDDS service as this is not readily available through MBS administrative data. This limits the conclusions that can be drawn from these analyses in terms of appropriateness of the services provided. Understanding patient characteristics of program participants would assist to substantiate or refute criticisms of over servicing and poor targeting of the program. Being able to identify participant's chronic disease status, which was the primary eligibility criteria, would assist in assessing whether the target population (those with chronic diseases) received services. While Knott et al. (2012) does use survey data, the study was not specific to dental health thus it does not control for dental health, instead it uses age and sex as a proxy for dental health status. Additional limitations to the studies above, with the exception of Kraatz et al. (2014) and Crocombe et al. (2015), are that they cover the early implementation period of the CDDS not the program's entire period. Further methodological limitations to the studies are that none have sought to determine the any causal impacts of the CDDS in terms of utilisation.

Research question and conclusion

While the CDDS was time-limited, it was an important program as it represented an expansion of public health insurance through Australia's Medicare at a cost that far exceeded initial estimates. It is unclear whether the criticisms aimed at the CDDS are warranted. These criticisms include that the CDDS was poorly targeted and that the services

provided, particularly the high costs restorative services, were inappropriate. Yet, the gaps in the literature to date mean these criticisms are not able to be addressed. No identified studies have sought to determine whether the CDDS did increase dental utilisation for the eligible population, those with a chronic condition, and none have sought to determine patient characteristics of the those who received a service.

Based on the international literature, which shows that an expansion of insurance increases utilisation, it is hypothesized that there will be an increase in utilisation for those who are eligible for the CDDS. Further, as shown in the literature review above, there may be a differential effect of insurance on different subgroups, particularly those with financial needs or dental health needs and those without PHI coverage. Finally, given the concerns regarding the use of high cost restorative services, there is a need to provide insight into the characteristics of those who received a service. The two questions posed in this thesis are:

1) *Did the use of dental services increase by those who were targeted by the CDDS?*
2) *What were the characteristics of those who received a CDDS service?*

Chapter 3 – Data

The data used in this PhD is from the ALSWH. There are two advantages of the ALSWH dataset. First, the ALSWH is a long-standing panel dataset. Panel data is used to answer the first question, which seeks to identify whether there was an increase in dental utilisation for those targeted by the CDDS. The second advantage to the ALWSH is that it is 'linked data', which means the survey component is linked to the MBS data. This linked data is used to answer the second question, which seeks to identify the characteristics of a known cohort of CDDS users.

Panel data

Panel data is data that follows the same population over time giving repeated observations on this population (Wooldridge 2002). Panel data is advantageous as it allows for stronger conclusions about behaviour to be identified (Baltagi 2005). As panel data is repeated observations on the same individual, it allows for the capture of changes by the one individual over time (Baltagi 2021), which cannot be observed in cross sectional data. This is because the cross sectional data contains new individuals in each survey wave. Further, observing the same individual over time allows for the capture the unobserved attributes of each individual that do not change over time (known as time invariant heterogeneity)(Baltagi 2021; Wooldridge 2009). This then allows for the use of specific econometric techniques that account for this time invariant heterogeneity within the econometric analysis thus reducing any potential omitted variable bias within the econometric model (Angrist & Pischke 2010; Wooldridge 2009). This thesis exploits the use of panel data by applying econometric techniques that capture any unobserved individual heterogeneity. (A discussion on the econometric techniques used in this thesis is in Chapter 4.) Further, due to the use of panel data this thesis allows for the observation of changes in dental utilisation patterns by the same individuals over time resulting in a reduction in omitted, time invariant, variable bias.

Australian Longitudinal Study on Women's Health - Background

The ALWSH follows women in different life stages (Australian Longitudinal Study on Women's Health (ALSWH) 2018). The aim of the ALSWH is to focus on factors across women's life course to understand the social, psychological, physical and environmental factors that determine good health or ill health with a focus on the health service use and

access (Dobson et al. 2015). Commencing in 1996, there were three initial cohorts: those born between 1973 and 1978; those born between 1946 and 1951; and those born between 1921 and 1926. A fourth cohort, born between 1989 and 1995, was recruited in 2011 (ALSWH 2018). For this thesis only the 1946-51 cohort, is used (see discussion below).

ALSWH – 1946-51 cohort - overview

Initially 28,000 women born between 1946 and 1951 were invited to participate in the survey. These women were sampled by random sampling from Australia's Medicare database[28], with an oversampling of women in rural and remote areas (ALSWH 1996). The response rate for the first survey was estimated to be 53.5% for this cohort with a total of 13,715 women included in Survey 1 (ALSWH 1996; Dobson et al. 2015). The demographic characteristics of the ALSWH cohort in Survey 1 were compared to the 1991 Australian census. In comparison to the census the ALSWH sample was found to have an overrepresentation of Australian and other English speaking countries, an overrepresentation of married women, an overrepresentation of employed women and an overrepresentation of tertiary educated women (ALSWH 1996).

Rationale for using the 1946-51 cohort of the ALSWH for this thesis

There are two reasons for choosing to focus the analysis on the 1946-51 cohort only. First, this cohort contains the most comprehensive set of dental health variables of all the cohorts. Specifically, self-reported dental health status, self-reported dental problem and a dental service visit are most detailed for this cohort. In comparison, in the 1921-26 cohort, use of dental services is not available in the years following the introduction of the CDDS (after 2007). It is only available in the time prior to the implementation of the CDDS in survey 1 (1996), survey 2 (1999) and survey 4 (2005). For the 1973-78 cohort a dental service visit variable is available; however, self-rated dental health status is not available in all time periods as it is only available in survey 7, in 2015, which is following the closure of the CDDS. This limits the scope of the analysis that can be undertaken using the other cohorts.

A second reason for focussing on the 1946-51 cohort is because use of CDDS services coincides with the age of the women in this cohort. Women in the 1946-51 were aged

[28] This database was the Health Insurance Commission in 1996.

between 56 and 61 at the commencement of the CDDS and 62 to 67 upon closure of the CDDS[29]. Using data to 2009, over two thirds of the services provided by the CDDS were to those aged over 55 years (Lam, Kruger & Tennant 2013b) and between 2007 and 2010 the majority of the costs associated with the program were for those aged between 55 and 74 years (Lam, Kruger & Tennant 2013a)

The ALSWH sample in this thesis

Survey time periods

Since survey 1 in 1996 there have been nine surveys with the latest occurring in 2019. The women are surveyed approximately every three years. This thesis uses data from ALSWH surveys 3 to 7 only. Surveys 1 and 2 (in 1998) are omitted as they occurred prior to significant PHI reforms that occurred between 1998 and 2000 (Butler 2002). Although PHI reforms were focused on increasing hospital insurance, there is a flow on effect to ancillary coverage as a large number of people have both hospital and ancillary coverage (ABS 2020). As there is a strong association between dental services utilisation and PHI (Gnanamanickam & Teusner 2018; Hopkins, Kidd & Ulker 2013), the large increase in PHI coverage across the population following these reforms may confound studies into dental services utilisation. Hence, this PhD focusses on the post PHI reform period[30], captured by survey 3 (in 2001) onward. Surveys 8 (in 2016) and 9 (in 2019) are excluded from all analyses as they represent the time following the closure of the CDDS as data from these studies goes beyond the effect of the expanded (CDDS) insurance coverage on dental visiting.

In this thesis the panel data is divided into two time periods. The pre-CDDS time period is prior to the 2007 commencement of the CDDS and is represented by surveys 3-5. Survey 5 is conducted in 2007 but is included in the pre-time period as 98% of survey responses are returned prior to the start date of the CDDS on 1 November 2007, thus it is the immediate pre-CDDS time period. The post-time period is covered by surveys 6 and 7 as these are conducted following the implementation of the CDDS. The announcement to close the CDDS

[29] The 1973-78 cohort were aged between 29 and 34 at commencement of the CDDS and 35 and 40 upon closure of the CDDS. The oldest cohort were born between 1921 and 1926 and were aged between 81 and 86 at the commencement of the CDDS. The newest cohort are not relevant for this study as they did not exist at the commencement of the CDDS.

[30] For the percentage who reported private health insurance hospital and ancillary coverage across surveys one to eight as well as the impacts on the uptake of health insurance for the 1946-51 cohort following reforms see (ALSWH 2017, p. 49).

was in August 2012 although it was not closed to new participants until September 2012 and to all participants on 30 November 2012 (Plibersek 2012). There was a concern that survey 7 straddled the time period over when the CDDS was closed. However, as the survey is retrospective and due to the large proportion of surveys that were received prior to the actual date that the CDDS closed (86% of survey 7 responses were received prior to 8 September 2013 and 96% of responses were received on or prior to 30 November 2013) analyses in this thesis consider survey 7 to be in scope as a post-CDDS survey time period. The relationship between the CDDS and surveys is presented

Table 2 - ALSWH surveys and years along with the relationship with the CDDS

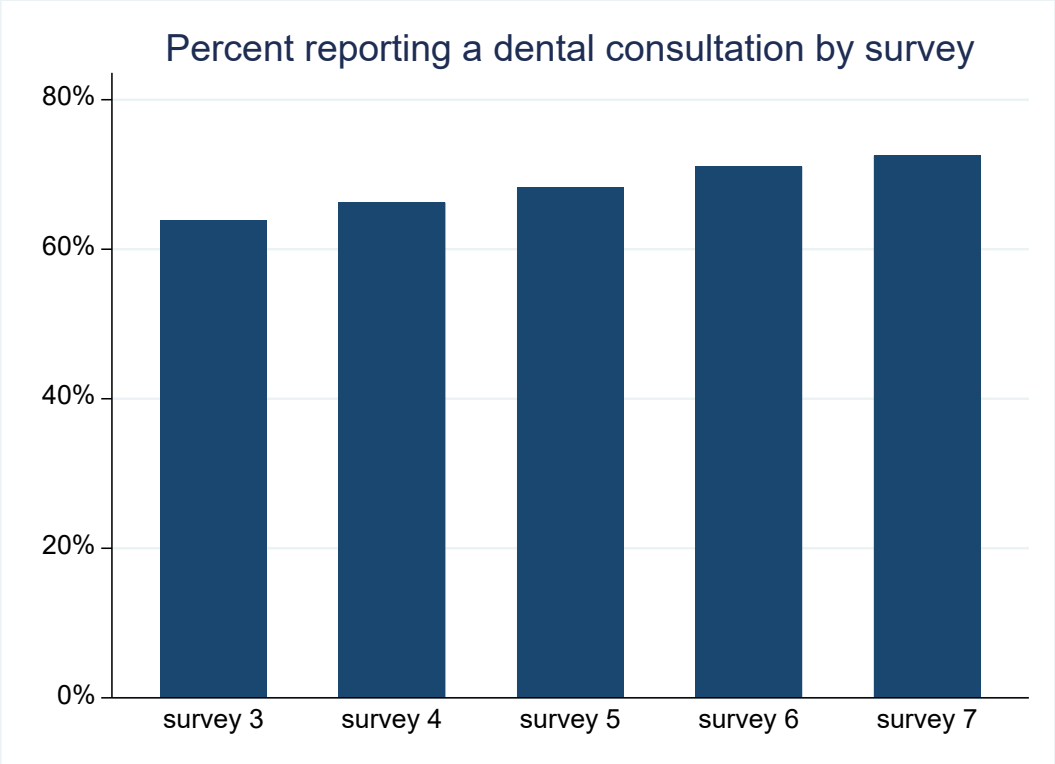
Survey	Year	Relationship with CDDS
1	1996	Omitted (pre-PHI reform time period)
2	1998	Omitted (pre-PHI reform time period)
3	2001	Pre-CDDS time period
4	2004	Pre-CDDS time period
5	2007	Pre-CDDS time period; CDDS started November 2007
6	2010	Post-CDDS time period
7	2013	Post-CDDS time period; CDDS closed November 2012[31]
8	2016	Omitted (CDDS closed)
9	2019	Omitted (CDDS closed)

[31] The program was closed to new persons in September and closed on 30 November 2012 (Plibersek 2012).

Dental health services utilisation

The ALSWH mid cohort includes a question on dental visiting from survey 2 onwards. It asks whether the study participant has visited a dentist in the 12 months prior to completing the survey. In this thesis this variable is coded as a binary variable identifying those who have and have not visited the dentist. Overall, for those who responded to surveys 3 to 7 there is a gradual increase in the percentage of women reporting a dental visit (Figure 4).

Figure 4 -Percentage of women reporting a dental visit in the last 12 month



Source: ALSWH data

Chronic disease status: health condition variables

As the CDDS was targeted to those with a chronic disease, an understanding of chronic disease prevalence is central to this thesis. Definitions of chronic disease are provided by the MBS and the AIHW. The MBS definition states that a chronic disease or complex condition is "one that has been or is likely to be present for at least six months including, but not limited to, asthma, cancer, cardiovascular illness, diabetes mellitus, mental disorders, arthritis and musculoskeletal conditions. A patient is considered to have complex care needs if they require ongoing care from a multidisciplinary team consisting of their GP and at least two other health or care providers" (DOHA 2008, p. 715). The AIHW definition of a chronic disease is "a physical or mental disturbance involving symptoms … dysfunction

or tissue damage that may lead to ill health … Common features of chronic diseases include a complex causality, with multiple factors leading to their onset; a long development period, for which there may be no symptoms; a prolonged course of illness, perhaps leading to other health complications; associated functional impairment or disability" (AIHW 2017). In 2017-18, 47.3% of Australians report at least one chronic condition where a chronic condition is defined as having lasted or expected to last 6 months or more (ABS 2018a). The most common reported chronic conditions are presented in Table 3.

Table 3 - Top 10 most reported chronic conditions

Chronic condition	Percentage of reported chronic conditions
Mental or behavioural conditions	20.1%
Back problems	16.4%
Arthritis	15%
Asthma	11.2%
Diabetes	4.9%
Heart, stroke and vascular disease	4.8%
Osteoporosis	3.8%
Chronic obstructive pulmonary disease	2.5%
Cancer	1.8%
Kidney disease	1%

Source (ABS 2018a).

As the CDDS was targeted to those with a chronic disease, identification of a chronic disease is important for the empirical chapters. The list of diseases and conditions surveyed within the ALSWH is broad. For the purposes of this thesis a chronic disease or chronic condition includes the following.

Diabetes, insulin-dependent and non-insulin dependent, as periodontal disease is a complication of diabetes (Kuo, Polson & Kang 2007). Further, although the evidence is limited, there is evidence showing periodontal treatment does improve glycaemic control in

those with diabetes (Simpson et al. 2019). In the ALWSH 1946-51 cohort survey a diabetes variable is available in all surveys 3 to 7.

Musculoskeletal conditions, osteoporosis and arthritis, are included as dental health can be impacted on by the use of bisphosphonates, which are a class of pharmaceuticals used to treat osteoporosis that can result in adverse dental health impacts (Kunchur & Goss 2008). There is some evidence that those with rheumatoid arthritis experience poorer dental health-related quality of life that may be due to their functional limitations resulting from their condition (Muhlberg et al. 2017). For arthritis, there is evidence that it can cause inflammation that can increase periodontal disease (Pokrajac-Zirojevic, Slack-Smith & Booth 2002). In the ALSWH 1946-51 cohort survey an arthritis and an osteoporosis variable is available in all surveys 3 to 7.

Cardiovascular disease is included as an increase in tooth loss has been found to be associated with an increased risk of heart disease and stroke (Cheng et al. 2018) although evidence regarding the impact of treating periodontitis on cardiovascular disease is limited (Liu et al. 2019). In the ALSWH 1946-51 cohort a cardiovascular disease variable is available in all surveys 3 to 7.

Respiratory conditions, consisting of asthma and bronchitis or emphysema, is included as the medications used to promote respiratory function can result in reduced saliva or xerostomia (dry mouth) and may potentially have an adverse effect on dental health (Thomas et al. 2010). In the ALWSH 1946-51 cohort an asthma and a bronchitis/ emphysema variable is available in all surveys 3 to 7.

There is some evidence suggesting an association between either periodontal disease and/or edentulism and an elevated risk of some cancers. For example, lung and colorectal cancers, and there is inconsistent evidence across several studies for breast cancers (Michaud et al. 2018). In the ALSWH 1946-51 cohort a breast cancer and a cervical cancer variable is available in all surveys 3 to 7. A lung cancer variable is available in survey 7 only. A skin cancer variable is included in surveys 4 to 7. A bowel cancer variable is available in surveys 3,4 and 7. An ‘other’ cancer variable is available in all surveys 3 to 7.

Mental health conditions consisting of anxiety, depression and other psychiatric conditions, are included as mental health conditions can be linked to poorer dental health in multiple

ways. Anxiety about dental visiting can prevent people from attending the dentist, depression and other mental health conditions can reduce the individual's self-care and the medications used to treat some common mental health conditions can cause xerostomia (Kisely 2016). In the ALWSH 1946-51 cohort a depression, an anxiety and an 'other' psychiatric variable is available in all surveys 3-7.

Conditions that were surveyed in the ALSWH but were considered inconsistent with the eligibility criterion for the CDDS were conditions such as sexually transmitted diseases, low iron levels or thrombosis. Other conditions were excluded on the basis they were not surveyed regularly, such as HIV. Table 4 provides a summary of the key chronic disease conditions and their availability by survey.

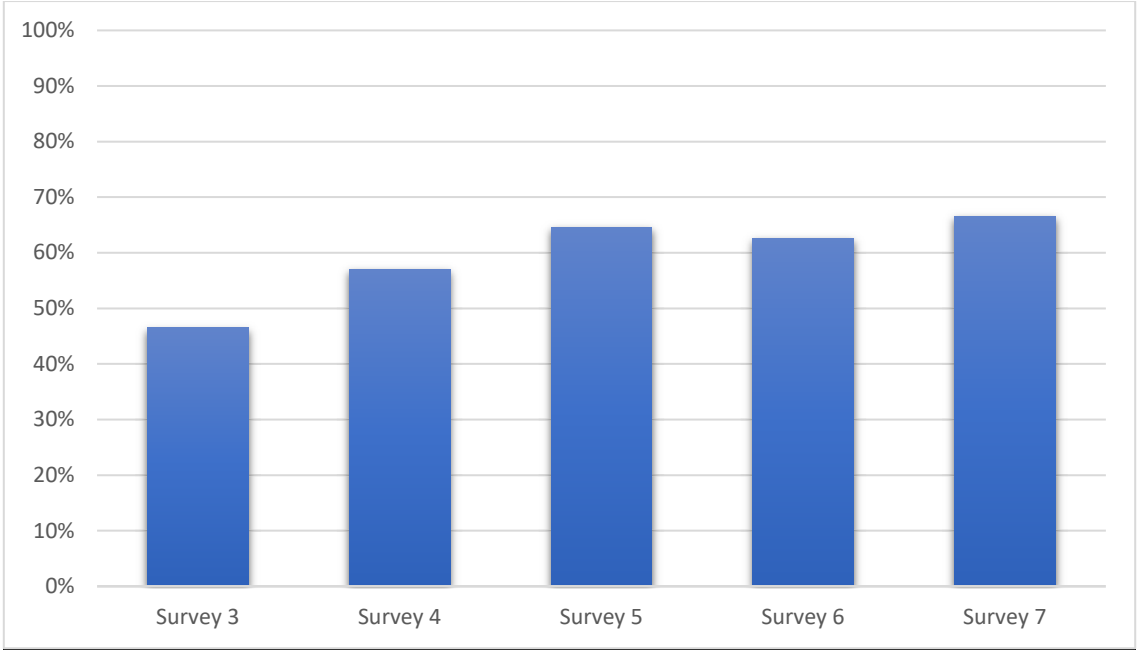
Table 4 - Chronic conditions data captured in ALWSH by survey

Chronic Disease	Survey 1 (1996)	Survey 2 (1998)	Survey 3 (2001)	Survey 4 (2004)	Survey 5 (2007)	Survey 6^ (2010)	Survey 7^* (2013)
Diabetes							
Diabetes	√	x	x	X	√	√	√
Insulin dependent diabetes	x	√	√	√	x	x	x
Non-insulin dependent diabetes	x	√	√	√	x	x	x
Musculoskeletal conditions							
Osteoporosis	√	√	√	√	√	√	√
Arthritis	x	x	√	√	x	x	x
Osteoarthritis	x	x	√	x	√	√	√
Rheumatoid arthritis	x	x	x	X	√	√	√
Other arthritis	x	x	x	x	√	√	√
Cardiovascular diseases							
Heart disease	√	√	√	√	√	√	√
Stroke	√	√	√	√	√	√	√
Respiratory diseases							
Asthma	√	√	√	√	√	√	√
Bronchitis	√	√	√	√	√	√	√
Cancers							
Breast cancer	√	√	√	√	√	√	√
Cervical cancer	√	√	√	√	√	√	√

Lung cancer	√	x	x	x	x	x	√
Skin cancer	√	√	X	√	√	√	√
Bowel cancer	√	√	√	√	x	x	√
Other cancer	X	√	√	√	√	√	√
Mental Health conditions							
Depression	x	√	√	√	√	√	√
Anxiety	x	√	√	√	√	√	√
Other psychiatric conditions	x	√	√	√	√	√	√
^represents the post CDDS time period							

As expected, given the age group of the women and the time span of the analysis[32] there is generally an increase in the proportion of women who experience a chronic disease. Figure 5 **-Percentage of women reporting at least one chronic disease** reports on the percentage who report a chronic disease by survey[33].

Figure 5 -Percentage of women reporting at least one chronic disease by survey



Source: ALSWH data

[32] Across surveys 3 to 7 is 12 years. The women were aged between 47 and 67 over this time.
[33] All women who were lost to attrition are excluded from all descriptions in this chapter.

Sociodemographic variables

Geographic location

The geographic location variable used in this thesis is the Accessibility/ remoteness Index of Australia (ARIA). The index is grouped into five geographic categories: major cities, inner regional areas, outer regional, remote and very remote areas. To account for the small numbers and to improve statistical precision, the five geographic groups are transformed into a three-category variable to identify those who live in major cities, those living in inner regional areas, and those living in outer regional, rural and remote areas. Across surveys 3 to 7 geographic location was relatively stable with the majority of women living in a major city (approximately 40%), or an inner regional area (approximately 40%) and the around 25% living in an outer regional, rural or remote area (Table 6).

Marital status

Marital status is a standard question in every survey. The six marital response options are: married, de-facto, separated, divorced, widowed, or never married. These six options are transformed into a binary variable to reflect the woman's current relationship status: a partnered relationships, defined as married or de-facto; and those who were separated, divorced, widowed or never married. While the majority of women report being either married or in a de-facto relationship, this number does decline slightly from survey 3 to 7. As previously identified initially this cohort was found to have an overrepresentation of women who were married as compared to the general population (Table 6).

Education attainment

The ALSWH survey contains questions on the educational attainment of women in survey 1 and in survey 6 only. There are seven response option: no formal qualification, school or intermediate certificate, high school leaving certificate, trade or apprenticeship, certificate or diploma, university degree and higher university degree. These responses are transformed into a variable representing four educational options. The majority of women in survey 6 reported a school or high school certificate. Few women reported no formal education and a similar proportion reported having a trade/ apprenticeship/certificate or diploma as degree or higher education levels. As previously identified initially this cohort of women was found to have an overrepresentation of women with a tertiary degree when compared to the general population (Table 6).

PHI insurance status

Two questions in the ALSWH survey seek information on the woman's PHI status for hospital and ancillary coverage. Response options are: yes, no- I am covered by Veterans' affairs, no- because I can't afford the cost, no – because I don't think you get value for money, no- because I don't think I need it, no because the services are not available where I live, and no – other reason. In regard to ancillary PHI coverage, women who identify as being covered by Veteran's Affairs are coded as being uninsured as dental services are available only for those with specific coverage, which are 'Gold cards' or 'White cards' (Department of Veterans' Affairs (DVA) 2021a), and eligibility for this specific coverage, or 'cards', is limited (DVA 2021b; DVA 2021c). These two questions are transformed into a variable that identifies four PHI coverage categories: no insurance; ancillary only coverage; hospital only coverage; and both ancillary and hospital coverage (otherwise known as comprehensive coverage). Over surveys 3 to 7 between 60% and 64% of women reported insurance that covered dental services, either ancillary coverage only or both hospital and ancillary coverage. Those on higher incomes are more likely to be covered with PHI. This is due to their higher incomes but also due to government policies, which penalises those in higher income groups who do not have PHI with hospital coverage (Headey & Warren 2007) (Table 6).

Financial management: financial difficulty or stress

Financial management is assessed through women's self-perceived financial situation. The ALSWH question is: "How do you manage on the income you have?" The five response options are: it is impossible, it is difficult all the time, it is difficult some of the time, it is not too bad, and it is easy. This variable is recoded to identify one of three financial positions: those who report no financial concern consistent with the response "it is easy"; those who report limited financial concern with their financial status consistent with a response to the financial management question as "not too bad"; and those who report that managing their finances are difficult "some of the time", difficult "all of the time" or "impossible" and are considered to have financial difficulty or stress. Over surveys 3 to 7 the majority of women reported no financial concerns (approx. 20%) or limited financial concerns (45%) but around one third report financial difficulty or stress (Table 6).

Concessional status

Commencing in survey 3 concessional status is defined as the presence of a health care card. This binary variable to identify those with a health care card those without. While there is an increase in the percentage reporting concessional status in each survey a large jump in the percentage with a concessional status is observed in survey 7. This is likely reflective of age as women reach 65 years of age, the pension age in survey 7 (Table 6).

Socioeconomic Index for Areas

The Socioeconomic Index for Areas (SEIFA) is an index that measures the characteristics of the people living in an area in terms of their relative socioeconomic advantage or disadvantage (ABS 2018b). The ABS defines the socioeconomic advantage and disadvantage as "people's access to material and social resources, and their ability to participate in society" thus it allows for comparison of socio-economic status between different areas. There are four SEIFA indexes, each based on the most recent census data (ABS 2018b). A range of variables contribute to the make-up of the SEIFA variable. These include: an income variable, which is a calculation of the proportion of people in each equivalised income level; an education variable, which calculates the proportion of people in each education category (such as up to year 12 high school through to tertiary education); an employment variable, which calculates the proportion of people who are in the labour force who are employed; an occupation variable, which calculates the proportion of people in a range of occupation categories based on the occupation's skill level; a housing variable, which is based on a range variables such as bedrooms in house, mortgage levels and rental payments; and a range of miscellaneous variables, such as the proportion of households under 70 years of age needing assistance due to illness or disability, the proportion who do not speak English and the proportion who are separated or divorced (Table 6).

Each SEIFA focuses on a particular aspect of socio-economic advantage or disadvantage (ABS 2018b). The SEIFA used in this thesis is the Index of Relative Socio-economic Advantage and Disadvantage (IRSAD) because it is a general measure that summarises variables from a wide range of socioeconomic dimensions (ABS 2018b, p. 31). The women are coded as per their survey 7 responses. The IRSAD reports an index from most disadvantaged to most advantaged, which corresponds with a low score of 550 (representing the most disadvantaged) to a high of 1,232.89 (representing the least disadvantaged). As per the ABS this value is converted to a quintile score with 1 representing the most disadvantaged, the

bottom 20% of the sample population, and 5 representing the least disadvantaged, the top 20% of all the sample population (Table 5).

Table 5 -- SEIFA scores and their corresponding quintile

Quintile	IRSAD index
1, most disadvantaged	550 - 917
2	918 - 974
3	974.6 - 1020
4	1021 - 1069
5, least disadvantaged	1070 – 1232.89

Source: ALSWH data

Health behaviour variables

General practitioner visit

Questions relating to health service utilisation include whether the women visited the GP in the previous 12 months. The vast majority of women report attending a GP in the last 12 months. General practitioner visiting is stable across all surveys (Table 6).

Smoking status

Health behaviour information, including smoking status, is sought in all ALSWH studies. For smoking status, the responses include “never smoked”, “ex-smoker” and for those who responded positively as a smoker there are four categories to identify the number of cigarettes consumed daily. This variable is converted into a binary variable to identify current smokers and non or ex-smokers. Overall, few women are smokers. Further, the percentage who report smoking reduces from 11% in survey 3 to 5% in survey 7 (Table 6).

Dental health status variables

Dentition status

Questions regarding the woman’s number of natural teeth were asked in surveys 5 and 6. Edentulous persons were identified as those who self-reported no natural teeth in either of these surveys. There were 550 who reported being edentulous (Table 6).

Dental health status

Commencing in survey 5 (which is the survey period that immediately pre-dates the implementation of the CDDS) dental health status (DHS) and self-reported identification of a dental problem are included in the ALSWH. Identifying those with poor dental health is based on the following ALSWH survey question: “How would you rate the overall condition

of your teeth, dentures and gums?" Response options are: excellent, very good, good, fair or poor. This response is dichotomised into two groups. Those who rate their dental health status as poor/ fair are considered to have poor DHS and those who rate their dental health status as good/very good/ excellent are considered to have a good DHS. This dichotomisation is consistent with Teusner, Brennan & Spencer (2015). Self-reported dental health status is stable over surveys 5,6, and 7. Just over 25% of the population report poor/ fair DHS. The majority report good (40%) or very good/ excellent (30%) DHS (Table 6).

Dental problem

In addition to dental status, also commencing in survey 5 are two questions on the presence of a dental problem. The first is: "In the last 12 months, have you had any of the following: mouth, teeth or gum problems?" The second is "In the last 12 months, have you had any of the following: avoided eating some foods because of problems with your teeth, mouth or dentures?" The response options for both questions are: never, rarely, sometimes, or often. From these responses a dental health problem binary variable is constructed. Those who responded rarely, sometimes or often to either question are considered to have a dental problem while those who answered never are considered to have no dental problem. Overall, the percentage reporting a dental problem is stable across surveys 5 to 7, with approximately 30% reporting a problem (Table 6).

Table 6 - Summary statistics for key variables

Variable	Survey 3 (2001) (%)	Survey 4 (2004) (%)	Survey 5 (2007) (%)	Survey 6^ (2010) (%)	Survey 7^ (2013) (%)
Sociodemographic variables					
Geographic residence					
Major city	35	39	38	38	39
Inner regional	40	39	39	40	40
Outer regional, rural and remote	24	23	23	22	22
Marital status					
Married or de-facto	82	81	80	78	75
Educational attainment	N/a	N/a	N/a		N/a
No formal				12	
Intermediate/ high school certificate				44	
Trade/apprentice/certificate/diploma				22	
Degree or higher				23	
Private health insurance status					
No insurance	25	27	28	26	26
Ancillary only	4	4	4	4	4
Hospital only	16	13	12	10	10

Comprehensive (hospital & ancillary)	55	56	57	59	60
Financial management					
No financial concern	21	19	22	19	22
Limited financial concern	45	46	45	47	48
Some financial concern/ stress	34	36	33	34	31
Concessional status					
Concession card holder	17	21	23	30	47
Health behaviour variables					
General practitioner visits					
GP attendance in past 12 months	93	93	94	95	95
Smoking status					
Smoker	11	10	8	7	5
Dental health variables					
Dental Health Status	N/a	N/a			
Poor/ fair dental status			27	29	27
Good dental status			42	41	41
Very good/ excellent status			31	30	32
Dental health problem	N/a	N/a			
Reporting a problem			29	30	33
May not add to 100 due to rounding. ^ Post CDDS time period					

Source: ALSWH data

Linked data: survey and MBS administrative data

A key advantage of using the ALSWH to assess the impacts of the CDDS is that the survey component of the ALSWH dataset is linked to various health administration datasets. This includes the Medicare Benefits Schedule (MBS) dataset, which is able to provide accurate information on health service utilisation for services covered by the MBS, with some restrictions (Young, Dobson & Byles 2001). Linkage for the ALSWH is extensive as in 2012 the ALSWH custodians sought to retrospectively link the survey data to administrative data on an opt out basis (Dobson et al. 2015). For this analysis only 758 out of 13,713 women opted out of record linkage. These women are removed from the linked data analyses.

Medicare administrative data

During the time of its operation, relevant CDDS dental services were listed on the MBS. (The CDDS MBS item numbers are at Appendix A.) MBS information is primarily an administration dataset and its primary purpose is for paying for medical (or CDDS dental) items and not for analysis purposes (ALSWH 2019). However, linking the MBS administrative data to ALSWH survey data allows for identification of MBS services that ALSWH women received, the date they received the service as well as their referral information (if there was a referral), the

benefit they received for each item including any safety net benefit[34], the amount charged by the service provider (thus an out-of-pocket costs borne by the individual), whether the service was 'bulk billed' (which means there was no cost to the patient), and the postcode of the woman at the time of the service. There is also information on the service provider, which type of provider: for example, doctor, dentist or allied health; as well as the provider's gender, age, the state the service provider is in, and if the service was provided in hospital a hospital identifier number (ALSWH 2019). Variables that are helpful in this research include whether a woman received a CDDS service, the value of the service in terms of how much was charged by the health professional and the amount the woman is reimbursed. By linking this administrative data with the survey data, analysis of the characteristics of the women who received a CDDS service can be undertaken.

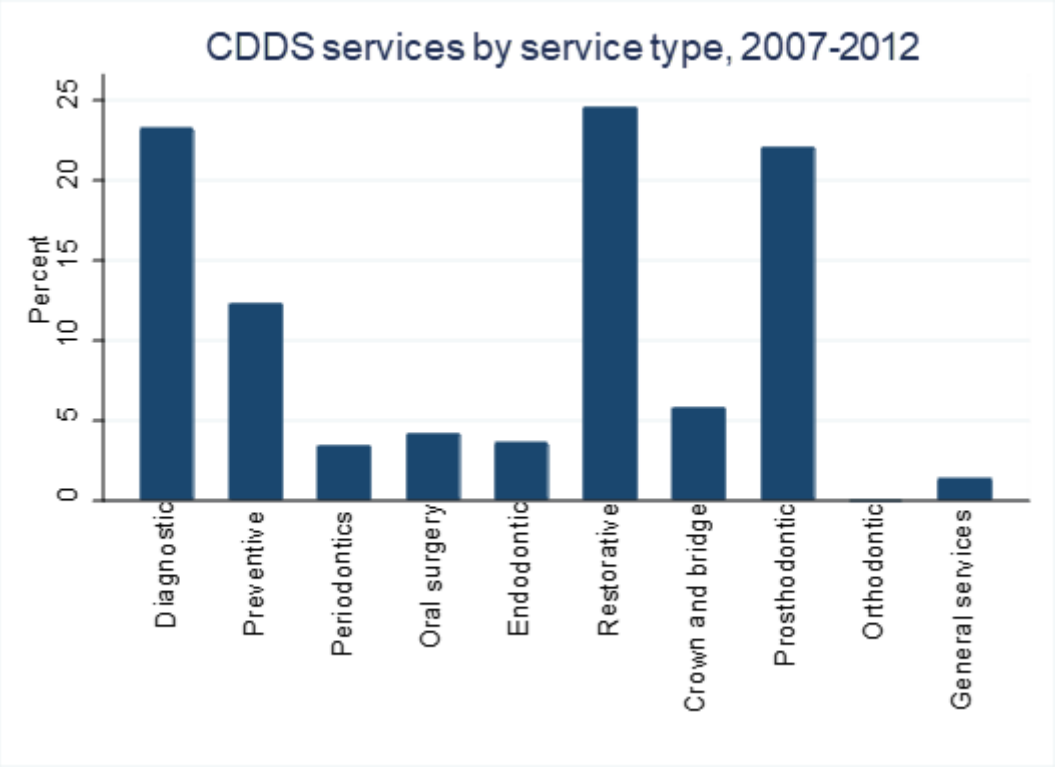
Overview of the CDDS using MBS data and ALSWH MBS administrative data

CDDS items by service type using ALWSH MBS linked data

There are 21,983 CDDS services provided to the women in this dataset between 2007 and 2012. Around 7% of women in this sample received a CDDS service. In the ALWSH sample the most frequently provided service type is restorative services, contributing 25% of the total number of services provided. The second most frequent service type is for diagnostic services, contributing 23% of the total number of services provided. The third most frequent service type is for prosthodontic services, contributing 22% of the total number of services provided. The fourth most frequently provided service type is for preventive services, contributing 12% of the total number of services provided (Figure 6).

[34] The Extended Medicare Safety Net applies to individuals who have exceeded a specified amount of out-of-pocket expenditure in one calendar year. Once the individual (or family) reaches this maximum out-of-pocket expenditure, they are reimbursed 80% of their out-of-pocket expenditure for the remainder of the calendar year (DOHA 2009c).

Figure 6 - CDDS items by service type for ALSWH cohort



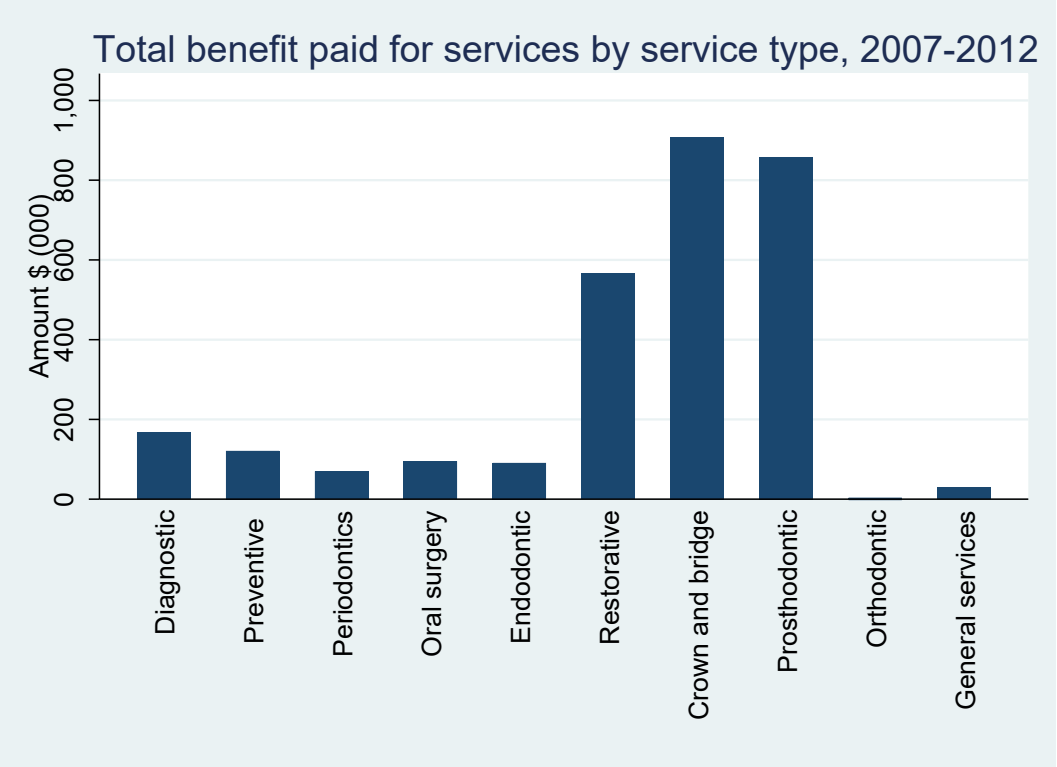
Source: ALSWH data

MBS benefit paid amount ($) by service type using ALSWH MBS linked data

For women in the ALSWH who received a CDDS service the majority of the MBS benefits went to services to restore dentition. Thirty one percent of the total benefit[35] went to crown and bridge services (whereas only 6% of the total volume of services attributable); 30% of the total MBS CDDS benefits was for prosthodontic services; 19% of the total benefit was for restorative services, which is broadly consistent with the proportion of the volume attributed to restorative services. In contrast, around 6% of the total MBS benefit went to diagnostic services, which contributed around 23% of the total volume of services provided. Similarly, for preventive services which contributed around 12% of the volume of services, the total MBS benefit was around 4% of the total benefit. This suggests that diagnostic and preventive services were relatively cheaper services to provide (Figure 7).

[35] Extended Medicare Safety Net benefit inclusive.

Figure 7 - MBS CDDS benefits paid by service type



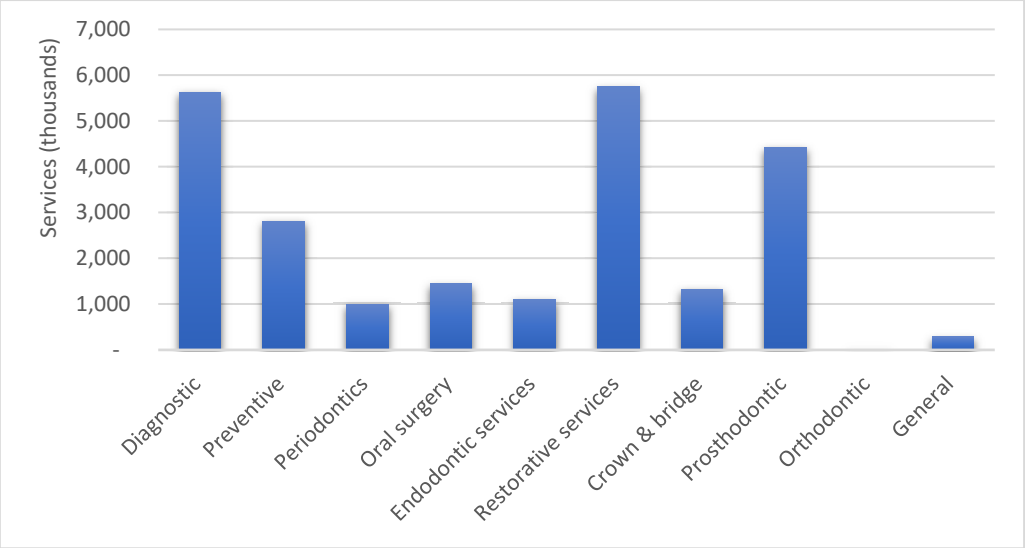
Soure: ALSWH data

Items by service type – MBS CDDS data

This section uses the MBS data online from the Department of Health, which covers all CDDS services provided to the whole CDDS population between 2007 and 2014[36] to provide an understanding of the data for the whole of the CDDS. The majority of services provided were diagnostic and restorative (24% each), prosthodontic (19%) and preventive (12%). Other services were less well used: crown and bridge and oral surgery (6% each), endodontic services (5%), periodontics (4%), general services (1%) and orthodontic services (<1%) (Figure 8).

[36] Note, this data includes the 2014 year data to account for reconciliation.

Figure 8 - CDDS services by type for all CDDS patients, 2007 -2014

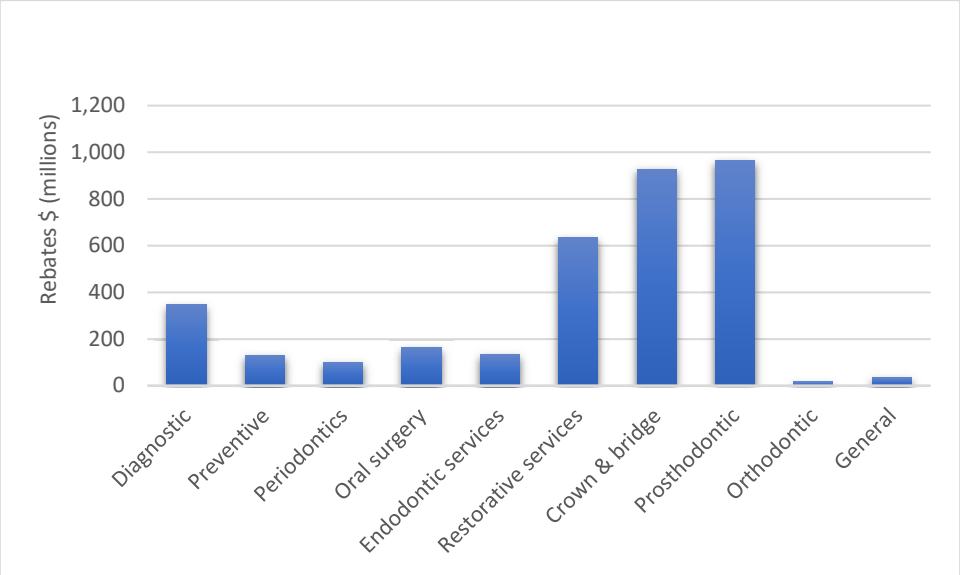


Source: MBS data online

MBS benefit paid amount ($) by service type – MBS CDDS data

In contrast to the services delivered, the majority of MBS benefits paid for all CDDS patients between 2007 and 2014 (from MBS data online) went to prosthodontics services at 28%, but which contributed 19% of services provided; and crown and bridge services at 27%, but which contributed to 6% of all services, reflecting the high costs of these services. Restorative services contributed 18% of the total MBS benefit provided. While diagnostic services contributed a large proportion of services delivered, they accounted for only 10% of the total costs. The remaining costs are oral surgery (5%), endodontic and preventive services (4% each), periodontics (3%), general services (1%) and orthodontic services (<1%) (Figure 9).

Figure 9 – MBS CDDS benefits ($) by service type for all CDDS patients, 2007-2014



Source: MBS data

Comparisons between the whole CDDS MBS population and the ALSWH cohort

Comparing service items between the ALSWH cohort and the whole of the CDDS MBS data, reveals a similar pattern of service delivery. However, the differences that are observed between the ALSWH cohort compared to the whole of the CDDS MBS shows the ALSWH cohort received a greater percentage of prosthodontic and crown and bridge services. This is observed in terms of services delivered and also in terms of the patient benefits received. For the whole of the CDDS population, patient benefits for prosthodontic services contributed 28% of the total benefit for the whole of the CDDS as compared to 30% of all benefits for the ALSWH cohort. For crown and bridge services, benefits contributed 27% of total benefits for the whole CDDS population while for the ALSWH cohort crown and bridge services contributed 31% of all benefits. The percentage of benefits for restorative services is broadly the same (19% for the ALSWH cohorts compared to 18% for the whole of the CDDS population) (Table 7).

