MONASH University

Economics of Disability in Australia

Implementing a National Disability Insurance Scheme

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Abstract

The thesis examines key aspects of the economics of disability. The economics of disability is a broad subject area bringing together various threads of economic research to explore the socio-economic determinants of disability, the demand for and supply of supports and the outcomes for people with a disability. These topics are important because of the rising prevalence of disability, significant government expenditure on services and supports for people with disabilities and increasing recognition of the inequities faced both across people with disability, and between people with and without disabilities.

In the Australian context, where the research in this thesis is set, these topics have gained importance due to major reforms to the supply of services and supports for people with a disability. The National Disability Insurance Scheme (NDIS) was launched in 2016 following a three-year pilot phase and was due to be fully rolled out across Australia by July 2020. Not only does the scheme represent a major expansion in funding, it also involves the introduction of choice and competition in the delivery of disability services.

While it is too early to assess the full effect of these reforms, it is important to set a benchmark for the efficiency and equity of disability services before and during the initial phase. This will allow the scheme to be adjusted to maximise its impact and so that other countries can learn from the Australian experience.

The thesis first explores the factors associated with the use of services and supports, and changes in unmet need for services across all disability types using the Survey of Disability and Carers. The findings indicate that there were differences in the pattern of service use before the NDIS was introduced across gender and education levels, which may have become entrenched under the NDIS due to assessment guidelines for access to supports based on historic levels. One measure of the success of increased funding for disability services is a reduction in unmet need for disability services. The thesis suggests that such a performance measure needs to account for the subjective nature of need, as we find evidence of an increase in subjective measures of unmet need after the NDIS was announced.

Given that autism accounts for the largest group of NDIS participants, the thesis then focuses on autism and the factors associated with the timing of diagnosis and estimates the impact of a child's autism diagnosis on maternal labour supply. The results suggest that the age of diagnosis could be reduced by improved awareness of the symptoms of autism in girls and greater follow up where parents have concerns with development at the

age of one. In addition, the significant impact of autism diagnosis on maternal labour indicates a need for a greater focus on measures to support mothers of children with autism to remain engaged in the labour market.

The results in the thesis provide a benchmark on which future research can build to evaluate the impact of the NDIS reforms on people with a disability.

New page (standard thesis only)

Declaration

This thesis is an original work of my research and contains no material which has been accepted for the award of any other degree or diploma at any university or equivalent institution and that, to the best of my knowledge and belief, this thesis contains no material previously published or written by another person, except where due reference is made in the text of the thesis.

Signature: …………………

Print Name: Angela Jackson

Date: 4 September 2020

Acknowledgements

There have been many changes since I commenced this journey almost seven years ago, including my daughter Genevieve becoming a big sister to Hamish, the relocation of the Centre for Health Economics, and finally the arrival of the first global pandemic in 100 years. But throughout all this change, one thing has remained steadfast. To my husband Xavier, thank you for everything, and supporting me to embark on this journey with your full blessing and encouragement. Completing a PhD was a childhood dream, which would not have been possible without you.

My mother first suggested I pursue Health Economics as a specialisation almost 20 years ago. Always my biggest fan and champion, after ten years her badgering paid off, and for once, I listened to her advice.

To all that have come through the Centre for Health Economics in my time studying including the PhD students, research and administrative staff, thank you for providing such a supportive learning environment. To my supervisors, your patience and generosity in imparting knowledge has been invaluable. I have become a much better and more skilled health economist as a result.

As I complete my journey, I also wish to acknowledge the role of Emma Beruter, a fellow PhD student, who tragically passed away 6 years ago. Emma was a passionate and skilled health economist, and there have been many days when her memory and giving meaning to her loss kept me on this journey.

1   Introduction

1.1   Background and Thesis Motivation

When in February 2010 the Australian Government asked its economic think-tank, the Productivity Commission (PC), to review the system of supports for people with a disability, it was noted that:

"… there remains a significant level of unmet demand for disability services which impacts upon the lives of people with disability, their families and carers. Demographic change and the anticipated decline in the availability of informal care are expected to place further pressure on the existing system over the coming decades." Nick Sherry, Assistant Treasurer, Letter to the Productivity Commission, 17 February 2010.

In providing its report back to the Government in July 2011, the PC delivered a damning assessment of the current disability system:

"The current disability support system is underfunded, unfair, fragmented, and inefficient, and gives people with a disability little choice and no certainty of access to appropriate supports. The stresses on the system are growing, with rising costs for all governments." PC, Disability Care and Support, 31 July 2011.

The PC report proposed a way forward, a National Disability Insurance Scheme (NDIS) that would replace existing state schemes and give people with a disability choice and control over their lives. Forecast to cost AUD $22 billion per year to deliver when fully established, the proposal for the NDIS was supported by all major political parties in Australia and commenced its roll-out in July 2013 at a number of trial sites.

The NDIS aims to improve the lives of individuals and the structure of society through reducing the disadvantage attached to having a disability. The objectives of the NDIS are outlined in the *National Disability Insurance Scheme Act 2013* and include:

- Supporting the social and economic participation of people with a disability;
- Providing reasonable and necessary supports, including early intervention services; and
- Giving people with a disability choice and control in setting their own objectives and in the planning and delivery of their supports.

The research for this thesis commenced in October 2013, three months after the NDIS commenced its pilot phase. At that time the NDIS was operating in four trial sites (see Appendix 1.1 for full implementation timeline) and had less than 1000 participants. Today, the NDIS is in its final stage of implementation, covering 364,879 individuals (National Disability Insurance Agency 2019). It was scheduled to be fully implemented by the end of June 2020 and cover 475,000 Australians with a disability (National Disability Insurance Agency 2019).

The catalyst for the NDIS originated in a grass-roots campaign by a coalition of providers, people with disabilities and their families, regarding the inequities in the existing system. A major argument made by campaigners was that the nature of supports varied considerably, dependent on geographic location, the type of disability, how it was acquired and the ability to agitate for services (Manne 2011, Productivity Commission 2011).

Geography was particularly important, due to Australia's federal system of government, with eight state and territory governments and one national Commonwealth government. The states and territories were historically responsible for the funding and management of disability services, creating potential for differences across the jurisdictions. Despite a series of Commonwealth-State Disability Agreements commencing in 1991 the nature and availability of supports varied considerably (Productivity Commission 2011, Purcal, Fisher et al. 2014).

Within jurisdictions, there was also significant variation in the nature of supports provided, depending on the type of disability and how it was acquired (Productivity Commission 2011). In the state of Victoria, people with disability could receive assistance through three different mechanisms, depending on how they acquired their disability (Victorian Disability Advisory Council 2010).

- A no-fault insurance scheme for those that acquired a disability due to a motor vehicle or work accident.
- Compensation payments for those that acquired a disability due to negligence or failure of duty-of-care (for example, a medical negligence).
- Publicly funded disability services through the Department of Human Services for people that acquired a disability under other circumstances, such as a genetic disorder or an accident in their home.

The system created potential inequities between individuals that received support through a no-fault insurance scheme, a compensation payment and those that received support through publicly funded disability services. Rather than receive services based on their reasonable needs, individuals receiving services from publicly funded services often faced significant shortfalls in the care they received, compared to the care they needed (Productivity Commission 2011).

In addition to issues around the equity of access to disability supports, arguments were made that the existing system, which relied heavily on informal care, was not economically efficient or sustainable. It was argued that the lack of early intervention and deficiencies in ongoing care increased long-term costs and did not support the economic participation of people with a disability or their carers (Productivity Commission 2011). Rising life expectancy of people with a disability would ultimately result in unsustainable increases in Government expenditure once ageing carers were no longer able to provide informal care.

The NDIS aims to address these deficiencies through creating a new national system which provides individuals with the reasonable and necessary supports to undertake activities of daily living. The NDIS's reliance on a combination of fee for service and individual choice of provider, introduced choice and competition into the market for disability services for the first time.

The motivation of the thesis is to add to the existing literature on Economics of Disability in Australia to better understand the lives of people with a disability before the introduction of the NDIS, including: the nature of demand for services and inequities in access; and what factors may impact its success in transforming the lives of people with a disability and their families. This will provide context when researchers and the government are evaluating the impact of the NDIS in the future and help inform future reforms to the delivery of disability services.