There are a number of potential explanations for this small discrepancy. Previous studies note women use dental services more than men (Kino, Bernabe & Sabbah 2017; Murakami & Hashimoto 2016) but that women are more likely to express discomfort with their dental appearance than males (31% and 23% respectively) (AIHW 2016a), which perhaps explains why the ALWSH cohort might have received more of the expensive restorative services. Additionally, the ALSWH sample was found to have an over-representation of married women, employed women and tertiary educated women. On one hand there is an

association between dental visiting and higher education (Jang, Kim & Kim 2017; Park et al. 2016) and income (Ju et al. 2022), which might suggest the ALWSH cohort are more likely to visit the dentist. However, it is also possible that those in higher socio-economic groups (because they are more likely to be employed and/ or because they have tertiary education) are more likely to report better self-reported dental health status (Srivastava, Chen & Harris 2017), suggesting they might be less likely to require the higher end restorative services.

Table 7 - Service provision and patient benefits for the CDDS, ALWSH cohort compared to the whole of the MBS CDDS population

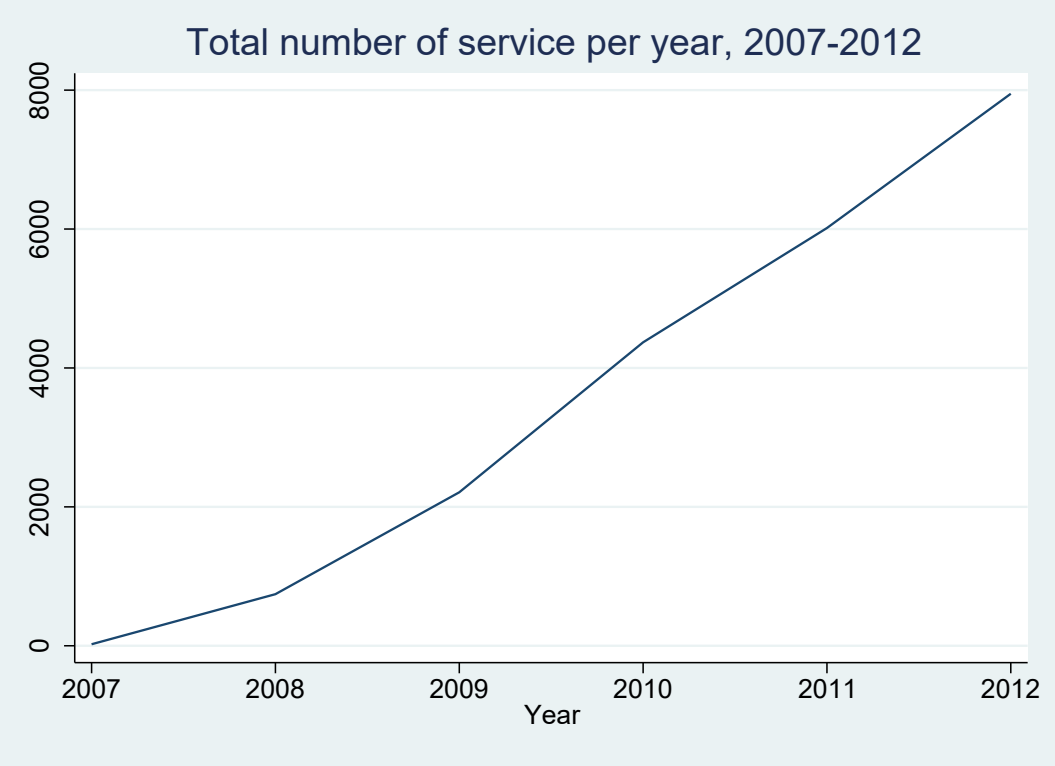
Population	Services provided (top 3)	Patient benefits provided (top 3)
Whole of CDDS population (MBS data)	1) Restorative (24%) 2) Diagnostic (24%) 3) Prosthodontic (19%)	1) Prosthodontic (28%) 2) Crown and bridge (27%) 3) Restorative (18%)
ALSWH cohort (ALWSH-MBS linked data)	1) Restorative (25%) 2) Diagnostic (23%) 3) Prosthodontic (22%)	1) Crown and bridge (31%) 2) Prosthodontic (30%) 3) Restorative (19%)

Source: ALSWH and MBS data

Aggregate services provided per year

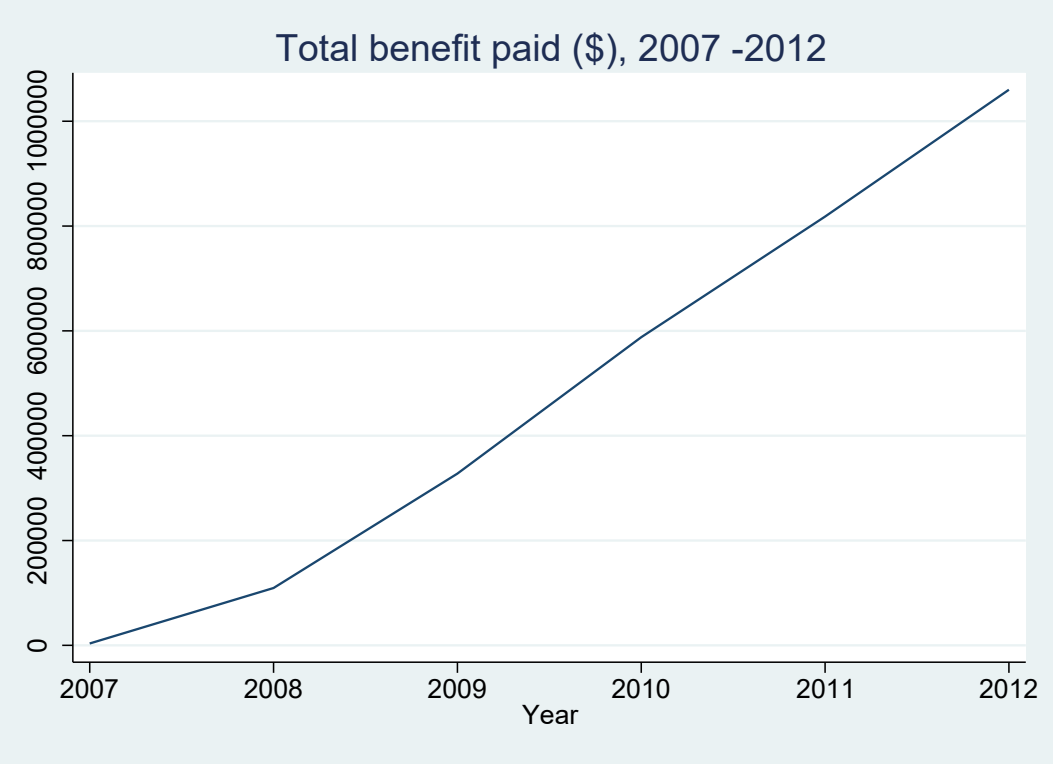
There is an increase in the number of services that are provided per year. In 2007, 22 CCDS services were provided to women in the ALSWH, 743 services were provided in 2008, 2,210 services in 2009, 4,369 services in 2010, 6,015 services in 2011 and 7,948 services in 2012 (Figure10). The pattern of uptake in services in CDDS services for the ALSWH cohort is similar to the pattern observed for all MBS CDDS services (see Chapter 1). MBS benefits paid also increased over this time, with $3,565.10 paid in 2007, $109,431.50 in 2008, $327,657.80 in 2009, $587,912.90 in 2010, $818,119.40 in 2011 and $1,060,146 in 2012 (Figure 10). This pattern is consistent with the pattern observed for all MBS CDDS benefits (see Chapter 1).

Figure 10 - Total CDDS services provided 2007-2012 for the ALSWH cohort



Source: ALSWH data

Figure 11 -Total CDDS benefits paid ($) 2007-2012



Source: ALSWH data

Attrition and retention

Attrition in panel data is where individuals may be lost from the sample. This may occur because the individual dies, moves and therefore is lost to follow-up, or refuses to participate in subsequent surveys. The consequences of attrition can be to bias the panel data (Winer 1983). Overall in the ALSWH there is good retention of survey participants, particularly in the 1946-51 cohort (Dobson et al. 2015). Table 8 is reproduced from (ALSWH 2016, p. 37) and provides information on the participation and retention rates of the women in this cohort for surveys 2 to 7. As noted, the response rates are high at 80% for all surveys up to survey 7.

Table 8 - Retention and attrition in each ALSWH survey

	Survey (year)					
	2 (1998)	**3 (2001)**	**4 (2004)**	**5 (2007)**	**6 (2010)**	**7 (2013)**
Age (years)	**47-52**	**50-55**	**53-58**	**56-61**	**59-64**	**62-67**
Deceased	50	119	216	328	474	671
Frail	7	23	34	51	70	100
Withdrawn	209	424	622	870	1,108	1,652
Total ineligible	**266**	**566**	**872**	**1,249**	**1,652**	**2,423**
Total non-responders	**1,111**	**1,923**	**1,938**	**1,828**	**2,052**	**2,141**
Completed responses	**12,338**	**11,226**	**10,905**	**10,638**	**10,011**	**9,151**
Number of eligible at survey	**13,449**	**13,149**	**12,843**	**12,466**	**12,063**	**11,292**
Response rate (% of eligible)	**91.7%**	**85.4%**	**84.9%**	**85.3%**	**83%**	**81%**

Source: (ALSWH 2016)

The analysis in this thesis has assumed that any missing variables and attrition are random. This assumption however can be assessed econometrically. The role of attrition is further assessed by running a probit equation of key explanatory variables to identify if any of the explanatory variables were affected significantly through attrition. The data set used is all women from surveys 1 to 7 (as survey 8 is beyond the scope of this analysis). A random effects probit model was run:

$$Y_{it} = \alpha_0 + \boldsymbol{\lambda X_{it}} + \varepsilon_{it},$$

where the dependent variable Y_{it} is a binary variable to identify whether the woman, *i*, was removed from the ALWSH cohort through attrition at time *t*. The λ represents a vector of

individual-level explanatory variables (geographic location, marital status, PHI status, financial status, concessional status, GP consultation in the last 12 months, smoking status, plus self-reported dental health status and the presence of a dental problem), and ε_{it} represents the error term. To account for the need to have clustered robust standard errors the errors are bootstrapped. Table 9 presents the results. The results show there are no significant effects of attrition on any of the key variables, meaning attrition is not likely to impact on the results in this analysis. Further, the Wald Chi square test is not significant implying that none of the explanatory variables significantly explain the dependent variable (the attrition of women in the cohort) ($p=0.559$). To further explore whether there was an effect due to attrition, a set of equations comparing the probability of a dental visit for all cohorts in the ALSWH as compared to only the cohorts used in this analysis. See Appendix A.2 for discussion and results. These results further strengthen that there is limited impact from attrition.

Table 9 - Attrition equation

Dependent variable 1= attrition	
Geographical location ARIA (base - major city)	
Inner regional	-0.040
	(0.818)
Outer regional, rural, remote	0.294
	(0.199)
Married	-0.092
	(0.634)
PHI status (base - no PHI)	
Ancillary only	-0.157
	(0.92)
Hospital only	-0.952
	(0.79)
Comprehensive - hospital and ancillary	-1.000
	(0.779)
Financial management (base - no financial difficulty)	
Limited financial difficulty	-0.092
	(0.466)
Financial difficulty or stress	0.088
	(0.577)
Concessional	0.157
	(0.101)
GP consult in last 12 months	0.066
	(0.76)
Smoker	-0.637
	(0.534)
Dental health status (base-poor/fair)	
Good	-0.136
	(0.236)
Very good/ excellent	-0.078
	(0.593)
Dental health problem	-0.096
	(0.306)
Constant	-7.936
	(0)***
Observations	26,368
Bootstrapped standard errors in parentheses. ***** p<0.001, ** p<0.01, * p<0.05**	
Source: derived from ALSWH data	

Strengths and limitations of the data

The ALSWH is a rich dataset that is appropriate for the analysis to be undertaken in this thesis. This strength of this data is that it is a long-standing panel dataset that covers the entire time period that the CDDS was operational. Further, this panel dataset is linked to various administrative datasets, including, importantly, the MBS administrative dataset. Linking the administrative data with the survey data allows for the analyses that provide insight into the characteristics of the women who received services.

There are a number of limitations. First, the ALSWH survey is undertaken once every three years. For the purposes of the DiD studies in this thesis this means that the outcome variable and the control variables are measured contemporaneously. Ideally, as our outcome variable for the DiD studies is a dental visit in the last 12 months, the control variables would also be measured retrospectively. This would have necessitated a dataset that included yearly survey responses.

Second, the ALSWH is, as the title says, a measure of Women's Health and therefore only representative of women, not men. This limits the generalisability of any studies undertaken with this dataset. Further, as the underlying data source is self-reported data, there may be issues regarding the validity of some of the self-reported data. Of particular interest for this thesis, there may be recall error for women in regard to their self-reported dental utilisation or their chronic disease status, although it should be noted that the ALSWH asks women whether they have been diagnosed or treated for one of the chronic conditions implying a degree of medical intervention. However, a previous study looking at the validation of self-reported data within the ALSWH has reported that self-reported diabetes, breast cancer, lung cancer and colorectal cancers are reported consistently with objective medical notes (Dobson et al. 2015). The weakness of the linked data is that it only captures those medical services that are available through the MBS. Services provided outside the MBS are not captured. Further, as the MBS captures services provided privately the use of public health services, for example, public dental services are not captured.

Given the above limitations, alternative datasets were explored. In particular, the SAX Institute's 45 and Up dataset (SaxInstitute 2022). The 45 and Up dataset has many characteristics similar to the ALWSH including being a large panel data set that can also be linked to MBS data. Its main advantage over the ALSWH dataset is that it includes both male

and female participants. However, the ALSWH was preferred due to the limitations of the 45 and Up dataset. These limitations include that it commenced in 2006, which limits the ability to gain an understanding of the dental visiting behaviour of participants prior to the introduction of the CDDS (in 2007). Additionally, it has limited dental health status variables thus limiting the ability to provide meaningful information on the characteristics of the CDDS participants.

Conclusion

This chapter has provided the overview of the ALWSH and the necessary data variables for the subsequent empirical chapters. It has outlined the relationship between the ALSWH surveys and how they relate to the introduction of the CDDS. It has identified the key variables used in the empirical chapters and provided the key characteristics of the women in the cohort. Of main relevance for this thesis is that the percentage of women who report a dental visit increased each survey period from 64% to 73% over the time period of interest.

Chapter 4 – Did the use of dental services increase?

This is the first empirical study of this thesis. The literature review has shown that where people are covered by dental insurance there is an increase in dental utilisation. The methodology employed in this chapter is a quasi-experimental analysis. This chapter divides the ALSWH cohort into two groups: those with a chronic disease as identified by self-report and who are therefore eligible for the CDDS (called the target group) and those who do not have a chronic disease as identified by self-report and therefore are not eligible for the CDDS (called the non-target group). There are two analyses. In Analysis 1, a difference-in-difference (DiD) is undertaken comparing the use of dental services before and after the introduction of the CDDS between these two groups. Analysis 2 is an extension and accounts for heterogeneity in treatment effect by recognising that some women developed a chronic disease during the time the CDDS was operational. In this analysis there are three target groups and one non-target group. The findings of this chapter go against expectations and shows that there is no increase in the probability of any dental visit following the implementation of the CDDS for those who are eligible as compared to those who are not. This chapter concludes with a discussion on the potential reasons for these results.

Research question

The research question for this chapter is:

1) *Did the use of dental services increase by those who were targeted by the CDDS?*

Methods and Data

Quasi-experimental approaches can be used to provide estimates of the impact of a policy in cases where a government policy or program is targeted towards one group of people (Angrist & Pischke 2009; Kahn-Lang & Lang 2018). Difference-in-difference provides causal estimates because it compares the outcome of interest in both a target group, those eligible to receive the policy intervention or program, and the non-target group, those not exposed to the program or policy, in the period prior to the introduction of the policy or program and the period following its introduction (Bertrand, Duflo & Mullainathan 2004; Verbeek 2008; Wooldridge 2009). The underlying assumption is that in the absence of the policy or program, the trajectory of the outcome of interest of both groups would have been the same (Angrist & Pischke 2014). The DiD is well established in providing causal interpretations stretching back to 1855 when John Snow used this approach to identify that

the causal transmission of cholera was via water (and not via air as had been initially thought) (Angrist & Pischke 2009; Jones, Parker & Jamieson 2014).

The first step is to identify and define the target group (also called a treatment group in the literature). In this study, the target group is those eligible for the CDDS who self-report having a chronic disease. It is important to note that the ALSWH survey asks women whether the woman has been diagnosed or treated implying medical advice has been provided to the woman. The second step is to identify the comparison group, the non-target group (also called a control group) who are not exposed to the policy of interest. In this case, the non-target group are those who self-report as being chronic disease free and therefore would not be eligible for the CDDS.

The Australian Longitudinal Study on Women's Health

Chapter 3 contains information on the data used in this study. As a brief reminder, this study uses data from the ALSWH's mid-cohort who were aged between 56 and 61 at the commencement of the CDDS in 2007 and 62 to 67 upon closure of the CDDS in 2012. Women who are edentulous[37], that is those who report no natural teeth in surveys 5 or 6, are excluded from this study. This is because edentulous individuals require different dental services to those with teeth and thus studies using dental visit as the outcome variable remove edentulous persons from analyses (Kreider et al. 2015; Teusner, Brennan & Spencer 2015). Data from ALSWH surveys 3 to 7 only[38] is used. Survey 3 (in 2001), survey 4 (in 2004) and survey 5 (in 2007) are the pre-intervention, or pre-CDDS, survey time periods. Survey 6 (in 2010) and survey 7 (in 2013) are the post-CDDS time periods.

Analysis 1: target and non-target group construction

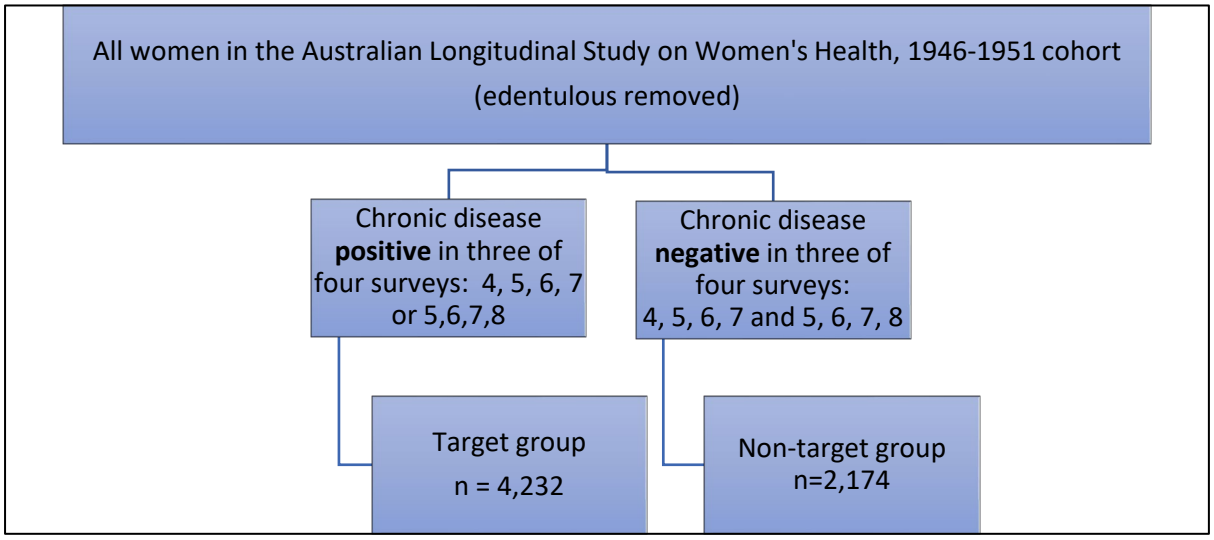
Construction of the target and non-target groups (Figure 12) is designed to capture as many suitable women as possible. To be eligible for the target group women need to have a chronic disease. This is measured by those who self-reported the presence of one of the chronic diseases of interest: diabetes, musculoskeletal conditions, cardiovascular diseases, respiratory diseases, cancers or mental health conditions. (The full list is in Chapter 3 along

[37] No natural teeth.

[38] As noted in chapter three, surveys 1 and 2 occurred prior to CDDS but are omitted as they occurred prior to PHI reforms. Survey 8, in 2016, and Survey 9, in 2019, are excluded from any analysis as they represent the time following the closure of the CDDS.

with a discussion of the links between each condition and dental health status.) The women need to have reported a chronic disease condition in three of four surveys 4, 5, 6 or 7; or in three of four surveys 5, 6, 7 or 8. The rationale for choosing three of four surveys for those who are in the target group rather than simply limiting it to those who are positive in surveys 5, 6 and 7 is that there may be instances where people have a temporary 'reprieve' or hiatus from the symptoms of their chronic disease but in reality their condition is chronic and ongoing and they are likely to suffer adverse consequences across time. To be eligible for the non-target group women need to be chronic disease free. This is measured by identifying the women who self-report an absence of all of the identified chronic diseases in any three of four surveys 4, 5, 6 or 7 or any three of four surveys 5, 6, 7 or 8. For the non-target group, the rationale for including those who did not have a chronic disease in one of the survey periods is to capture those who are mostly chronic disease free but who might have had a 'scare' or a temporary illness or condition but that is not ongoing. There are 4,232 women in the target group and 2,174 in the non-target group.

Figure 12 -Construction of target and non-target groups



Source: derived from ALSWH data

Comparison of the target and the non-target groups in Analysis 1

Ideally, the target group and the non-target group should be as similar as possible (Choi 2011) except for their exposure to the policy or intervention. The comparability of the target

and non-target group is assessed at survey 5[39], as this is the immediate pre-CDDS survey period, through a Chi Square test of significance to test the null hypothesis that there is no difference in key characteristics between the two groups (Guarnieri 2019). As it is not always possible to find directly comparable target and non-target groups (Wing, Kosali & Bello-Gomez 2018) the econometric regression includes additional control variables to account for any potential impact on the outcome variable (Wooldridge 2002).

Comparison between the target group and the non-target group shows there are statistically significant differences between the groups. Overall, those in the target group are less socioeconomically advantaged than those in the non-target group. Those in the target group are more likely to report financial difficulty or stress or be concessional and be more likely to have reported no formal education. Given the links between socioeconomic status and dental visiting this would suggest those in the non-target group would be more likely to report a dental visit before the CDDS commenced. Another important difference between the two groups is that those in the target group report poorer dental health than those in the non-target group as they are more likely to report dentures, are more likely to report a dental problem; and are more likely to report poor/fair dental health status and less likely to report very good to excellent dental health status. Dental health status and the presence of a dental problem are important determinants of a dental visit, with those reporting good dental health status more likely to visit a dentist than those with poor dental health status and those with a dental problem also more likely to report a dental visit (Brennan, Anikeeva & Teusner 2013; Gnanamanickam & Teusner 2018). This could suggest that those in the target group are less likely to have a favourable dental visiting pattern or it might also suggest that those in the target group are more likely to visit a dentist to attend to their dental problems. There is no difference between the groups in dental private health (ancillary) insurance coverage, so this is unlikely to have a differential impact on either of the groups. Further discussion on the two groups is in Appendix B1.

Econometric model – Analysis 1

The DiD estimator works by calculating the difference between the post and pre intervention time period for the outcome (the percentage who had a dental visit) prior to

[39] Immediate pre-CDDS time period.

the introduction of the CDDS and after the CDDS, between the target and non-target group (Verbeek 2008). This is described in the equation below:

$$\text{DiD: } \widehat{\beta 1} = (\bar{Y}^{\text{TARGET, POST}} - \bar{Y}^{\text{TARGET, PRE}}) - (\bar{Y}^{\text{NON-TARGET, POST}} - \bar{Y}^{\text{NON-TARGET, PRE}})$$

.

The DiD estimator can be estimated in an econometric model which, simultaneously, allows for additional control variables. The main econometric model for this analysis is a linear probability model and is represented by Equation 1:

$$Y_{it} = \alpha_0 + \alpha_1 \text{Target}_i + \alpha_2 \text{Post}_t + \beta_1 \text{Target}_i * \text{Post}_t + \boldsymbol{\lambda X_{it}} + \vartheta_t + \delta_i + \varepsilon_{it},$$

where the dependent variable Y_{it} is a binary variable to identify whether the woman, *i*, attended a dental visit in the 12 months prior to each survey at time, *t*. The α_0 represents women in the non-target group in the pre-intervention period, α_1 is a dummy variable equal to 1 if the woman is in the target group[40], α_2 is a dummy variable equal to 1 if the time period is the post time period (after 2007)[41], β_1 is the interaction variable for the post time period for those in the target group and is the variable of interest; λ represents a vector of individual-level control variables (discussed below), ϑ represents the time fixed effects and δ the individual fixed effects and ε represents the error term. The standard errors are clustered to the individual. The econometric analysis is undertaken in Stata version 15.1.

Control variables

Consideration of which control variables to include within this regression are based on their ability to explicitly control for those factors that impact on the dependent variable. This allows for reduced confounding and lessens the biased estimates of the impact of the coefficient of interest, which is β_1 (Gujarati & Porter 2009; Wooldridge 2009). Additionally, any differences inherent between the non-target and target groups are able to be accounted for with additional covariates within the regression analysis (Cameron & Trivedi 2005; Wooldridge 2002). The control variables included within the econometric model reflect the dual purpose of controlling for the differences in key characteristics between the target and non-target groups and controlling for the impact on the dependent variables.

Equation 1 is run with two different sets of control variables. In the primary model there are multiple pre-intervention time periods (surveys 3, 4, and 5). Having multiple pre-

[40] As a result of the fixed effects, the Target group coefficient does not appear in the results.
[41] As a result of the fixed effects, a separate Post coefficient does not appear in the results.

intervention time periods within the model allows for the model to account for underlying trends (Angrist & Pischke 2010; Meyer 1995). Additional variables include a series of dummy variables that identify geographic residence (ARIA) (major city; inner regional; and outer regional, rural or remote). This is used as CDDS services were predominantly through private dentists and, in comparison to main urban areas, there are a lack of private dentists available in regional and remote areas (AIHW 2019). A binary variable reflecting marital status is included as married women have been found to have better dental health patterns (Tada & Matsukubo 2003). A series of dummy variable identifying PHI coverage status identifies those with no insurance, with ancillary only coverage, with hospital only coverage and with both comprehensive PHI as ancillary PHI coverage, has been shown to be associated with dental service utilisation (Teusner, Brennan & Spencer 2015). A series of dummy variables identifying self-reported financial management identifies those with no financial stress or difficulty, with limited financial difficulty and with financial difficulty or stress, as financial difficulties are a barrier to the use of dental services (ABS 2017; AIHW 2021; Roberts-Thomson & Slade 2008). A binary variable identifies those who are concessional as this also recognises the presence of public services that are available for those with a concessional status and hence any impact these services have on dental utilisation (Hopkins, Kidd & Ulker 2013). Visiting a GP in the previous 12 months is included as it is not uncommon for patients to seek GP assistance prior to seeking dentist assistance (Barnett et al. 2016) and because the CDDS program required a GP referral for participation. Smoking is included as a control variable as there is an established link between smoking and dental health conditions such as periodontal disease (Do et al. 2008).

In the secondary model, geographic location (ARIA), marital status, PHI status, financial management, concessional status, GP visiting in the last 12 months, and smoking are included as control variables. Commencing in survey 5, the ALSWH sought information on dental health. A series of dummy variables identifies the woman's self-reported dental status as either poor or fair, good, or very good or excellent, as it is an important determinant of dental utilisation (Gnanamanickam & Teusner 2018). A binary variable identifies the presence of a dental problem as it has been shown those with a dental problem attend the dentist when their dental health is problematic (Brennan, Anikeeva & Teusner 2013). Including dental health control variables within the model has the effect of

reducing the number of pre-intervention time periods to one (survey 5 only). Table 10 provides a summary of the control variables for the primary and secondary models. (For a discussion on the construction of these variables, see Chapter 3.)

Table 10 - Control variables available in the primary and secondary model

Description	Primary model	Secondary model
Pre-intervention surveys	Surveys 3 – 5	Survey 5 only
Geographic location (ARIA) 0 = major city 1 = inner regional 2 = outer regional/rural/remote	✓	✓
Marital status 0 = separated/ divorced/ widowed/never married 1 = married or de-facto;	✓	✓
PHI status 0 = no insurance 1 = ancillary only 2 = hospital only 3 = ancillary insurance	✓	✓
Financial management 0 = no financial difficulty 1= limited financial difficulty 2 = financial difficulty or stress	✓	✓
Concessional status 0 = no health care card 1 = health care card	✓	✓
GP attendance in the last 12 months 0 = no 1 = yes	✓	✓
Smoking status 0 = non or ex-smoker 1 = smoker	✓	✓
Dental health status 0 = poor or fair 1 = good 2 = very good or excellent	✗	✓
Dental problem, a derived variable identifying those who avoided food or had mouth, teeth or gum problems 0 = never 1 = rarely, sometimes or often	✗	✓

Source: ALSWH data

Additional considerations for the empirical model

Using a binary dependent model

The ALSWH data dental utilisation variable captures whether the women attended a dentist in the last 12 months, but it does not capture the number of times women attended the dentists. Therefore, the outcome variable is a binary dependent variable, where women who attended the dentist are coded 1 and women who did not attend the dentist are coded 0. There are three modelling options for binary dependent variables: a linear probability model (LPM), or the probit model or logit model. This study follows Kosali, Soni & Cawley (2017) in using the LPM with as the preferred model while also presenting the results of the logit effects model, with the results presented in terms of odds ratios (ORs).

The LPM allows the probability of the woman attending a dental visit to be modelled. It uses an underlying probability function that is a linear function and thus it is modelled based on standard ordinary least squares methods (Baltagi 2005; Cameron & Trivedi 2010). One limitation of the LPM is that it can produce results that are less than 0 or greater than 1, which is non-sensical as probabilities can only be determined between 0 and 1 (Baltagi 2005). Unlike the LPM, the logit and probit models constrain the probabilities to between 0 and 1. As opposed to the LPM, which assumes a linear functional form for the model, both the logit and probit models use a non-linear functional form for the model. For the logit model, the probability of a dental visit can be modelled on a logistic function (Cameron & Trivedi 2010; Verbeek 2008).[42] The choice to use the LPM as the preferred model, despite the concerns regarding the potential for probabilities outside the 0-1 bounds, is that the LPM can present similar results to the non-linear model (Angrist & Pischke 2009).

Standard errors in the econometric model

Under the OLS assumptions, standard errors are assumed to have a mean of zero and are normally distributed. Further, ordinarily in cross-sectional data each observation is considered random (Gujarati & Porter 2009; Wooldridge 2009). There are two issues with the standard errors in this econometric model. The first relates to correlation due to the use

[42] The fixed effect logit model can be obtained by estimating the conditional maximum likelihood model to account for the incidental parameters problem (Allison 2009). A probit fixed effects model is not undertaken due to the incidental parameters problem (Cameron & Trivedi 2005). As the logit fixed effects model drops those observations where women do not exhibit a change in the dependent variable, the logit model results in a reduced sample size (Allison 2009), which is a limitation of the logit fixed effect model.

of panel data as panel data violates the assumption of randomness of the observations as, by its nature, the observations are linked due to being repeated observations for the same woman over time. The assumption of randomness remains valid as in panel data this assumption relates to the sampling of the women that are surveyed while the time dimension of the panel data (the repeated observations on the same woman) are able to be correlated within the panel data set (Wooldridge 2002). However, the fact that the observations are repeated on the same individual means that the error terms are correlated over time (autocorrelation) (Angrist & Pischke 2009) for each woman which means the estimators are not efficient (Gujarati & Porter 2009; Wooldridge 2009). A solution to this problem for panel data is to use clustered standard errors, which identifies each woman's observation is correlated over time (Bertrand, Duflo & Mullainathan 2004; Cameron & Trivedi 2010)[43]. The second issue with the use of a binary dependent model is that in the LPM the assumption of normally distributed errors cannot be maintained because the errors can only take two values and thus they are heteroskedastic (Gujarati & Porter 2009). As a result of the heteroskedastic errors robust standard errors are needed for inference (Cameron & Trivedi 2010). In the logit model to account for the need to have clustered robust standard errors the errors in each of the logit models are bootstrapped.

Intention-to-treat method

This analysis is premised on an intention to treat basis (ITT). That is, anyone with a relevant chronic disease is deemed to be eligible for treatment and, as a result, classified as being in the target group. While not everyone in this target group will have used the CDDS, this approach provides the most appropriate method to estimate the impact of the program on dental use. People in both groups will be using dentists, but only one group (should) have received additional insurance coverage. A consequence of the ITT method is that the estimate of the treatment effect can be conservative. The benefits of using a ITT method are to ensure adequate sample size (Gupta 2011) and to allow for generalisability of the study (Fergusson et al. 2002).

[43] In STATA using the code *vce (robust)* for *xtreg* is equivalent to using codes which clustered errors (StataCorp 2013, p. 383).

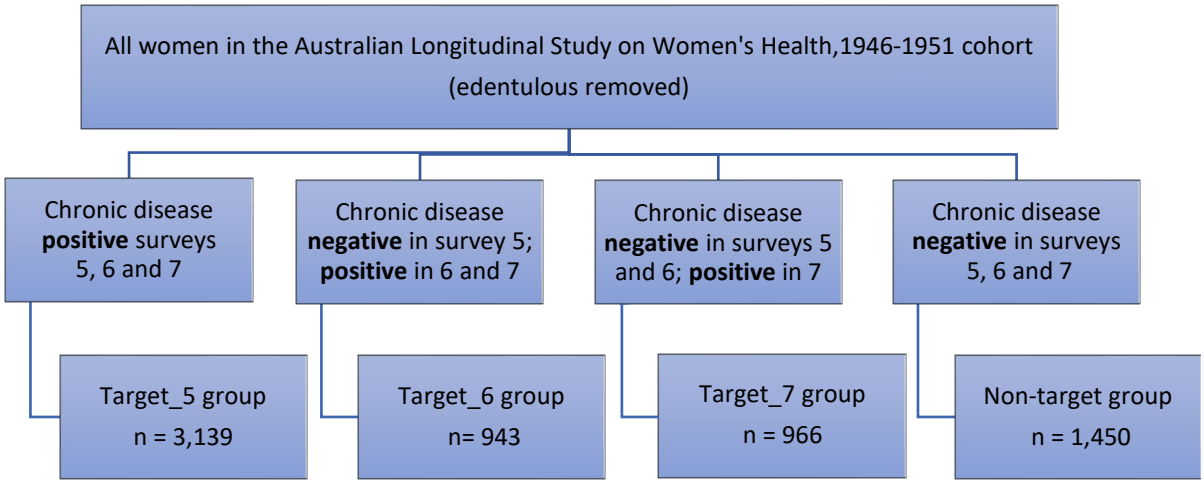
Analysis 2: target groups and non-target group construction

In Analysis 1, the assumption underpinning the construction of the target and non-target group is that the women's health condition is stable over multiple years. This may be a strong assumption given the women are aged between 56 and 67 during the time of the CDDS and the timeframe spans multiple years. Thus, Analysis 2 seeks to test whether there is a difference in utilisation for those who develop a chronic disease over the time the CDDS operated. There may be a difference in how GPs treat women who have a long-term ongoing chronic disease and those who are newly diagnosed, which may prompt CDDS referrals. This analysis captures concerns articulated in de Chaisemartin & D'Haultfoeuille (2020) where the treatment effect may not be constant. This analysis captures a larger cohort of women than Analysis 1 as three target groups are created.

The construction of the target and non-target groups for Analysis 2 is illustrated in Figure 13. The Target_5 group is constructed similarly to the target group in Analysis 1; however, its inclusion criterion is more restrictive. The Target_5 group includes only those who have a chronic disease as measured by their self-report in the pre-CDDS time period (survey 5) and two post-CDDS time periods (survey 6 and survey 7). There is no scope for any 'reprieve' from chronic disease status. There are 3,139 women in the Target_5 group. The Target_6 group consists of those who have a chronic disease in survey periods 6 and 7. This is measured through self-report, that is the women do not self-report a chronic disease in survey 5 but self-report as having a chronic disease in survey 6 and also in survey 7. There are 943 women in the Target_6 group. The Target_7 group consists of those are chronic disease free in surveys 5 and 6 but who develop a chronic disease in survey 7. This is measured by self-report. There are 966 women in the Target_7 group.

The non-target group for Analysis 2 consists of those who self-report no chronic disease in survey 5, survey 6 and survey 7. This is a tightening of the definition of the non-target group used in Analysis 1. There are 1,450 women in the non-target group.

Figure 13 – Construction of alternative target and non-target groups



Comparison of the non-target and the three target groups –Analysis 2

Comparison of the key characteristics of the three target groups to the non-target group shows that the target groups that develop a chronic disease in later survey periods, (Target_6 and Target_7) are more evenly matched to the non-target group. The table of key characteristics comparing the three alternative target groups to the non-target group is in Appendix B2.

Comparing the non-target and the Target_5 group shows the Target_5 group is less socioeconomically advantaged than those in the non-target group and report poorer dental health overall. Further, the Target_5 group is more likely to report being a smoker, which impacts on dental health adversely. Differences in financial status suggest those in the Target_5 group may be less likely to attend a dental visit due to the financial barriers. However, poorer dental health status might suggest those in the Target_5 group are more likely to attend for problem related dental health treatment. There is no difference between the groups in dental insurance coverage, so this is unlikely to have a differential impact on dental visiting in either of the groups.

Comparing the non-target group and the Target_6 group also shows the Target_6 group is less socioeconomically advantaged than the non-target group. Dental health is similar between the groups although the Target_6 group are more likely to report having dentures than the non-target group. The financial barriers mean those in the Target_6 group are less likely to attend a dental visit. The limited differences in dental health status and levels of

dental insurance coverage are similar so these attributes are unlikely to have a differential impact on dental visiting in either of the groups.

Comparing those in the Target_7 group with those in the non-target group, there are few statistically significant differences. This is to be expected as those in the Target_7 group only transition into having a chronic disease in survey 7. The differences relate to financial difficulty as those in the Target_7 group are more likely to report financial difficulty/stress. This might suggest those in the Target_7 group are less likely to visit a dentist due to financial barriers. There are no differences between the groups in relation to dental health and coverage with private health (ancillary) insurance similar, meaning there is unlikely to be a differential impact on dental visiting in either of these groups.

Econometric model - Analysis 2

For Analysis 2 the econometric model used is equation 2:

$$Y_{it} = \alpha_0 + \alpha_1 \text{Target\_5}_i + \alpha_2 \text{Target\_6}_i + \alpha_3 \text{Target\_7}_i + \alpha_4 \text{Post}_t + \alpha_5 \text{Post\_7}_t + \beta_1 \text{Target\_5}_i * \text{Post}_t + \beta_2 \text{Target\_6}_i * \text{Post}_t + \beta_3 \text{Target\_7}_i * \text{Post\_7}_t + \boldsymbol{\lambda X_{it}} + \vartheta \text{time}_t + \delta \text{individual}_i + \varepsilon_{it},$$

where equation 2 is an extension of equation 1 with the added complexity due to the multiple target groups and the multiple post CDDS periods reflecting the intertemporal changes in eligibility of the different target groups. In Analysis 2, the dependent variable remains the same. This dependent variable, Y_{it}, identifies whether the woman, *i*, attended a dental visit in the 12 months prior to each survey at time *t*. A set of dummy variables α_1, α_2 and α_3 indicates whether the woman is in any of the three target groups: Target_5, Target_6 and Target_7 respectively[44]. As eligibility for the CDDS is based on when the woman developed a chronic disease, there are two Post intervention dummy variables[45]. A dummy variable α_4, represents the post period for those in the Target_5 and Target_6 groups. A separate dummy variable α_5 represents the post period for those in the Target_7 group. There are two post periods in this model because those in Target_5 group and Target_6 group are both eligible for the CDDS from its implementation period, survey 6. In contrast, those in the Target_7 are not eligible for the CDDS until they develop a chronic disease, which is in survey 7. The β_1 to β_3 coefficients estimate the interactions between the target

[44] As a result of the fixed effects the target groups' coefficients do not appear in the results.
[45] As a result of the fixed effects the two post coefficients do not appear in the results.

groups and the post-CDDS period and are the variables of interest for Target_5, Target_6 and Target_7 groups respectively. Consistent with equation 1 (for Analysis 1): λ represents a vector of individual-level control variables using both sets of control variables presented in Table 10. As this is a fixed effects model, ϑ represents the time fixed effects and δ the individual fixed effects. Finally, Ɛ is the error term. Standard errors are clustered to the individual. Finally, LPM and logit models are undertaken.

Table ***11*** **– LPM results for difference-in-difference for all non-target/ target groups analyses (all primary and secondary models)**

	Analysis 0	Analysis 1		Analysis 2	
Dependent variable: 1 = dental consultation in last 12 months	**Model 4.0**	**Model 4.1**	**Model 4.2**	**Model 4.3**	**Model 4.4**
		(Primary)	(Secondary)	(Primary)	(Secondary)
Survey (base - Survey 3)					
Survey 4		0.026***	n/a	0.031***	n/a
		(0.007)		(0.007)	
Survey 5		0.044***	(Base- survey 5)	0.045***	(Base – survey 5)
		(0.007)		(0.007)	
Survey 6		0.069***	0.027**	0.064***	0.024*
		(0.010)	(0.010)	(0.010)	(0.010)
Survey 7		0.083***	0.036***	0.083***	0.038***
		(0.010)	(0.011)	(0.011)	(0.011)
Post	0.618***	n/a	n/a	n/a	n/a
	(0.007)				
Target_group (CDDS eligible; post period)	0.004	0.000	-0.000	n/a	n/a
	(0.009)	(0.010)	(0.012)		
Target_5 group (CDDS eligible; post period)		n/a	n/a	0.003	-0.004
				(0.010)	(0.013)
Target_6 group (CDDS eligible; post period)		n/a	n/a	-0.002	0.000
				(0.015)	(0.020)
Target_7 group (CDDS eligible; post_7 period)		n/a	n/a	-0.006	0.004
				(0.016)	(0.017)
Geographical location ARIA (base - major city)					
Inner regional		-0.002	-0.019	-0.019	-0.021
		(0.013)	(0.022)	(0.013)	(0.022)

Outer regional, rural, remote		-0.033^	-0.060*	-0.029	-0.051^
		(0.018)	(0.031)	(0.019)	(0.031)
Married		-0.003	0.029	-0.002	0.013
		(0.013)	(0.021)	(0.013)	(0.022)
PHI status (base - no PHI)					
Ancillary only		0.060*	0.042	0.061*	0.055
		(0.025)	(0.036)	(0.025)	(0.037)
Hospital only		0.035^	0.048	0.031	0.053^
		(0.020)	(0.031)	(0.019)	(0.031)
Comprehensive - hospital and ancillary		0.088***	0.070**	0.103***	0.107***
		(0.017)	(0.027)	(0.017)	(0.027)
Financial management (base - no financial difficulty)					
Limited financial difficulty		-0.022**	-0.017^	-0.021**	-0.017
		(0.008)	(0.010)	(0.008)	(0.011)
Financial difficulty or stress		-0.043***	-0.026^	-0.042***	-0.022
		(0.010)	(0.014)	(0.010)	(0.014)
Concessional		-0.004	-0.008	0.001	-0.012
		(0.008)	(0.010)	(0.008)	(0.010)
GP consult in last 12 months		0.060***	0.047*	0.060***	0.068***
		(0.013)	(0.019)	(0.013)	(0.019)
Smoker		-0.030^	-0.058^	-0.036^	-0.062*
		(0.018)	(0.030)	(0.018)	(0.030)
Dental health status (base-poor/fair)					
Good		n/a	0.056***	n/a	0.051***
			(0.011)		(0.011)
Very good/ excellent		n/a	0.131***	n/a	0.127***
			(0.015)		(0.014)
Dental health problem		n/a	0.126***	n/a	0.118***
			(0.009)		(0.009)
Constant	0.653***	0.566***	0.513***	0.520***	0.483***
	(0.001)	(0.024)	(0.036)	(0.024)	(0.036)

Observations	36,878	30,208	18,217	30,443	18,430
R-squared	0.0042	0.013	0.027	0.013	0.026
Number of women	6,406	6,402	6,386	6,490	6,467

Logit model coefficient results presented in odds ratios.
n/a: not applicable
Bootstrapped standard errors in parentheses *** p<0.001, ** p<0.01, * p<0.05, ^ p<0.1
Primary models have pre-CDDS surveys 3 to 5; do not include dental health variables. Secondary models have pre-CDDS survey 5 only; includes the dental health control variables.
Source: ALSWH data

Table 11 reports the main results of Models 4.1 and Model 4.2 from Analysis 1 and models 4.3 and 4.4 from Analysis 2. Although the LPM is the preferred model, the LPM and logit results are both presented. (See the Appendix B3 for the logit model results.) While the LPM and logit results are not directly comparable the direction and statistical significance of the variables within each model are broadly in alignment, implying the qualitative implications of results are not sensitive to the different functional forms. Statistical significance is considered at the conventional level of p=0.005 (the 5% level) although significance at p=0.10 (the 10% level) is also noted where relevant.

Analysis 0

Model 4.0

Consistent with Choi (2011), for the main econometric model (presented in Analysis 1) the simple DiD results are presented. This shows there is an increase in the probability of a dental visit in the post time period for all groups. However, there is no increase in the probability of a dental visit for the target group (Table 11).

Analysis 1

Model 4.1

Table ***11*** reports the results of model 4.1, which are based on 30,208 observations corresponding to 6,402 women. There were 2,374 women who report a consistent pattern of dental visiting in all surveys 3 to 7. That is, they either consistently attend the dentist in each survey period or consistently do not attend the dentist in each survey period. For the variable of interest, the interaction term for the target group in the post time period (this is the β_1 Target group), there is no increase in the probability of a dental visit in the last 12 months for the target group in the post-CDDS time period as compared to the non-target group in the pre-CDDS time period. The statistically insignificant result for the DiD estimator implies that the likelihood of a dental visit did not change from its pre-CDDS trajectory when compared to the non-target group trajectory.

There are several control variables that produce statistically significant impacts on the probability of a dental utilisation. There is a positive time trend across the surveys suggesting that the likelihood of a dental visit increases over time. Those covered with PHI have an increased probability of a dental visit as compared to those with no PHI cover.

Those who attended a GP consultation in the last 12 months have an increased probability of dental visit as compared to those who do not.

There are several variables that result in a statistically significant decrease in the probability of a dental visit in the last 12 months. Increasing rurality or remoteness results in a decrease in the probability of a dental visit. Those who experience some financial difficulty have a decrease in the probability of a dental visit and those experiencing financial stress have a decrease in the probability of a dental visit.

Model 4.2

Table ***11*** reports on the results of model 4.2, which are based on 18,217 observations corresponding to 6,386 women. There were 3,597 who report a consistent pattern of dental visiting in all surveys 5 to 7. Overall, the results of the secondary model reinforce previous results. There was no increase in the probability of a dental visit for the target group in the post-CDDS time period as compared to the non-target group in the pre-CDDS time period.

There are several control variables that result in a statistically significant increase in the probability of a dental visit. Again, a positive time trend is observed as, implying there was an increase in the likelihood of a dental visit over time. As compared to those with no PHI coverage there was an increase in the probability of a dental visit for those with comprehensive PHI, both hospital and ancillary coverage only. For those who attended a GP consultation in the last 12 months as compared to those who did not, there was an increase in the probability of a dental visit.

The additional dental health variables also find statistically significant increases in the probability of a dental visit. As compared to the base case of poor/fair dental health status, those with increased self-rated dental health resulted in an increasing probability of a dental visit. Those who report a dental problem as compared to those who do not report a dental problem had an increase in the probability of a dental visit.

Consistent with model 4.1, increasing rurality decreases the probability of a dental visit as compared to those who lived in a major city (base case). Increasing financial difficulty results in a decrease in the probability of a dental visit. Additionally, those who were smokers as

compared to those who did not smokers had a decrease in the probability of a dental visit, weakly significant.

Analysis 2

Model 4.3

Table ***11*** presents the results from Model 4.3, which are based on 30,443 observations corresponding to 6,490 women. There were 2,365 women who reported a consistent pattern of dental visiting all surveys 3 to 7. As this model accounts for the transitioning of women into chronic disease status there are three variables of interest for each of the target groups (Target_5, Target_6 and Target_7).

This model found no increase in the probability of a dental visit for any of the three target groups in the post-CDDS period as compared to the non-target group in the pre-CDDS period. Thus, for those who transitioned into a chronic disease state the statistically insignificant results mean the likelihood of a dental visit did not change from its pre-CDDS trajectory when compared to the non-target group trajectory.

Other finds are as reported in analysis one, with a positive time trend observed meaning there was an increase in dental visiting in each survey period. Those with no PHI coverage, compared to those with ancillary only coverage had an increase in the probability of a dental visit. Those who attended a GP consultation in the last 12 months as compared to those who did not, had an increase in the probability of a dental visit. Increasing financial difficulty or stress and smoking decreased the probability of a dental visit.

Model 4.4

Table ***11*** presents the result of model 4.4, which were based on 18,430 observations corresponding to 6,467 women. There were 3,617 women who report a consistent dental visiting pattern in all surveys 5 to 7. These results reinforce the results of the previous models. No statistically significant increase in the probability of a dental visit for any of the target groups following the introduction of the CDDS as compared to the pre-CDDS trajectory of the non-target group.

A statistically significant positive time trend is observed showing an increase in the likelihood of a dental visit over time. Coverage with comprehensive PHI compared with no PHI coverage increases the probability of a dental visit. Those who attended a GP consultation in the last 12 months compared with those who did not attend a GP consult had statistically significant increase in the probability of a dental visit. Those with better self-reported dental health status had an increase in the probability of a dental visit. Those with a dental health problem report an increase in the probability of a dental visit. Increasing rurality results in a decrease in the probability of a dental visit, although statistical significance is not achieved at conventional levels, it is at the 10 percent level. Finally, those who were smokers compared with non-smokers had a decrease in the probability of a dental visit.

Table 11 – LPM results for difference-in-difference for all non-target/ target groups analyses (all primary and secondary models)

	Analysis 0	Analysis 1		Analysis 2	
Dependent variable: 1 = dental consultation in last 12 months	**Model 4.0**	**Model 4.1**	**Model 4.2**	**Model 4.3**	**Model 4.4**
		(Primary)	(Secondary)	(Primary)	(Secondary)
Survey (base - Survey 3)					
Survey 4		0.026***	n/a	0.031***	n/a
		(0.007)		(0.007)	
Survey 5		0.044***	(Base- survey 5)	0.045***	(Base – survey 5)
		(0.007)		(0.007)	
Survey 6		0.069***	0.027**	0.064***	0.024*
		(0.010)	(0.010)	(0.010)	(0.010)
Survey 7		0.083***	0.036***	0.083***	0.038***
		(0.010)	(0.011)	(0.011)	(0.011)
Post	0.618***	n/a	n/a	n/a	n/a
	(0.007)				
Target_group (CDDS eligible; post period)	0.004	0.000	-0.000	n/a	n/a
	(0.009)	(0.010)	(0.012)		
Target_5 group (CDDS eligible; post period)		n/a	n/a	0.003	-0.004
				(0.010)	(0.013)
Target_6 group (CDDS eligible; post period)		n/a	n/a	-0.002	0.000
				(0.015)	(0.020)
Target_7 group (CDDS eligible; post_7 period)		n/a	n/a	-0.006	0.004
				(0.016)	(0.017)
Geographical location ARIA (base - major city)					
Inner regional		-0.002	-0.019	-0.019	-0.021
		(0.013)	(0.022)	(0.013)	(0.022)
Outer regional, rural, remote		-0.033^	-0.060*	-0.029	-0.051^
		(0.018)	(0.031)	(0.019)	(0.031)
Married		-0.003	0.029	-0.002	0.013
		(0.013)	(0.021)	(0.013)	(0.022)
PHI status (base - no PHI)					
Ancillary only		0.060*	0.042	0.061*	0.055

		(0.025)	(0.036)	(0.025)	(0.037)
Hospital only		0.035^	0.048	0.031	0.053^
		(0.020)	(0.031)	(0.019)	(0.031)
Comprehensive - hospital and ancillary		0.088***	0.070**	0.103***	0.107***
		(0.017)	(0.027)	(0.017)	(0.027)
Financial management (base - no financial difficulty)					
Limited financial difficulty		-0.022**	-0.017^	-0.021**	-0.017
		(0.008)	(0.010)	(0.008)	(0.011)
Financial difficulty or stress		-0.043***	-0.026^	-0.042***	-0.022
		(0.010)	(0.014)	(0.010)	(0.014)
Concessional		-0.004	-0.008	0.001	-0.012
		(0.008)	(0.010)	(0.008)	(0.010)
GP consult in last 12 months		0.060***	0.047*	0.060***	0.068***
		(0.013)	(0.019)	(0.013)	(0.019)
Smoker		-0.030^	-0.058^	-0.036^	-0.062*
		(0.018)	(0.030)	(0.018)	(0.030)
Dental health status (base-poor/fair)					
Good		n/a	0.056***	n/a	0.051***
			(0.011)		(0.011)
Very good/ excellent		n/a	0.131***	n/a	0.127***
			(0.015)		(0.014)
Dental health problem		n/a	0.126***	n/a	0.118***
			(0.009)		(0.009)
Constant	0.653***	0.566***	0.513***	0.520***	0.483***
	(0.001)	(0.024)	(0.036)	(0.024)	(0.036)
Observations	36,878	30,208	18,217	30,443	18,430
R-squared	0.0042	0.013	0.027	0.013	0.026
Number of women	6,406	6,402	6,386	6,490	6,467

Logit model coefficient results presented in odds ratios.
n/a: not applicable
Bootstrapped standard errors in parentheses *** p<0.001, ** p<0.01, * p<0.05, ^ p<0.1
Primary models have pre-CDDS surveys 3 to 5; do not include dental health variables. Secondary models have pre-CDDS survey 5 only; includes the dental health control variables.
Source: ALSWH data

Robustness tests

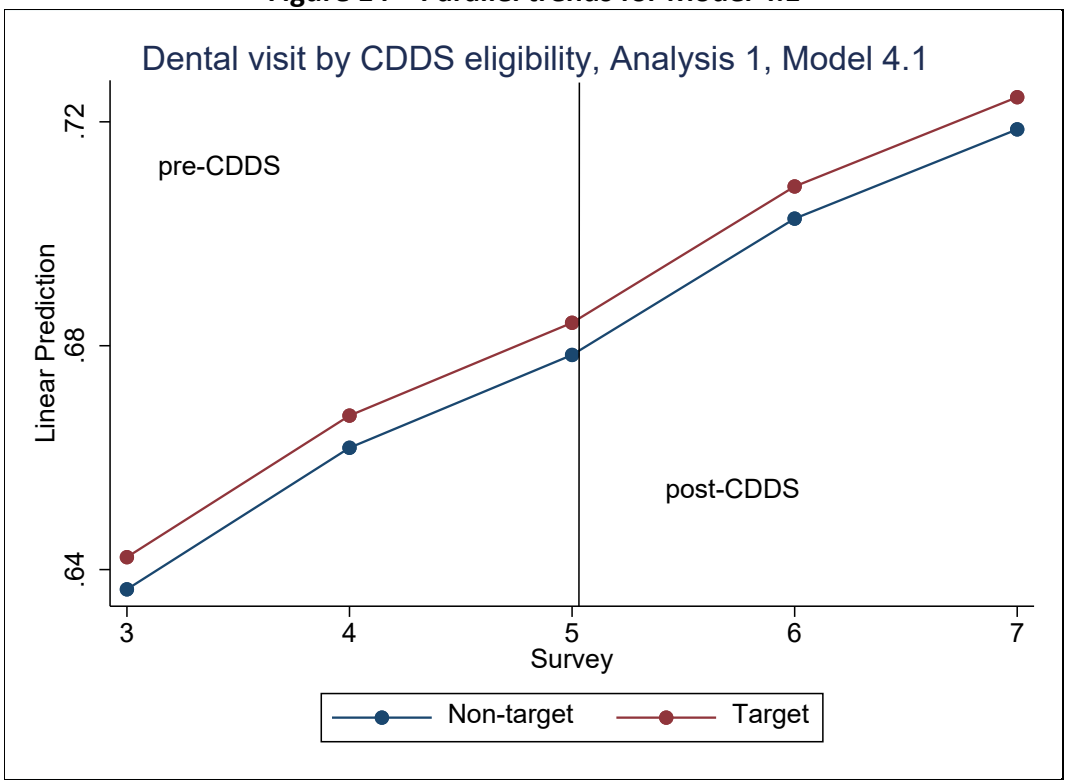
Robustness testing for the DiD assumptions and other modelling assumptions are applied to examine whether the assumptions of the research are internally valid (Wing, Kosali & Bello-Gomez 2018). As there was no statistically significant increase in the likelihood of a dental visit for any of the target groups in either analysis, the tests are presented for completeness.

Parallel trends

Difference-in-difference models are premised on the common trends assumption also known as the parallel trends assumption. This assumption says that in the absence of the stated intervention the trajectory of the outcome of interest of both the non-target group and target group(s) would have been the same (Angrist & Pischke 2014). The parallel trends can be presented visually to show the outcome variable (dental visit in the last 12 months) over the longer term by both groups. As previously identified, a longer time frame of pre-intervention periods is valuable for identifying underlying trends in the outcome variable (Angrist & Pischke 2010; Meyer 1995).

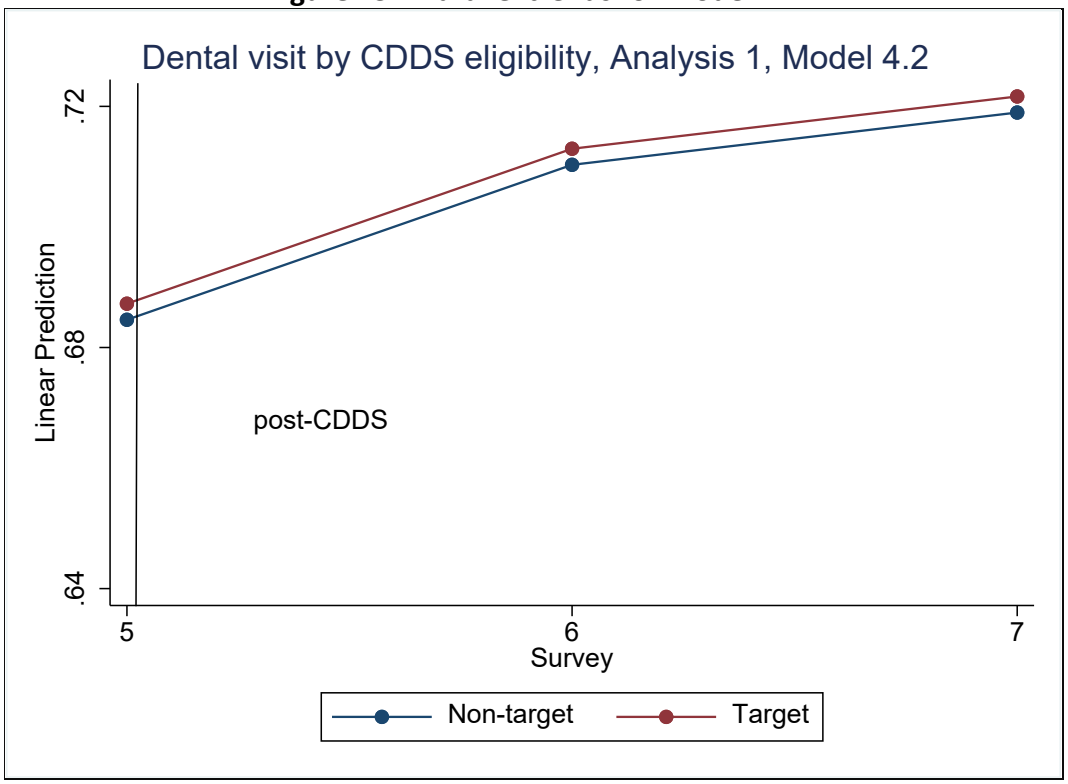
The parallel trends charts for all models in both analyses show the adjusted linear prediction of a dental visit for the target groups along with the non-target groups. In all figures in the pre-CDDS periods the trend in dental visits for the target groups and the non-target groups are similar. Thus, the assumption of parallel trends is satisfied visually. Additionally, in all figures there is an increase in self-reported dental visit for all groups in each survey year. Consistent with the findings from the econometric analysis there is no differential outcome in dental visit following the introduction of the CDDS in any of the target groups as compared to their respective non-target groups (See **Figure 14 – Parallel trends for Model 4.1**Figure 14 Figure 15 Figure 16 Figure 17).

Figure 14 – Parallel trends for Model 4.1



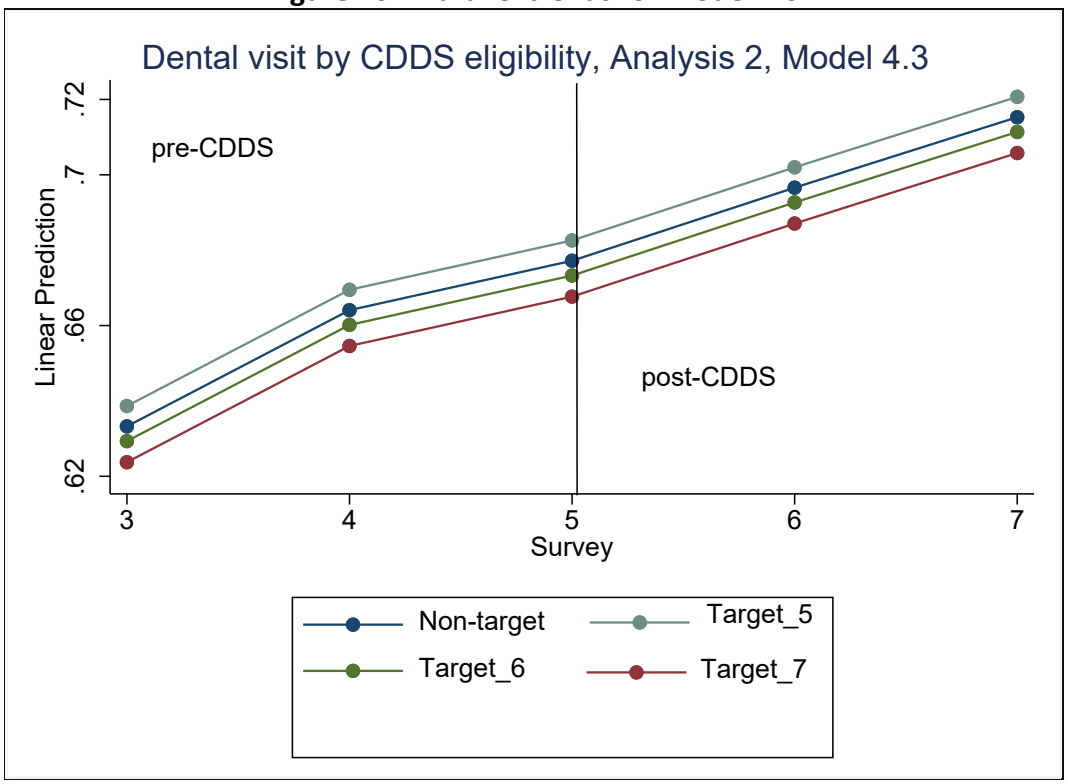
Source: derived from ALSWH data

Figure 15 – Parallel trends for Model 4.2



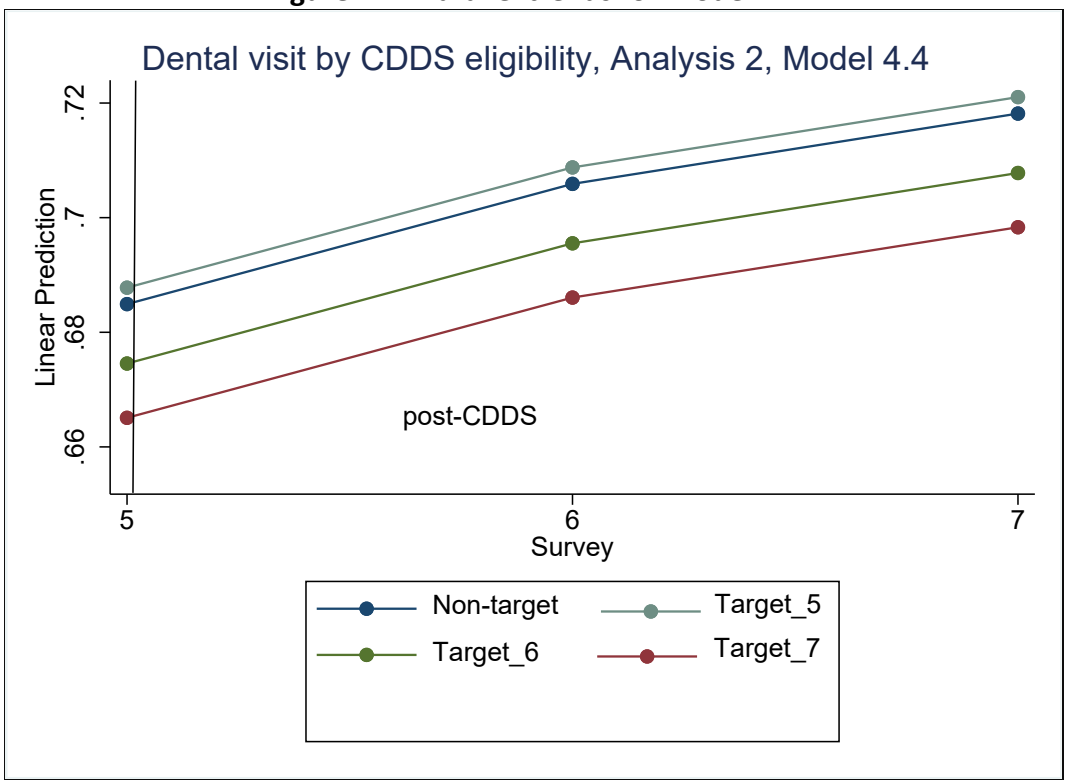
Source: derived from ALSWH data

Figure 16 – Parallel trends for Model 4.3



Source: derived from ALSWH data

Figure 17 – Parallel trends for Model 4.4



Source: derived from ALSWH data

Placebo test

A placebo test is also used to examine whether there are different trends between the target groups and respective non-target groups in the pre-CDDS time period (Elani, Kawachi & Sommers 2021; Kahn-Lang & Lang 2018). The placebo becomes survey period 5 as the first post period. This testing of the leads is undertaken by respecifying the model to identify whether the coefficient of interest, the interaction terms are significant in the time period prior to the implementation of the CDDS. If this coefficient is significant, it implies a differential effect in the pre-intervention period between the target groups and non-target groups prior to the implementation of the CDDS and the DiD would be biased (Kosali, Soni & Cawley 2017). For the models 4.1 and 4.3 this consists of estimating the model and allowing the pre-CDDS period to be surveys 3 and 4 and the post-CDDS periods to be surveys 5, 6 and 7[46].

For models 4.2 and 4.4 an additional step is needed. Due to the data limitation in the ALSWH, the dental health variables (dental health status and the dental problem variables) are only available from survey 5 onward. Thus, to facilitate the placebo test where survey 4 is the pre-CDDS survey period and surveys 5, 6, and 7 are the post-CDDS periods a lead variable is constructed to bring the dental health variables into survey 4. This means the dental status variables for survey 5 are recoded to appear in survey 4, the variables for survey 6 are recoded to survey 5, survey 7 are recoded to survey 6 and survey 8 are recoded to survey 7.

Table 12, shows the placebo test for all models. Noting that there was no outcome in the main results for any of the target groups, the placebo test confirms there is no statistically significant outcome in any of the main variables of interest, the interaction terms. Thus, there is no pre-intervention effect on the variable of interest and the identification assumption has not been violated.

[46] Survey 5 is the immediate pre-CDDS time period.

Table 12 - Results of the placebo test for all models

	Analysis 1		Analysis 2	
Dependent variable: 1 = dental consultation in last 12 months	**Model 4.1**	**Model 4.2**	**Model 4.3**	**Model 4.4**
	(Primary)	(Secondary)	(Primary)	(Secondary)
Survey (Base - Survey 3)				
Survey 4	0.026***	(Base survey4)	0.031***	(Base – survey 4)
	(0.007)		(0.007)	
Survey 5	0.047***	0.019	0.042***	0.009
	(0.010)	(0.011)	(0.010)	(0.011)
Survey 6	0.072***	0.045***	0.063***	0.031**
	(0.010)	(0.011)	(0.010)	(0.011)
Survey 7	0.086***	0.064***	0.082***	0.054***
	(0.010)	(0.011)	(0.011)	(0.012)
Target group (CDDS eligible; placebo post period)	-0.004	0.001		
	(0.010)	(0.012)		
Target_5 group (CDDS eligible; placebo post period)			0.006	0.016
			(0.011)	(0.013)
Target_6 group (CDDS eligible; placebo post period)			-0.004	-0.005
			(0.015)	(0.019)
Target_7 group (CDDS eligible; placebo post_7 period)			-0.006	-0.002
			(0.014)	(0.016)
Geographical location ARIA (base - major city)				
Inner regional	-0.002	-0.014	-0.019	-0.019
	(0.013)	(0.017)	(0.013)	(0.017)
Outer regional, rural, remote	-0.033	-0.034	-0.029	-0.024
	(0.018)	(0.024)	(0.019)	(0.024)
Married	-0.003	0.010	-0.002	0.003
	(0.013)	(0.017)	(0.013)	(0.017)
PHI status (base - no PHI)				
Ancillary only	0.060*	0.057	0.061*	0.050
	(0.025)	(0.030)	(0.025)	(0.030)
Hospital only	0.035	0.074**	0.031	0.076**
	(0.020)	(0.025)	(0.019)	(0.024)
Hospital and ancillary	0.088***	0.100***	0.103***	0.122***
	(0.017)	(0.021)	(0.017)	(0.021)
Financial management (base - no financial difficulty)				

Limited financial difficulty	-0.022**	-0.015	-0.021**	-0.016
	(0.008)	(0.009)	(0.008)	(0.009)
Financial difficulty or stress	-0.043***	-0.031*	-0.042***	-0.034**
	(0.010)	(0.012)	(0.010)	(0.012)
Concessional	-0.004	-0.010	0.000	-0.008
	(0.008)	(0.009)	(0.008)	(0.009)
GP consult in last 12 months	0.060***	0.037*	0.060***	0.045**
	(0.013)	(0.016)	(0.013)	(0.015)
Smoker	-0.030	-0.043	-0.036	-0.050*
	(0.018)	(0.023)	(0.018)	(0.024)
Dental health status (base-poor/fair)				
Good		0.011		0.011
		(0.010)		(0.010)
Very good/ excellent		0.012		0.012
		(0.012)		(0.012)
Dental health problem		-0.030***		-0.027***
		(0.008)		(0.008)
Constant	0.566***	0.593***	0.556***	0.579***
	(0.024)	(0.029)	(0.024)	(0.029)
Observations	30,208	23,304	30,443	23,490
R-squared	0.013	0.010	0.013	0.011
Number of women	6,402	6,392	6,490	6,419

Coefficient results presented in odds ratios, n/a: not applicable
Bootstrapped standard errors in parentheses *** p<0.001, ** p<0.01, * p<0.05, ^ p<0.1
Primary models have pre-CDDS surveys 3 to 5; do not include dental health variables. Secondary models have pre-CDDS survey 4 only; includes a lead variables for the dental health control variables.
Source: ALSWH data

Hausman test

This study uses a fixed effects model to limit bias by controlling for the unobserved heterogeneity contained within the model. However, it may be the case that there are minimal concerns regarding unobserved heterogeneity, in which case, a random effects model, which is a more efficient model, should be used (Wooldridge 2009). The Hausman test is useful in determining the appropriateness of the fixed effects or the random effects model (Cameron & Trivedi 2010; Gujarati & Porter 2009; Verbeek 2008). The null hypothesis for this test is that there should be no difference in the coefficients for the random effects and the fixed effects models (Cameron & Trivedi 2010; Gujarati & Porter 2009; Verbeek 2008). Based on the results of the equation (Appendix B4), the null hypothesis can be rejected in all models meaning the fixed effect model is the appropriate model for obtaining coefficients.

Limitations

Due to data limitations, this study assesses the likelihood of dental visiting in the last 12 months and does not take into account whether there was an increased number of dental visits that occurred, neither does it account for the intensity of treatment that occurred during the visits. It is possible that because of the CDDS those in the target groups may have visited the dentist more frequently (e.g., possibly twice yearly instead of yearly) while those in the non-target group may have visited only once. Further, this study cannot provide insight into the type of dental services that were received. It is possible that those in the target groups received higher cost services that were needed but were previously unaffordable.

Additional limitations are consistent with those identified in Chapter 3. The ALSWH is a women's only data set, thus these findings may not be generalisable for a male cohort. Further, as the underlying data source is self-reported data, there may be issues regarding the validity of some of the self-reported data. In particular, there may be recall error for women in regard to their self-reported dental health utilisation, although this may have affected the target and non-target groups similarly. Additionally, there may be errors related to self-reported chronic disease status. However, a previous study looking at the validation of self-reported data within the ALSWH has reported that self-reported diabetes, breast cancer, lung cancer and colorectal cancers are reported consistently with objective

medical notes (Dobson et al. 2015). Finally, while the ALSWH captures a broad range of chronic diseases it does not capture all the chronic diseases that might be considered to make women eligible for the CDDS. If these women are classified as being in the non-target groups, this may attenuate any treatment effect on the target groups.

Discussion

This study sought to identify whether during the time that the CDDS was operational there was an observable increase in the likelihood of a dental visit for the CDDS-eligible population (those with a chronic disease) as compared to those who were not eligible (those without a chronic disease). Overall, no treatment effect is observed, meaning there is no increase in dental visits for the target groups found. These results are robust to the differences in target group construction in analyses one and two, to the differences in control variables and robust to the differences in model specification as shown by the LPM and logit models. These findings are consistent with a study by (ARCPOH 2011) which undertook a cross-sectional analysis of dental utilisation and found no difference in dental visiting between those who had a chronic disease and those who did not. However, the finding of an absence of a treatment effect for any of the target groups is inconsistent with the previous research showing increasing dental insurance coverage increases utilisation and is unexpected.

The results instead show that there is a positive time trend in all models across all surveys. This implies there is an increase in the probability of a dental visit over time. Further, it shows attending a GP consultation increases the probability of a dental visit by between 4.7 to 6.8 percentage points. This may be the result of those with a dental problem seeking help from a GP for their problem (Palfreeman & Zoellner 2012) and subsequently following through on their GP's advice for a dental examination (Barnett et al. 2016). Coverage with PHI increases the probability of any dental visit by between 7 to 10.7 percentage points and this finding is consistent with previous studies (Anikeeva, Brennan & Teusner 2013; Brennan, Anikeeva & Teusner 2013; Brennan et al. 2020; Gnanamanickam & Teusner 2018; Hopkins, Kidd & Ulker 2013; Srivastava, Chen & Harris 2017; Teusner, Brennan & Spencer 2013). The presence of a dental problem increases the probability of a dental visit by between 11.8 to 12.6 percentage, which is a large amount, statistically significant. Further, those reporting good dental health status as opposed to poor/fair dental health status have

a 5.1 to 5.6 percentage point, statistically significant, increase in the probability of a dental visit and those reporting very good to excellent dental status have a 12.7 to 13.1 percentage point increase, statistically significant. This finding is consistent with prior research that finds those with poor or fair self-rated dental health are more likely to be infrequent dental users (Roberts-Thomson & Slade 2008) and that those with poorer self-rated dental health attend a dentist when they have a problem (Brennan, Anikeeva & Teusner 2013). Finally, there is some evidence to show that there are statistically significant decreases in the likelihood of a dental visit for those with financial difficulty (2.1 to 2.2 percentage points) and financial stress (4.2 to 4.3 percentage points), consistent with the financial barriers associated with dental visiting.

The fundamental purpose of health insurance is to provide financial protections for ill health and to increase health outcomes, or in this case dental health outcomes. Thus, the outcomes of two groups are of particular interest. First, those with financial difficulty would benefit should benefit from insurance cover. From this study, there is evidence those who are financially stressed are less likely to report a dental visit, consistent with experiencing financial barriers. Another group of interest are those with poorer dental health status. In this study those with poorer dental health status are less likely to have a dental visit. In contrast those with a dental problem are more likely to attend a dental visit. These results highlight the differential visiting patterns or additional needs of those with poorer dental health status. As this study has aggregated the effects for all with a chronic disease, the next chapter seeks to refine this study and explore whether there are heterogeneous effects for those who are financially vulnerable and who have poorer dental health status.

Conclusion

This study found that during the time in which the CDDS was operational there was no increase in the likelihood of a dental visit for the target groups, those with a chronic disease, as compared to the non-target groups, those without a chronic disease. This result is robust to the use of differing model assumptions across multiple non-target and target groups. As the CDDS was closed due to concerns regarding costs and its lack of appropriate outcomes, there remains a need to further understand what the program did deliver. Further research in the next chapter will seek to identify whether there was an impact on those who may be deemed in higher need of dental care.

Chapter 5 – Did the use of dental services increase by the vulnerable?

The absence of an increase in dental visiting for those in the target group in Chapter 4 was not expected. This chapter seeks to build on the study undertaken in Chapter 4 by identifying whether there were any factors in addition to the presence of a chronic disease that may have influenced patient participation in the CDDS. This chapter focuses on those who might be considered vulnerable. There are four vulnerable groups identified in this study. The first vulnerable group is defined as having poor self-rated dental health status, the second is defined as having a dental problem, the third is defined as experiencing financial hardship and the fourth, entitled the 'any vulnerability' group, is an all-encompassing group that is defined as having any of the aforementioned vulnerabilities. The method used in this study is a heterogeneity analysis. Again, no increase in the probability of a dental visit is observed for those who report being eligible and vulnerable. Given the make-up of the vulnerable groups in this study, the absence of a finding is against expectations

Research question

The absence of an increase in the probability of a dental visit for the target group in study one lead to further questions regarding the impact of the CDDS. It raises a question as to whether other subgroups may have been more likely to have benefited. It is hypothesized that although increased dental insurance coverage did not have a result in an increase in dental visiting for those in the broader target groups, it may have improved access for specific vulnerable groups. To date no studies have sought to provide insight into whether the CDDS increased dental utilisation for those who might have been considered vulnerable. The research question is:

> *Did the use of dental services increase by those who were targeted by the CDDS and who also might be considered vulnerable?*

Data and methodology

Data

The data used in this chapter is from the ALSWH. The reasons and rationale for using this data are documented in Chapter 3. The analysis in this chapter is possible due to the comprehensiveness of the ALSWH which asks multiple repeated questions on the women's dental status and financial status.

This study seeks to identify whether there was an increase in the probability of a dental visit in the last 12 months for those in any of the four vulnerable groups who were also eligible for the CDDS. To isolate the effects on those who are eligible for the CDDS and who are vulnerable and eligible a heterogeneity analysis is undertaken. The methodology employed is an extension of the DiD method. The advantage of the heterogeneity estimator is that it further refines the outcomes for a group of interest beyond that which the DiD does and can therefore provide a more convincing analysis. The heterogeneity analysis works creating variation across three dimensions: those not in a vulnerable group who were also CDDS eligible, those who were not CDDS eligible, and between the pre and post time periods covering the CDDS's introduction.

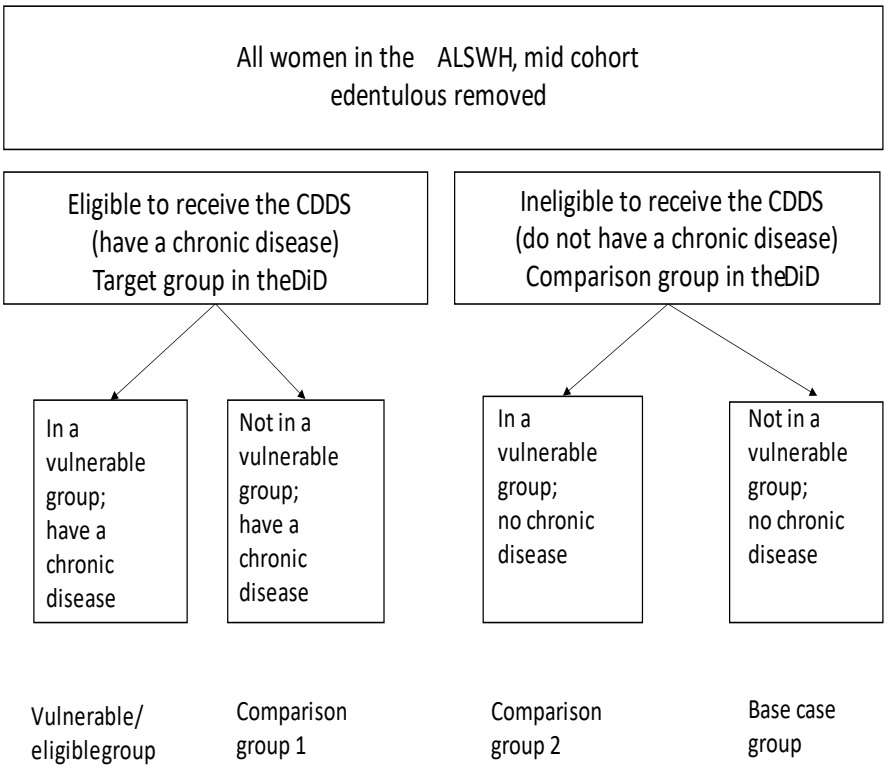
Vulnerable groups – construction

In the previous chapter the target group is those who are eligible for the CDDS (those who have a chronic disease as measured by self-report), and the non-target group is those who are not eligible for the CDDS (those who do not have a chronic disease, as measured by self-report). In this study the target and non-target groups are further divided into those who are vulnerable and those who are not (

Figure *18*). The main group of interest is the vulnerable/eligible group who are those who are CDDS eligible and who are also vulnerable. There are two comparison groups: those who are eligible for the CDDS but who are not vulnerable (Comparison 1 group); and those who are not eligible for the CDDS but who are vulnerable (Comparison 2 group). These groups are all compared to a Base case group who are neither eligible for the CDDS nor are they vulnerable. Identification of those in each vulnerable group is identified by their responses in survey 5 as this survey coincides with the commencement of the CDDS in November

2007. Those who become vulnerable during subsequent studies are removed. There are four vulnerable groups identified in the chapter. Each is discussed below.

Figure 18 - Construction of the vulnerable groups – heterogeneity analysis



Source: derived from ALSWH data

Vulnerable group - poor dental health status

The first vulnerable group identified is those with poor dental status. This vulnerable group responded that their dental health status was poor or fair in survey 5. Those who responded that their dental health status was good, very good or excellent are considered to have good dental health status. One hundred and seventeen women, or 1.8% of the sample population, who did not report their dental health status in survey 5 (missing observations)

are removed. Those who initially report good dental health status and then recorded poorer dental health status (poor or fair) in subsequent surveys (surveys 6 and 7) are also removed to isolate the effect on those whose vulnerability status coincided with the program's commencement. A total of 992 women, or 16% of the total population, who 'transitioned' into poorer dental health status are removed. Table 13 reports the number of women in each group.

Vulnerable group – dental problem

The dental problem vulnerable group is defined as those who have a dental problem at the commencement of the CDDS. This is measured by self -report. There are two ALSWH questions in survey 5 related to the presence of a dental problem: "In the last 12 months, have you had any of the following: mouth, teeth or gum problems?" and "In the last 12 months, have you had any of the following: avoided eating some foods because of problems with your teeth, mouth or dentures?" The response options for both questions are: never, rarely, sometimes, or often. Those who report a problem rarely, sometimes or often are considered to have a dental problem. Dental problem is separately identified to differentiate it from those with poor dental health status to capture all of the individuals who self-report a dental problem irrespective of their dental health status. It should be noted the correlation between poor dental health status and dental health problem is positive but mild, with the Pearson's correlation coefficient being 0.36 (significant). Around 15% of women report poor or fair dental health status also report a dental problem. One hundred and fifty-three individuals, or 2.4% of the population, who did not report a response for these questions in survey 5 (missing observations) are removed. Those who initially report no dental problem but who report a problem in subsequent surveys are also removed. There is a total of 1,460 women, or 23% of the population, who 'transitioned' into a dental problem and who are removed (Table 13).

Vulnerable group – financial hardship

The financial hardship vulnerable group is defined as those who experience financial hardship at the commencement of the CDDS. This is measured by self-report. Responses from survey 5 to the financial management question are used to identify financial difficulty or stress. The vulnerable group are those who responded: "it is impossible, it is difficult all the time, or it is difficult some of the time". One hundred and twenty-four women (1.9% of the population) who do not report a response to the financial management question in

survey 5 (missing observations) are removed from this analysis. Again, those who transitioned into financial difficulty or stress in subsequent surveys (surveys 6 or 7) are removed from the analysis. A total of 1,055 women, or 17% of the population, are removed due to transitioning into financial hardship (Table 13)

Vulnerable group – any vulnerability

The any vulnerability group is an all-encompassing group to capture those with any of the three vulnerability groups (defined above) at the commencement of the CDDS. Construction of the any vulnerability group uses the responses to the ALSWH questions previously presented in survey 5. One hundred and four individuals (or 1.6% of the population) who do not report a response to all the vulnerable variables: dental health status, dental problem or the financial management question are considered to have missing observations and are removed. Those who were not identified as being vulnerable in survey 5 but who subsequently transitioned into one of the vulnerable groups in survey 6 or 7, are removed. A total of 1,294 women, or 20% or the population, are removed who were in one of the transition groups. This leaves a total cohort of which the majority of the cohort, 3,662 (73%), are considered vulnerable. There are 2,066 women (56%) who identify with one vulnerability type; 1,145 (31%) who identify with two vulnerability types; and 451 (12%) who identify with all three vulnerability types[47]. (See Table 13 for the number of women in each group.)

Table 13 - Number of women in each vulnerability group

	Vulnerable/eligible group: CDDS eligible and vulnerable	Comp group 1: CDDS eligible and not vulnerable	Comp group 2: Not CDDS eligible and vulnerable	Base case group: Not CDDS eligible and not vulnerable
Poor dental status (n=5,297)	1,218	2,241	521	1,317
Dental problem (n=4,793)	1,346	1,762	524	1,161
Financial hardship (n=5,227)	1,596	1,820	504	1,307
Any vulnerability (n=5,008)	2,612	748	1,050	598

Source: ALSWH data

[47] Do not add to 100% due to rounding.

Comparison of groups

The vulnerable/eligible group is compared to the Base Case group using a Chi Square test of differences. The null hypothesis for this test is there is no difference between the vulnerable/eligible group and the Base case group. Overall, as may be expected given the vulnerable/eligible group is more likely to report being less socioeconomically advantaged, is more likely to report poorer health and less healthy behaviours and is more likely to report poorer dental health status. This is not unexpected considering the vulnerable/eligible group represents those who are CDDS eligible, meaning they report a chronic disease, and they also report vulnerability.

Comparison of groups – Vulnerable group: poor dental health

For the poor dental status vulnerable group analysis, those in the primary group of interest (vulnerable and eligible) are less socioeconomically advantaged than the Base Case group. Those in the vulnerable/eligible group are less likely to be married or in a de-facto relationship, are more likely to report no formal education and less likely to report a degree or higher qualification, are less likely to be employed, are very much more likely to report financial difficulty or stress, are more likely to be concessional, and are less likely to be covered with comprehensive PHI. Regarding health status and health behaviours, those in the vulnerable/ eligible group are more likely to report poor or fair health status, are more likely to report an unhealthy weight and are more likely to report nil or low exercise levels. The vulnerable/ eligible group are more likely to report dentures and a dental problem. Further discussion on the characteristics of the groups is shown in Appendix C1.

Comparison of groups – Vulnerable group: dental health problem

For the dental health problem vulnerable group analysis, those in the vulnerable/eligible group are less socioeconomically advantaged as they are less likely to report being married or in a de-facto relationship, are less likely to be employed, are more likely to report financial difficulty or stress, are more likely to be concessional and are less likely to be covered with comprehensive PHI. Regarding health status and behaviours, the vulnerable/eligible group is more likely to report poor or fair health status and is more likely to report low to nil exercise levels. In regard to dental health status, those in the vulnerable/eligible group are more likely to report dentures. Further discussion on the characteristics of the groups is shown in Appendix C1.

Comparison of groups – Vulnerable group: financial hardship

For the financial hardship group analysis, again, the vulnerable/eligible group is less socioeconomically advantaged, with those in the vulnerable/eligible group less likely to be married or in a de-facto relationship, more likely to report no formal education, less likely to be employed, more likely to be concessional and less likely to be covered with comprehensive PHI. Regarding health status and behaviours, those in the vulnerable/eligible group are more likely to report poor or fair health status, are more likely to smoke, are more likely to report an unhealthy weight range, and are more likely to report nil to low exercise levels. On two of the three dental health variables there are statistically significant differences with the vulnerable/eligible group more likely to report dentures and also more likely to report a dental problem. Further discussion on the characteristics of the groups is shown in Appendix C1.

Comparison of groups – Vulnerable group: any vulnerability

For the any vulnerability analysis, the findings are similar to the findings previous in that the vulnerable/eligible group is less socioeconomic advantaged, has poorer health status and has poorer health behaviours, and poorer dental health status based on the presence of dentures. The vulnerable/ eligible group is less likely to be married or in a de-facto relationship, more likely to report no formal education, is less likely to be employed, is more likely to report financial difficulty or stress, more likely to be concessional and is less likely to be covered with comprehensive PHI. Regarding health status, those in the vulnerable/ eligible group are more likely to report poor or fair health status, are more likely to report an unhealthy weight range and are more likely to report nil to low exercise levels. Further discussion on the characteristics of the groups is shown in Appendix C1.