1.2   The Economics of Disability

The Economics of Disability covers a broad range of areas of interest to economists which have been explored across a wide range of literature (Haveman and Wolfe 2000): socio-economic determinants (Chirikos and Nestel 1984, Krokstad and Westin 2004); the demand for and supply of supports (Kemper 1992, Bolin, Lindgren et al. 2008); the financing of disability support services (Diamond and Sheshinski 1995,

David and Duggan 2006, Fontaine 2012, Wouterse and Smid 2017); and the impact of policies to support people with a disability and their carers (Bound and Burkhauser 1999, Gruber 2000, Powers 2001, Chen and Van der Klaauw 2008, French and Song 2014). But before each of these areas is explored, an understanding of what disability is and how it is defined is required.

1.2.1 Defining Disability

Economists often conceive disability through the prism of an individual's impediments in undertaking daily activities and performing productive work (Haveman and Wolfe 2000). However, disability as a concept has been evolving and this narrow definition fails to recognise the many dimensions and complexities that make a single definition elusive (Leonardi, Bickenbach et al. 2006, Mitra 2006, WHO 2011, Shakespeare 2013). Language has changed significantly in the last 30 years, where there was a "disabled person", today a person has a disability (Fleischer, Zames et al. 2012). While disability no longer defines the individual, it can affect an individual's functioning.

Much of the discourse on defining disability centres around what mechanisms manifest to impact an individual's functioning. Is it the underlying medical impairment, or the environment or the society within which the individual operates? (Shakespeare 2013). As a result, there are definitions of a disability from medical, sociological and political perspectives that are variously applied to medical and administrative contexts. These are discussed below.

The traditional medical model of disability focuses on the individual's characteristics and defines disability through an individual's physical and mental 'deficiencies'. For administrators and researchers this view of disability is attractive, as it allows easy categorisation for determining access to government programs or assessing need. However, it equates disability with inferiority and fails to incorporate the importance of the social and environmental context within which a disability manifests (Hughes and Paterson 2006). The social model of disability incorporates these factors and views people as being disabled by environmental and social factors, rather than their physical or mental impairments (Shakespeare 2013). Importantly the social model of disability does not view disability as inferior to societal norms.

While the medical and social models of disability are hard to reconcile, the World Health Organisation (WHO 2011) offers a definition incorporating a balanced

approach. The WHO International Classification of Functioning, Disability and Health (ICF) defines disability as covering impairments, activity limitations and participation restrictions (WHO 2011). Impairments are underlying problems or differences in physical functioning such as deafness; activity limitations are difficulties in undertaking activities such as self-dressing, and participation restrictions are issues with undertaking any aspect of life, for example, using public transport. Disability is viewed as the interaction between a person's health condition or impairment and personal and environmental factors.

The WHO definition moves disability beyond being about deficiencies in the person to incorporate deficiencies in the environment that impede social participation. Environmental factors which contribute to disability are wider than the physical environment, and include an individual's support and relationships, attitudes and importantly for this thesis, the policies and service delivery systems on which they rely. Personal factors which influence a person's participation in society include motivation and self-esteem.

There have also been attempts to define disability using Sen's Capability Approach (Mitra 2006, Anand, Roope et al. 2020). Unlike standard utility theory which dominates economics, the Capability Approach focuses on the type of life that people are able to live rather than the life that they actually live (Sen 1993). The Capability Approach distinguishes between an individual's capabilities and functionings[1].

An individual's capability set refers to the feasible opportunities an individual can achieve (Mitra 2006, Anand, Roope et al. 2020). Sen chooses not define a list of basic capabilities, instead insisting that these depend on personal and societal value judgements. He does provide examples including the ability to live a long life, the ability to read, and the ability to be well nourished. The ambiguity is intentional and often frustrates scholars and those looking to apply the framework, but it allows each society and individual to define the basic capability set. As a result, this capability set can change over time, due to personal characteristics, the basket of available goods, the environment but also society views on what forms part of the basic capability set.

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[1] Functioning has a different meaning in the Capability Approach to that used more broadly in the disability literature where it refers to the ability to undertake specific activities or tasks.

Under the Capability Approach functionings is what an individual actually achieves out of the feasible capability set, and can refer to both an activity but also a state (Anand, Roope et al. 2020). Disability in this framework can be understood as a deprivation in an individual's capabilities or functionings that result from their personal characteristics, the basket of available goods and the environment (Mitra 2006). As such as with the other definitions of disability, variations in personal abilities remain central to the concept of disability. In Figure 1-1 a visual representation of the capability approach is provided.