Econometric model

The econometric model is estimated for each of the four vulnerable groups and is represented by:

$$Y_{itg} = \alpha_0 + \alpha_1 CDDS_i + \alpha_2 Post_t + \alpha_3 Vul_g + \beta_1 CDDS_i * Vul_g + \beta_2 CDDS_i * Post_t + \beta_3 Vul_g * Post_t + \beta_4 CDDS_i * Vul_g * Post_t + \lambda X_{it} + \vartheta time_t + \delta individual_i + \varepsilon_{itg},$$

where the dependent variable Y_{itg} is a binary variable representing the probability of a dental visit for the woman, *i*, in each vulnerable group, *g*, in the last 12 months prior to survey at time, *t*. The α_0 represents those who are not CDDS eligible, who are not in a vulnerable group in the pre-CDDS time period. The α_1 represents those who are eligible for

the CDDS. The α_2 represents the post time period, that is after the introduction of the CDDS in 2007. The α_3 represents those in each of the respective vulnerable groups. The interaction term β_1 represents those eligible for the CDDS and those in the respective vulnerable group in the pre-CDDS period[48]. The interaction term β_2 represents the interaction term for those eligible for the CDDS in the post period. Due to the presence of the vulnerable/eligible interaction term β_2 does not include those who are CDDS eligible and who are in the respective vulnerable group. Therefore, it represents Comparison 1 group. The interaction term β_3 represents those in the respective vulnerable group in the post time period. Due to the presence of the vulnerable/eligible interaction term the β_3 interaction term does not include those who are in the vulnerable group and who are CDDS eligible. Therefore, it represents Comparison 2 group. The main variable of interest is the vulnerable/eligible interaction term β_4 as this is the vulnerable/ eligible group representing (those who are eligible for the CDDS and who are vulnerable) in the post period. The ϑ term represents the time fixed effects and δ represents the individual fixed effects. A vector of individual-level control variables is represented by λ. There are two sets of control variables which are discussed below. Finally, ε represents the error term. The standard errors are clustered at the individual. The linear probability model (LPM) is the preferred model[49] in this study, with the logit model also presented.

The variable of interest, the vulnerable/eligible term, represented by the coefficient β_4, which can be expressed as the difference between the two difference-in-difference estimators. This is articulated in Equation 2 where HA represents heterogeneity analysis, vul. represents those in a vulnerable group, CDDS represents those who are CDDS eligible; and post represents the post time period.

$$HA = \hat{\beta} = [(\bar{y}_{vul, CDDS, post} - \bar{y}_{vul, CDDS, pre}) - (\bar{y}_{vul, not\ CDDS, post} - \bar{y}_{vul, not\ CDDS, pre})] - [(\bar{y}_{not\ vul, CDDS, post} - \bar{y}_{not\ vul, CDDS, pre}) - (\bar{y}_{not\ vul, not\ CDDS, post} - \bar{y}_{not\ vul, not\ CDDS, pre})]$$

[48] As this is a fixed effects model α_1 α_2 α_3 and β_1 drop out of the final result.
[49] See Chapter 4 for an explanation on why the LPM is the preferred model.

Control variables

Two models containing two sets of control variables are presented, giving rise to a primary model and a secondary model. Control variables for both models are geographic location, marital status, financial status (except for the financial hardship and any vulnerability groups; see discussion below), concessional status, PHI status, GP attendance and smoking status. The difference between the models is that in the primary model surveys 3 to 5 are used to allow for a longer pre-intervention period, while in the secondary model there is a reduced pre-intervention time frame to one period only (survey 5 only). The secondary model contains additional dental health control variables that are only available since survey 5. The control variables are tailored to each of the groups to account for the construction of the vulnerable groups. Thus, where the vulnerable group is poor dental status, the control variable dental status is omitted as it duplicates the identification strategy of the vulnerable group. Where the vulnerable group is the presence of a dental problem, the control variable dental problem is omitted. Where the vulnerability is financial hardship the control variable financial difficulty or stress is omitted. Finally, in the any vulnerability group, the financial difficulty or stress, dental status and dental problem variables are omitted. The full set of control variables for each model are summarised in Table 14.

Table 14 - Control variables used in each model

	Vulnerable group one: poor dental health status		Vulnerable group two: dental health problem		Vulnerable group three: financial difficulty or stress		Vulnerable group four: any vulnerability
Control variables	Model 5.1 primary model	Model 5.2 secondary model	Model 5.3 primary model	Model 5.4 secondary model	Model 5.5 primary model	Model 5.6 secondary model	Model 5.7 primary model
Survey periods	Surveys 3-7	Survey 5-7	Surveys 3-7	Survey 5-7	Surveys 3-7	Survey 5-7	Surveys 3-7
Geographic location	√	√	√	√	√	√	√
Marital status	√	√	√	√	√	√	√
PHI status	√	√	√	√	√	√	√
Financial management	√	√	√	√	Omit	Omit	Omit
Concessional status	√	√	√	√	√	√	√
GP attendance	√	√	√	√	√	√	√
Smoking status	√	√	√	√	√	√	√
Dental status	N/a	Omit	N/a	√	N/a	√	Omit
Dental problem	N/a	√	N/a	Omit	N/a	√	Omit

N/a means the variable is not applicable for the model. Omit means the variable is removed as a control variable in the model to account for the construction of the vulnerable group.
Source: ALSWH data

Robustness tests

Parallel trends

This study takes a guide from the triple difference methodology in regard to parallel trends. There are different identification assumptions for the triple difference method. For example, Chen et al. (2020); Hochuli (2020) note that in a triple difference methodology there is a relaxation of the parallel trends assumption. Chen et al. (2020, p. 657) also notes that in relaxing the parallel trends assumption there is a need to assume the pre-intervention trends "can be extrapolated to later time period" for those not exposed to the intervention. Gruber (1994, p. 627) notes the identification strategy is 'fairly weak', stating there should be no shock that affects the relative outcomes of the treatment group in the post intervention period. Olden & Moen (2020), however, argue the triple difference does require a parallel trend assumption in the form of the relative outcomes in those exposed to the intervention to trend the same as those not exposed to the intervention.

In this study, it is assumed that the pre-intervention trends would remain in the post intervention period in the absence of the CDDS. To assess the pre-intervention trends this study presents the adjusted trends charts (which contains both the pre-intervention trends, and the post intervention trends) for each of the groups within each study (Appendix C3). The figures presented are adjusted for control variables. In all charts there is no evidence that the parallel trends assumption is not met. Further, it is also noted that there is no shock that would affect the outcomes of each of the groups in the post intervention period. However, to assess whether there are any violations of these assumptions a placebo test is also conducted.

Placebo test

Although no significant outcome is observed, the placebo test is undertaken for each of the models for completeness. A significant variable for the any of the vulnerable/eligible coefficients implies there was a differential effect prior to the implementation of the CDDS and would nullify the results of the models presented above. No statistically significant effect on the variable of interest is observed. Thus, the assumption that there is no pre-intervention effect on the variable of interest prior to the implementation of the CDDS is validated and this provides confidence in our models' results. However, it should be noted that for model 5.2, while the vulnerable/eligible variable shows there is no statistically

significant difference in the probability of a dental visit for those in the vulnerable/eligible group, there is a statistically significant increase in the probability of a dental visit for those in the Comparison 2 group, (dental problem; not CDDS eligible) in the placebo test. This implies that those with a dental problem were more likely to receive a dental visit prior to the CDDS's commencement. (See Appendix C4.)

Hausman test

As with study one and previously identified, this study exploits the panel data from the ALSWH by using a fixed effects econometric model to reduce bias in the model as it accounts for unobserved time-invariant heterogeneity. However, as identified in Chapter 4, the Hausman test is used to test that the individual effects are not correlated with the error term instead they are random. For all models used in this study we can reject the null hypothesis that the random effects model should be used. Our assumption that the fixed effects model is appropriate is upheld. The results of the Hausman test for each model is in Appendix C5.

Limitations

The limitations to this study are similar to those in Chapter 4. Briefly, these include the dichotomous nature of the dependent variable means that the outcome variable is limited to a dental visit in the last 12 months, so it does not capture any increase in the intensity of dental visiting and that the type of dental service received is not available. Further, there is no way to control for compliance of the program. Additionally, the nature of the data limits its generalisability to men. Finally, there may be recall error as this data is self-reported data.

Limitations specific to this study include that this study does not capture those who transition into chronic disease while the CDDS was operational. Although as was shown in previously including those who become chronic disease positive did not affect the outcome.

There are limitations in relation to the construction of those in the vulnerable groups. In this study only those who identified as having poor dental health status, a dental problem or financial difficulty or stress in survey 5 were included in the vulnerable groups. The rationale for limiting the vulnerable group construction to those vulnerable in survey 5 is that survey 5 aligns closely with the commencement of the CDDS thus those who are vulnerable in the immediate period prior to the CDDS's commencement and for whom the program may be

targeted toward are captured. For clarity, those who transition into vulnerability in surveys 6 or 7 are not included in the vulnerable group, rather they are removed from this study, thus any effect from this group is not captured. One further limitation might have been that including those who identified as vulnerable in survey 5 and who saw an improvement in their vulnerability status in surveys 6 or 7 (because their dental health or financial situation improved) might have impacted the results[50]. However, further analysis removing these groups generally found limited impact in all models.

A further limitation relates to the inability to disentangle the endogeneity between dental visiting and dental health status and/ or the presence of a dental problem. This is because some individuals may experience good dental health status or an absence of a dental problem as a result of their dental visit. Depending on how the individual answered these questions it could be that those who should have been considered vulnerable are misclassified as not vulnerable. One potential solution to this problem is to use a lagged dental health status or dental health problem variable. However, this is not possible due to the limitations of the data as the dental health status and dental problem variables are not available prior to survey 5. The effect of this misclassification may lead to an underestimate of the CDDS impact.

Discussion

This study builds on the previous empirical study (in chapter 4), which found no increase in the probability of a dental visit for those who were eligible for the CDDS. Those results raised questions as to whether there may have been a differential effect for those who were vulnerable and eligible. Four vulnerable groups are used in this study: those who report poor dental status, those who report a dental problem, those with financial hardship and those who report any of these three vulnerabilities. A heterogeneity analysis methodology was used to determine whether there is an increase in the probability of a dental visit for

[50] For vulnerability group one, those with poor dental status, there are 721 individuals, or 14% of the population, who report an improvement in their dental status.
For vulnerable group two, those with a dental problem, there are 798 individuals, or 17% of the population, who report an improvement in their dental health problem.
For vulnerability group three, those with financial difficulty or stress, there are 872 individuals, or 17% of the population, who report an improvement in their financial situation.
For vulnerability group four, those who report any vulnerability, there are 1,012 individuals, or 20% of the population, who report an improvement in their any vulnerability status.

those who are CDDS eligible and who also report vulnerability compared to those who are not CDDS eligible, do not report a vulnerability and in the pre CDDS period. Overall, no increase in dental visit is observed for any of the models suggesting there was no differential change in dental visiting for those who were eligible and reported some vulnerability.

For those who report poor dental status (models 5.1 and 5.2) the absence of a significant result aligns with the findings in Chapter 4 in which it was observed that those with better self-rated dental health status had a statistically significant increase in the probability of a dental visit as compared to those who with poorer dental status. It also aligns with prior research that finds individuals with poor self-rated dental health are more likely to be infrequent dental users (Roberts-Thomson & Slade 2008; Torppa-Saarinen et al. 2019) suggesting it is dental treatment that improves dental health status (Gnanamanickam & Teusner 2018).

For those who report a dental problem (models 5.3 and 5.4) the absence of a result is unexpected. This is because a large statistically significant increase in the probability of a dental visit for those with a dental problem was observed in Chapter 4. Further, the literature shows that individuals are more likely to visit the dentist when they have a dental problem (Brennan, Anikeeva & Teusner 2013; Teusner, Brennan & Spencer 2013). In model 5.4 a statistically significant decrease in the probability of a dental visit is observed in the post period for Comparison 2 group, those with a dental problem and not CDDS eligible, which may be suggestive of this group missing out or falling behind their peers in the time period following the CDDS's implementation.

Financial barriers to dental services are well documented (ABS 2017; Roberts-Thomson & Slade 2008). Therefore, those who are CDDS eligible and report financial difficulty or stress should have been in a strong position to benefit from the CDDS. However, again, the results (models 5.5 and 5.6) find no increase in the probability of a dental visit in the last 12 months for those in the vulnerable/eligible group. Previous research shows dental utilisation increases with insurance coverage mostly for those in lower income groups (Anikeeva, Brennan & Teusner 2013). A possible explanation for the absence of an effect in this study may be that nearly half of the vulnerable/eligible group report concessional status (46%). This could reduce the propensity for this group to use private dentists, which was the mode of administering the CDDS. The concessional group are more likely to qualify for state public

funded services and thus may be more incline to seek care through the public system. Although, it is noted that the median reported waiting times for general dental services in the public system can be significant, with reports that across Australia in 2013-14 waiting times can range from 105 days in South Australia to 568 in Tasmania (AIHW 2018b).

Where vulnerability is defined as any one of the three previously mentioned vulnerabilities, the results (model 5.7) again also show no increase in the probability of a dental visit for those in the vulnerable/eligible group. This result is opposed to other studies, which showed a degree of pent up demand was met following the introduction of health insurance (Lyu, Shane & Wehby 2020; Manning et al. 1985; Sevilla-Dedieu, Billaudeau & Paraponaris 2020; Singhal, Damiano & Sabik 2017).

These vulnerability groups were chosen due to their propensity to need dental insurance either because of their dental health status or their financial vulnerability may reduce their financial ability to purchase insurance themselves. For those with poorer dental health status and a dental problem the absence of a finding is inconsistent with the aim of the CDDS, which was to provide subsidised dental services to increase dental utilisation for those who are in need. As Weerakoon, Fitzgerald & Porter (2014) reported, GPs felt pressured by patients and dentists to refer people onto the CDDS. This suggests that as opposed to encouraging non-attenders to attend the dentist, those who did already attended the dentist may have been more likely to use the CDDS. Another possible explanation for the absence of a result could be that dentists were able to charge additional out-of-pocket costs for CDDS services. Thus, it is possible that there still may have been a financial barrier (real or perceived) for patients who are in need.

Across the models presented here it has been found there is a statistically significant, positive time trend across all surveys indicating that the probability of a dental visit increases for the whole cohort. Further, attending a GP consultation reports a large and statistically significant increase in the probability of a dental visit across most models. This aligns with Chapter 4, which also showed a statistically significant increase in the probability of a dental visit for those who attended the GP. Additionally, as was the case in Chapter 4, those with relatively better dental health status reported a large statistically significant increase in the probability of a dental visit. So too does the presence of a dental problem, which shows a large and statistically significant increase in the probability of a dental visit.

Conversely, increasing financial difficulty and stress is found to show a statistically significant decrease in the probability of a dental visit. Comprehensive PHI is found to increase the likelihood of a dental visit in all models, although the effect from ancillary PHI coverage is more limited. The persistence of comprehensive PHI as a driver of the probability of a dental utilisation is an important finding. This is because it is unclear whether the CDDS may have provided a duplication of insurance for those who may have already been covered by PHI. How the CDDS may have interacted with PHI is unclear. This is to be explored in the next chapter.

Conclusion

This study sought to provide insight into the impact of the CDDS for those who were both eligible and who were vulnerable. In this study no increase in the probability of at least one dental visit is found for any of the vulnerable/eligible groups for any of the four vulnerable groups. Consistent with Chapter 4, those with PHI coverage have an increase in the probability of a dental visit as compared to those not covered with PHI. Considering the persistent impact of PHI coverage on the probability of a dental visit further research is needed to identify whether there was an impact on those who were not covered with PHI at the time the CCDS was introduced.

Chapter 6 – Did the use of dental services increase by the uninsured?

The previous two chapters found there was no increase in the probability of a dental visit for the main variables of interests. However, a consistent finding was that those covered with comprehensive PHI had a statistically significant increase in the probability of a dental visit as compared to those who are not covered. Over 50% of the Australian population are covered with ancillary PHI, which covers allied health service including dental (APRA 2022). While in 2021 insurance companies paid the majority of their ancillary benefits to cover dental services (APRA 2022), the cost to the individual for dental visiting can still be high. The majority of people who visited a dentist report that the cost of the dental visit was shared between themselves and the PHI company, with few reporting that PHI covered all of their expenses (AIHW 2021)[51].

The study presented in this Chapter seeks to understand whether there was an increase in the use of dental services by those not covered by ancillary PHI, that is those who are uninsured. There are two analyses undertaken. In the first dental utilisation is compared using a DiD methodology for those who are uninsured (do not have ancillary PHI coverage) as compared to those who are insured (covered by ancillary PHI). In the second analysis the uninsured group is further refined and the impact on those who are not insured but who also report poor dental health status is assessed using a heterogeneity analysis methodology. Again, no increase in the probability of a dental visit is observed.

Research questions

The research question for Analysis one is:

- *Did the use of dental services increase for those who were uninsured (not covered by ancillary PHI)?*

In Analysis two the research question is expanded to identify whether there was a differential impact on those who were previously uninsured through ancillary PHI and who report poorer dental health status. The rationale for choosing to focus on those with poor self-rated dental status is that this group is clearly in need of dental treatment.

- *Did the use of dental services increase for those who were uninsured and who reported poor dental health status?*

[51] See discussion in Chapter 1.

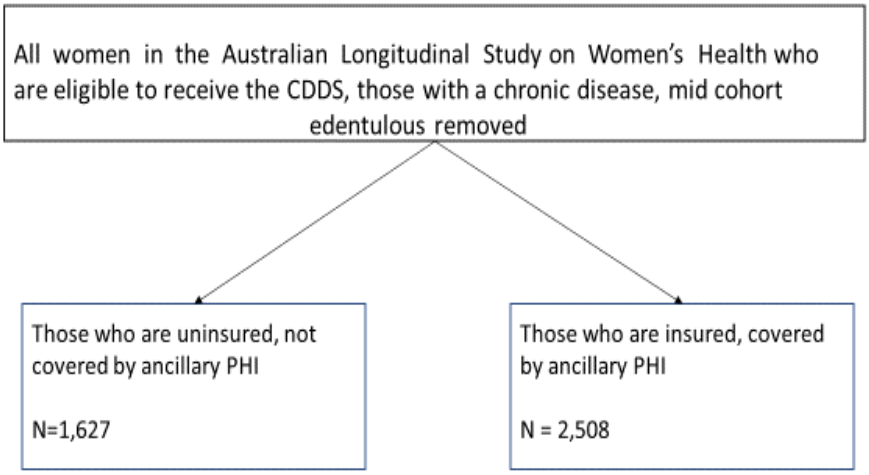
Data

This study also uses data from the ALSWH, surveys 3 to 7. In contrast to previous chapters only those who are eligible for the CDDS (that is they self-reported a chronic disease) are included in the study. Those who do not self-report as having a chronic disease, and are therefore ineligible for the CDDS, are removed. Identification of those with a chronic disease is described in Chapter 3.

Analysis 1: Insured and uninsured group construction

The sample is categorised into those who are covered by ancillary PHI and those who are not, using responses from survey 5 as it is the survey immediately preceding the introduction of the CDDS. Identification of those with ancillary coverage is discussed in Chapter 3PHI insurance status. There are 97 individuals, or 2.3% of the population, who did not report their ancillary PHI status and are removed from the analysis. Those who initially reported they were covered with ancillary PHI but who subsequently (in surveys 6 and 7) 'transitioned' into uninsured status, a total of 3.8% of the population, were also removed. Their removal is to account for any possible 'crowding out effect' from the introduction of the CDDS where the public insurance program is a substitute for privately purchased PHI (Lo Sasso & Buchmueller 2004). As shown in Figure 19, there are 3,982 women within the cohort. Of this group, there are 1,627 in the uninsured group and 2,355 in the insured group. As previously, edentulous women are removed.

Figure 19 - Construction of the PHI groups, Analysis 1



Source: derived from ALSWH data

Comparison of uninsured and insured group

As with previous studies, the insured and uninsured groups are compared using a Chi Square test of differences. Overall, those in the uninsured group are less socioeconomically advantaged and report poorer health and worse health behaviours, such as smoking, and less exercise compared to the insured group. Importantly for dental utilisation, those in the uninsured group report poorer self-rated dental health status, are more likely to report a dental problem and are more likely to report dentures. The effect of these differences means those in the target group may be less likely to attend the dentist or they may be more likely to attend to their dental problem. A comprehensive discussion is in the Appendix D1.

Econometric model

In this analysis a DiD is undertaken. The econometric model is shown in the equation below:

$$Y_{it} = \alpha_0 + \alpha_1 \text{uninsured}_i + \alpha_2 \text{Post}_t + \beta_1 \text{uninsured}_i * \text{Post}_t + \boldsymbol{\lambda X_{it}} + \vartheta \text{time}_t + \delta \text{individual}_i + \varepsilon_{it},$$

where the dependent variable Y_{it} is a binary variable representing the probability of a dental visit for each woman, *i*, in the 12 months prior to completing the survey at time, *t*. The α_0 represents those who are insured with ancillary PHI in the pre-CDDS period. The α_1 represents those who are uninsured. The α_2 represents the post time period. As this is a DiD there is one interaction term: β_1 is the coefficient of interest and is the interaction term representing the post CDDS time period for those in the uninsured group. The λ represents a vector of individual-level control variables. As with the previous studies there are two models, a primary model and a secondary model. The primary model control variables are geographic location, marital status, financial stress, concessional status, GP attendance and smoking status. In the primary model the pre-intervention time periods are surveys 3 to 5. The secondary model contains the same control variables as well as dental health control variables: dental health status and a dental problem variable. As the dental health control variables are not available until survey 5 the secondary model has a reduced pre-intervention time period. In this secondary model, survey 5 is the only pre-intervention time period. Table 16 provides a list of control variables for both the primary and secondary models. As panel data allows for fixed effects to allow for unobserved time invariant heterogeneity to be accounted for, ϑ represents the time fixed effects and δ the individual

fixed effects. Finally, Ɛ represents the error term. Due to the use of panel data the standard errors are clustered to the individual.

Table 15 - Control variables for the primary and secondary models

Control variables	Primary model Model 6.1/6.3	Secondary model Model 6.2/6.4
Survey periods	Surveys 3-7	Surveys 5-7
Geographic location	√	√
Marital status	√	√
Financial management s	√	√
Concessional status	√	√
GP attendance	√	√
Smoking status	√	√
Dental status	N/a	√
Dental problem	N/a	√

Source: ALSWH data

Table 17 – LPM and logit models results for difference-in-difference, uninsured analysis

Dependent variable = dental consultation in last 12 months	Model 6.1 (Primary model)		Model 6.2 (Secondary model)	
	LPM	Logit (ORs)	LPM	Logit (ORs)
Survey (base – Survey 3)				
Survey 4	0.014	1.095		
	(0.009)	(0.068)		
Survey 5	0.033***	1.254***		
	(0.009)	(0.080)		
Survey 6	0.058***	1.605***	0.023*	1.251**
	(0.010)	(0.133)	(0.010)	(0.105)
Survey 7	0.071***	1.759***	0.031**	1.299**
	(0.010)	(0.150)	(0.010)	(0.114)
β1 Uninsured group (Uninsured and Post CDDS period)	0.017	0.965	0.022	1.058
	(0.012)	(0.083)	(0.016)	(0.117)
Geographical location ARIA (base - major city)				
Inner regional	-0.011	0.919	-0.010	0.973
	(0.017)	(0.104)	(0.026)	(0.206)
Outer regional, rural, remote	-0.047^	0.728*	-0.048	0.783
	(0.024)	(0.113)	(0.040)	(0.214)
Married	-0.020	0.896	0.001	1.063
	(0.017)	(0.099)	(0.028)	(0.20)
Financial management (base - no financial difficulty)				
Limited financial difficulty	-0.025*	0.817*	-0.032*	0.716**
	(0.010)	(0.066)	(0.014)	(0.092)
Financial difficulty or stress	-0.038**	0.754**	-0.038*	0.678*
	(0.013)	(0.072)	(0.018)	(0.104)
Concessional	-0.004	0.979	-0.007	0.949
	(0.010)	(0.065)	(0.013)	(0.097)
GP consult in last 12 months	0.088***	1.719**	0.073^	1.773^
	(0.024)	(0.276)	(0.039)	(0.542)

Smoker	-0.024	0.863	-0.031	0.852
	(0.022)	(0.121)	(0.037)	(0.219)
Dental health status (base-poor/fair)				
Good			0.063***	1.519***
			(0.015)	(0.154)
Very good/ excellent			0.144***	2.872***
			(0.018)	(0.404)
Dental problem			0.122***	2.472***
			(0.011)	(0.228)
Constant	0.624***		0.551***	
	(0.031)		(0.050)	
Observations	18,856	10,593	11,377	4,389
R-squared	0.011		0.028	
Number of individuals	3,981	2,225	3,972	1,511
Robust standard errors in parentheses *** p<0.001, ** p<0.01, * p<0.05, ^ p<0.1; Logit model has bootstrapped standard errors				
LPM robust standard errors in parentheses n/a: not applicable For logit model bootstrapped standard errors in parentheses *** p<0.001, ** p<0.01, * p<0.05, ^ p<0.1 Primary models have pre-CDDS surveys 3 to 5; do not include dental health variables. Secondary models have pre-CDDS survey 5 only; includes the dental health control variables. Source: ALSWH data				

Results

The results from the LPM are presented as the main results with the logit model presented in odds ratios presented for completeness (Table 17). For this analysis, statistical significance is considered at the conventional 5 percent level although significance at the 10 percent level is also noted where relevant. The logit model results reiterate the findings of the LPM in terms of direction and statistical significance. This implies the results are not sensitive to the assumptions of statistical model selection.

For model 6.1, across surveys 3 to 7, 1,494 individuals report a consistent dental visiting pattern. For model 6.2, across surveys 5 to 7, 2,249 individuals report a consistent dental visiting pattern. In both models there is no statistically significant increase in the probability of a dental visit for the uninsured group (β_1) as compared to those who are insured by ancillary PHI in the pre-intervention period. Rather, there is a positive time trend for both groups.

For those who have a GP consultation in the last 12 months, as compared to those who do not, there is a statistically significant increase in the probability of a dental visit for model 6.1 and for model 6.2 this is weakly significant. For model 6.2, as compared to the base of poor or fair dental health status, those with good dental health status have a 6.3 percentage point increase in the probability of a probability of a dental visit. Those with very good to excellent dental health status have a 14.4 percentage point increase in the probability of a dental visit. Those with a dental problem have a 12.2 percentage point increase in the probability of a dental visit.

For those who reside in an outer regional, rural or remote area as compared to those in a major city there is a 4.7 percentage point decrease in the probability of a dental visit ($p=0.05$) in model 6.1 only. Increasing financial difficulty and stress results in a decrease in the probability of a dental visit for both models. As compared to no financial difficulty or stress, those experiencing some financial difficulty have a 2.5 to 3.8 percentage point decrease in the probability of a dental visit. As compared to no financial difficulty or stress those experiencing financial stress have a 3.8 percentage point decrease in the probability of a dental visit in both models.

Table 16 – LPM and logit models results for difference-in-difference, uninsured analysis

Dependent variable = dental consultation in last 12 months	Model 6.1 (Primary model)		Model 6.2 (Secondary model)	
	LPM	Logit (ORs)	LPM	Logit (ORs)
Survey (base – Survey 3)				
Survey 4	0.014	1.095		
	(0.009)	(0.068)		
Survey 5	0.033***	1.254***		
	(0.009)	(0.080)		
Survey 6	0.058***	1.605***	0.023*	1.251**
	(0.010)	(0.133)	(0.010)	(0.105)
Survey 7	0.071***	1.759***	0.031**	1.299**
	(0.010)	(0.150)	(0.010)	(0.114)
β_1 Uninsured group (Uninsured and Post CDDS period)	0.017	0.965	0.022	1.058
	(0.012)	(0.083)	(0.016)	(0.117)
Geographical location ARIA (base - major city)				
Inner regional	-0.011	0.919	-0.010	0.973
	(0.017)	(0.104)	(0.026)	(0.206)
Outer regional, rural, remote	-0.047^	0.728*	-0.048	0.783
	(0.024)	(0.113)	(0.040)	(0.214)
Married	-0.020	0.896	0.001	1.063
	(0.017)	(0.099)	(0.028)	(0.20)
Financial management (base - no financial difficulty)				
Limited financial difficulty	-0.025*	0.817*	-0.032*	0.716**
	(0.010)	(0.066)	(0.014)	(0.092)
Financial difficulty or stress	-0.038**	0.754**	-0.038*	0.678*
	(0.013)	(0.072)	(0.018)	(0.104)
Concessional	-0.004	0.979	-0.007	0.949
	(0.010)	(0.065)	(0.013)	(0.097)
GP consult in last 12 months	0.088***	1.719**	0.073^	1.773^
	(0.024)	(0.276)	(0.039)	(0.542)
Smoker	-0.024	0.863	-0.031	0.852
	(0.022)	(0.121)	(0.037)	(0.219)

Dental health status (base-poor/fair)				
Good			0.063***	1.519***
			(0.015)	(0.154)
Very good/ excellent			0.144***	2.872***
			(0.018)	(0.404)
Dental problem			0.122***	2.472***
			(0.011)	(0.228)
Constant	0.624***		0.551***	
	(0.031)		(0.050)	
Observations	18,856	10,593	11,377	4,389
R-squared	0.011		0.028	
Number of individuals	3,981	2,225	3,972	1,511
Robust standard errors in parentheses *** p<0.001, ** p<0.01, * p<0.05, ^ p<0.1; Logit model has bootstrapped standard errors				
LPM robust standard errors in parentheses n/a: not applicable For logit model bootstrapped standard errors in parentheses *** p<0.001, ** p<0.01, * p<0.05, ^ p<0.1 Primary models have pre-CDDS surveys 3 to 5; do not include dental health variables. Secondary models have pre-CDDS survey 5 only; includes the dental health control variables. Source: ALSWH data				

Robustness tests

Parallel trends

The DiD assumption of parallel trends is assessed visually for both the primary model and the secondary model. The figures are adjusted for the control variables and are presented in the Appendix D2. For the primary model a consistent trend in the pre-intervention in surveys 3 to 5, between the insured and uninsured groups is observed. For the secondary model, there is only one pre-intervention period, thus the parallel trends in the pre-intervention period cannot be shown.

Placebo test

Although the analysis did not find a significant result, placebo tests were undertaken for both models for completeness. The results of the placebo test are reported in Appendix D3. There is no statistically significant increase in the probability of a dental visit for the main variable of interest, β_1, the uninsured group in the post-CDDS period in both models. This outcome supports the assumption that there was no differential impact for the variable of interest prior to the introduction of the CDDS.

Hausman test

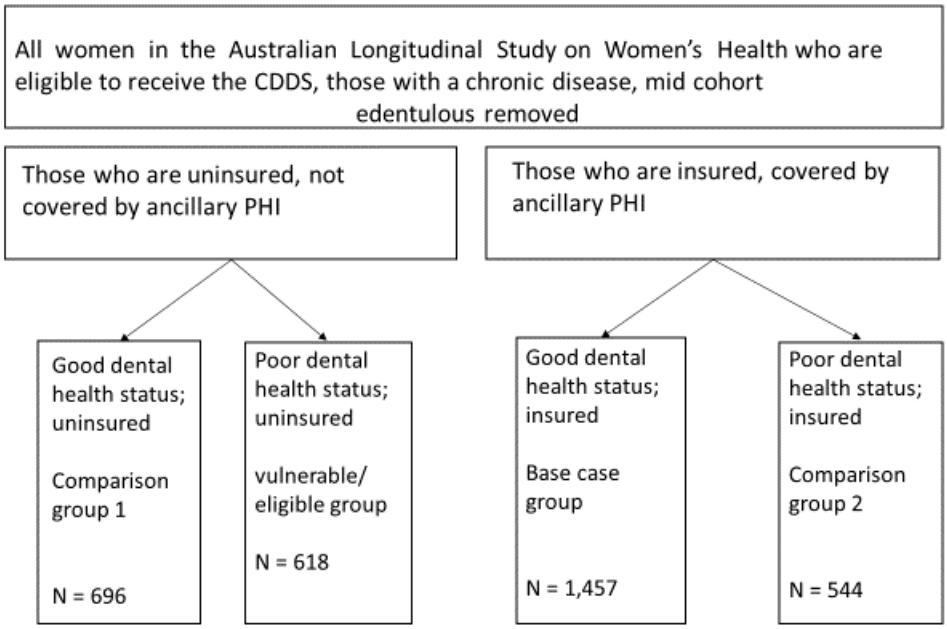
The Hausman test determines whether the random effects or the fixed effects model is more suitable. The results for both models are reported in Appendix D4. In both cases the null hypothesis that the individual effects are not correlated with the error term can be rejected and the assumption that the fixed effects model is suitable in this study is upheld.

Analysis 2: Heterogeneity analysis : assessing the impact on uninsured with poor dental health

Analysis 2 is an extension of Analysis 1 but uses a heterogeneity analysis to determine the impact on those who are uninsured and who also have poor dental health status. The cohort from Analysis 1 is further divided into two dental health groups: those with poor dental health status and those witht good dental health status (Figure 20). Briefly, as this is describe more fully in Chapter 3, those who self-report their dental status as poor/fair in survey 5 are considered to have poor dental status and those who report their dental status as good, very good/ excellent are considered to have good dental status. There are nine women (0.2% of the population) who did not self-report a dental health status observation in survey 5 and they are removed from the sample. There are also 658 women (17% of the

population) who transition from having good DHS in survey 5 to poor DHS in subsequent studies who are removed. Edentulous women are removed.

Figure 20 – Construction of the PHI heterogeneity analysis groups, Analysis 2



Source: derived from ALSWH data

Comparison of groups

Consistent with previous studies the uninsured/ poor dental health vulnerable/eligible group is compared to the comparison groups and the base case group with a Chi Square test of differences. Statistically significant differences between the vulnerable/eligible group and the other three groups find those in the vulnerable/eligible group are less socioeconomically advantaged, have poorer health status and have poorer health behaviours and are more likely to report dentures. These differences may mean those in the vulnerable/eligible group may be less likely to attend the dentist in comparison to the other groups. These differences are discussed in the Appendix D5.

Econometric model

The econometric model for analysis two is represented by the following equation:

$$Y_{itg} = \alpha_0 + \alpha_1 \text{uninsured}_i + \alpha_2 \text{Post}_t + \alpha_3 \text{Poor DHS}_g + \beta_1 \text{ uninsured}_i * \text{PoorDHS}_g + \beta_2 \text{ uninsured}_i * \text{Post}_t + \beta_3 \text{ PoorDHS}_g * \text{Post}_t + \beta_4 \text{ uninsured}_i * \text{PoorDHS}_g * \text{Post}_t + \lambda X_{it} + \vartheta \text{ time}_t + \delta \text{ individual}_i + \varepsilon_{itg},$$

where the dependent variable Y_{itg} is a binary variable representing the probability of a dental visit in the last 12 months prior to survey t. Uninsured represents those who are not covered by ancillary PHI. Post represents the post CDDS time period. PoorDHS represents those who report poor dental health status. There are four interaction terms for this equation in total. The β_1 term represents those who are uninsured and with poor dental health status in the pre-CDDS period[52]. The β_2 term represents the interaction term for those who are uninsured in the post CDDS period. Due to the presence of the vulnerable/eligible interaction term β_2 does not include those who report poor dental health status. Therefore, it represents Comparison 1 group. The β_3 term represents those who report poor dental health status in the post time period. Due to the presence of the vulnerable/eligible term the β_3 interaction term does not include those who are uninsured. Therefore, it represents Comparison 2 group. The main variable of interest is the vulnerable/eligible interaction term, β_4, as this is the interaction term for those who are uninsured with poor dental health status, the vulnerable/eligible group, and in the post CDDS period. The ϑ term represents the time fixed effects and δ represents the individual fixed effects. A vector of individual-level control variables is represented by λ. As with previous chapters there are two sets of control variables for this econometric model (see Table 16). The dependent variable, the probability of a dental visit is a binary dependent variable and consistent with the previous two studies the linear probability model (LPM) is the preferred model although the logit model is presented for completeness. The standard errors are clustered at the individual level.

Results

The results for the heterogeneity analysis for both the LPM and the logit models for those who are uninsured with PHI and who report poor dental health status are presented in Table 18. Statistical significance is reported at conventional levels with weakly significant variables, those significant at the 10% level, also reported.

For model 6.3, 1,272 women report a consistent pattern of dental visiting across surveys 3 to 7. For model 6.4, 1,903 women report a consistent pattern of dental visiting across surveys 5 to 7. For model 6.3 there is no increase in the probability of a dental visit for those

[52] As this is a fixed effects model α_1 α_2 α_3 and β_1 drop out of the final result.

in the vulnerable/eligible group as compared to the base case group. For model 6.4, there is an increase in the probability of a dental visit for those in the vulnerable/eligible group, those who are uninsured with poor dental health status in the post period, as compared to the Base case group, those who are covered with ancillary PHI with good dental health status, in the pre-CDDS period. However, this result is not consistent with the results of the logit model, which does not find a statistically significant variable. The absence of a consistent finding with the logit model may mean the result is sensitive to model specification or it may be that the results of the LPM are based on a larger sample while the results of the logit model are based on fewer individuals and fewer observations as the logit model omits observations where there is insufficient variation in the dependent variable.

For both models, there is no statistically significant difference in the probability of a dental visit for those in Comparison group 1, who are those who are uninsured with good dental health status as compared to the Base case group. Further there is no statistically significant difference in the probability of a dental visit for those in Comparison group 2, who are those who are insured with PHI but who report good dental health status as compared to the Base case group. Post estimation tests show there are no statistically significant differences between the vulnerable/eligible, group coefficient and: (i) the Comparison 1 (uninsured/good dental health) group coefficient[53]; (ii) the Comparison 2 group[54] (insured/good dental health).

Both models find there is a positive time trend when compared to the base survey years. In model 6.4 only surveys 5, 6 and 7 find a statistically significant increase in the probability of a dental visit as compared to the base survey year of survey 3. For model 6.4 survey, there is a weakly significant increase in the probability of a dental visit in survey 7 as compared to survey five. These mixed results suggest ceteris paribus, there is no strongly observed positive time trend for all of these groups when taking into account other variables. In

[53] In model 6.3, there is no statistical difference between the vulnerable/eligible group coefficient and the coefficient for Comparison 1 group (Post estimation test: $F(_{1,\ 3313}) = 0.22$; $p = 0.6397$). In model 6.5, there is no statistical difference between the vulnerable/eligible group coefficient and the coefficient for Comparison 1 group (Post estimation test: ($F(_{1,\ 3307}) = 2.11$; $p = 0.1462$).

[54] In model 6.3, there is no statistically significant difference between the vulnerable/eligible group coefficient and the coefficient for the Comparison 2 group (Post estimation test: $F(_{1,\ 3313}) = 0.42$; $p = 0.5172$). In model 6.4, there is no statistically significant difference between the vulnerable/eligible group coefficient and the coefficient for the Comparison 2 group (Post estimation test: $F(_{1,\ 3307}) = 0.96$; $p = 0.3275$).

model 6.3, for those who attended a GP consult in the last 12 months there is an increase in the probability of a dental visit; however, GP consult is not significant in model 6.5. For model 6.4, there is a statistically significant 10.2 percentage point increase in the probability of a dental visit for those who have dental health problem as compared those without a problem.

There are multiple variables that result in a statistically significant decrease in the probability of a dental visit. Women who are married as compared to those who are not, have a 3.8 percentage point decrease in the probability of a dental visit in model 6.4. In both models, as compared to those with no financial difficulty or stress, those experiencing some financial difficulty have a 2 to 3.6 percentage point decrease in the probability of a dental visit and those experiencing financial stress have a 3.2 to 4 percentage point decrease in the probability of a dental visit in all models.

Table 17 –LPM and logit model results for the heterogeneity analysis (poor dental status, uninsured)

Dependent variable = dental consultation in last 12 months	Model 6.3 (primary model)		Model 6.4 (secondary model)	
	LPM	Logit (OR)	LPM	Logit (OR)
Survey (base - survey 3)				
Survey 4	0.011	1.072		
	(0.010)	(0.071)		
Survey 5	0.031**	1.239**	Base	Base
	(0.010)	(0.082)		
Survey 6	0.055***	1.593***	0.018	1.200
	(0.012)	(0.153)	(0.012)	(0.137)
Survey 7	0.060***	1.653***	0.021^	1.218^
	(0.012)	(0.166)	(0.013)	(0.140)
β_2 Comparison 1 group (uninsured; good dental health status, post period)	0.012	0.956	-0.004	0.911
	(0.016)	(0.114)	(0.021)	(0.156)
β_3 Comparison 2 group (insured; poor dental health status; post period)	0.004	0.993	0.019	1.177
	(0.017)	(0.145)	(0.022)	(0.224)
β_4 vulnerable/eligible (uninsured; poor dental health status; post period)	0.030	1.161	0.070*	1.399
	(0.028)	(0.223)	(0.036)	(0.375)
Geographical location ARIA (base – major city)				
Inner regional	0.004	1.025	0.009	1.095
	(0.018)	(0.134)	(0.029)	(0.268)
Outer regional, rural & remote	-0.028	0.821	-0.042	0.794
	(0.026)	(0.145)	(0.043)	(0.235)
Married	-0.038*	0.792^	-0.023	0.860
	(0.018)	(0.098)	(0.031)	(0.170)
Financial management (base - no financial difficulty)				
Limited financial difficulty	-0.020^	0.847^	-0.036*	0.704*
	(0.011)	(0.072)	(0.015)	(0.102)

Financial difficulty or stress	-0.032*	0.783*	-0.040*	0.688*
	(0.014)	(0.079)	(0.019)	(0.114)
Concessional	0.007	1.057	0.005	1.047
	(0.010)	(0.081)	(0.014)	(0.115)
GP consult in last 12 months	0.093***	1.788***	0.067	1.706^
	(0.026)	(0.298)	(0.042)	(0.527)
Smoker	-0.033	0.821	-0.065	0.647
	(0.025)	(0.129)	(0.042)	(0.173)
Dental problem			0.102***	2.240***
			(0.013)	(0.232)
Constant	0.625***		0.649***	
	(0.033)		(0.053)	
Observations	15,688	8,628	9,478	3,549
R-squared	0.012		0.021	
Number of individuals	3,314	1,813	3,308	1,220
Robust standard errors in parentheses *** p<0.001, ** p<0.01, * p<0.05, ^ p<0.1; Logit model has bootstrapped standard errors				
n/a: not applicable LPM robust standard errors in parentheses For logit model, coefficient results presented in odds ratios, Bootstrapped standard errors in parentheses. *** p<0.001, ** p<0.01, * p<0.05, ^ p<0.1 Primary models have pre-CDDS surveys 3 to 5; do not include dental health variables. Secondary models have pre-CDDS survey 5 only; includes the dental health control variables. Source: derived from ALSWH data				

Robustness tests

Parallel trends

The parallel trends chart is presented in the Appendix D6246. The parallel trends charts show that in the pre-intervention period, surveys 3 to 5 in model 6.3 there is a consistent trend between all four groups. This chart visually supports the assumption of no differential trends in dental visits prior to the implementation of the CDDS. As there is only one pre-intervention period in model 6.4, the parallel chart cannot be shown, but the trends chart is presented.

Placebo test

The results of the placebo test for model 6.3 are presented for completeness but are more relevant for model 6.4 due to the statistically significant finding for the vulnerable/eligible group. The results of the placebo test show there is no statistically significant increase in the probability of a dental visit for the main variable of interest, the uninsured/ poor dental status vulnerable/eligible group, nor is there any increase in the probability of a dental visit for the comparison groups. The absence of a statistical result in the placebo test means the assumption of no effect prior to the introduction of the CDDS is upheld and the results of our analysis are supported. The full analysis is at the Appendix D7.

Hausman test

The Hausman test to determine fixed or random effects is presented in Appendix D8. The results of the Hausman tests for all models show that the assumptions supporting the use of the fixed effects model are met. This means the fixed effects model is most suitable.

Limitations

The limitations to this study remain consistent with those previously reported in studies one and two. These include the limitations associated with the outcome variable, a dental visit. As the outcome variable is dichotomous it cannot account for an increase in the number of dental visits which may have occurred for those who are eligible for the CDDS. Nor does this study provide insight into whether previously unaffordable treatments became more accessible to those who were eligible. The issue of compliance remains a possible limitation with this study. As discussed in Chapter 4, it is possible that those who were not eligible for the CDDS might have received a CDDS item due to claims the eligibility criteria were poorly defined and as GPs reportedly felt pressured to provide referrals. Other limitations that remain in this study include questions related to generalisability as this dataset is focused on

women only. Further, there may be recall bias related to the presence of a chronic disease, dental visit and GP visit as these variables rely on self-reported data.

As with Chapter 5 this study does not capture those who transitioned into vulnerable status or who become uninsured and in surveys 6 and 7[55]. A rationale for excluding those who become uninsured was due to the potential for the CDDS to 'crowd out' ancillary PHI, although it is probable, given the short duration of the CDDS, that this effect was minimal. Additionally, further analysis excluding those who transitioned into becoming uninsured found limited impact as there were no changes in direction or statistical significance for any of the main variables of interest. Endogeneity between dental health status and dental visiting cannot be disentangled due to limitations with the data.

Discussion

This study sought to determine whether following the introduction of the CDDS there was an increase in dental visiting for those who were not covered with PHI. This means the CDDS effectively represents new insurance for uninsured persons. It further sought to determine whether those with self-rated poor dental health status and who were uninsured were more likely to increase dental utilisation following the introduction of the CDDS. The rationale for choosing to focus on those with poor dental health status is that this group self-identify needing dental treatment and they gained access to dental insurance coverage through the CDDS.

In Australia there are multiple studies showing a positive correlation between PHI and a dental visit. However, in this chapter, as with the previous chapters, there is no increase in a dental visit in most models. While one exception is for the vulnerable/eligible group (uninsured with poor dental health status) in model 6.4, which showed a statistically significant increase in the probability of a dental visit by 7 percentage points, this result is not replicated in the logit model. This analysis shows the CDDS did not influence the probability of a dental visit in contrast to coverage with PHI. This might be due to the fact

[55] For Analysis one there are 158 individuals (4% of the population) who were uninsured in survey 5 became insured in survey 6 and 163 individuals (4% of the population) who were uninsured in survey 5 and 6 but who became insured in survey 7.
For Analysis two there are 126 individuals (3.8% of the population) who were uninsured in survey 5 but who became insured in survey 6 and 134 individuals (4% of the population) people who were uninsured in survey 5 and 6 but who became insured in survey 7.

that the purchase of PHI reflects more strongly the inherent behavioural differences between those who purchase PHI and those who do not.

The absence of an effect suggests the CDDS did not change behaviour and those who were already attending the dentist continued to do so. Thus, those who were already attending the dentist may have simply transferred from a state of self-insurance where the individual paid for the dental services themselves to a state where the government paid for their dental services. This finding aligns with research by Weerakoon, Fitzgerald & Porter (2014) which states there were dentists suggesting to chronic disease patients they should obtain a referral from their dentist onto the program (otherwise known as 'reverse referrals'). Despite an absence of a finding, given that there are still out-of-pocket expenses for dental visits for those covered with PHI, it is possible that the CDDS did provide an additional level of insurance coverage and reduce the cost of dental services if the recipients of the CDDS received services they may previously have avoided due to cost.

As with previous empirical studies a positive time trend is observed in most models, suggesting an increase in the probability of a dental visit for the entire cohort. Attending a GP consultation increases the probability of a dental visit in most models and those with a dental problem as compared to those with no dental problem also report a substantial statistically significant increase in the probability of a dental visit. Conversely, financial difficulty and financial stress produce a statistically significant decrease in the probability of a dental visit.

A question that is not answered in this study is whether there was an increase in the number of dental visits attended by those who received a CDDS service. This is due to the dichotomous nature of the outcome variable, which is highlighted as a limitation. Further research into whether there was a change in self-reported dental status or the presence of a dental problem may provide additional information on the effects of the CDDS. It may also find the CDDS produced beneficial results not captured in these studies. The findings in this chapter leave additional questions around who used the program and who the money was spent on. These questions will be explored in the next chapter.

Conclusion

This study sought to understand the effects of the CDDS on those who were not covered by PHI and those who were not covered by PHI with poor self-rated dental status. Again, there

is no evidence of an increase in the probability of a dental visit following the introduction of the CDDS for those who were eligible as compared to those who were not in the pre-CDDS time period. If the CDDS did not increase dental visits for those who were eligible as compared to those who were not, questions around the impact of the program remains. Given the cost of the program it is important to understand who received the CDDS services and where the money went.

Chapter 7 – What were the characteristics of those who received a CDDS service?

Previous empirical chapters did not identify an increase in the probability of a dental visit for those who were eligible following the introduction of the CDDS. This is a concern because the CDDS outlaid significant government funds (at around $2.8 billion overall (Crocombe et al. 2015)). Further, the CDDS was subject to multiple criticisms. The then Labour government argued it was too costly, it was being misused, it was poorly targeted and that some dentists were rorting the program (Plibersek 2012). The literature assessing the CDDS was also critical arguing that the eligibility criteria into the program, the presence of chronic disease, was poorly defined (Crocombe et al. 2015; Weerakoon, Fitzgerald & Porter 2014). A limited qualitative study suggested GPs reported they felt pressured to refer patients to the program (Weerakoon, Fitzgerald & Porter 2014). Other key concerns related to the appropriateness of services provided and the geographic variation in service provision (Crocombe et al. 2015; Kraatz et al. 2014). Only one study by Knott et al. (2012) reported any positive effect of the CDDS, noting that it may have been used more by those in financial need. However, there are limitations to these studies, primarily stemming from the use of MBS administrative data, which means links between service provision and patient needs cannot be determine and thus conclusions on the impact of the CDDS are limited (Crocombe et al. 2015; Kraatz et al. 2014; Lam, Kruger & Tennant 2012, 2013a, 2013b, 2014; Palfreeman & Zoellner 2012) or were limited to only one year of the CDDS's operation (Knott et al. 2012). (See Chapter 2, Literature Review for a more detailed discussion on the CDDS literature.)

Research question

Given the limitations of the current literature, unanswered questions remain. Specifically, who received the CDDS? This study fills this gap. It identifies the characteristics of those who claimed a CDDS item and seeks to determine the characteristics of those who were more likely to receive a larger CDDS MBS benefit. There are two research questions in this chapter:

1. *What were the characteristics of those who received a CDDS service?*
2. *For women who received a CDDS service, what were the characteristics were associated with greater CDDS benefits?*

Data

This chapter will use the survey component of the ALSWH, which has been linked to MBS administrative data. This chapter uses data in a cross-sectional format rather than a panel format as the aim is to capture the characteristics of the women who used the CDDS rather than to explain any changes in behaviour over time. This study identified whether the woman received a CDDS service by identifying any of the CDDS MBS item numbers. (See Appendix A for the list of CDDS MBS item numbers) in the linked data. The benefit amount received by the woman is also identified. Where women received multiple CDDS services the benefit amount received by the woman is aggregated. The survey data from survey 7, in 2013, is used. The rationale for using survey 7 is that its timing is coincidental with the endpoint in the CDDS program when there was a large uptake in both the number of CDDS service items and the benefits paid per year. This large increase in services provided and benefits is evident in Chapter 3.

Methodology

Research question 1

Research questions one seeks to provide information on the characteristics associated with CDDS utilisation. The methodology includes descriptive analysis to capture chronic disease status and PHI status of the women as well as econometric analysis. The econometric model is:

$$Y_i = X\beta_i + \varepsilon_i,$$

where Y_i is a binary variable equal to 1 if the women received a CDDS service and 0 if they did not. As the dependent variable is binary, a linear probability model is used. There are multiple independent variables included in this regression: country of birth, marital status, geographic location (ARIA), education level, socioeconomic status based on the woman's geographic location (SEIFA), concessional status, retirement status, financial status, PHI status, chronic disease status (see below), smoking status, dental health status and the presence of a dental health problem. Robust standard errors are used.

Results

The results from the LPM models (primary and secondary) are presented as it is the preferred model in Table 15. The logit model, presented in odds ratios, is also presented in the Appendix C2. As the models are fixed effects models based on panel data, the results

are based on the variables that change over time. Statistical significance is considered at the conventional level of p=0.005 (the 5% level) although significance at p=0.10 (the 10% level) is also noted where relevant.

For all models[56][57][58][59] there is no statistically significant increase in the probability of a dental visit for the vulnerable/eligible group as compared to the Base case group. With the exception of Model 5.4, there is no statistically significant increase in the probability of a dental visit for those in any of the comparison groups as compared to the Base case group. Post estimation tests find no statistically significant difference between each of the vulnerable/eligible groups with the respective coefficients for each of the Comparison groups[60].

[56]For Model 5.1 there were 2,070 women reporting a consistent visiting pattern in each survey three to seven. For Model 5.2 there were 2,574 women reporting a consistent visiting pattern in all surveys five to seven

[57] For Model 5.3 there were 1,836 women reporting a consistent dental visiting pattern across surveys three to seven. For Model 5.4 there were 2778 women reporting a consistent dental visiting pattern across surveys five to seven.

[58] For Model 5.5 there were 1,989 women reporting a consistent dental visiting pattern across surveys three to seven. For Model 5.6 there were 2,984 women reporting a consistent dental visiting pattern across surveys five to seven.

[59] For Model 5.7 there were 1,877 women reporting a consistent dental visiting pattern across surveys five to seven.

[60] For Model 5.1 there is no statistical difference between the coefficient for the vulnerable/eligible group and the Comparison 1 group (Post estimation test: $F_{(1, 5292)} = 0.87$, p=0.35) and there is no statistical difference between the vulnerable/eligible group and the Comparison 2 group coefficients (Post estimation test: $F_{(1, 5292)} = 0.32$, p=0.57).

For Model 5.2, there is no statistical difference between the vulnerable/eligible group coefficient and the coefficient for Comparison 1 group (Post estimation test: $F(_{1, 5280}) = 1.33$, p = 0.25) and there is no statistically significant difference between the vulnerable/eligible group coefficient and the coefficient for the Comparison 2 group (Post estimation test: $F(_{1, 5280}) = 0.07$, p = 0.79).

For Model 5.3 there is no statistical difference between the coefficient for the vulnerable/eligible group and the Comparison 1 group (Post estimation test $F_{(1, 4788)} = 0.25$; p=0.62) and there is no statistical difference between the coefficient for the vulnerable/eligible group and the Comparison 2 group (Post estimation test $F_{(1, 4788)} = 0.55$; p=0.46).

For Model 5.5 there is no statistically significant difference in the coefficient for the vulnerable/eligible group and the Comparison 1 group (Post estimation test: $F_{(1, 5225)} = 0.72$; p=0.40) and there is no statistically significant difference in the coefficient for the vulnerable/eligible group and the Comparison 2 group (Post estimation test: $F_{(1, 5225)} = 0.45$; p=0.50).

For Model 5.6, there is no statistically significant difference in the coefficient for the vulnerable/eligible group and the Comparison 1 group (Post estimation test: $F_{(1, 5219)} = 2.18$; p=0.14) and there is no statistically significant difference in the coefficient for the vulnerable/eligible group and the Comparison 2 group (Post estimation test: $F_{(1, 5219)} = 1.20$; p =0.27).

For Model 5.7 there is no statistical difference in the coefficient for vulnerable/eligible group and the Comparison 1 group (Post estimation test: $F_{(1, 5006)} = 1.89$; p=0.17). There is no statistically significant difference in the coefficients for the vulnerable/eligible group and the Comparison 2 group (Post estimation test: $F_{(1, 5006)} = 1.52$; p=0.22)

However, Model 5.4, for those in Comparison group 2, who are not CDDS eligible but are vulnerable (where vulnerable is defined as having a dental problem) there is a statistically significant decrease in the probability of a dental visit of 4.6 percentage points, implying those with a dental health problem who are not CDDS eligible in the period following the CDDS's implementation are less likely to have a dental visit. It should be noted, however, that post estimation tests undertaken for the coefficient for the vulnerable/eligible group and the Comparison groups indicate there is no statistically significant difference between the vulnerable/eligible difference group and the Comparison 2 group[61]

Across all models there are a number of variables that present a statistically significant increase in the probability of a dental visit. A positive time trend is observed with the likelihood of a dental visit increasing over time for the entire cohort in all models. Across all models there is an increase in the probability of a dental visit for those covered with comprehensive PHI as compared to those who have no PHI insurance, ranging from 5.9 (significant at the 10% level) to 9.4 percentage points. An increase in the probability of a dental visit is observed for those who attended a GP consultation in the last 12 months in most models (with the exception of model 5.7), ranging from 5 to 6.9 percentage points.

Across models 5.1 to 5.4 increasing financial difficulty or stress shows a statistically significant decrease in the probability of a dental visit. For those who experience limited financial difficulty there is a 2 to 2.2 percentage point decrease in the probability of a dental visit. For those with financial difficulty or stress there is a 3.7 to 4.9 percentage point decrease in the probability of a dental visit, except for model 5.2 (representing those with poor dental health status). There is some evidence (in models 5.2, 5.5 and 5.6) that those living in rural and remote areas have a decreased probability of a dental visit compared to those living in major cities. There is limited evidence that smoking reduces the probability of a dental visit by 8.2 percentage points, although statistical significance is only achieved in model 5.2 and statistical significance is achieved at the 10% level in model 5.6.

[61] For Model 5.4 there is no statistical difference in the coefficient between the vulnerable/eligible group and the Comparison 1 group (Post estimation test: $F_{(1, 4780)} = 0.00$; $p=0.95$) and there is no statistically significant difference between the coefficients for the vulnerable/eligible group and the Comparison 2 group (Post estimation test ($F_{(1, 4780)} = 0.83$; $p= 0.36$).

Table 18 - LPM results for heterogeneity analysis for all vulnerability groups, all models

	Poor dental health		Dental problem		Financial hardship		Any vulnerability
Dependent variable = dental consultation in last 12 months	Model 5.1	Model 5.2	Model 5.3	Model 5.4	Model 5.5	Model 5.6	Model 5.7
	(Primary)	(Secondary)	(Primary)	(Secondary)	(Primary)	(Secondary)	(Primary)
Survey	Base		Base		Base		Base
Survey 4	0.025**		0.023**		0.019*		0.022**
	(0.008)		(0.008)		(0.008)		(0.008)
Survey 5	0.042***	Base	0.052***	Base	0.041***	Base	0.046***
	(0.008)		(0.008)		(0.008)		(0.008)
Survey 6	0.071***	0.028*	0.064***	0.025^	0.080***	0.036**	0.084***
	(0.012)	(0.013)	(0.012)	(0.014)	(0.011)	(0.013)	(0.016)
Survey 7	0.080***	0.035**	0.071***	0.030*	0.096***	0.046***	0.097***
	(0.012)	(0.013)	(0.013)	(0.014)	(0.012)	(0.013)	(0.016)
β_2 Comparison 1 group (CDDS eligible; not vulnerable, post period)	-0.007	-0.014	-0.005	-0.000	-0.014	-0.018	-0.026
	(0.012)	(0.015)	(0.014)	(0.017)	(0.013)	(0.016)	(0.019)
β_3 Comparison 2 group (Not CDDS eligible; vulnerable, post period)	-0.000	0.018	0.008	-0.046*	-0.014	-0.017	-0.020
	(0.019)	(0.024)	(0.018)	(0.023)	(0.019)	(0.025)	(0.018)
β_4 vulnerable/eligible group (CDDS eligible; vulnerable, post period)	0.022	0.035	-0.021	-0.002	0.013	0.041	0.029
	(0.023)	(0.029)	(0.023)	(0.028)	(0.023)	(0.030)	(0.023)
Geographical location ARIA (base – major city)							
Inner regional	0.005	-0.013	0.001	-0.020	-0.006	-0.028	0.002
	(0.015)	(0.025)	(0.015)	(0.025)	(0.015)	(0.025)	(0.015)
Outer regional, rural & remote	-0.026	-0.060^	-0.029	-0.057	-0.036^	-0.070*	-0.021
	(0.020)	(0.035)	(0.022)	(0.036)	(0.021)	(0.035)	(0.021)
Married	-0.021	0.012	-0.004	0.007	-0.011	0.022	-0.013
	(0.015)	(0.024)	(0.015)	(0.025)	(0.015)	(0.023)	(0.015)
PHI Status							
Ancillary only	0.065*	0.032	0.044	0.025	0.043	0.007	0.057*
	(0.027)	(0.041)	(0.03)	(0.045)	(0.028)	(0.042)	(0.028)
Hospital only	0.023	0.040	0.014	0.004	0.022	0.028	0.028
	(0.022)	(0.033)	(0.024)	(0.038)	(0.022)	(0.035)	(0.023)

Comprehensive - both ancillary and hospital only	0.08***	0.061*	0.089***	0.059^	0.076***	0.059*	0.094***
	(0.018)	(0.028)	(0.020)	(0.032)	(0.02)	(0.03)	(0.019)
Financial management (base - no financial difficulty)							
Limited financial difficulty	-0.022**	-0.020^	-0.020*	-0.021^	N/a	N/a	N/a
	(0.008)	(0.012)	(0.009)	(0.012)			
Financial difficulty or stress	-0.042***	-0.024	-0.049***	-0.037*	N/a	N/a	N/a
	(0.011)	(0.015)	(0.012)	(0.016)			
Concessional	0.004	0.000	0.002	-0.003	-0.004	-0.009	-0.007
	(0.008)	(0.011)	(0.009)	(0.012)	(0.009)	(0.012)	(0.009)
GP consult in last 12 months	0.065***	0.053*	0.064***	0.050*	0.053***	0.034	0.069***
	(0.014)	(0.021)	(0.015)	(0.022)	(0.014)	(0.021)	(0.015)
Smoker	-0.031	-0.082*	-0.022	-0.061^	-0.030	-0.057^	-0.027
	(0.020)	(0.033)	(0.020)	(0.035)	(0.020)	(0.033)	(0.020)
Dental health status (base-poor/fair)							
Good		N/a		0.039**	N/a	0.056***	N/a
				(0.013)		(0.012)	
Very good/ excellent		N/a		0.109***	N/a	0.129***	N/a
				(0.017)		(0.016)	
Dental problem		0.108***		N/a	N/a	0.123***	N/a
		(0.010)				(0.010)	
Constant	0.582***	0.599**	0.569***	0.609***	0.572***	0.535***	0.535***
	(0.025)	(0.038)	(0.027)	(0.042)	(0.022)	(0.039)	(0.026)
Observations	25,054	15,159	22,656	13,760	24,863	15,008	23,770
R-squared	0.014	0.020	0.012	0.011	0.012	0.026	0.012
Number of individuals	5,293	5,281	4,789	4,781	5,226	5,220	5,007

n/a: not applicable
Robust standard errors in parentheses *** p<0.001, ** p<0.01, * p<0.05, ^ p<0.1
Primary models have pre-CDDS surveys 3 to 5; do not include dental health variables. Secondary models have pre-CDDS survey 5 only; includes the dental health control variables.
Source: ALSWH data

Research question 2

Research question 2 seeks to understand the drivers of CDDS benefits where this is defined as the amount of CDDS MBS benefits received over the time the CDDS was operational. For this analysis, the entire sample of women in the ALSWH who responded to survey 7 is used. As there are only 602 women who report claiming a CDDS item from a cohort of 8,676, there are a large number of women reporting zero CDDS expenditure (no MBS benefit received). In ordinary least squares (OLS) there is an assumption of random sampling (Wooldridge 2009). The problem in this analysis is that there are a large number of zeroes in the dependent variable. The reason the women did not receive a CDDS service is not clear. For example, some women will have had a dental visit through public dental services or private services paid for by themselves or PHI. Thus, the zero may represent systematic differences in socioeconomic status or systematic differences in access or no dental health need. The zeros therefore represent non-random missing data. Ignoring these observations can mean the OLS model is biased (Certo et al. 2016). To account for this sample selection bias, the Heckman model is used (Heckman 1979) as it allows for the correction of any biases created by the zero observations in the dependent variable (Kone et al. 2019). The Heckman model is a two-step model. The assumption of the Heckman model is that there is an unobserved factor that affects the outcomes measure as well as selection into the model (Kone et al. 2019). The Heckman model allows for this dependence between the two parts of the model (Cameron & Trivedi 2010). It allows for the error terms between the selection model and the outcome model to be correlated (Certo et al. 2016; Verbeek 2008). For the CDDS the unobserved factor may be program knowledge or health practitioner that leads some to be referred onto the CDDS while others miss out.

In the first step, the selection model is estimated and in the second step the outcome model is estimated (Galimard et al. 2018; Verbeek 2008). The selection model is estimated via a probit model in which the demand for the program is estimated (Angulo et al. 2011). (This model is the probit version of the LPM model in research question one.) The second model, the outcome model, is estimated via OLS and includes the 'inverse Mills ratio', which is a correction term, that is obtained from the first part, the probit model (Certo et al. 2016; Galimard et al. 2018; Heckman 1979; Verbeek 2008). This second model can also be thought of as the quantity demanded conditioned on the existence of demand (Angulo et al. 2011).

In applied work, an exclusion restriction is included in the selection model (Cameron & Trivedi 2010). The exclusion restriction involves including one variable in the selection model but not in the outcome model (Certo et al. 2016), which impacts the probability of being selected into the CDDS program but does not impact on the outcome variable. For this model the exclusion restriction is the presence of a chronic disease as this is a necessary requirement for the CDDS.

The econometric model for this study is:

The selection equation estimated via probit:

$$R_i = z_i\Theta + \mu_i,$$

where R_i is the probability of receiving a CDDS service. For the selection equation z_i is a vector of variables that explain the woman's probability of receiving the CDDS. These variables are country of birth, marital status, geographic location (ARIA), education level, socio-economic status (SEIFA), concessional status, retirement status, financial management status, PHI status, smoking status, dental health status, the presence of a dental health problem, with the woman's chronic disease status[62] acting as the exclusion restriction. For this model the error term is represented by μ_i.

The outcome model:

$$Y_i = x_i\beta + \varepsilon_i, \text{ observed only if the } R_i > 0 \text{ and not observed where } R_i \leq 0,$$

where Y_i is the CDDS benfit amount received. As this study is concerned with interpreting the characteristics associated with greater benefits the dependent variable not converted to logs, rather it is modelled as a dollar amount. The vector x_i of variables explaining the characteristics of the woman who received a CDDS benefit are country of birth, marital status, geographic location (ARIA), education level, socio-economic status (SEIFA), concessional status, retirement status, financial management status, PHI status, smoking status, dental health status and the presence of a dental health problem. The error term is ε_i.

[62] For the purposes of this study, having a chronic disease means reporting one of the conditions identified in Chapter 3: diabetes, musculoskeletal conditions, cardiovascular diseases, respiratory diseases, cancers and mental health conditions in survey 6 or 7 as the CDDS was operational in both survey periods and would have made the women eligible for the program.

Results

Research question 1 – the characteristics of the women who received a CDDS service

The results of the descriptive analysis show that of the 602 women (out of 8,676) who received a CDDS item, the majority reported having a chronic disease in either survey 6 or survey 7 (Table 19). This does suggest that those with diabetes, musculoskeletal conditions, cardiovascular diseases, respiratory diseases, cancers or mental health conditions capture a large range of the conditions appropriate for CDDS eligibility. Regarding the 9% of women who received a CDDS item who did not report a chronic disease in this study it should be acknowledged that there are other health conditions not included in the definition of a chronic disease in this thesis (such as for example Parkinson's disease[63]) that may be present making these women eligible for CDDS services.

Table 19 - CDDS service and chronic disease status

	Chronic disease negative	Chronic disease positive	Total
No CDDS service item	2,690 (33%)	5,384 (67%)	8,074
CDDS service item	57 (9%)	545 (91%)	602
Total	2,747	5,929	8,676

Source: derived from ALSWH data

Of the 602 women who received a CDDS service item, the majority (50.5%) did not report any PHI. However, 38.5% did report dental insurance coverage with either ancillary only or comprehensive PHI. In contrast, those who did not have a CDDS service item, the majority reported comprehensive PHI (60%). Including those who were covered with ancillary only PHI, over two thirds (64%) reported dental insurance coverage (Table 20).

Table 20 - CDDS and PHI status

	No PHI	Ancillary only	Hospital only	Comprehensive PHI
Number receiving CDDS item	304 (50.5%)	29 (5%)	67 (11%)	202 (33.5%)
Number not receiving a CDDS	2,127 (26.5%)	335 (4%)	780 (9.5%)	4,810 (60%)

[63] Parkinson's disease was omitted as a chronic disease as it was only included in survey 7 of the ALSWH. Other inclusions in survey 7 are Alzheimer's disease and mild cognitive impairment.

item				

Source: derived from ALSWH data

Econometric results

Table 21 shows the results of model 7.1, which shows the econometric results for the characteristics of women who received a CDDS service. Those who were European born, Asian born, or born in an 'other' overseas location had a greater probability of receiving a CDDS item compared to the base case of Australian born women. Those who were concessional have a greater probability of receiving a CDDS item as compared to those who were non-concessional. Those who reported financial stress as compared to those with no financial difficulty had a greater probability of receiving a CDDS item. Those who reported a chronic disease had a greater probability of receiving a CDDS item as were those who had a dental problem. Those who were retired had a greater probability of receiving a CDDS item as compared to those who were not retired, although this was not statistically significant at conventional levels, it was at the 10% level.

There were a number of variables that decrease the probability of receiving a CDDS item. Compared to the base case of living in a major city, those who lived in an inner regional area and an outer regional/ rural or remote area were less likely to receive a CDDS item. Compared to the base case of living in the least advantaged area (SEIFA category 1), those who lived in the least disadvantaged area (SEIFA category 5) were less likely to receive a CDDS item. Compared to the base case of no PHI, those who had dental insurance (either ancillary only or comprehensive PHI) were less likely to receive a CDDS item. These results are consistent with a program that sought to increase insurance coverage to increase utilisation of dental services for those for whom financial barriers may prevent access.

Table 21 - Econometric results- characteristics of women who received a CDDS service

Dependent variable: 1 = received a CDDS item	Model 7.1
Country of birth: Australian born (base)	
Other English country	-0.012
	(0.008)
European	0.038*
	(0.015)
Asian	0.075**
	(0.029)
Other	0.091^
	(0.049)
Married/ de-facto	-0.007
	(0.007)
Geographical location (ARIA): Major city (base)	
Inner regional	-0.039***
	(0.007)
Outer regional/ rural/ remote	-0.059***
	(0.008)
Education: no formal education (base)	
School/ higher school qualification	0.000
	(0.010)
Trade/apprenticeship/ certificate/ diploma	0.002
	(0.011)
Degree or higher	-0.001
	(0.011)
Socioeconomic status (SEIFA): Category 1 least advantaged (base)	
Category 2 SEIFA	0.000
	(0.011)
Category 3 SEIFA	-0.007
	(0.010)
Category 4 SEIFA	-0.014
	(0.010)
Category 5 SEIFA: least disadvantaged	-0.045***
	(0.010)
Concessional status	0.026***
	(0.006)
Retirement status	0.005^
	(0.003)
Financial management: no financial difficulty	
Some financial difficulty	0.010^
	(0.006)
Financial difficulty or stress	0.050***
	(0.008)
PHI Status: no PHI (base)	
Ancillary only	-0.032*
	(0.016)
Hospital only	-0.010
	(0.012)
Comprehensive PHI	-0.045***

	(0.008)
Chronic disease	0.051***
	(0.005)
Smoking status	0.008
	(0.014)
Dental Status: poor/ fair (base)	
Good dental	0.007
	(0.008)
Very good/ excellent	0.000
	(0.008)
Dental health problem	0.021**
	(0.007)
Constant	0.060***
	(0.017)
Observations	7,463
R-squared	0.058
Robust standard errors in parentheses *** p<0.001, ** p<0.01, * p<0.05, ^ p<0.1 Source: derived from ALSWH data	

Research question 2 – characteristics associated with greater CDDS benefits

Table 22 shows the results from the Heckman selection model. Model 7.2 is the selection model which shows the results of the probit model [64] for the probability of having a CDDS service item and the outcome model, which reports the drivers of CDDS benefit (or rebate) amount. The Inverse Mills Ratio indicates the error terms in the selection and outcomes equations are positively correlated. Statistically significant results show those who were European born or born in an 'other' overseas location compared to Australian born who received a greater CDDS benefit ($1,068 and $1,727 respectively). Those who reported a concessional status received a greater CDDS benefit of $841. Those with financial stress and a dental health problem also received a greater CDDS benfit, although these results are not statistically significant at conventional levels, rather they are statistically significant at the 10% percent level. The effect of geography was apparent as those who lived in an inner regional area or an outer regional/ rural or remote area received substantially less CDDS benefits when compared to those who lived in a major city ($811 and $1,106 respectively). Finally, those with very good/ excellent dental health received less CDDS benefits ($503) compared to those with poor/fair dental health.

[64] This model is the probit version of model 7.1.

Table 22 - Heckman model results of CDDS expenditure

	Model 7.3	
VARIABLES	Stage 1 - probit	Stage 2 - CDDS expenditure
Country of birth: Australian born (base)		
Other English country	-0.087	-175.253
	(0.074)	(259.379)
European	0.274**	1,067.499***
	(0.098)	(321.318)
Asian	0.534***	612.454
	(0.154)	(521.652)
Other	0.450*	1,726.635**
	(0.227)	(656.137)
Married/ de-facto	-0.030	-126.045
	(0.055)	(184.441)
Geographical location (ARIA): Major city (base)		
Inner regional	-0.310***	-811.115***
	(0.057)	(226.504)
Outer regional/ rural/ remote	-0.487***	-1,105.507***
	(0.073)	(321.404)
Education: no formal education (base)		
School/ higher school qualification	-0.003	-103.550
	(0.074)	(239.183)
Trade/apprenticeship/ certificate/ diploma	0.008	293.736
	(0.083)	(272.250)
Degree or higher	-0.018	317.189
	(0.091)	(306.867)
Socioeconomic status (SEIFA): Category 1 least advantaged (base)		
Category 2 SEIFA	0.003	-104.981
	(0.077)	(248.625)
Category 3 SEIFA	-0.057	21.008
	(0.075)	(244.057)
Category 4 SEIFA	-0.106	-97.406
	(0.075)	(248.281)
Category 5 SEIFA: least disadvantaged	-0.398***	-517.790
	(0.089)	(344.430)
Concessional status	0.235***	841.252***
	(0.053)	(216.482)
Retirement status	0.039^	-108.509
	(0.024)	(86.183)
Financial management: no financial difficulty		
Some financial difficulty	0.172*	240.294
	(0.079)	(307.327)
Financial stress	0.443***	689.843^
	(0.082)	(357.785)
PHI Status: no PHI (base)		
Ancillary only	-0.223^	-391.289

	(0.120)	(409.377)
Hospital only	-0.015	-332.243
	(0.083)	(269.259)
Comprehensive PHI	-0.342***	48.899
	(0.058)	(242.917)
Chronic disease	0.586***	
	(0.067)	
Smoking status	0.027	-326.962
	(0.092)	(290.623)
Dental Status: poor/ fair (base)		
Good dental	0.062	117.362
	(0.061)	(201.469)
Very good/ excellent	-0.014	-502.690*
	(0.071)	(240.522)
Dental health problem	0.157**	353.103^
	(0.055)	(197.970)
Constant	-1.956***	118.875
	(0.149)	(1,108.557)
Inverse Mills Ratio		1,204.936*
		(522.222)
Observations	7,463	7,463
Robust standard errors in parentheses *** p<0.001, ** p<0.01, * p<0.05, ^ p<0.1 Source: derived from ALSWH data		

Discussion

This study sought to build on the current CDDS literature by addressing concerns raised regarding the appropriateness of service provision and whether there was a difference in utilisation based on geography. There were also suggestions that the eligibility criteria for the program, the presence of chronic disease, were poorly defined (Crocombe et al. 2015; Weerakoon, Fitzgerald & Porter 2014) and GPs reported they felt pressured by patients to provide referrals s to the program (Weerakoon, Fitzgerald & Porter 2014), leading to concern that those who received a service may not have been eligible. It also sought to identify whether those with less financial means were more or less likely to receive a service. The strength of this study is the use of the linked data, which enabled CDDS service utilisation and patient characteristics to be linked.

In this cohort of women who responded to survey 7, the majority of the women who received a CDDS item reported a chronic disease, with 9.5% of women who received a CDDS service not reporting a chronic disease in survey 6 or 7. It should be noted that these women may have had another condition outside those used in this study. A statistically significant increase in the probability of having a CDDS service for those with a chronic

disease of 5.1 percentage points is reported. On this basis it is suggested that there was compliance with the program's eligibility criteria.

This study found an increase in the probability of a CDDS service item for those who were: concessional, experiencing financial difficulty, residing in the least advantaged SEIFA category, not covered with any PHI compared to those with ancillary only or comprehensive PHI, and those reporting a dental health problem. Results from the Heckman model show that those who were concessional received greater CDDS benefits ($841), statistically significant, and, those experiencing financial stress also received greater benefits ($690), weakly significant. These findings are consistent with Knott et al. (2012) who found those in the lowest income group received more than two and a half times the amount of CDDS benefit compared to those in the highest income group. Given that financial barriers to attending a dental visit are often reported, with the lowest two socioeconomic groups more likely to report not receiving recommended services due to cost as compared to those in the highest two socioeconomic groups (AIHW 2016), this would suggest the CDDS provided those with less financial means and possibly poorer dental health status the opportunity to receive dental services.

The cost of the CDDS was also a source of concern, in particular the use of expensive restorative services. Those with a dental problem reported a statistically significant increase in the probability of receiving a CDDS service and, while not statistically significant at conventional levels, those with a dental health problem also report higher CDDS expenditure. Additionally, those with very good/ excellent dental health status report significantly less benefits ($503) than those with poor/ fair dental health status. This is consistent with other finding that those with poor/fair self-rated dental health and those experiencing a tooth ache have higher dental expenditures (Teusner et al. 2017; Teusner, Brennan & Gnanamanickam 2013) and that those with poorer dental health are more likely to attend a dentist for a problem (Teusner et al. 2017). Additionally, the RAND HIE observed that expenses per user fall as incomes increases as a result of the more common but less expensive services being used by higher income individuals (Manning et al. 1985). This suggests the use of expensive restorative services may have been directed to those with a dental problem or poorer dental health status. This would suggest appropriate targeting of the program.

There is a large and significant difference in both the probability of receiving a CDDS service and the benefit received under the program for those living outside major cities. Compared to those living in a major city, those in an inner regional area received $812 less and those in an outer regional, rural/ remote area received $1,106 less. This finding is consistent with Kraatz et al. (2014) who found those living outside a major city received less CDDS services and Knott et al. (2012) who found people in regional and remote areas were 69% less likely to use the CDDS. Likewise, Crocombe et al. (2015) found the majority of the expenses associated with the CDDS were for those living in a major city. One possible explanation is that the primary providers of CDDS services were private dentists[65], who were more likely to be employed in major cities than in remote and very remote areas (AIHW 2016a), although as this study focused on CDDS participation rather than dentist attendance it is unclear whether women might have attended a dental service through other avenues. Implementation of a health program through private providers may exacerbate inequities in health outcomes for those in rural and remote areas (Wakerman & Humphreys 2013). It is unclear whether in the longer term the CDDS would result in increased service providers in regional areas as a result of an increase in purchasing power for those residents or whether it would simply entrench the current inequities in service provision. This is an important consideration for policy makers when designing future dental health programs.

Limitations

This study has a number of limitations. First, there are relatively few women who participated in the CDDS. Second, the ALSWH data is limited to women and also there may be recall error in the survey data from women identifying their chronic disease, PHI, concessional or retirement status. Third, as individual level socioeconomic status is poorly collected, the socioeconomic variable used is SEIFA. The SEIFA variable is limited as it is a measure of socioeconomic status of an area level rather than a measure of individual socioeconomic status. A final limitation relates to the Heckman model results (model 7.3) regarding the total CDDS expenditure, which is defined as benefit paid. It is important to remember that this benfit may be inclusive of any Medicare safety net benefits. Thus, for higher Medicare users, such as those with a chronic disease or those who are more likely to

[65] Noting that public dental services may also provide services.

reach the safety net threshold, who are those who are concessional, the CDDS benefit received could be inflated due to the additional benefits they receive upon reaching the safety net threshold. Further research may seek to identify the effect of any safety net benefits.

Further research

In the limitations section it was identified that there were comparatively few women who received a CDDS service. There is merit in replicating this study using either the older ALSWH cohort and/or using another linked dataset, such as the Multi-Agency Data Integration Project (MADIP) to identify whether these findings can be replicated.

This study identified that 9.5% of women who responded to survey 7 of the ALSWH did not report a chronic condition. Further investigation into the range of health conditions for this cohort could provide insight into whether these women also fulfilled the eligibility criterion and would also provide insight into referral practices of GPs.

There is merit in further interrogating the data to identify the types of services used by women disaggregated by socioeconomic status and by dental health status. This might help to identify whether the CDDS provided women with a greater opportunity to receive expensive and possibly neglected dental services. Additionally, research into whether there was a change in women's self-reported dental health problem following the introduction of the CDDS would provide greater insights into the program's outcomes.

Conclusion

This study is the first to provide insight into the characteristics of a population who received a CDDS item. Despite concerns raised in the literature regarding the eligibility criteria being poorly defined, this study found the vast majority of women in the ALSWH who received a CDDS service did report a chronic disease in surveys 6 or 7. In contrast to concerns from the Labor government and others suggesting the program was poorly targeted, this study found there was a degree of targeting as those who: were concessional, experienced financial stress, did not have ancillary PHI coverage, lived in a lower socioeconomic area, and those with a dental problem had a greater probability of receiving a CDDS service. Further, greater benefits were received by those who were concessional and those who had very good/ excellent dental received less benefits as compared to those with poor/ fair dental status. This would suggest the CDDS did provide an insurance benefit for those in need.

Importantly, this study found implementation of a dental program through private dentists may disadvantage those who live outside a major city and policy makers should be cognisant of potential inequities in service provision.

Chapter 8 – Discussion and conclusion

Discussion regarding whether Australia's Medicare should include subsidies for dental health services are ongoing. It was once again raised by the Australian Green party in the 2022 Australian election who aimed to 'Bring Dental into Medicare' (Australian Greens 2022). Proponents of Medicare-backed insurance coverage would argue there is a need for coverage on the basis that there is a link between dental health status and general health status (ARCPOH 2011) and that there are inequities of dental health outcomes across socio-economic (Brennan et al. 2020) and intergenerational groups (Ha et al. 2020; Peres & Lalloo 2020). The inclusion of the CDDS on the MBS serves a vital role in informing policy makers of the possible consequences of such a policy.

This thesis has employed techniques (quasi-experimental analyses and the use of linked data) that have not previously been used to provide insights into the CDDS that was not previously available. This absence of any increase in the probability of a dental visit in any of the quasi-experimental analyses undertaken in this thesis are surprising (and one could suspect disappointing for policy makers), especially given the large budgetary overspend. The results of the linked data study show that as opposed to criticisms that the CDDS was not targeting those in need, those who were more likely to have received a service could be considered to be in need of subsidised dental services. Further, an overview of the costs of CDDS services show the majority of costs went toward higher cost restorative services, which may be needed to improve dental health status. Overall, the conclusion of this thesis is that the benefit of the CDDS, while not necessarily increasing a dental visit in non-attendees, may have been to allow recipients, particularly those with poorer dental health status and those with financial difficulties or concessional patients, to receive dental benefits. There is a potential that these were dental services that were previously unaffordable. This final chapter summarises the findings of the empirical chapters, discusses the policy implications, the thesis limitations and options for future research.

Summary of findings from empirical chapters

The descriptive summary of the CDDS services (in Chapter 3) provides an overview of where the money for the CDDS went. It found that, the majority of services provided were for: restorative, diagnostic and prosthodontic services. In contrast, the majority of benefits paid

were for: prosthodontic, crown and bridge and restorative services. These findings are similar to those in the RAND HIE findings which showed that prosthodontic, endodontic, and periodontic services were used by few but accounted for the majority of the expenditure for dental insurance (Manning et al. 1985). Importantly this descriptive analysis showed that the ALSWH sample had service delivery patterns broadly consistent with the whole of the CDDS population (using MBS data), although it was noted that in the ALSWH cohort there was a greater percentage of benefits attributed to expensive restorative services than in the general CDDS population (

Table *23*). Possible explanations include that women are more likely to use dental services (Kino, Bernabe & Sabbah 2017; Murakami & Hashimoto 2016) but are more likely to express discomfort with their dental appearance than males (AIHW 2016a), suggesting the ALSWH cohort could have sought to also improve dental aesthetics through the CDDS. On the other hand, the ALSWH cohort reported an over-representation of employed women and an over-representation of tertiary educated women in the initial sample[66] (ALSWH 1996). While this could suggest the ALSWH cohort were more likely to use dental services, due to the association between dental visiting and income (Ju et al. 2022) and education (Jang, Kim & Kim 2017; Park et al. 2016), it is also possible the ALSWH cohort reported greater dental health as a result of their socioeconomic status (Slade, Spencer & Roberts-Thomson 2007; Srivastava, Chen & Harris 2017). This could suggest the ALSWH cohort would have been less likely to need higher end restorative services. In the RAND HIE it was noted that there were differences in the types of services demanded between higher and lower income individuals (Manning et al. 1985).

[66] Comparing the demographics of the ALSWH in survey 1 to the Australian census in 1991.

Table 23 - Service provision and MBS benefits for the CDDS, ALSWH cohort and whole of CDDS population

Population	Services provided (top 3)	MBS Benefits provided (top 3)
Whole of CDDS population (MBS data)	1) Restorative (24%) 2) Diagnostic (24%) 3) Prosthodontic (19%)	1) Prosthodontic (28%) 2) Crown and bridge (27%) 3) Restorative (18%)
ALSWH cohort	1) Restorative (25%) 2) Diagnostic (23%) 3) Prosthodontic (22%)	1) Crown and bridge (31%) 2) Prosthodontic (30%) 3) Restorative (19%)

Source: ALSWH data and MBS data

Three quasi-experimental studies (Chapters 4, 5 and 6) were undertaken to determine whether there was an increase in the probability of a dental visit (in the previous 12 months) for eligible populations using a range of groups of interest. The first study (in Chapter 4) using a DiD technique found those who were eligible for the CDDS, defined as those with a chronic disease, did not report an increase in the probability of a dental visit, as compared to those who were not eligible, those without a chronic disease. The second study (in Chapter 5) used a heterogeneity analysis technique to refine the cohorts into those who were eligible and vulnerable (where four vulnerable groups were identified: those with poor/fair self-rated dental health status, those with a dental health problem, those experiencing financial hardship and those and those with any of the three vulnerable groups). This study also found there was no increase in the probability of a dental visit for those who were eligible and also vulnerable. The third study (in Chapter 6) used both a difference in DiD and a heterogeneity analysis technique and sought to determine whether there was a differential effect for those who were covered by PHI as compared to those who

were not covered with PHI. The results in this study were consistent with the two previous studies also finding there was no increase in the probability of a dental visit for those not covered by PHI and those not covered by PHI and vulnerable.

Based on these three empirical chapters, the primary conclusion is that the CDDS did not increase dental visiting. Rather these three empirical chapters show that dental visiting was increasing over time, that those with PHI (hospital and ancillary) coverage (excluding the third study as PHI was the focus of the study), those who attended a GP visit in the previous 12 months, those with relatively better dental health status and those with a dental health problem had an increased probability of a dental visit. In contrast, a decrease in the probability of a dental visit was observed for those with increasing financial hardship as compared to those with no financial hardship.

The finding of the quasi-experimental analyses left further questions. This was explored in the final empirical chapter (in Chapter 7) where the characteristics of the women who received a CDDS service were assessed. This chapter found 91% of those who received a CDDS service had a chronic disease and over 60% were not covered with ancillary or comprehensive PHI. Further, those with a CDDS service were more likely to be concessional, those experiencing financial hardship, and those with a dental health problem. In contrast, those who were in rural and remote areas as compared to those in a major city, those in a lower socioeconomic area, and those who were covered with ancillary or comprehensive PHI as compared to those with no PHI were less likely to receive a CDDS service. Finally, in terms of who received the greatest benefits, those who were concessional received on average $841 more in CDDS benefits, although it should be noted that this can also include any EMSN benefits. In contrast, those with very good/ excellent self-rated dental health status as compared to those with poor/ fair self-rated dental health status received on average $503 less in CDDS benefits and those who lived in inner regional and outer regional, rural, and remote areas as compared to those in major cities received $811 and $1,106 less in benefits than those in major cities respectively.

Limitations

There are several limitations resulting from the ALSWH sample. It may be that, given the ALSWH cohort was over-representative of married, employed and tertiary educated women, the ALSWH cohort was more likely to attend the dentist on a regular basis so the

introduction of the CDDS would not have caused a change in behaviour. Additionally, as many of the women in the ALWSH cohort were covered with PHI, it was possible that any effect of the CDDS was not captured in by the outcome variable used (a dental visit in the last 12 months) in the quasi-experimental analyses. It is possible that the CDDS facilitated greater dental utilisation by allowing women to attend the dentist more regularly (i.e., twice a year rather than annually) or facilitated a greater number of treatments. Additionally, as the data only relate to women, there is a question of generalisability to men regarding both the quasi-experimental analyses and the linked data analyses. As with all survey data there is the potential for recall bias, particularly around dental visiting.

A threat to validity of the quasi-experimental analyses relates to compliance within the program, particularly the potential for those who were ineligible to receive a CDDS service. However, this is unlikely given the finding that 91% of women who received a CDDS service had a chronic disease.

This thesis provides strong evidence on the impact of the CDDS, due to the strength of the techniques employed in this thesis and the data source, which is panel data. However, one limitation of these analyses is related to the age of the women used in this study. It is possible the CDDS benefited those in an older cohort who are more likely to have poorer dental health status. This may be a topic of further research (see below).

Further research

The potential budgetary impact associated with provision of comprehensive universal dental services through Medicare are likely to be large. Given the expenditure, policy makers are most interested in understanding whether there would be a commensurate benefit. As no effect in the quasi-experimental analyses was observed in this thesis, there is a need for further research to confirm these results. Further research should target data sources that include an older cohort, such as those aged over 65 years. Lam, Kruger & Tennant (2013a) identified that (between 2007 and 2010) the largest proportion of the costs were for those aged between 55-74 years. It is possible that dentists may have targeted those between 65 and 75 as these cohorts are more likely to have greater dental health needs, which could potentially explain the costs associated with the use of restorative services. While it may be more difficult to undertake quasi-experimental analyses on this cohort, as there may be few who are not eligible (i.e., without a chronic disease), analysis could use linked data to

provide insight into characteristics of those with a CDDS service and to further understand patterns of service use.

It is possible there were benefits from the CDDS that could not be captured due to the limitations associated with the use of the outcome variable (a dental visit in the last 12 months). The RAND HIE identified the effect of insurance was on the treatment of diseased teeth, not on the prevention of disease itself (Bailit et al. 1985). Yet criticism of the CDDS stemmed from the use of high cost restorative services, particularly the use of more aesthetically pleasing (tooth-coloured) restorations as opposed to the longer-lasting metallic restorations (Lam, Kruger & Tennant 2012, 2013a, 2013b; Palfreeman & Zoellner 2012). These questions were beyond the scope of this thesis but are pertinent to discussions about appropriateness of benefits, affordability of dental services for governments, and also the extend of the insurance benefit of the CDDS to recipients. Further research is needed to identify whether CDDS recipients identified increased dental health status. This could confirm whether the benefit from the CDDS was in allowing recipients to receive services they might previously have not been able to afford, especially as the cost associated with having a chronic disease can be high (Essue et al. 2011; Jan, Essue & Leeder 2012).

One gap in the implementation of the policy was that CDDS services were not subject to any assessment criteria that such as that imposed on other services through the Medical Services Advisory Committee criteria (also a requirement for pharmaceuticals through the Pharmaceutical Benefits Advisory Committee). In particular, services under the CDDS did not have to provide evidence on effectiveness and cost effectiveness. This sort of research would assist policy makers in being able to direct limited resources toward those services that yield the greatest overall benefit.

A further area for research is to quantify whether there were any impacts on dental utilisation from the closure of the CDDS, such as a greater than expected reduction in dental visiting for those with a chronic disease as compared to those without a chronic disease. If this was the case, it may identify that the CDDS did maintain dental utilisation for the eligible population while it was operational.

Policy implications

The finding that there was no increase in the probability of a dental visit in the previous 12 months following the introduction of the CDDS is incongruent with expectations. This is

because the aim of providing subsidised MBS services is to increase utilisation. This is finding is also in contrast to findings from the seminal RAND Health Insurance Experiment, which showed that service utilisation increased with increasing generosity of insurance coverage (Manning et al. 1985) and inconsistent with the outcomes observed following the introduction of the *Affordable Care Act*, which found an increase in dental utilisation with Medicaid insurance coverage (Elani, Kawachi & Sommers 2021; Kosali, Soni & Cawley 2017; Lyu, Shane & Wehby 2020; Nasseh & Vujicic 2017a, 2017b; Wehby, Lyu & Shane 2019).

One possible explanation for no effect may be due to real or perceived costs associated with the CDDS that may have still presented a barrier to dental visiting. This is because dental practitioners were able to charge out-of-pocket expenses for CDDS items. This is an important consideration for policy makers because it implies that even if services are subsidised through the MBS there may not necessarily be an increase in uptake. This raises questions about whether the MBS is the most appropriate method for implementation of a dental health program.

It is also important to note that in the case of the *Affordable Care Act,* Medicaid targets those with lower incomes. In contrast, eligibility for the CDDS was based on chronic disease status, not an individual's financial situation. There is some qualitative evidence to suggest the CDDS suffered from 'reverse referrals' where dentists could identify those who were eligible and direct them to request a referral from their GP (Weerakoon, Fitzgerald & Porter 2014). The issue of reverse referrals means that those who received a CDDS service may have been more likely to have been regular dental attendees. As there is a positive relationship between dental visiting and PHI in Australia (Gnanamanickam & Teusner 2018), it possibly explains why those with ancillary PHI coverage were found to have been more likely to attend a dental visit and why there was no increase in effect for those not covered by PHI comparable to those with PHI coverage. This is supported to a degree by the findings of the linked data analysis, which showed that around 40% of the women who received a CDDS service were also covered with dental PHI. This means that a substantial proportion of the CDDS eligible population effectively had double dental insurance: insurance through both PHI and the CDDS. Although on current evidence those covered with PHI still report that PHI does not cover their costs, (of those covered with PHI few (8.5%) reported that their PHI paid all of their dental visiting expenses (AIHW 2021)), a concern for policy makers

is the potential for cost shifting (or 'crowding out') from the PHI providers and individuals onto the government as a result of the introduction of publicly funded insurance.

It is interesting to note that the absence of an effect in the quasi-experimental studies is contrasted with the results of the linked data study which shows that the CDDS did appear to benefit those who might have been considered in need. The linked data study also found that women who were concessional and those experiencing financial hardship were more likely to receive a CDDS benefit. This is consistent with Knott et al. (2012) who also identified that those who were concessional were more likely to use the CDDS. Additionally, those with poor dental health status were also more to receive CDDS benefits. Possible explanations for this result might be that in the absence of the CDDS, the women with a chronic disease may have reduced their dental visiting. There is some evidence to suggest that out-of-pocket costs for the chronically ill at the time of the CDDS's introduction were a source of concern (Essue et al. 2011; Jan, Essue & Leeder 2012). Without the CDDS, women with chronic diseases may have sought to reduce expenditure, possibly by reducing dental visits.

One of the arguments for closing the CDDS was that it was poorly targeted (Plibersek 2012). Other criticisms included that there were poor governance arrangements, with some suggesting the eligibility criteria were poorly defined (Crocombe et al. 2015; Weerakoon, Fitzgerald & Porter 2014). However, in contrast to this claim, this thesis using a known cohort of CDDS recipients, found that 91% of those who received a CDDS service reported a chronic disease, suggesting that there was limited program leakage to ineligible recipients. This is possibly an underestimate as a chronic disease in this thesis was limited to musculoskeletal conditions, cardiovascular diseases, respiratory diseases, cancers, and mental health conditions. Including a range of additional chronic conditions (e.g., cognitive conditions) could have identified more eligible women. Additionally, this finding that women in financial and dental health needs (see above paragraph) were more likely to receive a service also suggests the program 'targeted' those in need.

An important finding that should not be dismissed was that those in inner regional and outer regional, rural and remote areas were less likely to receive a CDDS services and also received substantially less benefits, consistent with the literature (Crocombe et al. 2015; Knott et al. 2012; Kraatz et al. 2014). While the CDDS was not directly targeted to those in

rural and remote areas, and given the distribution of the dental workforce, with the majority found in major cities with far fewer in rural, remote and very remote areas (AIHW 2016), it is not an unexpected finding. This is an important consideration for policy makers as this suggests the CDDS may have had the potential to exacerbate inequities of dental health outcomes between those in major cities and those in rural and remote areas. One possible solution may be for policy makers to provide additional incentives for dentists to practice in rural and remote areas. It is possible that over time, the CDDS might have provided sufficiently to attract dentists into regional areas.

Overall, the findings in this thesis suggest that the CDDS was targeted appropriately as it did provide an opportunity for those with financial difficulty and those with dental needs to receive expensive subsidised services, even if it did not increase the probability of a dental visit at a population level. There is evidence that people avoid or delay dental care due to cost and there are also reports of individuals not receiving recommended treatment due to cost (AIHW 2021). Further, based on the descriptive analysis in Chapter 3, it appears the majority of CDDS benefits went toward expensive restorative services (crown and bridge, prosthodontic, and general restorative services). These findings are consistent with the CDDS addressing unmet need and would align with the benefits found in the RAND HIE, which identified that the benefit of insurance was on the treatment of diseased teeth (Manning et al. 1985). A problem for policymakers is how to balance the needs of the population with large costs of dental service provision and to consider the most appropriate implementation of a dental health policy program. This may be particularly difficult politically especially given the calls by the Greens political party for expanded Medicare dental services.

Overall, the costs of a universal, comprehensive dental scheme cannot be underestimated. For this reason, a targeted dental program may be preferred. Examples from overseas include expansion of dental services to include pregnant women in Chile (Cornejo-Ovalle et al. 2015) or Korea and Chile where dental provision was based on age (Choi & Jung 2020; Cornejo-Ovalle et al. 2015; Jang, Kim & Kim 2017; Park et al. 2016). However, while targeting those on concessions in theory makes sense, based on the findings of Chapter 7 (linked data analysis) even a limited program may also be expensive. This is because the association between poorer dental health status and socioeconomic status means those

who are concessional are likely to require the more expensive restorative services. Therefore, in addition to restricting the number of participants to only concessional patients there may be benefit in restricting the number or types of services provided, particularly around restorative services, which accounted for the large cost. In the first instance, concessional patients with less than an inadequate dentition level (that is under 21 teeth), should be prioritised to capture those most in need. As there is improvement in dental status for younger cohorts in the longer-term, consideration should be given to broadening any government program to include preventive services to concessional patients as these are likely to provide the best option for preventing longer-term issues. At the same time a universal children's preventive program may provide the best option for future generations.

Conclusion

The CDDS was introduced to support those with chronic disease to receive dental services with the aim of improving their overall health status. The program resulted in a large overspend and was criticised, leading to its closure. The contribution of this thesis is the use of quasi-experimental techniques to provide outcomes from the program, the first such analysis of this program. These findings suggest that even when dental services are subsidised there is not necessarily an increase in dental visiting for those who do not already attend regularly. Findings from this thesis using linked data and analysing a known cohort of women who received CDDS services, rebuke some of the criticisms of the CDDS. This thesis has shown that there was a degree of targeting, with those who were concessional, experiencing financial hardship and with poorer overall self-rated dental health more likely to receive a service. The propensity for the use of higher cost restorative services is suggestive that the value of the CDDS was in providing an opportunity for those in need to receive services they might previously have been able to afford. However, this thesis also found those in outer regional, rural and remote areas were less likely to receive a CDDS service and this finding should not be dismissed.

To date, comprehensive adult dental services remain excluded from Australia's Medicare program leaving dental services to be funded privately. There are ongoing calls to expand Medicare to include subsidised dental services such as in the 2022 election by the Australian Greens. Overall, universal dental services should be included consistent with 'general' health services, especially in light of increasing evidence of links between dental health and

general health. The cost of such a program, however, cannot be underestimated. This cost is likely to be unpalatable to any government. The challenge, therefore, is how to target services appropriately to balance the needs of the population with the costs of service provision.

Appendix A.1 - CDDS MBS item numbers

Table 24 - MBS CDDS item numbers

Type of service provided by dentists by group (MBS item numbers)	Type of service provided by dental specialists by group (MBS item numbers)	Type of service provided by dental prosthetists by group (MBS item numbers)
Diagnostic services: examinations, radiological examination and interpretation, other diagnostic services (85 011 - 85 071)	Diagnostic services: examinations, radiological examination and interpretation, other diagnostic services (86 012 – 86 082)	Diagnostic services: examinations & diagnostic services (87 011 – 87 071)
Preventive services: dental prophylaxis, remineralising agents, other preventive services (85 111 – 85 171)	Preventive services: dental prophylaxis, remineralising agents, other preventive services (86 111 – 86 171)	
Periodontics (85 213 – 85 245)	Periodontics (86 213 – 86 245)	
Oral surgery: extractions, surgical extractions, surgery for prostheses, general surgical, other surgical procedures (85 311 – 85 392)	Oral surgery: extractions, surgical extractions, surgery for prostheses, general surgical, other surgical procedures (86 311 – 86 395)	
Endodontic services: pulp & root canal treatments, periradicular surgery, other endodontic services (85 411 – 85 458)	Endodontic services: pulp & root canal treatments, periradicular surgery, other endodontic services (86 411 – 86 458)	
Restorative services: metallic restorations, direct and indirect; adhesive restorations, direct and indirect; tooth colour	Restorative services: metallic restorations, direct and indirect; adhesive restorations, direct and indirect; tooth colour	

restorations, indirect; other restorative services (85 511 – 85 597)	restorations, indirect; other restorative services (86 511 -86 597)	
Crown and bridge: crowns and bridges and implant prostheses (85 613 – 85 673)	Crown and bridge: crowns and bridges and implant prostheses (86 613 – 86 691)	
Prosthodontics: dentures & components, repairs and maintenance (85 711 – 85 777)	Prosthodontics: dentures & components, repairs and maintenance (86 711 – 86 777)	Prosthodontic services: dentures & components, denture maintenance, denture repairs, other prosthodontic services (87 711 – 87 777)
Orthodontics: removable appliances and fixed appliances (85 811 – 85 831)	Orthodontics: removable appliances and fixed appliances (86 811 – 86 862)	
General services: emergencies, drug therapy, occlusal therapy, miscellaneous (85 911 – 85 986)	General services: emergencies, drug therapy, anaesthesia & sedation, occlusal therapy, miscellaneous (86 911 – 86 986)	

Source: MBS data

Appendix A.2 – attrition equation

The econometric equation for attrition is a fixed effects linear probability model:

$$Y_{it} = \alpha_0 + \boldsymbol{\lambda X_{it}} + \vartheta_t + \delta_i + \varepsilon_{it},$$

where the dependent variable Y_{it} is a binary variable to identify whether the woman, *i*, had a dental visit in the 12 months prior to each survey at time *t*. The λ represents a vector of individual-level control variables(geographic location, marital status, PHI status, financial status, concessional status, GP consultation in the last 12 months, smoking status, plus self-reported dental health status and the presence of a dental problem), ϑ_t represents the time fixed effects and δ_i the individual fixed effects and ε_{it} represents the error term. The standard errors are clustered to the individual. **Table *25*** presents the results. In columns 1 and 3 is the cohort of women is those are included in the empirical studies in chapters 4,5 and 6 and in columns 2 and 4 are all women including those who were lost to attrition over the course of the study. Overall, the results show the effect of attrition is limited as equations between the two different cohorts are very similar in terms of direction and statistical significance, implying limited effect from bias.

Table 25 - Additional attrition equations

	(1)	(2)	(3)	(4)
Dependent variable: 1 = dental consultation in last 12 months				
Survey (base - Survey 3)				
Survey 4	0.026***	0.026***		
	(0.007)	(0.006)		
Survey 5	0.044***	0.039***	(base)	(base)
	(0.007)	(0.006)		
Survey 6	0.069***	0.061***	0.027***	0.024***
	(0.007)	(0.006)	(0.007)	(0.006)
Survey 7	0.083***	0.079***	0.036***	0.037***
	(0.008)	(0.006)	(0.007)	(0.006)
Geographical location ARIA (base - major city)				
Inner regional	-0.002	-0.008	-0.019	-0.020
	(0.013)	(0.011)	(0.022)	(0.020)
Outer regional, rural, remote	-0.033^	-0.026^	-0.060*	-0.053*
	(0.018)	(0.016)	(0.031)	(0.027)
Married	-0.003	-0.005	0.029	0.013
	(0.013)	(0.011)	(0.021)	(0.019)
PHI status (base - no PHI)				
Ancillary only	0.060*	0.068**	0.042	0.044
	(0.025)	(0.021)	(0.036)	(0.032)
Hospital only	0.035^	0.022	0.048	0.044
	(0.020)	(0.016)	(0.031)	(0.027)
Hospital and ancillary	0.088***	0.089***	0.070**	0.085***
	(0.017)	(0.015)	(0.027)	(0.024)
Financial management (base - no financial difficulty)				
Limited financial difficulty	-0.022**	-0.021**	-0.017^	-0.012
	(0.008)	(0.007)	(0.010)	(0.009)
Financial difficulty or stress	-0.043***	-0.040***	-0.026^	-0.014
	(0.010)	(0.009)	(0.014)	(0.012)

Concessional	-0.004	0.001	-0.008	-0.009
	(0.008)	(0.007)	(0.010)	(0.009)
GP consult in last 12 months	0.060***	0.043***	0.047*	0.055***
	(0.013)	(0.011)	(0.019)	(0.016)
Smoker	-0.030^	-0.035*	-0.058^	-0.051*
	(0.018)	(0.014)	(0.030)	(0.025)
Dental health status (base-poor/fair)				
Good			0.056***	0.053***
			(0.011)	(0.010)
Very good/ excellent			0.131***	0.122***
			(0.015)	(0.013)
Dental health problem			0.126***	0.128***
			(0.009)	(0.008)
Constant	0.566***	0.572***	0.513***	0.494***
	(0.024)	(0.020)	(0.036)	(0.031)
Observations	30,208	46,060	18,217	26,268
R-squared	0.013	0.011	0.027	0.026
Number of id	6,402	11,281	6,386	10,152
Robust standard errors in parentheses *** p<0.001, ** p<0.01, * p<0.05, ^ p<0.1				

Source: derived from ALSWH data

Appendix B – Appendix to Chapter 4

Appendix B1: Analysis 1 – Chi square test of the difference between groups

Table 26 compares the main characteristics of the Target and Non-target groups in Analysis 1. Overall, those in the Target group are less socioeconomically advantaged as they are less likely to married or in a de-facto relationship (78% vs 82%), are less educated as they are more likely no report no formal education (14% vs 10%), are less likely to be employed (64% vs 77%), are more likely to report financial stress (39% vs24%), and are nearly twice as likely to hold a concession card (29% vs 15%). Those in the Target group are over five times more likely to report poorer health status (17% vs 3%), which is expected given the Target group is defined as those with a chronic disease while the Non-target group are those without a chronic disease and therefore it is assumed they are healthier. There are also differences between the groups in terms of visiting a GP. Unsurprisingly, given the potential need to manage their chronic disease those in the Target group are more likely to report a GP consultation in the last 12 months (98% vs 86%). Importantly for a study into dental health, those in the Target group report poorer dental health as they are more likely to report dentures (34% vs28%), are more likely to report a dental problem (33% vs25%), and are more likely to report poor/fair dental health status(29% vs 24%) and less likely to report very good to excellent dental status (29% vs 34%). In regard to PHI status there is a statistically significant difference in PHI coverage overall between the groups, however this difference is driven by coverage through hospital PHI (10% vs 14%). There is no difference between the groups in regard to dental insurance through ancillary and comprehensive coverage.

Table 26 – Comparison of characteristics between Non-target and Target group, Analysis 1

	Non-target		Target		
Characteristic/Category	**N**	**%**	**N**	**%**	**Statistical significance**
Country of birth[#]					
Australian born	1,618	75%	3,310	79%	
Other English Speaking	320	15%	587	14%	
Europe	152	7%	198	5%	
Asia	58	3%	66	2%	
Other	11	1%	33	1%	
Total	*2,159*		*4,194*		Pearson chi2(4) = 28.132 Pr = 0.000
Language spoken at home[#]					
English, Australia	2,041	95%	4,029	97%	
European	71	3%	110	3%	
Asian	21	1%	19	0%	
Other	11	1%	15	0%	
Total	*2,144*		*4,173*		Pearson chi2(3) = 9.483 Pr = 0.024
ARIA					
Major city	822	38%	1,600	39%	
Inner regional	805	38%	1,631	39%	
Outer regional, rural or remote	513	24%	918	22%	
Total	*2,140*		*4,149*		Pearson chi2(2) = 3.169 Pr = 0.205
Marital status					
Not married	381	18%	926	22%	
Married or de-facto	1,758	82%	3,202	78%	
Total	*2,139*		*4,128*		Pearson chi2(1) = 18.220 Pr = 0.000
Education[#]					
No formal	208	10%	598	14%	
High school	1,055	49%	2,019	48%	
Trade/ apprenticeship/ diploma	487	23%	901	21%	
Degree and higher	411	19%	688	16%	
Total	*2,161*		*4,206*		Pearson chi2(3) = 30.653 Pr = 0.000

Employment					
Not in labour force/ unemployed	502	23%	1,483	36%	
Part time or full time	1,636	77%	2,656	64%	
Total	*2,138*		*4,139*		Pearson chi2(1) = 99.442 Pr = 0.000
Financial management					
No financial difficulty	561	*26%*	807	*19%*	
Limited financial difficulty	1,074	*50%*	1,740	*42%*	
Financial difficulty or stress	504	*24%*	1,596	*39%*	
Total	*2,139*		*4,143*		Pearson chi2(2) = 145.187 Pr = 0.000
Concession card					
No	1,823	85%	2,958	71%	
Yes	311	15%	1,190	29%	
Total	*2,134*		*4,148*		Pearson chi2(1) = 154.380 Pr = 0.000
PHI status					
None	533	25%	1,196	29%	
Ancillary only	79	4%	167	4%	
Hospital only	293	14%	435	10%	
Comprehensive - both hospital and ancillary	1,230	58%	2,348	57%	
Total	*2,135*		*4,146*		Pearson chi2(3) = 21.037 Pr = 0.000
Health Status					
Poor / fair	64	3%	725	17%	
Good	564	26%	1,786	43%	
Very good/ excellent	1,506	71%	1,637	39%	
Total	*2,134*		*4,148*		Pearson chi2(2) = 611.870 Pr = 0.000
Alcohol intake					
High risk drinker	131	6%	272	7%	
Low risk drinker	1,997	94%	3,849	93%	
Total	*2,128*		*4,121*		Pearson chi2(1) = 0.459 Pr = 0.498
Smoking status					
Smoker	168	8%	388	9%	
Non/ ex-smoker	1,969	92%	3,754	91%	
Total	*2,137*		*4,142*		Pearson chi2(1) = 3.961 Pr = 0.047

Weight range					
Unhealthy weight range	1,132	54%	2,688	66%	
Healthy weight range	972	46%	1,386	34%	
Total	*2,104*		*4,074*		Pearson chi2(1) = 87.176 Pr = 0.000
Exercise level					
Low to nil	737	36%	1,738	44%	
Moderate to high	1,300	64%	2,227	56%	
Total	*2,037*		*3,965*		Pearson chi2(1) = 32.524 Pr = 0.000
GP consultation in last 12 months					
No	290	14%	81	2%	
Yes	1,850	86%	4,064	98%	
Total	*2,140*		*4,145*		Pearson chi2(1) = 341.742 Pr = 0.000
Dentures					
No	1,544	72%	2,725	66%	
Yes	598	28%	1,429	34%	
Total	*2,142*		4,154		Pearson chi2(1) = 27.208 Pr = 0.000
Dental health problem [a]					
No	1,606	75%	2,777	67%	
Yes	524	25%	1,346	33%	
Total	2,130		*4,123*		Pearson chi2(1) = 43.365 Pr = 0.000
Dental health status					
Fair/ poor	521	24%	1,218	29%	
Good	884	41%	1,730	42%	
Very good/ excellent	736	34%	1,200	29%	
Total	*2,141*		*4,148*		Pearson chi2(2) = 26.585 Pr = 0.000

[#] Characteristic at survey one

[a] This is a combination variable that captures those who have a dental health problem and/ avoid foods due to their dental health

Statistical significance:* p<0.05; ** p<0.01; *** p<0.001

Source: derived from ALSWH data

Appendix B2: Analysis 2 - Chi square test of the difference between groups

Key characteristics comparisons between non-target group and Target_5 group

Comparing key characteristics of the Target_5 group with the Non-target group shows several statistically significant differences (Table 27). Those in the Target_5 group are less socio-economically advantaged than those in the Non-target group. Those in the Target_5 group are less likely to be married or in a de-facto relationship (77% vs 83%), are less educated as they are more likely to report no formal education (15% vs 10%), are less likely to be employed (63% vs 77%), are more likely to report financial stress (40% vs 23%), and are twice as likely to be concessional (30% vs 15%). Regarding health status and health behaviours, those in the Target_5 group are nine times more likely to report poor/fair health status (19% vs 2%), which is expected given the differentiation between the groups is due to the presence of a chronic disease, and they report more negative health behaviours (e.g., smoking (10% vs 7%). The Target_5 group are more likely to report a GP consultation in the last 12 months (98% vs 85%). There are significant differences in dental health with those in the Target_5 group more likely to report dentures (35% vs 29%), and more likely to report poor/fair dental health status (31% vs 24%). Coverage with ancillary PHI is the same in both groups.

Key characteristics comparisons between non-target group with Target_6 group

Comparing those in the Target_6 group to the Non-target group shows that those in the Target_6 group are less socio-economically advantaged than those in the Non-target group (Table 27). Those in the Target_6 group are more likely to report no formal education (13% vs 10%), are less likely to be employed (71% vs77%), are more likely to report financial stress (31% vs 23%), and are more likely to report a concession card (20% vs 15%). Unsurprisingly, given the Target_6 and Non-target group are differentiated on the basis of a chronic disease, those in the Target_6 group are more likely to report poor/fair health status (7% vs 2%) although the difference is not as stark as between the non-target and Target_5 groups. Those in the Target_6 group are more likely to report a GP consult in the last 12 months (94% vs 85%). There is a difference in relation to dental health although only in relation to denture status with those in the Target_6 group more likely to report dentures (35% vs 29%). The percent reporting ancillary insurance coverage is similar.

Key characteristics comparisons between non-target group with Target 7 group

In comparing the Target_7 group with the Non-target group there are few statistically significant differences in the key characteristics (Table 27). The statistically significant differences are financial management, with those in the Target_7 group more likely to report financial stress (28% vs 23%); health status, with those in the Target_7 group less likely to report very good/ excellent health status (64% vs 73%); and GP consultation in the last 12 months as those in the Target_7 group more likely to report a consultation (89% vs 85%).

Table 27 – Comparison of characteristics between Non-target and target groups, Analysis 2

	Non-target group		Target_5 group		Target_6 group		Target_7 group	
Characteristic/Category	**N**	**%**	**N**	**%**	**N**	**%**	**N**	**%**
Country of birth[#]								
Australian born	1,077	75%	2,465	79%	723	78%	722	76%
Other English Speaking	216	15%	427	14%	124	13%	143	15%
Europe	102	7%	143	5%	53	6%	59	6%
Asia	41	3%	55	2%	15	2%	18	2%
Other	6	0%	24	1%	11	1%	11	1%
Total	*1,442*		*3,114****		*926**		*953*	
Pearson chi square			Chi2(4) = 22.248 Pr = 0.000		Chi2(4) = 11.661 Pr = 0.020		Chi2 (4) = 7.280 Pr = 0.122	
Language spoken at home[#]								
English, Aust	1,366	95%	2,993	97%	882	95%	904	95%
European	44	3%	79	3%	34	4%	31	3%
Asian	16	1%	14	0%	7	1%	8	1%
Other	8	1%	13	0%	2	0%	9	1%
Total	*1,434*		*3,099**		*925*		*952*	
			Chi2(3) = 8.088 Pr = 0.044		Chi2(3) = 2.920 Pr = 0.404		Chi2 (3) = 1.707 Pr = 0.635	
Geographic location (ARIA)								
Major city	561	39%	1,199	38%	299	38%	337	40%
Inner regional	544	38%	1,237	39%	325	42%	317	38%
Outer regional, rural, or remote	341	24%	698	22%	159	20%	179	21%
Total	*1,446*		*3,134*		*783*		*833*	
			Chi2(2) = 1.694 Pr = 0.429		Chi2(2) = 4.446 Pr = 0.108		Chi2 (2) = 1.411 Pr = 0.494	
Marital status								
Not married	251	17%	708	23%	134	17%	154	19%
Married or de-facto	1,197	83%	2,409	77%	647	83%	672	81%
Total	*1,448*		*3,117****		*781*		*826*	
			Chi2(1) = 17.244 Pr = 0.000		Chi2(1) = 0.011 Pr = 0.916		Chi2(1) = 0.616 Pr = 0.432	
Education[#]								

No formal	148	10%	456	15%	124	13%	101	11%
High school	683	47%	1,506	48%	448	48%	481	50%
Trade/ apprenticeship/ diploma	316	22%	659	21%	207	22%	213	22%
Degree and higher	298	21%	502	16%	155	17%	161	17%
Total	*1,445*		*3,123****		*934**		*956*	
			Chi2(3) = 26.329 Pr = 0.000		Chi2(3) = 9.481 Pr = 0.024		Chi2(3) = 5.509 Pr = 0.138	
Employment								
Not in labour force/ unemployed	336	23%	1,145	37%	225	29%	187	23%
Part time or full time	1,112	77%	1,980	63%	552	71%	642	77%
Total	*1,448*		*3,125****		*777***		*829*	
			Chi2(1) = 81.571 Pr = 0.000		Chi2(1) = 8.876 Pr = 0.003		Chi2(1) = 0.125 Pr = 0.724	
Financial management								
No financial difficulty	391	*27%*	585	*19%*	182	*23%*	192	*23%*
Limited financial difficulty	721	*50%*	1,300	*42%*	359	*46%*	406	*49%*
Financial difficulty or stress	334	*23%*	1,243	*40%*	239	*31%*	231	*28%*
Total	*1,446*		*3,128****		*780****		829*	
			Chi2(2) = 127.056 Pr = 0.000		Chi2(2) = 15.440 Pr = 0.000		Chi2(2) = 7.999 Pr = 0.018	
Concession card								
No	1,225	85%	2,185	70%	625	80%	697	84%
Yes	218	15%	946	30%	159	20%	135	16%
Total	*1,443*		*3,131****		*784***		*832*	
			Chi2(1) = 118.815 Pr = 0.000		Chi2(1) = 9.667 Pr = 0.002		Chi2(1) = 0.504 Pr = 0.478	
PHI Status								
None	376	26%	950	30%	193	25%	185	22%
Ancillary only	55	4%	131	4%	33	4%	36	4%
Hospital only	201	14%	325	10%	94	12%	116	14%
Comprehensive - both hospital and ancillary	812	56%	1,722	55%	463	59%	494	59%
Total	*1,444*		*3,130***		*784*		*831*	
			Chi2(3) = 17.689 Pr = 0.001		Chi2(3) = 2.746 Pr = 0.433		Chi2(3) = 4.361 Pr = 0.225	

Health Status								
Poor / fair	29	2%	608	19%	52	7%	32	4%
Good	367	25%	1,387	44%	275	35%	270	32%
Very good/ excellent	1,048	73%	1,136	36%	456	58%	530	64%
Total	*1,444*		*3,131****		*783****		*832****	
			Chi2(2) = 579.744 Pr = 0.000		Chi2(2) = 62.006 Pr = 0.000		Chi2(2) = 21.986 Pr = 0.000	
Alcohol intake								
High risk drinker	79	5%	205	7%	51	7%	47	6%
Low risk drinker	1,363	95%	2,901	93%	730	93%	781	94%
Total	*1,442*		*3,106*		*781*		*828*	
			Chi2(1) = 2.116 Pr = 0.146		Chi2(1) = 1.018 Pr = 0.313		Chi2(1) = 0.039 Pr = 0.843	
Smoking status								
Smoker	108	7%	298	10%	68	9%	65	8%
Non/ ex-smoker	1,341	93%	2,827	90%	715	91%	765	92%
Total	*1,449*		*3,125**		*783*		*830*	
			Chi2(1) = 5.308 Pr = 0.021		Chi2(1) = 1.061 Pr = 0.303		Chi2(1) = 0.107 Pr = 0.743	
Weight range								
Unhealthy weight range	745	52%	2,073	67%	470	61%	445	55%
Healthy weight range	679	48%	1,001	33%	305	39%	364	45%
Total	*1,424*		*3,074****		*775****		*809*	
			Chi2(1) = 95.069 Pr = 0.000		Chi2(1) = 14.077 Pr = 0.000		Chi2(1) = 1.498 Pr = 0.221	
Exercise level								
Low to nil	493	36%	1,369	46%	266	36%	290	36%
Moderate to high	888	64%	1,627	54%	463	64%	505	64%
Total	*1,381*		*2,996****		*729*		*795*	
			Chi2(1) = 38.637 Pr = 0.000		Chi2(1) = 0.129 Pr = 0.719		Chi2(1) = 0.133 Pr = 0.715	
GP consultation in last 12 months								
No	210	15%	53	2%	50	6%	94	11%
Yes	1,237	85%	3,077	98%	733	94%	739	89%

Total	*1,447*		*3,130****		*783****		*833**	
			Chi2(1) = 300.262 Pr = 0.000		Chi2(1) = 32.581 Pr = 0.000		Chi2(1) = 4.768 Pr = 0.029	
Dentures								
No	1,028	71%	2,045	65%	512	65%	589	71%
Yes	420	29%	1,091	35%	271	35%	244	29%
Total	*1,448*		3,136***		783**		833	
			Chi2(1) = 14.998 Pr = 0.000		Chi2(1) = 7.468 Pr = 0.006		Chi2(1) = 0.021 Pr = 0.885	
Dental problem [a]								
No	1,102	76%	2,053	66%	584	75%	610	74%
Yes	341	24%	1,062	34%	198	25%	219	26%
Total	1,443		*3,11***5*		*782*		*829*	
			Chi2(1) = 50.659 Pr = 0.000		Chi2(1) = 0.788 Pr = 0.375		Chi2(1) = 2.200 Pr = 0.138	
Dental health status								
Fair/ poor	354	24%	963	31%	190	24%	210	25%
Good	590	41%	1,303	42%	329	42%	349	42%
Very good/ excellent	504	35%	868	28%	263	34%	274	33%
Total	*1,448*		*3,134****		*782*		*833*	
			Chi2(2) = 30.477 Pr = 0.000		Chi2(2) = 0.425 Pr = 0.809		Chi2(2) = 0.862 Pr = 0.650	

[#] Characteristic at survey one

[a] This is a combination variable that captures those who have a dental health problem and/ avoid foods due to their dental health.

Statistical significance:* p<0.05; ** p<0.01; *** p<0.001

Source: derived from ALSWH data

Appendix B3: Results for logit model

Table 28 - Logit model results for all non-target/ target groups difference-in-difference analyses, all models

	Analysis 1		Analysis 2	
Dependent variable: 1 = dental consultation in last 12 months	Model 4.1	Model 4.2	Model 4.3	Model 4.4
	(Primary)	(Secondary)	(Primary)	(Secondary)
Survey (base - Survey 3)				
Survey 4	1.189***	n/a	1.223***	n/a
	(0.062)		(0.058)	
Survey 5	1.338***	Base survey	1.352***	Base survey
	(0.072)		(0.066)	
Survey 6	1.668***	1.246**	1.554***	1.202*
	(0.144)	(1.011)	(0.105)	(0.098)
Survey 7	1.790***	1.316**	1.783***	1.33**
	(0.154)	(0.109)	(0.135)	(0.12)
Target group (CDDS eligible; post period)	0.976	0.990	n/a	n/a
	(0.094)	(0.093)		
Target_5 group (CDDS eligible; post period)	n/a	n/a	1.023	0.957
			(0.079)	(0.097)
Target_6 group (CDDS eligible; post period)	n/a	n/a	0.978	0.945
			(0.105)	(0.137)
Target_7 group (CDDS eligible; post_7 period)	n/a	n/a	0.946	1.043
			(0.110)	(0.147)
Geographical location ARIA (base - major city)				
Inner regional	0.964	0.887	0.865^	0.873
	(0.087)	(0.151)	(0.075)	(0.138)
Outer regional, rural, remote	0.793^	0.687^	0.807^	0.686^
	(0.098)	(0.149)	(0.100)	(0.145)
Married	0.998	1.272	0.999	1.145
	(0.087)	(0.189)	(0.089)	(0.173)
PHI status (base - no PHI)				
Ancillary only	1.352*	1.172	1.336*	1.273
	(0.203)	(0.275)	(0.182)	(0.286)
Hospital only	1.196	1.273	1.151	1.214

	(0.152)	(0.255)	(0.134)	(0.241)
Comprehensive - hospital and ancillary	1.753***	1.606**	1.881***	1.958***
	(0.186)	(0.288)	(0.183)	(0.323)
Financial management (base - no financial difficulty)				
Limited financial difficulty	0.854**	0.851^	0.853*	0.861
	(0.052)	(0.082)	(0.0522)	(0.079)
Financial difficulty or stress	0.736**	0.798^	0.745***	0.828^
	(0.055)	(0.092)	(0.054)	(0.096)
Concessional	0.976	0.934	1.013	0.902
	(0.053)	(0.075)	(0.054)	(0.070)
GP consult in last 12 months	1.392***	1.352*	1.404***	1.525**
	(0.112)	(0.174)	(0.107)	(0.201)
Smoker	0.824	0.662^	0.795^	0.637*
	(0.098)	(0.145)	(0.095)	(0.145)
Dental health status (base-poor/fair)				
Good		1.486***		1.411***
		(0.124)		(0.114)
Very good/ excellent		2.601***		2.493***
		(0.267)		(0.260)
Dental health problem		2.592***		2.432***
		(0.196)		(0.177)
Observations	16,963	6,983	17,338	7,242
Number of women	3,580	2,408	3,654	2,483

Coefficient results presented in odds ratios, n/a: not applicable
Bootstrapped standard errors in parentheses *** p<0.001, ** p<0.01, * p<0.05, ^ p<0.1
Primary models have pre-CDDS surveys 3 to 5; do not include dental health variables. Secondary models have pre-CDDS survey 5 only; includes the dental health control variables.
Source: derived from ALSWH data

Appendix B4: Hausman tests

Table 29 - Hausman test for Model 4.1 (target/non-target, primary model)

	Coefficients			
	(b)	(B)	(b-B)	sqrt(diag(V_b-V_B))
	LPM_FE_D	LPM_RE_D	Difference	S.E.
Survey				
Survey 4	0.026	0.025	0.000	0.001
Survey 5	0.044	0.042	0.002	0.001
Survey 6	0.069	0.064	0.005	0.001
Survey 7	0.083	0.080	0.003	0.002
Target group (CDDS eligible; post period)	0.000	0.003	-0.003	0.001
Geographical location ARIA (base - major city)				
Inner regional	-0.002	-0.033	0.031	0.011
Outer regional, rural, remote	-0.033	-0.070	0.037	0.014
Married	-0.003	-0.019	0.016	0.010
PHI status (base - no PHI)				
Ancillary only	0.060	0.131	-0.071	0.015
Hospital only	0.035	0.095	-0.061	0.013
Hospital and ancillary	0.088	0.180	-0.092	0.013
Financial management (base - no financial difficulty)				
Limited financial difficulty	-0.022	-0.033	0.012	0.004
Financial difficulty or stress	-0.043	-0.073	0.029	0.006
Concessional	-0.004	-0.025	0.021	0.004
GP consult in last 12 months	0.060	0.079	-0.020	0.005
Smoker	-0.030	-0.056	0.026	0.013
Chi2(16) = 149.3 Prob>chi2 = 0.0000 Source: derived from ALSWH data				

Table 30 - Hausman test for Model 4.2 (target/non-target, secondary model)

	Coefficients			
	(b)	(B)	(b-B)	sqrt(diag(V_b-V_B))
	LPM_FE_D	LPM_RE_D	Difference	S.E.
Survey				
Survey 6	0.027	0.024	0.003	0.001
Survey 7	0.036	0.032	0.004	0.002
Target group (CDDS eligible; post period)	0.000	0.003	-0.003	0.001
Geographical location ARIA (base - major city)				
Inner regional	-0.019	-0.038	0.018	0.019
Outer regional, rural, remote	-0.060	-0.072	0.011	0.025
Married	0.029	-0.010	0.039	0.019
PHI status (base - no PHI)				
Ancillary only	0.042	0.136	-0.094	0.026
Hospital only	0.048	0.092	-0.044	0.024
Hospital and ancillary	0.070	0.177	-0.106	0.022
Financial management (base - no financial difficulty)				
Limited financial difficulty	-0.017	-0.027	0.010	0.007
Financial difficulty or stress	-0.026	-0.070	0.043	0.010
Concessional	-0.008	-0.029	0.021	0.007
GP consult in last 12 months	0.047	0.067	-0.020	0.010
Smoker	-0.058	-0.071	0.013	0.024
Dental health status (base-poor/fair)				
Good	0.056	0.085	-0.029	0.007
Very good/ excellent	0.131	0.162	-0.031	0.010
Dental health problem	0.126	0.150	-0.025	0.005
Chi2(17) = 115.21 Prob>chi2 = 0.0000 Source: derived from ALSWH data				

Table 31 - Hausman test for Model 4.3 (alternative non-target/target groups, primary model)

	Coefficients			
	(b)	(B)	(b-B)	sqrt(diag(V_b-V_B))
	LPM_FE_D	LPM_RE_D	Difference	S.E.
Survey				
Survey 4	0.031	0.031	0.000	0.001
Survey 5	0.045	0.044	0.001	0.001
Survey 6	0.064	0.062	0.002	0.001
Survey 7	0.083	0.082	0.001	0.002
Target_5 group (CDDS eligible; post period)	0.003	0.005	-0.002	0.001
Target_6 group (CDDS eligible; post period)	-0.002	-0.004	0.002	0.002
Target_7 group (CDDS eligible; post_7 period)	-0.006	-0.011	0.004	0.002
Geographical location ARIA (base - major city)				
Inner regional	-0.019	-0.038	0.019	0.011
Outer regional, rural, remote	-0.029	-0.066	0.037	0.015
Married	-0.002	-0.018	0.017	0.010
PHI status (base - no PHI)				
Ancillary only	0.061	0.137	-0.076	0.015
Hospital only	0.031	0.092	-0.061	0.013
Hospital and ancillary	0.103	0.187	-0.084	0.013
Financial management (base - no financial difficulty)				
Some financial difficulty	-0.021	-0.034	0.013	0.004
Financial stress	-0.042	-0.074	0.031	0.006
Concessional	0.001	-0.021	0.021	0.004
GP consult in last 12 months	0.060	0.081	-0.021	0.005
Smoker	-0.036	-0.056	0.020	0.013
Chi2(18) = 148.04 Prob>chi2 = 0.0000 Source: derived from ALSWH data				

Table 32 - Hausman test for Model 4.4 (alternative non-target/target groups, secondary model)

	Coefficients			
	(b)	(B)	(b-B)	sqrt(diag(V_b-

				V_B))
	LPM_FE_D	LPM_RE_D	Difference	S.E.
Survey				
Survey 6	0.024	0.023	0.001	0.002
Survey 7	0.038	0.035	0.003	0.002
Target_5 group (CDDS eligible; post period)	-0.004	-0.002	-0.002	0.002
Target_6 group (CDDS eligible; post period)	0.000	-0.006	0.005	0.003
Target_7 group (CDDS eligible; post_7 period)	0.004	-0.002	0.006	0.004
Geographical location ARIA (base - major city)				
Inner regional	-0.021	-0.037	0.016	0.019
Outer regional, rural, remote	-0.051	-0.063	0.012	0.026
Married	0.013	-0.017	0.030	0.019
PHI status (base - no PHI)				
Ancillary only	0.055	0.139	-0.084	0.026
Hospital only	0.053	0.088	-0.035	0.024
Hospital and ancillary	0.107	0.184	-0.077	0.022
Financial management (base - no financial difficulty)				
Some financial difficulty	-0.017	-0.033	0.016	0.007
Financial stress	-0.022	-0.071	0.049	0.010
Concessional	-0.012	-0.031	0.019	0.007
GP consult in last 12 months	0.068	0.082	-0.014	0.010
Smoker	-0.062	-0.062	0.000	0.024
Dental health status (base-poor/fair)				
Good	0.051	0.086	-0.036	0.007
Very good/ excellent	0.127	0.164	-0.038	0.010
Dental health problem	0.118	0.142	-0.024	0.005
Chi2(19) = 115.15 Prob>chi2 = 0.0000 Source: derived from ALSWH data				

Appendix C – Appendix to Chapter 5

Appendix C1: Chi Square test of the difference between groups

Chi Square difference between groups, poor dental health status

The vulnerable/eligible group are eligible for the CDDS and report poor/ fair dental health status. In contrast, the Base case group is not eligible for the CDDS and they report better dental health status than the vulnerable/eligible group. The vulnerable/eligible group is less socioeconomically advantaged than the Base case group. Compared to the Base case group, the vulnerable/eligible group is less likely to be married or in a de-facto relationship (72% vs 84%); is nearly twice as likely to report no formal education (17% vs 9%) and less likely to report a degree or higher qualification (13% vs 21%); is less likely to be employed (60% vs 77%); is nearly three times more likely to report being financially stressed (51% vs18%); and is nearly three times more likely to report being concessional (38% vs 13%). In terms of health status and behaviours those in the vulnerable/eligible group are less likely to report coverage with comprehensive PHI (45% vs 62%); are exceedingly more likely to report poor or fair health status (29% vs 1%); are nearly three times more likely to smoke (14% vs 5%); are more likely to be in an unhealthy weight range (69% vs53%); are more likely to report nil to low exercise levels (51% vs 34%); and are much more likely to report a GP consultation (99% vs 88). Those in the vulnerable/eligible group report poorer dental health status across all three of the dental health variables, with those in the vulnerable/eligible group more likely to report dentures (43% vs 24%); more four times likely to report a dental problem (56% vs 14%); and, as is expected, there is a complete difference between the groups for the self-rated dental health variable (Table 33).

Table 33 – Comparison of characteristics between vulnerable/eligible (poor dental health status) and base case group

	Vulnerable/eligible group CDDS eligible; poor DHS		Base case group; Not CDDS eligible; good DHS		
Characteristic/ Category	**N**	**%**	**N**	**%**	**Statistical significance**
Country of birth[#]					
Australian born	947	78%	976	75%	
Other English speaking	172	14%	206	16%	
Europe	71	6%	95	7%	
Asia	10	1%	24	2%	
Other	9	1%	8	1%	
Total	1,209		1,309		Chi2(4) = 8.832 Pr = 0.065
Language spoken at home[#]					
English, Aust	1,155	96%	1,242	96%	
European	34	3%	43	3%	
Asian	6	1%	8	1%	
Other	5	0%	7	1%	
Total	*1,200*		*1,300*		*Chi2(3) = 0.830 Pr = 0.842*
ARIA					
Major city	442	36%	535	41%	
Inner regional	489	40%	488	37%	
Outer regional	283	23%	291	22%	
Total	*1,214*		*1,314*		*Chi2(2) = 5.017 Pr = 0.081*
Marital status					
Not married	335	28%	216	16%	
Married or de-facto	873	72%	1,097	84%	
Total	*1,208*		*1,313****		*Chi2(1) = 46.879 Pr = 0.000*
Education[#]					
No formal	209	17%	120	9%	
High school	600	50%	654	50%	
Trade/ apprenticeship/ diploma	241	20%	262	20%	
Degree and higher	161	13%	273	21%	
Total	*1,211*		*1,309****		*Chi2(3) = 52.45 Pr = 0.000*

Employment					
Not in labour force/ unemployed	484	40%	302	23%	
Part time or full time	728	60%	1,013	77%	
Total	*1,212*		*1,315****		*Chi2(1) = 84.739 Pr = 0.000*
Financial management					
No financial stress	155	13%	400	30%	
Not too bad	439	36%	679	52%	
Financially stressed	621	51%	234	18%	
Total	*1215*		*1,313****		*Chi2(2) = 331.541 Pr = 0.000*
Concession card					
No	746	62%	1,144	87%	
Yes	467	38%	165	13%	
Total	*1,213*		*1,309****		*Chi2(1) = 224.793 Pr = 0.000*
PHI Status					
None	503	41%	499	38%	
Ancillary only	52	4%	43	3%	
Hospital only	117	10%	187	14%	
Comprehensive – both hospital and ancillary	542	45%	815	62%	
Total	*1,215*		*1,314****		*Chi2(3) = 139.082 Pr = 0.000*
Health Status					
Fair / poor	349	29%	17	1%	
Good	553	46%	268	20%	
Very good/ excellent	313	26%	1,023	78%	
Total	*1,215*		*1,308****		*Chi2(2) = 775.038 Pr = 0.000*
Alcohol intake					
High risk drinker	80	7%	71	5%	
Low risk drinker	1,124	93%	1,236	95%	
Total	*1,204*		*1,307*		*Chi2(1) = 1.629 Pr = 0.202*
Smoking status					
Smoker	176	14%	71	5%	
Non/ ex-smoker	1,038	86%	1,244	95%	
Total	*1,214*		*1,315****		*Chi2(1) = 59.293 Pr = 0.000*
Weight range					

Unhealthy weight range	814	69%	686	53%	
Healthy weight range	372	31%	608	47%	
Total	*1,186*		*1,294****		*Chi2(1) = 63.172 Pr = 0.000*
Exercise level					
Low to nil	583	51%	426	34%	
Moderate to high	570	49%	827	66%	
Total	*1,153*		*1,253****		*Chi2(1) = 67.669 Pr = 0.00*
GP consultation in last 12 months					
No	18	1%	160	12%	
Yes	1,195	99%	1,154	88%	
Total	*1,213*		*1,314****		*Chi2(1) = 110.136 Pr = 0.000*
Dentures					
No	689	57%	1,003	76%	
Yes	529	43%	313	24%	
Total	*1218*		*1,316****		*Chi2(1) = 110.057 Pr = 0.000*
Dental problem [a]					
No	529	44%	1,120	86%	
Yes	678	56%	189	14%	
Total	*1,207*		*1,309****		*Chi2(1) = 484.277 Pr = 0.00*
Dental health status					
Fair/ poor	1,218	100%	0	0%	
Good	0	0%	622	47%	
Very good/ excellent	0	0%	695	53%	
Total	*1,218*		*1,317****		

[#] Characteristic at survey one

[a] This is a combination variable that captures those who have a dental health problem and/ avoid foods due to their dental health

Statistical significance:* p<0.05; ** p<0.01; *** p<0.001

Source: derived from ALSWH data

Chi square test of differences between groups – dental problem

The vulnerable/eligible group is eligible for the CDDS and report the presence of a dental health problem. In contrast, the Base case group is not eligible for the CDDS and do not report a dental problem. There are differences between the groups in regard to socioeconomic status, with the vulnerable/eligible group less socioeconomically advantaged. The vulnerable/eligible group is less likely to be married or in a de-facto relationship (74% vs 84%); is more likely to report no formal education (15% vs 10%); is less likely to report being employed (63% vs 76%); is twice as likely to report financial stress (46% vs 20%); is twice as likely to report being concessional (34% vs 14%); and is less likely to be covered with comprehensive PHI (53% vs 59%). Regarding health status and behaviours, the Target group is exceedingly more likely to report poor or fair health status (23% vs 2%); is more likely to smoke (11% vs 7%); is more likely to report an unhealthy weight range (64% vs 54%); is more likely to report low to nil exercise (48% vs 35%); and is far more likely to report a GP consultation (98% vs 87%). Across all three dental health variables there are statistically significant differences, with those in the vulnerable/eligible group more likely to report dentures (38% vs 27%); have a dental problem (which is a given); and over three times more likely to report poor or fair dental health status (51% vs 13%) (Table 34).

Table 34 - Comparison of characteristics between vulnerable/eligible (dental problem) and base case group

	Vulnerable/eligible group CDDS eligible; dental problem		Base case group Not CDDS eligible; no dental problem		Statistical significance
Characteristic/ category	**N**	**%**	**N**	**%**	
Country of birth[#]					
Australian born	1,029	77%	882	76%	
Other English Speaking	194	15%	170	15%	
Europe	73	5%	80	7%	
Asia	25	2%	17	1%	
Other	14	1%	5	0%	
Total	*1,335*		*1,154*		Chi2(4) = 5.866 Pr = 0.209
Language spoken at home[#]					
English, Aust	1,270	96%	1,093	96%	
European	40	3%	39	3%	
Asian	12	1%	7	1%	
Other	4	0%	4	0%	
Total	*1,326*		*1,143*		*Chi2(3) = 0.996 Pr = 0.802*
ARIA					
Major city	527	39%	455	39%	
Inner regional	532	40%	441	38%	
Outer regional	284	21%	264	23%	
Total	*1,343*		*1,160*		Chi2(2) = 1.146 Pr = 0.564
Marital status					
Not married	349	26%	183	16%	
Married or de-facto	986	74%	974	84%	
Total	*1,335*		*1,157****		*Chi2(1) = 39.357 Pr = 0.000*
Education[#]					
No formal	202	15%	115	10%	
High school	624	47%	593	51%	
Trade/ apprenticeship/ diploma	288	21%	232	20%	
Degree and higher	226	17%	214	19%	
Total	*1,340*		*1,154***		*Chi2(3) = 17.249 Pr = 0.001*

Employment					
Not in labour force/ unemployed	493	37%	282	24%	
Part time or full time	846	63%	877	76%	
Total	*1,339*		*1,159****		*Chi2(1) = 45.269 Pr = 0.000*
Financial Stress					
No financial stress	213	16%	329	28%	
Some difficulty	516	38%	593	51%	
Financially stressed	615	46%	235	20%	
Total	*1,344*		*1,157****		*Chi2(2) = 187.119 Pr = 0.000*
Concession card					
No	892	66%	994	86%	
Yes	450	34%	159	14%	
Total	*1,342*		*1,153****		Chi2(1) = 131.0 Pr = 0.000
PHI Status					
None	442	33%	273	24%	
Ancillary only	64	5%	32	3%	
Hospital only	119	9%	167	14%	
Comprehensive - both hospital and ancillary	716	53%	685	59%	
Total	*1,342*		*1,157***		*Chi2(3) = 46.051 Pr = 0.000*
Health Status					
Poor / fair	302	23%	21	2%	
Good	592	44%	266	23%	
Very good/ excellent	448	33%	866	75%	
Total	*1,342*		*1,153****		Chi2(2) = 489.791 Pr = 0.000
Alcohol intake					
High risk drinker	85	6%	67	6%	
Low risk drinker	1,248	94%	1,084	94%	
Total	*1,333*		*1,151*		Chi2(1) = 0.332 Pr = 0.565
Smoking status					
Smoker	141	11%	82	7%	
Non/ ex-smoker	1,198	89%	1,077	93%	
Total	*1,339*		*1,159***		Chi2(1) = 9.123 Pr = 0.003

Weight range					
Unhealthy weight range	840	64%	614	54%	
Healthy weight range	472	36%	526	46%	
Total	*1,312*		*1,140****		Chi2(1) = 26.113 Pr = 0.000
Exercise level					
Low to nil	607	48%	89	35%	
Moderate to high	667	52%	714	65%	
Total	*1,274*		*1,103****		*Chi2(1) = 37.205 Pr = 0.000*
GP consultation in last 12 months					
No	27	2%	147	13%	
Yes	1,309	98%	1,012	87%	
Total	*1,336*		*1,159****		Chi2(1) = 108.754 Pr = 0.000
Dentures					
No	830	62%	848	73%	
Yes	515	38%	312	27%	
Total	1,345		*1,160****		*Chi2(1) = 36.559 Pr = 0.000*
Dental problem [a]					
No	0		1,161		
Yes	1,346		0		
Total	*1,346*		*1,161****		Chi2(1) = 2.5e+03 Pr = 0.000
Dental health status					
Fair/ poor	678	51%	145	13%	
Good	504	38%	497	43%	
Very good/ excellent	159	12%	517	45%	
Total	*1,341*		*1,159****		*Chi2(2) = 524.357 Pr = 0.000*

[#]Characteristic at survey one

[a] This is a combination variable that captures those who have a dental health problem and/ avoid foods due to their dental health

Statistical significance: * p<0.05; ** p<0.01; *** p<0.001

Source: derived from ALSWH data

Chi square test of differences between groups – financial hardship

The vulnerable/eligible group is eligible for the CDDS and report financial hardship. In contrast, the Base case group is not eligible for the CDDS and do not reporting any financial difficulty or stress. Unsurprisingly, the vulnerable/eligible group is less socially socioeconomically advantaged than the Base case group. Those in the vulnerable/eligible group are less likely to be married or in a de-facto relationship (68% vs 86%); are far more likely to report no formal education (19% vs 7%) and are half as likely to report a degree or higher qualification (11% vs 22%); are less likely to report being employed (59% vs 74%); are four times more likely to be concessional (46% vs 11%); and are less likely to be covered by comprehensive PHI (42% vs 64%). In regard to health status and health behaviours, those in the vulnerable/eligible group are eight times more likely to report poor or fair health status (25% vs 3%); are twice as likely to smoke (14% vs 6%); are more likely to report an unhealthy weight range (71% vs 50%); and are more likely to report a GP consultation (98% vs 87%). Those in the vulnerable/eligible group are more likely to report poorer dental health across the three dental health variables. They are more likely to report dentures (39% vs 25%); are more likely to report a dental problem (39% vs 25%); and are almost twice as likely to report poor or fair dental health status (39% vs 20%). There are also statistically significant differences in regard to: country of birth; language spoken at home, with a marginal but significant difference observed; and geographic location, with the vulnerable/eligible group less likely to report living in a major city (35% vs 41%) (Table 35).

Table 35 - Comparison of characteristics between vulnerable/eligible (financial hardship) and base case group

	Vulnerable/eligible group CDDS eligible; financial difficulty or stress		Base case group Not CDDS eligible; No financial difficulty or stress		
Characteristic/ category	**N**	**%**	**N**	**%**	**Statistical significance**
Country of birth[#]					
Australian born	1,268	80%	968	74%	
Other English speaking	208	13%	194	15%	
Europe	78	5%	94	7%	
Asia	17	1%	39	3%	
Other	11	1%	5	0%	
Total	1,582		1,300***		Chi2(4) = 25.773 Pr = 0.000
Language spoken at home[#]					
English, Aust	1,512	96%	1,226	95%	
European	49	3%	41	3%	
Asian	5	0%	17	1%	
Other	8	1%	7	1%	
Total	*1,574*		*1,291**		*Chi2(3) = 9.334 Pr = 0.025*
ARIA					
Major city	552	35%	529	41%	
Inner regional	673	42%	483	37%	
Outer regional	366	23%	293	22%	
Total	*1,591*		*1,305***		*Chi2(2) = 11.674 Pr = 0.003*
Marital status					
Not married	513	32%	186	14%	
Married or de-facto	1,073	68%	1,118	86%	
Total	*1,586*		*1,304****		*Chi2(1) = 127.596 Pr = 0.000*
Education[#]					
No formal	297	19%	96	7%	
High school	815	51%	603	46%	
Trade/ apprenticeship/ diploma	300	19%	312	24%	
Degree and higher	172	11%	288	22%	
Total	*1,584*		*1,299****		*Chi2(3) = 137.151 Pr = 0.000*

Employment					
Not in labour force/ unemployed	656	41%	335	26%	
Part time or full time	931	59%	970	74%	
Total	*1,587*		*1,305****		*Chi2(1) = 78.021 Pr = 0.000*
Financial management					
No financial stress	0	0%	521	40%	
Not too bad	0	0%	786	60%	
Financially stressed	1,596	100%	0		
Total	*1596*		*1,307****		*Chi2(2) = 2.9e+03 Pr = 0.000*
Concession card					
No	856	54%	1,159	89%	
Yes	734	46%	143	11%	
Total	*1,590*		*1,302****		*Chi2(1) = 419.309 Pr = 0.000*
PHI Status					
None	724	45%	238	18%	
Ancillary only	69	4%	40	3%	
Hospital only	132	8%	197	15%	
Comprehensive – both hospital and ancillary	664	42%	829	64%	
Total	*1,590*		*1,304****		*Chi2(3) = 258.753 Pr = 0.000*
Health Status					
Fair / poor	392	25%	34	3%	
Good	729	46%	298	23%	
Very good/ excellent	472	30%	972	75%	
Total	*1,593*		*1,304****		*Chi2(2) = 632.324 Pr = 0.000*
Alcohol intake					
High risk drinker	107	7%	76	6%	
Low risk drinker	1,474	93%	1,224	94%	
Total	*1,581*		*1,300*		*Chi2(1) = 1.019 Pr = 0.313*
Smoking status					
Smoker	222	14%	83	6%	
Non/ ex-smoker	1,370	86%	1,219	94%	
Total	*1,592*		*1,302****		*Chi2(1) = 43.531 Pr = 0.000*
Weight range					

Unhealthy weight range	1,109	71%	644	50%	
Healthy weight range	446	29%	643	50%	
Total	*1,555*		*1,287****		*Chi2(1) = 134.910 Pr = 0.000*
Exercise level					
Low to nil	757	50%	422	34%	
Moderate to high	770	50%	825	66%	
Total	*1,527*		*1,247****		*Chi2(1) = 69.529 Pr = 0.000*
GP consultation in last 12 months					
No	28	2%	173	13%	
Yes	1,564	98%	1,130	87%	
Total	*1,592*		*1,303****		*Chi2(1) = 147.135 Pr = 0.000*
Dentures					
No	976	61%	980	75%	
Yes	619	39%	326	25%	
Total	*1,595*		*1,306****		*Chi2(1) = 62.685 Pr = 0.000*
Dental problem [a]					
No	967	61%	990	76%	
Yes	615	39%	305	24%	
Total	*1,582*		*1,295****		*Chi2(1) = 76.862 Pr = 0.000*
Dental health status					
Fair/ poor	621	39%	264	20%	
Good	607	38%	551	42%	
Very good/ excellent	362	23%	490	38%	
Total	*1,590*		*1,305****		*Chi2(2) = 139.241 Pr = 0.000*

[#]Characteristic at survey one

[a] This is a combination variable that captures those who have a dental health problem and/ avoid foods due to their dental health

Statistical significance: * p<0.05; ** p<0.01; *** p<0.001

Source: derived from ALSWH data

Chi square test of differences between groups - any vulnerability analysis

The vulnerable/eligible group is eligible for the CDDS and report any one of the aforementioned vulnerability status characteristics: poor dental health status, a dental health problem or financial hardship. In contrast, the Base case group are not eligible for the CDDS and do not report any of the vulnerabilities. The vulnerable/eligible group is less socioeconomically advantaged than the Base case group. Those in the vulnerable/eligible group are less likely to be married or in a de-facto relationship (73% vs 87%); are twice as likely to report no formal education (16% vs 8%) and are less likely to report a degree or higher qualification (15% vs 22%); are less likely to be employed (62% vs 74%); are three times more likely to be concessional (36% vs 11%); and are less likely to be covered by comprehensive PHI (50% vs 65%). Regarding health status and health behaviours, those in the vulnerable/eligible group are very much more likely to report poor or fair health status (22% vs 1%); are far more likely to smoke (12% vs 5%); are more likely to report an unhealthy weight range (68% vs 49%); are more likely to report low to nil exercise levels (48% vs 33%); and are more likely to report a GP consultation (98% vs 88%). Given that the vulnerable/eligible group include any vulnerability there are expected differences regarding dental health status and a dental problem. Additionally, the vulnerable/eligible group are more likely to report dentures (38% vs 22%). There are also differences in geographic location, with the vulnerable/eligible group less likely to live in a major city (36% vs 42%) (Table 36).

Table 36 - Comparison of characteristics between vulnerable/eligible (any vulnerability) and base case group

	Vulnerable/eligible group CDDS eligible; any vulnerability		Base case group Not CDDS eligible; no vulnerability		Statistical significance
Characteristic/ category	**N**	**%**	**N**	**%**	
Country of birth					
Australian born	2,031	79%	450	76%	
Other English speaking	365	14%	91	15%	
Europe	133	5%	38	6%	
Asia	37	1%	12	2%	
Other	20	1%	2	0%	
Total	*2,586*		*593*		*Chi2(4) = 4.8056 Pr = 0.308*
Language spoken at home					
English, Aust	2,482	96%	566	96%	
European	70	3%	14	2%	
Asian	13	1%	5	1%	
Other	9	0%	3	1%	
Total	*2,574*		*588*		*Chi2(3) = 1.536 Pr = 0.674*
ARIA					
Major city	950	36%	250	42%	
Inner regional	1,066	41%	212	36%	
Outer regional	589	23%	135	23%	
Total	*2,605*		*597**		*Chi2(2) = 7.352 Pr = 0.025*
Marital status					
Not married	691	27%	79	13%	
Married or de-facto	1,903	73%	516	87%	
Total	*2,594*		*595****		*Chi2(1) = 47.174 Pr = 0.000*
Education					
No formal	415	16%	49	8%	
High school	1,272	49%	295	50%	
Trade/ apprenticeship/ diploma	532	20%	116	20%	
Degree and higher	377	15%	132	22%	
Total	*2,596*		*592****		*Chi2(3) = 38.195 Pr = 0.000*

Employment					
Not in labour force/ unemployed	976	38%	153	26%	
Part time or full time	1,624	62%	444	74%	
Total	*2,600*		*597****		*Chi2(1) = 30.150 Pr = 0.000*
Financial management					
No financial stress	293	11%	260	44%	
Not too bad	720	28%	335	56%	
Financially stressed	1,596	61%	0	0%	
Total	*2609*		*595****		*Chi2(2) = 781.133 Pr = 0.000*
Concession card					
No	1,672	64%	530	89%	
Yes	933	36%	65	11%	
Total	*2,605*		*595****		*Chi2(1) = 139.838 Pr = 0.000*
PHI Status					
None	947	36%	104	17%	
Ancillary only	118	5%	12	2%	
Hospital only	246	9%	92	15%	
Comprehensive (hospital and ancillary)	1,293	50%	389	65%	
Total	*2,604*		*597****		*Chi2(3) = 99.276 Pr = 0.000*
Health Status					
Fair / poor	566	22%	6	1%	
Good	1,182	45%	108	18%	
Very good/ excellent	860	33%	481	81%	
Total	*2,608*		*595****		*Chi2(2) = 470.095 Pr = 0.000*
Alcohol intake					
High risk drinker	173	7%	30	5%	
Low risk drinker	2,415	93%	564	95%	
Total	*2,588*		*594*		*Chi2(1) = 2.160 Pr = 0.142*
Smoking status					
Smoker	308	12%	29	5%	
Non/ ex-smoker	2,296	88%	567	95%	
Total	*2,604*		*596****		*Chi2(1) = 24.950 Pr = 0.000*

Weight range					
Unhealthy weight range	1,731	68%	286	49%	
Healthy weight range	818	32%	302	51%	
Total	*2,549*		*588****		*Chi2(1) = 77.282 Pr = 0.000*
Exercise level					
Low to nil	1,183	48%	190	33%	
Moderate to high	1,302	52%	382	67%	
Total	*2,485*		*572****		*Chi2(1) = 38.91 Pr = 0.000*
GP consultation in last 12 months					
No	49	2%	72	12%	
Yes	2,553	98%	524	88%	
Total	*2,602*		*596****		*Chi2(1) = 138.515 Pr = 0.000*
Dentures					
No	1,628	62%	464	78%	
Yes	983	38%	133	22%	
Total	*2,611*		*597****		*Chi2(1) = 50.601 Pr = 0.000*
Dental problem [a]					
No	1,247	48%	593	100%	
Yes	1,346	52%	0		
Total	*2,593*		*593****		*Chi2(1) = 532.998 Pr = 0.000*
Dental health status					
Fair/ poor	1,218	47%	0	0%	
Good	919	35%	250	42%	
Very good/ excellent	468	18%	348	58%	
Total	*2,605*		*598****		*Chi2(2) = 594.23 Pr = 0.000*

[#]Characteristic at survey one

[a] This is a combination variable that captures those who have a dental health problem and/ avoid foods due to their dental health

Statistical significance: * p<0.05; ** p<0.01; *** p<0.001

Source: derived from ALSWH data

Appendix C2: Results – logit model

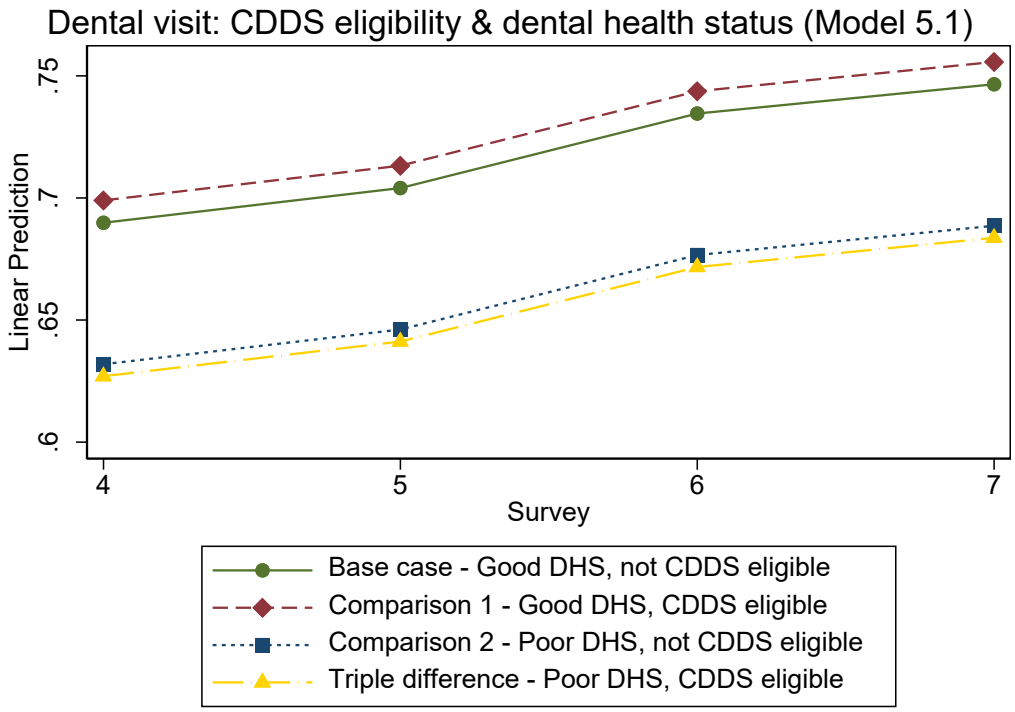
Table 37 Logit model results for all vulnerability groups heterogeneity analyses, all models

	Poor dental status		Dental problem		Financial hardship		Any Vulnerability
Dependent variable = dental consultation in last 12 months	Model 5.1	Model 5.2	Model 5.3	Model 5.4	Model 5.5	Model 5.6	Model 5.7
	(Primary)	(Secondary)	(Primary)	(Secondary)	(Primary)	(Secondary)	(Primary)
Survey (base - survey 3)							
Survey 4	1.186***		1.170**		1.138*		1.162**
	(0.062)		(0.066)		(0.060)		(0.062)
Survey 5	1.338***	Base	1.455***	Base	1.328***	Base	1.370***
	(0.073)		(0.085)		(0.073)		(0.077)
Survey 6	1.668***	1.237*	1.578***	1.203^	1.815	1.376**	1.849***
	(0.145)	(0.127)	(0.141)	(0.127)	(0.160)	(0.148)	(0.218)
Survey 7	1.790***	1.309*	1.66***	1.230^	2.061***	1.464**	2.034***
	(0.154)	(0.137)	(0.155)	(0.132)	(0.187)	(0.162)	(0.242)
β_2 Comparison 1 group (CDDS eligible; not vulnerable, post period)	0.976	0.906	0.972	1.013	0.931	0.856	0.863
	(0.094)	(0.114)	(0.099)	(0.136)	(0.095)	(0.120)	(0.132)
β_3 Comparison 2 group (Not CDDS eligible; vulnerable, post period)	0.975	1.147	1.080	0.704^	0.838	0.812	0.846
	(0.133)	(0.216)	(0.150)	(0.132)	(0.108)	(0.147)	(0.115)
β_4 vulnerable/eligible group (CDDS eligible; vulnerable, post period)	1.105	1.212	0.846	0.976	1.061	1.387	1.172
	(0.181)	(0.273)	(0.148)	(0.227)	(0.168)	(0.307)	(0.204)
Geographical location ARIA (base – major city)							
Inner regional	1.024	0.929	0.988	0.898	0.950	0.846	1.007
	(0.102)	(0.172)	(0.102)	(0.164)	(0.094)	(0.161)	(0.101)
Outer regional, rural & remote	0.831	0.707	0.806	0.696	0.785	0.655^	0.851
	(0.109)	(0.165)	(0.112)	(0.162)	(0.103)	(0.156)	(0.113)
Married	0.890	1.124	0.986	1.063	0.935	1.218	0.942
	(0.088)	(0.183)	(0.101)	(0.185)	(0.098)	(0.202)	(0.094)
PHI Status (base – none)							
Ancillary only	1.389*	1.120	1.211	1.076	1.219	0.990	

	(0.232)	(0.316)	(0.209)	(0.300)	(0.204)	(0.298)	1.306
Hospital only	1.128	1.242	1.064	0.982	1.118	1.135	(0.225)
	(0.152)	(0.289)	(0.155)	(0.233)	(0.155)	(0.263)	1.171
Comprehensive – both hospital and ancillary	1.696***	1.547*	1.782***	1.510*	1.652***	1.507^	(0.161)
	(0.192)	(0.318)	(0.216)	(0.294)	(0.205)	(0.321)	1.871***
Financial management (base - no financial difficulty)							(0.226)
Some financial difficulty	0.841*	0.846^	0.855*	0.822^	N/a	N/a	N/a
	(0.057)	(0.085)	(0.061)	(0.086)			
Financial stress	0.735***	0.832	0.702***	0.729*	N/a	N/a	N/a
	(0.062)	(0.103)	(0.063)	(0.095)			
Concessional	1.028	1.007	1.022	0.968	0.968	0.916	0.961
	(0.059)	(0.092)	(0.065)	(0.091)	(0.058)	(0.085)	(0.058)
GP consult in last 12 month	1.443***	1.418*	1.432***	1.378*	1.333**	1.250	1.480***
	(0.127)	(0.201)	(0.139)	(0.204)	(0.111)	(0.180)	(0.138)
Smoker	0.827	0.556*	0.857	0.634^	0.838	0.679^	0.846
	(0.105)	(0.134)	(0.118)	(0.164)	(0.111)	(0.156)	(0.104)
Dental Status							
Good	N/a	N/a	N/a	1.313**	N/a	1.495***	N/a
				(0.128)		(0.136)	
Very good	N/a	N/a	N/a	2.186***	N/a	2.560***	N/a
				(0.263)		(0.294)	
Dental problem	N/a	2.324***	N/a	N/a	N/a	2.602***	N/a
		(0.188)				(0.208)	
Observations	13,790	5,728	12,508	5,165	13,932	5,760	13,380
Number of individuals	2,899	1,964	2,636	1,769	2,919	1,979	2,809
Bootstrapped standard errors in parentheses; Statistical significance: *** p<0.001, ** p<0.01, * p<0.05, ^ p<0.1 Source: derived from ALSWH data							

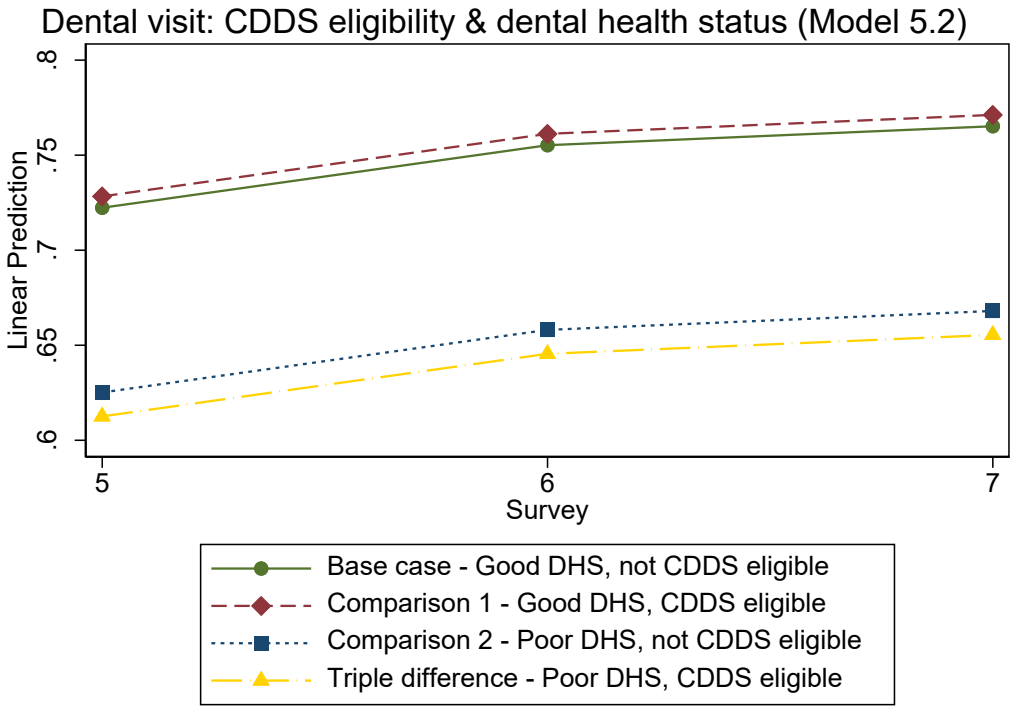
Appendix C3: Parallel trends

Figure 21 – Parallel trends for model 5.1



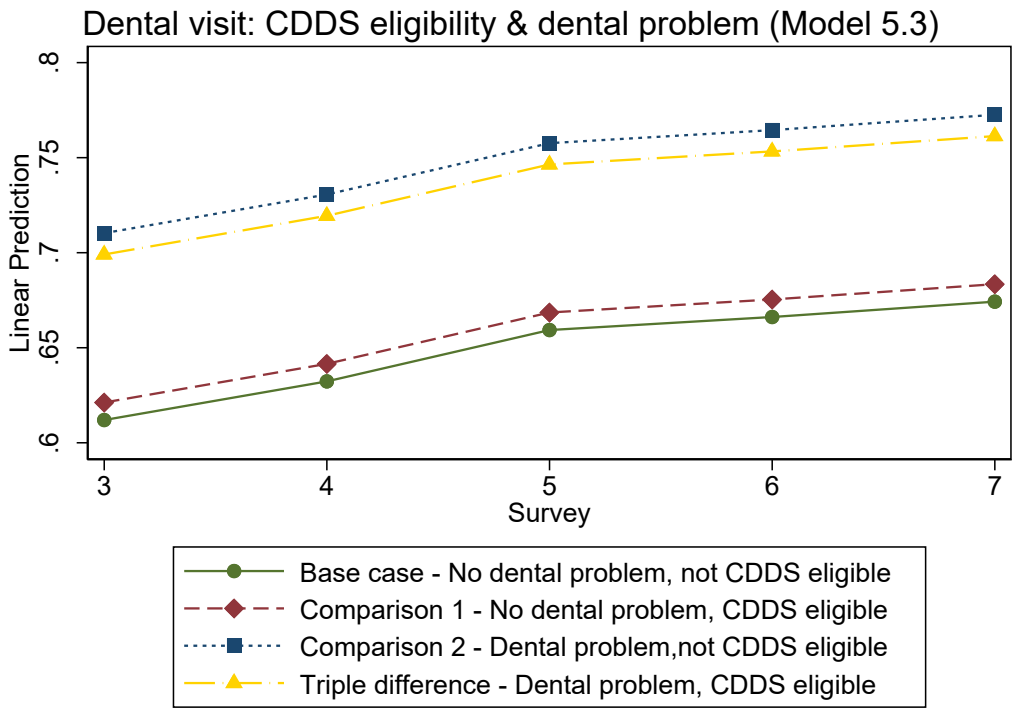
Source: derived from ALSWH data

Figure 22 - Parallel trends for model 5.2



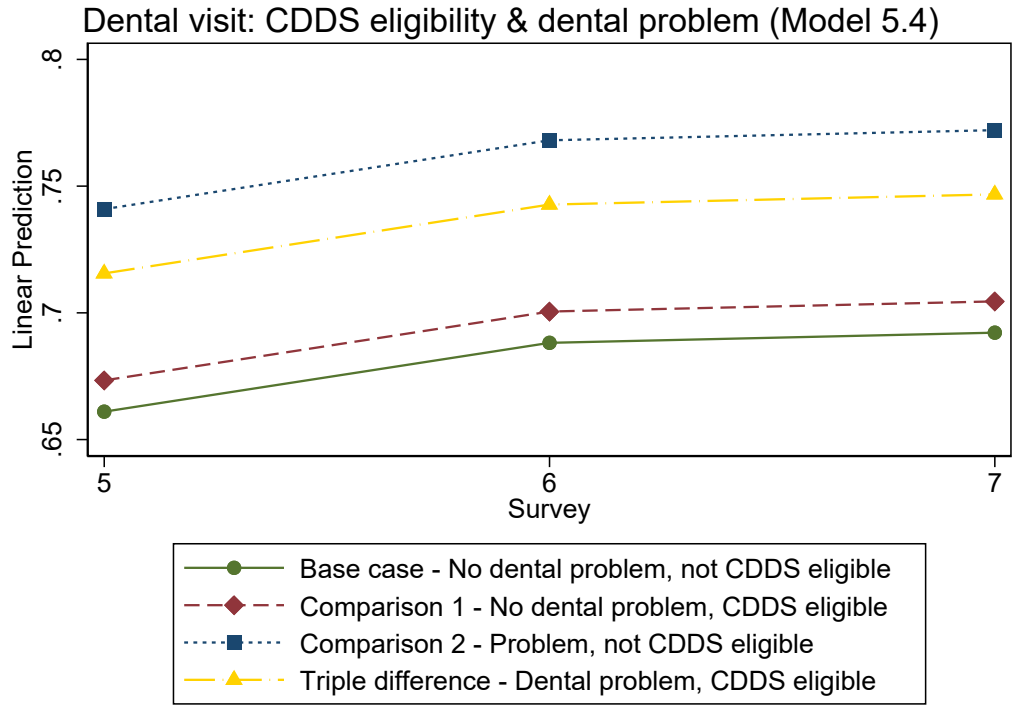
Source: derived from ALSWH data

Figure 23 - Parallel trends for model 5.3



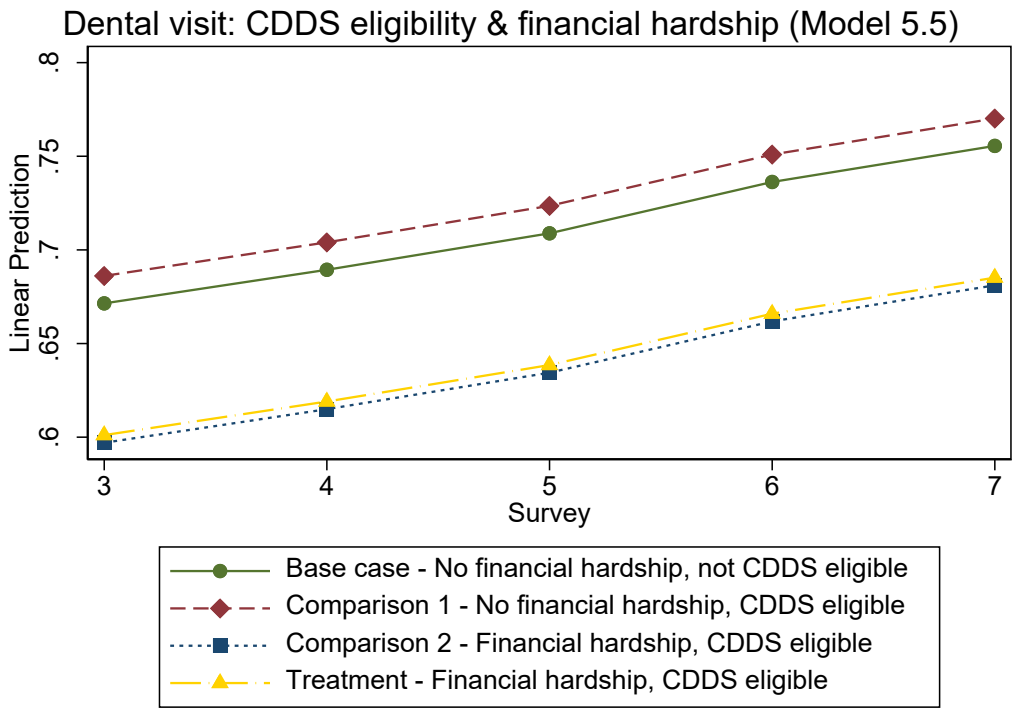
Source: derived from ALSWH data

Figure 24 - Parallel trends for model 5.4



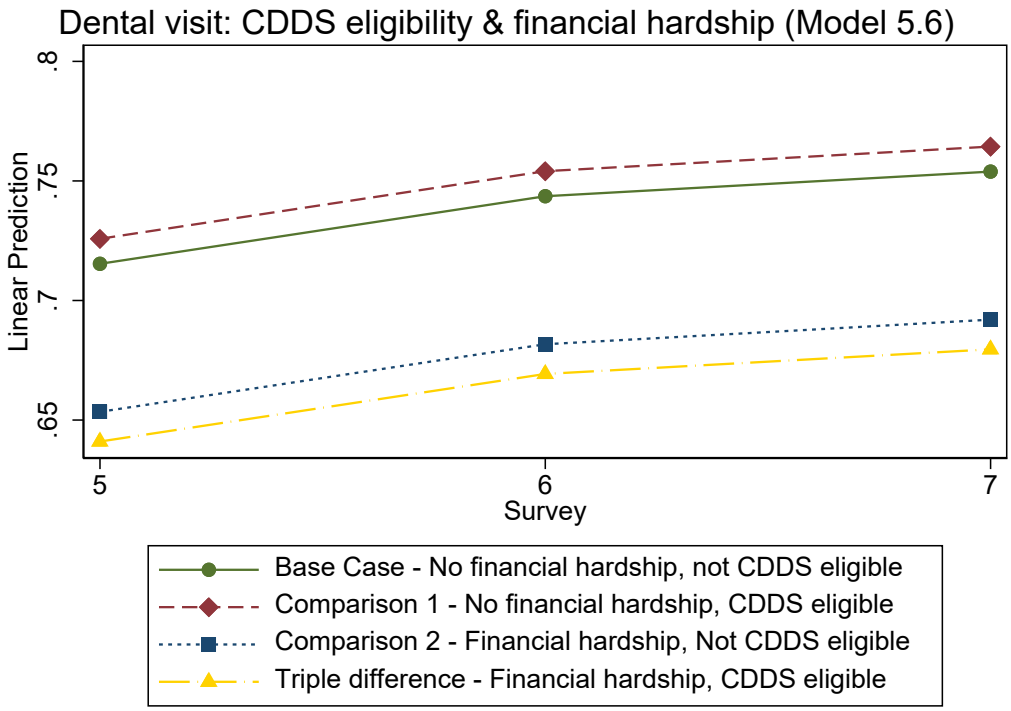
Source: derived from ALSWH data

Figure 25 - Parallel trends for model 5.5



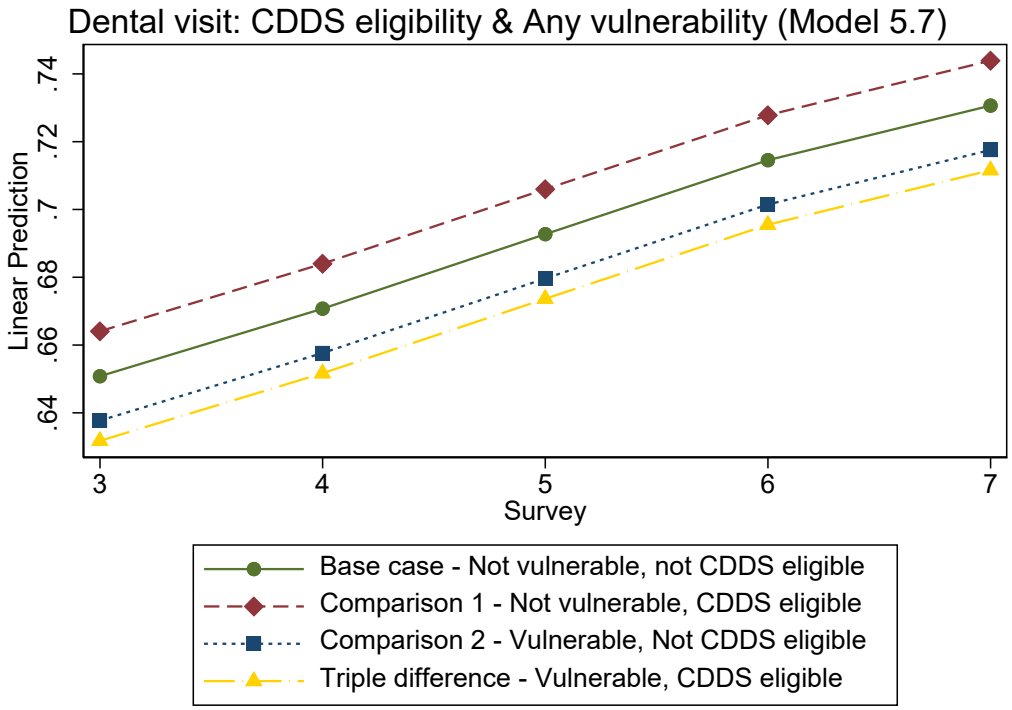
Source: derived from ALSWH data

Figure 26 - Parallel trends for model 5.6



Source: derived from ALSWH data

Figure 27 - Parallel trends for model 5.7



Source: derived from ALSWH data

Appendix C4: Placebo test results

Table 38 - Placebo test results for all models

	Poor DHS		Dental problem		Financial hardship		Any vulnerability
Dependent variable = dental consultation in last 12 months	Model 5.1	Model 5.2	Model 5.3	Model 5.4	Model 5.5	Model 5.6	Model 5.7
	(Primary)	(Secondary)	(Primary)	(Secondary)	(Primary)	(Secondary)	(Primary)
Survey (base - survey 3)							
Survey 4	0.025**	Base	0.026**		0.019*		0.022**
	(0.008)		(0.008)		(0.008)		(0.008)
Survey 5	0.046***	0.018	0.045***	0.023	0.055***	0.036**	0.052**
	(0.012)	(0.013)	(0.012)	(0.014)	(0.011)	(0.013)	(0.015)
Survey 6	0.075***	0.048***	0.051***	0.030*	0.083***	0.064***	0.073***
	(0.012)	(0.013)	(0.013)	(0.014)	(0.012)	(0.013)	(0.015)
Survey 7	0.084***	0.062***	0.057***	0.039**	0.100***	0.085***	0.086***
	(0.012)	(0.013)	(0.013)	(0.015)	(0.012)	(0.014)	(0.016)
β_2 Comparison 1 group (CDDS eligible; not vulnerable, placebo post period)	0.000	0.007	-0.004	-0.002	-0.008	-0.006	-0.004
	(0.013)	(0.016)	(0.014)	(0.017)	(0.013)	(0.016)	(0.019)
β_3 Comparison 2 group (Not CDDS eligible; vulnerable, placebo post period)	-0.011	-0.018	0.052**	0.038	-0.012	-0.029	0.000
	(0.020)	(0.025)	(0.019)	(0.024)	(0.020)	(0.025)	(0.018)
β_4 Vulnerable/eligible group (CDDS eligible; vulnerable, placebo post period)	-0.005	0.004	-0.036	-0.024	-0.014	0.008	-0.007
	(0.024)	(0.030)	(0.024)	(0.029)	(0.024)	(0.029)	(0.024)
Geographical location ARIA (base – major city)							
Inner regional	0.005	-0.009	0.001	-0.012	-0.006	-0.018	0.002
	(0.015)	(0.019)	(0.015)	(0.019)	(0.015)	(0.019)	(0.015)
Outer regional, rural & remote	-0.027	-0.027	-0.031	-0.034	-0.036	-0.042	-0.021
	(0.020)	(0.027)	(0.022)	(0.028)	(0.021)	(0.026)	(0.021)
Married	-0.021	-0.002	-0.003	0.016	-0.012	0.001	-0.012
	(0.015)	(0.019)	(0.015)	(0.020)	(0.015)	(0.019)	(0.015)
PHI Status							

Ancillary only	0.066*	0.058^	0.044	0.029	0.042	0.036	0.057*
	(0.027)	(0.033)	(0.03)	(0.036)	(0.028)	(0.034)	(0.028)
Hospital only	0.022	0.075**	0.014	0.047	0.021	0.056*	0.027
	(0.022)	(0.026)	(0.024)	(0.029)	(0.022)	(0.028)	(0.023)
Comprehensive (ancillary and hospital)	0.079***	0.103***	0.089***	0.094***	0.074***	0.083**	0.094***
	(0.018)	(0.022)	(0.020)	(0.024)	(0.02)	(0.024)	(0.019)
Financial management (base - no financial difficulty)							
Some financial difficulty	-0.022*	-0.017^	-0.020*	-0.012	N/a	N/a	N/a
	(0.008)	(0.010)	(0.009)	(0.010)			
Financial stress	-0.042***	-0.030*	-0.049***	-0.040**	N/a	N/a	N/a
	(0.011)	(0.013)	(0.012)	(0.014)			
Concessional	0.004	-0.004	0.002	-0.005	-0.004	-0.005	-0.006
	(0.008)	(0.010)	(0.009)	(0.010)	(0.009)	(0.010)	(0.009)
GP consult in last 12 month	0.065***	0.047**	0.065***	0.048**	0.053***	0.030	0.069***
	(0.014)	(0.017)	(0.015)	(0.018)	(0.014)	(0.017)	(0.015)
Smoker	-0.033	-0.062*	-0.021	-0.044	-0.031	-0.043	-0.027
	(0.020)	(0.025)	(0.020)	(0.026)	(0.021)	(0.025)	(0.020)
Dental health status (base-poor/fair)							
Good		N/a		0.011		0.009	
				(0.012)		(0.011)	
Very good/ excellent		N/a		0.010		0.008	
				(0.014)		(0.014)	
Dental problem		-0.026**		N/a		-0.027**	
		(0.009)				(0.009)	
Constant	0.584***	0.604***	0.567***	0.581***	0.574***	0.608***	0.535***
	(0.025)	(0.030)	(0.027)	(0.033)	(0.025)	(0.031)	(0.026)
Observations	25,054	19,486	22,666	17,665	24,863	19,255	23770
R-squared	0.014	0.011	0.012	0.008	0.013	0.011	5007
Number of individuals	5,293	5,290	4,789	4,784	5,226	5,222	0.012
Robust standard errors in parentheses *** p<0.001, ** p<0.01, * p<0.05 Source: derived from ALSWH data							

Appendix C5: Hausman test results

Table 39 - Hausman test for model 5.1 (poor dental health status, primary model)

	Coefficients			
	(b)	(B)	(b-B)	sqrt(diag(V_b-V_B))
	LPM_FE_D	LPM_RE_D	Difference	S.E.
Survey				
Survey 4	0.025	0.024	0.001	0.001
Survey 5	0.042	0.039	0.002	0.001
Survey 6	0.071	0.067	0.004	0.001
Survey 7	0.080	0.078	0.001	0.002
CDDS * Post	-0.007	-0.004	-0.003	0.001
Poor DHS * Post	-0.001	-0.002	0.001	0.002
Poor DHS * CDDS * Post	0.023	0.024	0.000	0.002
Geography ARIA urban (base)				
Inner regional	0.005	-0.031	0.036	0.012
Rural and remote	-0.026	-0.066	0.039	0.016
Married/ de-facto	-0.021	-0.024	0.003	0.011
PHI Status				
Ancillary only	0.065	0.125	-0.060	0.017
Hospital only	0.023	0.079	-0.057	0.015
Comprehensive (ancillary and hospital)	0.080	0.169	-0.089	0.015
Financial difficulty: none (base)				
Some difficulty	-0.022	-0.030	0.009	0.004
Financial stress	-0.042	-0.066	0.024	0.006
Concessional	0.004	-0.019	0.023	0.004
GP consultation	0.065	0.083	-0.018	0.006
Smoker	-0.031	-0.051	0.020	0.014
chi2(18) = 112.17 p = 0.0000 Source: derived from ALSWH data				

Table 40 - Placebo test for model 5.2 (poor dental health status, secondary model)

	Coefficients			
	(b)	(B)	(b-B)	sqrt(diag(V_b-V_B))
	LPM_FE_D	LPM_RE_D	Difference	S.E.
Survey				
Survey 6	0.0273	0.0266	0.0007	0.0017
Survey 7	0.0351	0.0362	-0.0011	0.0025
CDDS * Post	-0.0139	-0.0112	-0.0027	0.0017
Poor DHS * Post	0.0179	0.0148	0.0031	0.0025
Poor DHS * CDDS * Post	0.0341	0.0352	-0.0011	0.0032
Geography ARIA urban (base)				
Inner regional	-0.0132	-0.0405	0.0273	0.0211
Rural and remote	-0.0600	-0.0702	0.0102	0.0276
Married/ de-facto	0.0122	-0.0107	0.0229	0.0201
PHI Status				
Ancillary only	0.0321	0.1228	-0.0907	0.0295
Hospital only	0.0401	0.0839	-0.0438	0.0270
Comprehensive (ancillary and hospital)	0.0606	0.1718	-0.1112	0.0252
Financial difficulty: none (base)				
Some difficulty	-0.0200	-0.0314	0.0114	0.0078
Financial stress	-0.0240	-0.0715	0.0475	0.0109
Concessional	0.0008	-0.0245	0.0253	0.0073
GP consultation	0.0535	0.0720	-0.0185	0.0107
Smoker	-0.0819	-0.0718	-0.0101	0.0257
Dental problem	0.1083	0.1277	-0.0194	0.0057
chi2(17) = 88.59 p= 0.0000 Source: derived from ALSWH data				

Table 41 - Placebo test for model 5.3 (dental problem, primary model)

	Coefficients			
	(b)	(B)	(b-B)	sqrt(diag(V_b-V_B))
	LPM_FE_D	LPM_RE_D	Difference	S.E.
Survey 4	0.023	0.022	0.000	0.001
Survey 5	0.052	0.050	0.002	0.001
Survey 6	0.064	0.061	0.003	0.002
Survey 7	0.071	0.069	0.002	0.002
CDDS * Post	-0.005	-0.003	-0.002	0.001
Dental problem * Post	0.008	0.006	0.002	0.002
Dental problem * CDDS * Post	-0.021	-0.019	-0.002	0.002
Geography ARIA urban (base)				
Inner regional	0.001	-0.034	0.035	0.012
Rural and remote	-0.029	-0.074	0.045	0.016
Married/ de-facto	-0.004	-0.018	0.014	0.011
PHI Status				
Ancillary only	0.044	0.108	-0.064	0.017
Hospital only	0.014	0.083	-0.069	0.015
Comprehensive (ancillary and hospital)	0.089	0.177	-0.088	0.015
Financial difficulty: none (base)				
Some difficulty	-0.020	-0.031	0.011	0.005
Financial stress	-0.049	-0.080	0.031	0.007
Concessional	0.002	-0.019	0.021	0.005
GP consultation	0.064	0.083	-0.019	0.006
Smoker	-0.022	-0.050	0.028	0.014
chi2(18) = 116.71 p = 0.0000 Source: derived from ALSWH data				

Table 42 - Hausman test for model 5.4 (dental problem, secondary model)

	Coefficients			
	(b)	(B)	(b-B)	sqrt(diag(V_b-V_B))
	LPM_FE_D	LPM_RE_D	Difference	S.E.
Survey 6	0.025	0.027	-0.001	0.002
Survey 7	0.030	0.031	-0.002	0.003
CDDS * Post	0.000	-0.001	0.001	0.002
Dental problem * Post	-0.046	-0.055	0.008	0.003
Dental problem * CDDS * Post	-0.002	0.004	-0.007	0.003
Geography ARIA urban (base)				
Inner regional	-0.020	-0.044	0.024	0.022
Rural and remote	-0.057	-0.077	0.020	0.029
Married/ de-facto	0.007	-0.011	0.017	0.021
PHI Status				
Ancillary only	0.025	0.118	-0.093	0.030
Hospital only	0.004	0.078	-0.074	0.028
Comprehensive (ancillary and hospital)	0.059	0.172	-0.113	0.026
Financial difficulty: none (base)				
Some difficulty	-0.021	-0.027	0.006	0.008
Financial stress	-0.037	-0.076	0.038	0.011
Concessional	-0.003	-0.022	0.019	0.008
GP consultation	0.050	0.071	-0.020	0.011
Smoker	-0.061	-0.066	0.004	0.027
Dental Status				
Good	0.039	0.065	-0.027	0.008
Very good	0.109	0.145	-0.036	0.011
chi2(18) = 69.30 p= 0.0000 Source: derived from ALSWH data				

Table 43 - Hausman test for model 5.5 (financial hardship, primary model)

	Coefficients			
	(b)	(B)	(b-B)	sqrt(diag(V_b-V_B))
	LPM_FE_D	LPM_RE_D	Difference	S.E.
Survey 4	0.020	0.020	0.000	0.001
Survey 5	0.041	0.040	0.001	0.001
Survey 6	0.080	0.076	0.004	0.001
Survey 7	0.097	0.095	0.002	0.002
CDDS * Post	-0.014	-0.012	-0.002	0.001
Financial difficulty * Post	-0.015	-0.014	-0.001	0.002
Financial difficulty * CDDS * Post	0.013	0.014	0.000	0.002
Geography ARIA urban (base)				
Inner regional	-0.006	-0.032	0.025	0.012
Rural and remote	-0.036	-0.066	0.030	0.016
Married/ de-facto	-0.011	-0.022	0.011	0.011
PHI Status				
Ancillary only	0.043	0.110	-0.067	0.016
Hospital only	0.022	0.091	-0.069	0.015
Comprehensive (ancillary and hospital)	0.076	0.171	-0.094	0.015
Concessional	-0.004	-0.024	0.020	0.004
GP consultation	0.053	0.073	-0.020	0.006
Smoker	-0.030	-0.060	0.030	0.014
chi2(16) = 92.54 p= 0.0000 Source: derived from ALSWH data				

Table 44 - Hausman test for model 5.6 (financial hardship, secondary model)

	Coefficients			
	(b)	(B)	(b-B)	sqrt(diag(V_b-V_B))
	LPM_FE_D	LPM_RE_D	Difference	S.E.
Survey 6	0.036	0.034	0.002	0.001
Survey 7	0.046	0.043	0.003	0.002
CDDS * Post	-0.018	-0.015	-0.003	0.001
Financial difficulty * Post	-0.017	-0.017	0.000	0.002
Financial difficulty * CDDS * Post	0.041	0.038	0.003	0.003
Geography ARIA urban (base)				
Inner regional	-0.028	-0.036	0.007	0.022
Rural and remote	-0.070	-0.072	0.003	0.029
Married/ de-facto	0.022	-0.013	0.035	0.020
PHI Status				
Ancillary only	0.007	0.104	-0.097	0.030
Hospital only	0.028	0.083	-0.055	0.027
Comprehensive (ancillary and hospital)	0.059	0.164	-0.105	0.026
Concessional	-0.009	-0.026	0.017	0.008
GP consultation	0.034	0.056	-0.022	0.011
Smoker	-0.057	-0.078	0.021	0.026
Dental Status				
Good	0.056	0.080	-0.024	0.007
Very good	0.129	0.159	-0.030	0.011
Dental problem	0.123	0.147	-0.023	0.006
chi2(17) = 63.81 p = 0.0000 Source: derived from ALSWH data				

Table 45 - Hausman test for model 5.7 (any vulnerability, primary model)

	Coefficients			
	(b)	(B)	(b-B)	sqrt(diag(V_b-V_B))
	LPM_FE_D	LPM_RE_D	Difference	S.E.
Survey 4	0.022	0.022	0.000	0.001
Survey 5	0.046	0.045	0.000	0.001
Survey 6	0.084	0.081	0.003	0.002
Survey 7	0.097	0.096	0.001	0.002
CDDS * Post	-0.026	-0.024	-0.002	0.001
Any vulnerability * Post	-0.020	-0.019	0.000	0.001
Any vulnerability* CDDS * Post	0.029	0.030	-0.001	0.002
Geography ARIA urban (base)				
Inner regional	0.002	-0.032	0.034	0.012
Rural and remote	-0.021	-0.065	0.043	0.016
Married/ de-facto	-0.013	-0.013	0.001	0.011
PHI Status				
Ancillary only	0.057	0.132	-0.075	0.017
Hospital only	0.028	0.104	-0.077	0.015
Comprehensive (hospital and ancillary)	0.094	0.195	-0.101	0.015
Concessional	-0.007	-0.032	0.025	0.005
GP consultation	0.069	0.082	-0.013	0.006
Smoker	-0.027	-0.060	0.033	0.014
chi2(16) = 102.70 p = 0.0000 Source: derived from ALSWH data				

Appendix D – Appendix to Chapter 6

Appendix D1 – Analysis 1 - Chi Square test of differences between groups: Insured and Uninsured with ancillary PHI

The insured group and the uninsured group in analysis one is compared using a Chi Square of differences. As might be expected those who are uninsured are less socioeconomically advantaged. They also report poorer health and health behaviours as well as poorer dental health status. Statistically significant differences are discussed below (Table 46).

Those in the uninsured group are less likely to be married or in a de-facto relationship (73% vs 81), have a lower level overall of education with those in the uninsured group more than twice as likely to report no formal schooling (22% vs 9%) and half as likely to report a degree or higher degree education (10% vs 21%), are less likely to be employed (57% vs 69%), are more likely to report financial difficulty or stress (53% vs 29%), and are over twice as likely to report being concessional (44% vs 18%). In regard to health status and behaviours, those who are insured are more likely to report their health status as poor/fair (23% vs 13%) and are twice as likely to report being a smoker (13% vs 6%), are slightly less likely to report a healthy weight range (32% vs 35%) and are more likely to report low to nil exercise levels (48% vs 41%). In regard to dental health status those who are insured are more likely to report dentures (43% vs 28%), are more likely to report a dental health problem (35% vs 31%) and are more likely to report poor/fair dental health status (38% vs 23%). There are differences regarding country of birth with those in the uninsured group less likely to be Australian born (77% vs 81%) and there are marginal but statistically significant differences in language spoken at home. There are no statistically significant differences between the groups regarding alcohol intake or GP consultation in the last 12 months.

Table 46 - Comparison of characteristics between insured and non-insured groups

	Insured (ancillary)		Uninsured		Total	
Characteristic	**N**	**%**	**N**	**%**	**N**	**%**
Country of birth[#]						
Australian born	1,883	81%	1,237	77%	3,120	79%
Other English Speaking	314	13%	247	15%	561	14%
Europe	89	4%	89	6%	178	5%
Asia	40	2%	19	1%	59	1%
Other	13	1%	17	1%	30	1%
Total	*2,339***		*1,609*		3,948	
				Chi2(4) = 15.3085 Pr = 0.004		
Language spoken at home[#]						
English, Aust	2,268	98%	1,538	96%	3,806	97%
European	40	2%	53	3%	93	2%
Asian	9	0%	5	0%	14	0%
Other	5	0%	10	1%	15	0%
Total	*2,322***		*1,606*		3,928	
			Chi2(3) = 14.6149 Pr = 0.002			
ARIA						
Major city	1,033	44%	501	31%	1,534	39%
Inner regional	834	35%	729	45%	1,563	39%
Outer regional, rural and remote	485	21%	392	24%	877	22%
Total	*2,352****		*1,622*		3,974	
				Chi2(2) = 69.6707 Pr = 0.000		
Marital status						
Not married	450	19%	436	27%	886	22%
Married or de-facto	1,895	81%	1,172	73%	3,067	78%
Total	*2,345****		*1,608*		3,953	
				Chi2(1) = 34.4485 Pr = 0.000		

Education[#]						
No formal	200	9%	351	22%	551	14%
High school	1,078	46%	821	51%	1899	48%
Trade/ apprenticeship/ diploma	571	24%	278	17%	849	21%
Degree and higher	491	21%	168	10%	659	17%
Total	*2,340****		*1,618*		3958	
			Chi2(3) = 210.9081 Pr = 0.000			
Employment						
Not in labour force/ unemployed	717	31%	697	43%	1,414	36%
Part time or full time	1,631	69%	919	57%	2,550	64%
Total	*2,348****		*1,616*		3,964	
				Chi2(1) = 66.1682 Pr = 0.000		
Financial management						
No financial difficulty	589	*25%*	195	*12%*	784	20%
Limited financial difficulty	1,090	*46%*	572	*35%*	1662	42%
Financial difficulty or stress	671	*29%*	853	*53%*	1524	38%
Total	*2,350****		*1,620*		3,970	
				Chi2(2) = 255.5968 Pr = 0.000		
Concession card						
No	1,928	82%	911	56%	2,839	71%
Yes	426	18%	711	44%	1,137	29%
Total	*2,354****		*1,622*		3,976	
				Chi2(1) = 311.5477 Pr = 0.000		
PHI Status						
No	0		1,192		1,192	
Ancillary only	133		0		133	
Hospital only	0		435		435	
Comprehensive PHI	2,220		0		2,200	
Total	*2,353****		*1,627*		3,980	
				Chi2(3) = 4.0e+03 Pr = 0.000		
Health Status						
Poor / fair	313	13%	369	23%	682	17%
Good	1,003	43%	710	44%	1713	43%

Very good/ excellent	1,033	44%	545	34%	1578	40%
Total	*2,349****		*1,624*		3973	
				Chi2(2) = 75.8562 Pr = 0.000		
Alcohol intake						
High risk drinker	149	6%	108	7%	257	7%
Low risk drinker	2,191	94%	1,499	93%	3690	93%
Total	*2,340*		*1,607*		3947	
				Chi2(1) = 0.1951 Pr = 0.659		
Smoking status						
Smoker	147	6%	218	13%	365	9%
Non/ ex-smoker	2,202	94%	1,399	87%	3601	91%
Total	*2,349****		*1,617*		3966	
				Chi2(1) = 59.8078 Pr = 0.000		
Weight range						
Unhealthy weight range	1,496	65%	1,074	68%	2,570	66%
Healthy weight range	820	35%	513	32%	1,333	34%
Total	*2,316**		*1,587*		*3,903*	
				Chi2(1) = 3.9743 Pr = 0.046		
Exercise level						
Low to nil	916	41%	739	48%	1,655	44%
Moderate to high	1,333	59%	811	52%	2,144	56%
Total	*2,249****		*1,550*		3,799	
				Chi2(1) = 18.0183 Pr = 0.000		
GP consultation in last 12 months						
No	36	2%	37	2%	73	2%
Yes	2,314	98%	1,583	98%	3897	98%
Total	*2,350*		*1,620*		*3,970*	
				Chi2(1) = 3.0047 Pr = 0.083		

Dentures						
No	1,693	72%	929	57%	2,622	66%
Yes	660	28%	697	43%	1,357	34%
Total	*2,353****		1,626		*3,979*	
				Chi2(1) = 93.9297 Pr = 0.000		
Dental health problem						
No	1,618	69%	1,051	65%	2,669	68%
Yes	720	31%	558	35%	1,278	32%
Total	2,338*		*1,609*		3,947	
				Chi2(1) = 6.5680 Pr = 0.010		
Dental health status						
Fair/ poor	544	23%	618	38%	1,162	29%
Good	1,014	43%	647	40%	1,661	42%
Very good/ excellent	792	34%	358	22%	1,150	29%
Total	*2,350****		*1,623*		3,973	
				Chi2(2) = 120.5973 Pr = 0.000		

[#]Characteristic at survey one

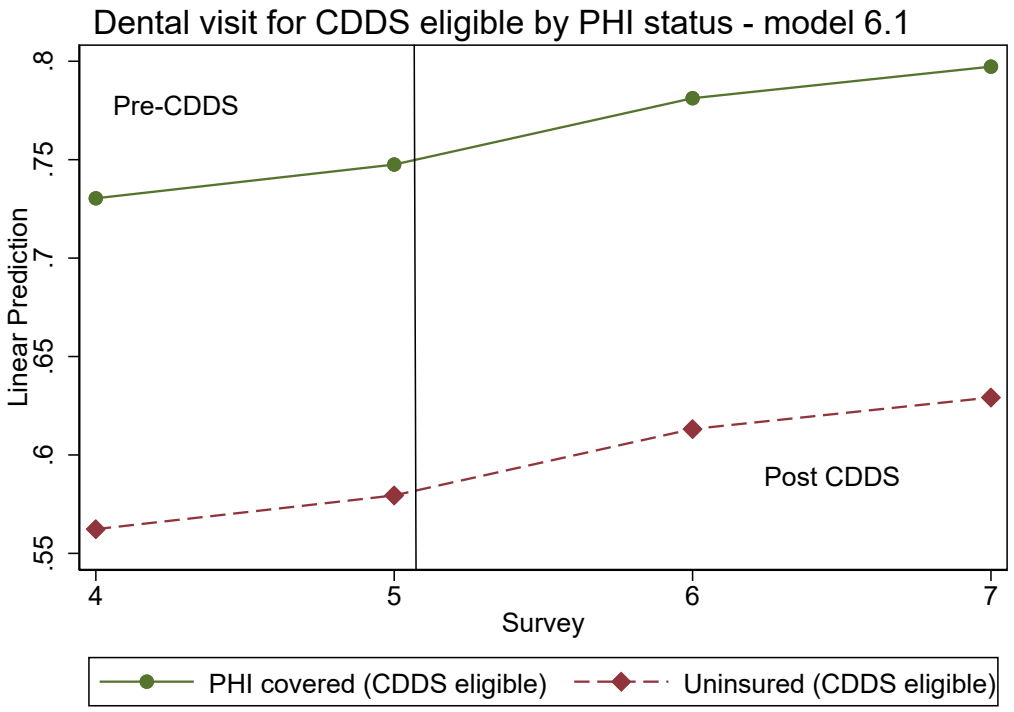
[a] This is a combination variable that captures those who have a dental health problem and/ avoid foods due to their dental health

Statistical significance: * p<0.05; ** p<0.01; *** p<0.001

Source: derived from ALSWH data

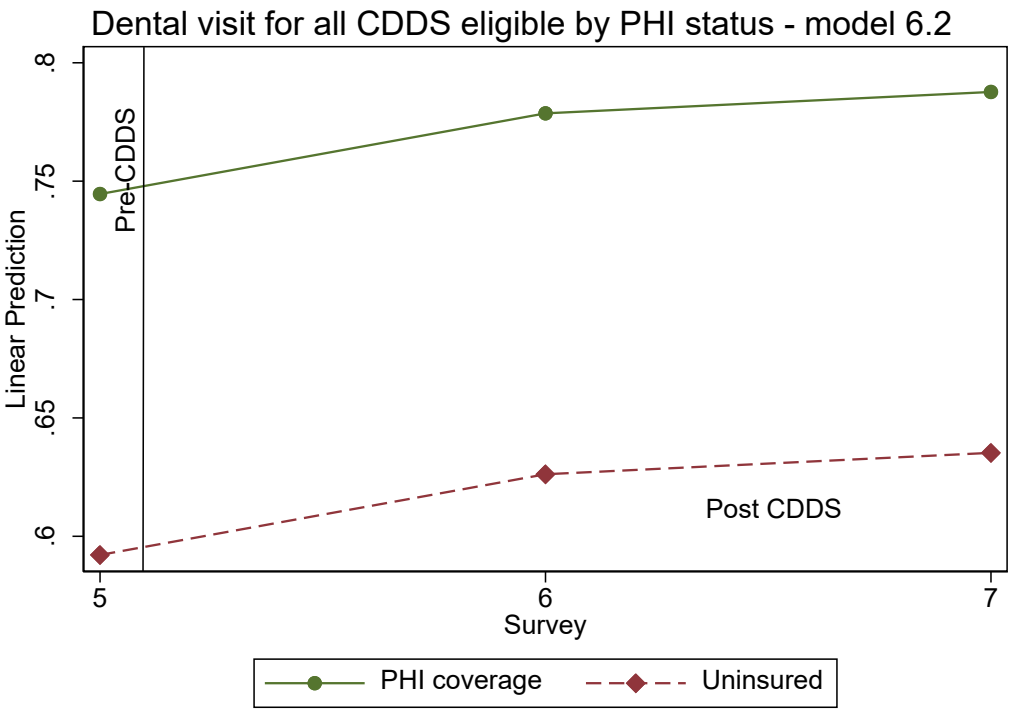
Appendix D2 -Parallel trends

Figure 28 - Parallel trends for model 6.1



Source: derived from ALSWH data

Figure 29 - Parallel trends for model 6.2



Source: derived from ALSWH data

Appendix D3 - Placebo Test

Table 47 - Placebo test for models 6.1 and 6.2 (uninsured)

Dependent variable = dental consultation in last 12 months	Model 6.1 Primary model	Model 6.2 Secondary model
Survey (base - Survey 3)		
Survey 4	0.014	(base - Survey 4)
	(0.009)	
Survey 5	0.031**	0.017
	(0.010)	(0.010)
Survey 6	0.063***	0.050***
	(0.010)	(0.010)
Survey 7	0.076***	0.066***
	(0.010)	(0.011)
B_1 Uninsured group (uninsured; altered (PT) post period)	0.005	0.005
	(0.013)	(0.016)
Geographical location ARIA (base - major city)		
Inner regional	-0.011	-0.009
	(0.017)	(0.021)
Outer regional, rural, remote	-0.047	-0.045
	(0.024)	(0.031)
Married	-0.021	-0.018
	(0.017)	(0.022)
Financial management (base - no financial difficulty)		
Limited financial difficulty	-0.025*	-0.023*
	(0.010)	(0.012)
Financial difficulty or stress	-0.039**	-0.030*
	(0.013)	(0.015)
Concessional	-0.004	-0.004
	(0.010)	(0.011)
GP consult in last 12 months	0.088***	0.067*
	(0.024)	(0.029)
Smoker	-0.025	-0.030
	(0.023)	(0.029)
Dental health status (base-poor/fair)		
Good		0.015
		(0.013)
Very good/ excellent		0.015
		(0.016)
Dental health problem		-0.029**
		(0.010)
Constant	0.624***	0.654***
	(0.031)	(0.039)
Observations	18,856	14,570
R-squared	0.011	0.010
Number of individuals	3,981	3,974
Robust standard errors in parentheses *** p<0.001, ** p<0.01, * p<0.05 Source: derived from ALSWH data		

Appendix D4 - Hausman Test

Table 48 - Hausman test for model 6.1 (uninsured, primary model)

	Coefficients			
	(b)	(B)	(b-B)	sqrt(diag(V_b-V_B))
Survey	LPM_FE_D	LPM_RE_D	Difference	S.E.
Survey 4	0.014	0.013	0.000	0.001
Survey 5	0.033	0.031	0.003	0.001
Survey 6	0.058	0.059	-0.001	0.001
Survey 7	0.071	0.075	-0.004	0.002
B_1 Uninsured group, post CDDS period	0.017	0.014	0.003	0.001
Geographical location ARIA (base - major city)				
Inner regional	-0.011	-0.033	0.022	0.013
Outer regional, rural, remote	-0.047	-0.079	0.031	0.018
Married	-0.020	-0.017	-0.003	0.012
Financial management (base - no financial difficulty)				
Limited financial difficulty	-0.025	-0.041	0.016	0.005
Financial difficulty or stress	-0.038	-0.077	0.039	0.008
Concessional	-0.004	-0.027	0.024	0.005
GP consult in last 12 months	0.088	0.092	-0.004	0.008
Smoker	-0.024	-0.060	0.036	0.015
Chi2(13) = 73.28 p=0.0000				
Source: derived from ALSWH data				

Table 49 - Hausman test for model 6.2 (uninsured, secondary model)

	Coefficients			
	(b)	(B)	(b-B)	sqrt(diag(V_b-V_B))
Survey	LPM_FE_D	LPM_RE_D	Difference	S.E.
Survey 6	0.023	0.027	-0.004	0.001
Survey 7	0.031	0.036	-0.006	0.003
B_1 Uninsured group, post CDDS period	0.022	0.017	0.006	0.002
Geographical location ARIA (base - major city)				
Inner regional	-0.010	-0.030	0.020	0.024
Outer regional, rural, remote	-0.048	-0.077	0.029	0.033
Married	0.001	-0.006	0.008	0.024
Financial management (base - no financial difficulty)				
Limited financial difficulty	-0.032	-0.042	0.010	0.010
Financial difficulty or stress	-0.038	-0.086	0.048	0.013
Concessional	-0.007	-0.031	0.024	0.008
GP consult in last 12 months	0.073	0.062	0.011	0.018
Smoker	-0.031	-0.069	0.039	0.029
Dental health status (base-poor/fair)				
Good	0.063	0.085	-0.022	0.008
Very good/ excellent	0.144	0.170	-0.026	0.012
Dental health problem	0.122	0.142	-0.020	0.007
Chi2(14) = 50.45 p = 0.0000 Source: derived from ALSWH data				

Appendix D5 - Analysis 2 – Chi Square test of difference between groups

The uninsured poor dental status vulnerable/eligible group and the Base case group are diametrically opposed, with the Base case group being covered with ancillary PHI and reporting good dental health status. As is expected, those in the uninsured poor dental status vulnerable/eligible group are less socioeconomically advantaged than those in the Base Case group. There are differences in relation to their health status and health behaviours and, as expected, differences in relation to dental health status. The statistically significant differences are discussed below.

Those in the uninsured poor dental status vulnerable/eligible group are less likely to be married or in a de-facto relationship (67% vs 81%); are overall less educated as they are three times more likely to report no formal education (25% vs 8%) and a third less likely to report a degree or higher qualification (7% vs 22%); are less likely to be employed (52% vs 71%); are much more likely to report financial stress (64% vs 25%); are three times more likely to report concessional status (54% vs 17%); and are far less likely to report comprehensive PHI coverage. Those in the vulnerable/eligible group are three times more likely to report poor or fair health status (33% vs 9%); are over three times more likely to be a smoker (18% vs 5%); are more likely to report being in an unhealthy weight range (70% vs 63%); and are more likely to report low to nil exercise levels (54% vs 37%). There are differences regarding dental health status, with those in the uninsured poor dental status vulnerable/eligible group twice as likely to report dentures (51% vs 24%); over twice as likely to report a dental problem (53% vs 20%) and, as expected, there are differences in relation to dental health status. There are also differences in relation to country of birth, language spoken at home and geographical location, with those in the vulnerable/eligible group less likely to live in a major city (30% vs 46%). There are no statistically significant differences regarding alcohol intake and GP consultation in the last 12 months (Table 50).

Table 50 - Comparison of characteristics between vulnerable/eligible group (uninsured, poor dental health status) and base case group

Characteristic/ Category	Uninsured / poor DHS vulnerable/eligible group		Base Case group: insured and good DHS		
	N	**%**	**N**	**%**	**Statistical significance**
Country of birth[#]					
Australian born	462	75%	1,165	81%	
Other English Speaking	97	16%	197	14%	
Europe	44	7%	50	3%	
Asia	3	0%	27	2%	
Other	6	1%	6	0%	
Total	*612*		*1,445****		*Chi2(4) = 23.948 Pr = 0.000*
Language spoken at home[#]					
English, Aust	583	95%	1,409	98%	
European	23	4%	25	2%	
Asian	1	0%	3	0%	
Other	4	1%	2	0%	
Total	*611*		*1,439***		*Chi2(3) = 11.742 Pr = 0.008*
ARIA					
Major city	185	30%	660	46%	
Inner regional	279	45%	505	35%	
Outer regional, rural and remote	152	25%	290	20%	
Total	*616*		*1,455****		*Chi2(2) = 42.293 Pr = 0.000*
Marital status					
Not married	202	33%	276	19%	
Married or de-facto	408	67%	1,174	81%	
Total	*610*		*1,450****		*Chi2(1) = 47.77 Pr = 0.000*
Education[#]					
No formal	151	25%	120	8%	
High school	320	52%	654	45%	
Trade/ apprenticeship/ diploma	100	16%	361	25%	
Degree and higher	42	7%	312	22%	*Chi2(3) = 160.427 Pr = 0.000*
Total	*613*		*1,447****		
Employment					

Not in labour force/ unemployed	292	48%	430	30%	
Part time or full time	322	52%	1,022	71%	
Total	*614*		*1,452****		*Chi2(1) = 61.109 Pr = 0.000*
Financial management					
No financial difficulty	51	*8%*	416	29%	
Limited financial difficulty	168	*27%*	680	47%	
Financial difficulty or stress	397	*64%*	358	25%	
Total	*616*		*1,454****		*Chi2(2) = 307.587 Pr = 0.000*
Concession card					
No	281	46%	1,215	84%	
Yes	336	54%	241	17%	
Total	*617*		*1,456****		*Chi2(1) = 309.976 Pr = 0.000*
Comprehensive PHI					
No	501	81%	0	0	
Ancillary only	0		65	4%	
Hospital only	117	19%	0	0	
Comprehensive PHI	0		1,392	96%	
Total	*618*		*1,457****		*Chi2(3) = 2.1e+03 Pr = 0.000*
Health Status					
Poor / fair	205	33%	133	9%	
Good	278	45%	581	40%	
Very good/ excellent	134	22%	738	51%	
Total	*617*		*1,452****		*Chi2(2) = 243.209 Pr = 0.000*
Alcohol intake					
High risk drinker	38	6%	89	6%	
Low risk drinker	570	94%	1,361	94%	
Total	*608*		*1,450*		*Chi2(1) = 0.009 Pr = 0.923*
Smoking status					
Smoker	110	18%	66	5%	
Non/ ex-smoker	505	82%	1,389	96%	
Total	*615*		*1,455****		*Chi2(1) = 99.034 Pr = 0.000*
Weight range					
Unhealthy weight range	421	70%	910	63%	

Healthy weight range	177	30%	525	36%	
Total	*598*		*1,435***		*Chi2(1) = 9.114 Pr = 0.003*
Exercise level					
Low to nil	317	54%	533	37%	
Moderate to high	265	46%	862	60%	
Total	*582*		*1,395****		*Chi2(1) = 44.297 Pr = 0.000*
GP consultation in last 12 months					
No	12	2%	25	2%	
Yes	602	98%	1,428	99%	
Total	*614*		*1,453*		*Chi2(1) = 0.134 Pr = 0.714*
Dentures					
No	303	49%	1,107	77%	
Yes	315	51%	348	24%	
Total	618		*1,455****		*Chi2(1) = 145.935 Pr = 0.000*
Dental health problem					
No	286	47%	1,161	80%	
Yes	325	53%	283	20%	
Total	*611*		1,444***		*Chi2(1) = 232.568 Pr = 0.000*
Dental health status					
Fair/ poor	618	100%	0	0%	
Good		0%	722	50%	
Very good/ excellent		0%	735	51%	
Total	*618*		*1,457****		*Chi2(2) = 2.1e+03 Pr = 0.000*

[#]Characteristic at survey one

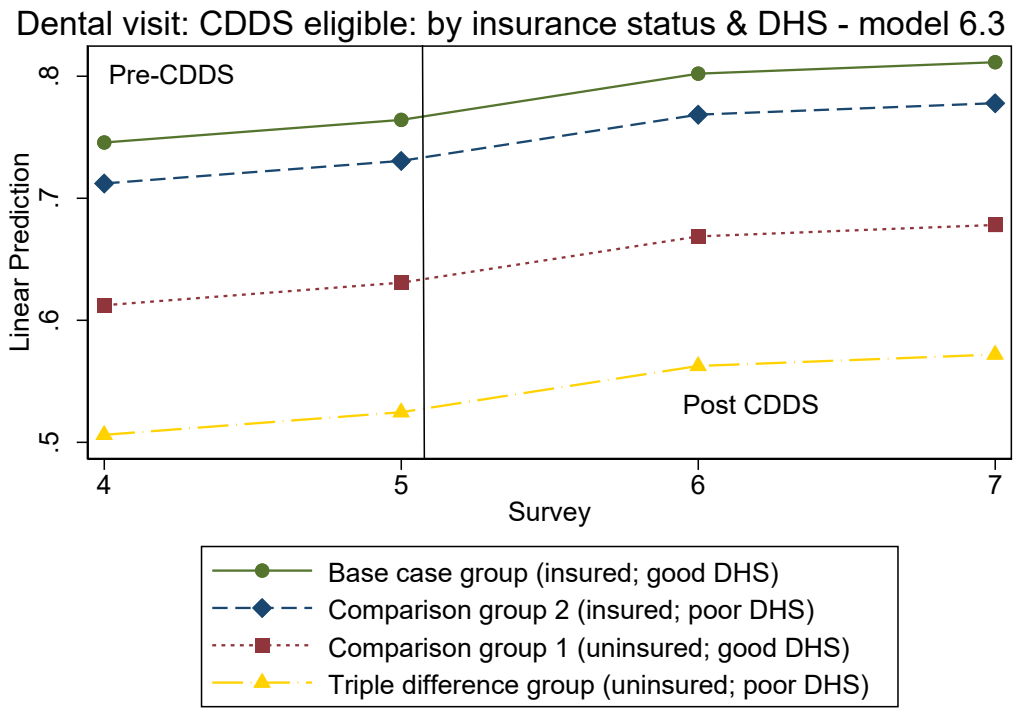
[a] This is a combination variable that captures those who have a dental health problem and/ avoid foods due to their dental health

Statistical significance: * p<0.05; ** p<0.01; *** p<0.001

Source: derived from ALSWH data

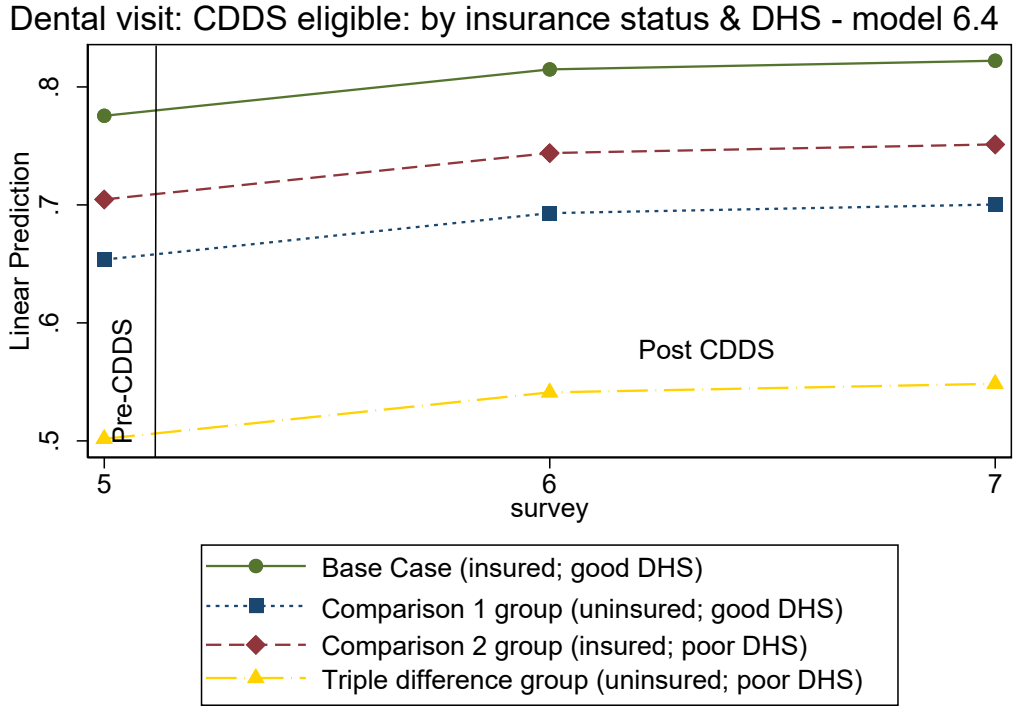
Appendix D6 – Parallel trends

Figure 30 - Parallel trends for model 6.3



Source: derived from ALSWH data

Figure 31 - Parallel trends for model 6.4



Source: derived from ALSWH data

Appendix D7 - Placebo test

Table 51 - Placebo test for heterogeneity analysis (uninsured, poor dental health status)

Dependent variable = dental consultation in last 12 months	Model uninsured-Poor	Model uninsured-Poor
Survey		
Survey 4	0.011	
	(0.010)	
Survey 5	0.029*	0.014
	(0.012)	(0.012)
Survey 6	0.064***	0.050***
	(0.012)	(0.012)
Survey 7	0.069***	0.060***
	(0.012)	(0.013)
β_2 Comparison 1 group (uninsured; good dental health status, post period)	0.024	0.031
	(0.018)	(0.022)
β_3 Comparison 2 group (insured; poor dental health status; post period)	-0.010	-0.003
	(0.018)	(0.022)
β_4 Vulnerable/eligible group (uninsured; poor dental health status; post period)	-0.020	-0.037
	(0.029)	(0.036)
Geographical location ARIA (base – major city)		
Inner regional	0.004	-0.005
	(0.018)	(0.023)
Outer regional, rural & remote	-0.029	-0.031
	(0.026)	(0.033)
Married	-0.040*	-0.031
	(0.019)	(0.024)
Financial management (base - no financial difficulty)		
Limited financial difficulty	-0.021	-0.023
	(0.011)	(0.013)
Financial difficulty or stress	-0.033*	-0.025
	(0.014)	(0.016)
Concessional	0.007	0.004
	(0.010)	(0.012)
GP consult in last 12 months	0.093***	0.072*
	(0.026)	(0.032)
Smoker	-0.036	-0.061
	(0.025)	(0.032)
Dental problem		-0.025*
		(0.011)
Constant	0.628***	0.669***
	(0.033)	(0.041)
Observations	15,688	12,143
Number of individuals	3,314	3,312
R-squared	0.012	0.011
Robust standard errors in parentheses *** p<0.001, ** p<0.01, * p<0.05 Source: derived from ALSWH data		

Appendix D8 - Hausman test

Table 52 - Hausman test for model 6.3 (uninsured, poor dental health status, primary model)

	Coefficients			
	(b)	(B)	(b-B)	sqrt(diag(V_b-V_B))
	LPM_FE_D	LPM_RE_D	Difference	S.E.
Survey				
Survey 4	0.011	0.010	0.001	0.001
Survey 5	0.031	0.029	0.002	0.001
Survey 6	0.055	0.056	-0.002	0.002
Survey 7	0.060	0.066	-0.006	0.002
β_2 Comparison 1 group (uninsured; good dental health status, post period)	0.012	0.009	0.003	0.001
β_3 Comparison 2 group (insured; poor dental health status; post period)	0.004	0.005	0.000	0.001
β_4 Vulnerable/eligible difference group (uninsured; poor dental health status; post period)	0.030	0.029	0.002	0.002
Geography ARIA urban (base)				
Inner regional	0.004	-0.029	0.033	0.014
Rural and remote	-0.028	-0.075	0.047	0.019
Married/ de-facto	-0.038	-0.023	-0.016	0.014
Financial management (base - no financial difficulty)				
Some financial difficulty	-0.020	-0.036	0.016	0.006
Financial stress	-0.032	-0.067	0.035	0.008
Concessional	0.007	-0.020	0.027	0.005
GP consultation	0.093	0.097	-0.005	0.008
Smoker	-0.033	-0.053	0.020	0.017
chi2(15) = 70.94 p=0.000 Source: derived from ALSWH data				

Table 53 - Hausman test for model 6.4 (uninsured, poor dental health status, secondary model)

	Coefficients			
	(b)	(B)	(b-B)	sqrt(diag(V_b-V_B))
	LPM_FE_D	LPM_RE_D	Difference	S.E.
Survey				
Survey 6	0.018	0.024	-0.005	0.002
Survey 7	0.021	0.031	-0.010	0.003
β_2 Comparison 1 group (uninsured; good dental health status, post period)	-0.004	-0.007	0.003	0.002
β_3 Comparison 2 group (insured; poor dental health status; post period)	0.019	0.020	-0.001	0.002
β_4 Vulnerable/eligible group (uninsured; poor dental health status; post period)	0.070	0.063	0.007	0.004
Geography ARIA urban (base)				
Inner regional	0.009	-0.034	0.043	0.026
Rural and remote	-0.042	-0.081	0.039	0.035
Married/ de-facto	-0.023	-0.009	-0.013	0.026
Financial management (base - no financial difficulty)				
Some financial difficulty	-0.036	-0.048	0.011	0.010
Financial stress	-0.040	-0.090	0.050	0.014
Concessional	0.005	-0.024	0.029	0.009
GP consultation	0.067	0.058	0.010	0.019
Smoker	-0.065	-0.072	0.006	0.032
Dental problem	0.102	0.116	-0.014	0.007
chi2(14) = 43.26 p= 0.0001 Source: derived from ALSWH data				

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