Figure 1-1: The Capability Approach
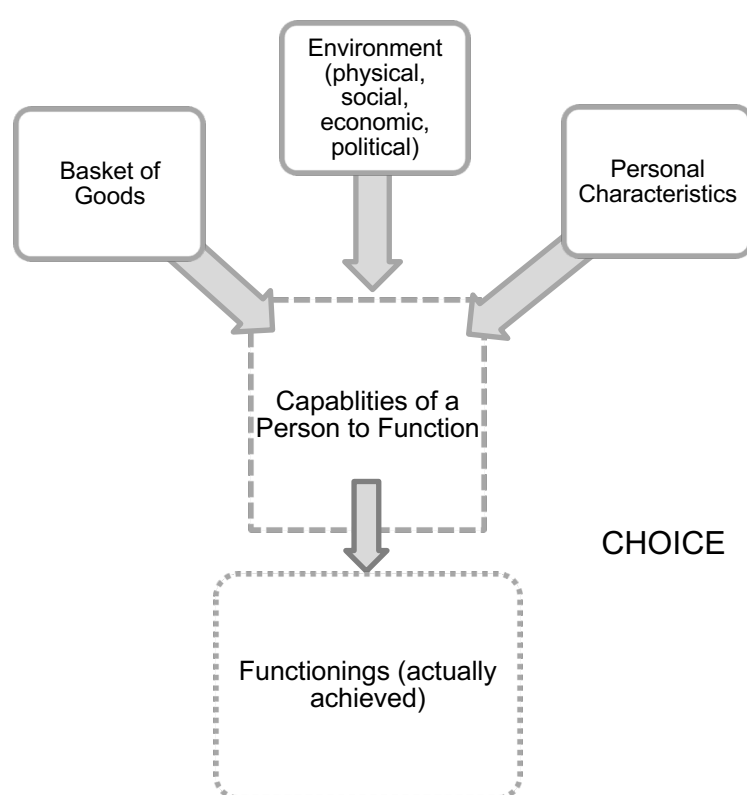
Source: Mitra (2006)

While the WHO and the Capability Approach to defining a disability are holistic, administrators require a definition of disability which they can apply to assess eligibility to government programs. Historically governments have relied on the medical view to make such assessments, with disability defined in terms of the activities impacted such as vision, movement, memory, learning, communicating, hearing, mental health or social relationships (Shakespeare 2006). For example, an individual is assessed has having paraplegia, and therefore can access specific equipment such as a wheelchair

and a set number of personal care hours a week. This approach does not factor in an individual's environment or preferences (or under Sen's Capability Approach desired functionings).

Throughout this thesis, a pragmatic approach to the definition of disability is taken. While the medical model of disability is often used to allow easy measurement and categorisation, the aim is to explore how an individual's access to resources and changes in environment impact their disability. As such we align with the more universal WHO definition and Sen's Capability Approach through exploring how personal, environmental and societal factors influence an individual's capabilities and functionings.

Next, the major areas of inquiry in the economies of disability are outlined, including the socio-economic determinates and impacts of disability, the market for disability services and supports, the financing systems for those supports and the economic impacts of policies to support people with a disability and their carers.

1.2.2 Determinants and impacts of disability

Having a disabling condition can impact individuals in a number of ways, including their ability to undertake daily tasks involving communication, self-care and mobility. Any disability that affects these activities is classified as being a 'core activity limitation' (Australian Bureau of Statistics 2016). Communication includes the ability to be understood or to understand family and friends. Self-care includes washing, eating and dressing. Mobility includes getting in and out of bed, moving around one's home and using public transport. In this thesis, the research focuses on individuals who have at least one core activity limitation and need assistance in daily living, as these are the pre-requisites for access to services under the NDIS (National Disability Insurance Agency 2019).

Australia has similar rates of disability to other developed countries, with one in five people reporting having a core activity limitation that impacts their daily functioning (Australian Bureau of Statistics 2016). As shown in Figure 1.2, disability rates generally increase across age groups for both genders, with just 3.4 per cent of children age 0 to 4 having a disability reported compared to 85.4 per cent of those

aged over 90 years of age.[2]   Males are more likely to report having a disability in younger age groups but less likely to report a disability in older age groups. This reflects more males being impacted by congenital conditions from birth (Lary and Paulozzi 2001).

Figure 1-2: Incidence of Disability by Age
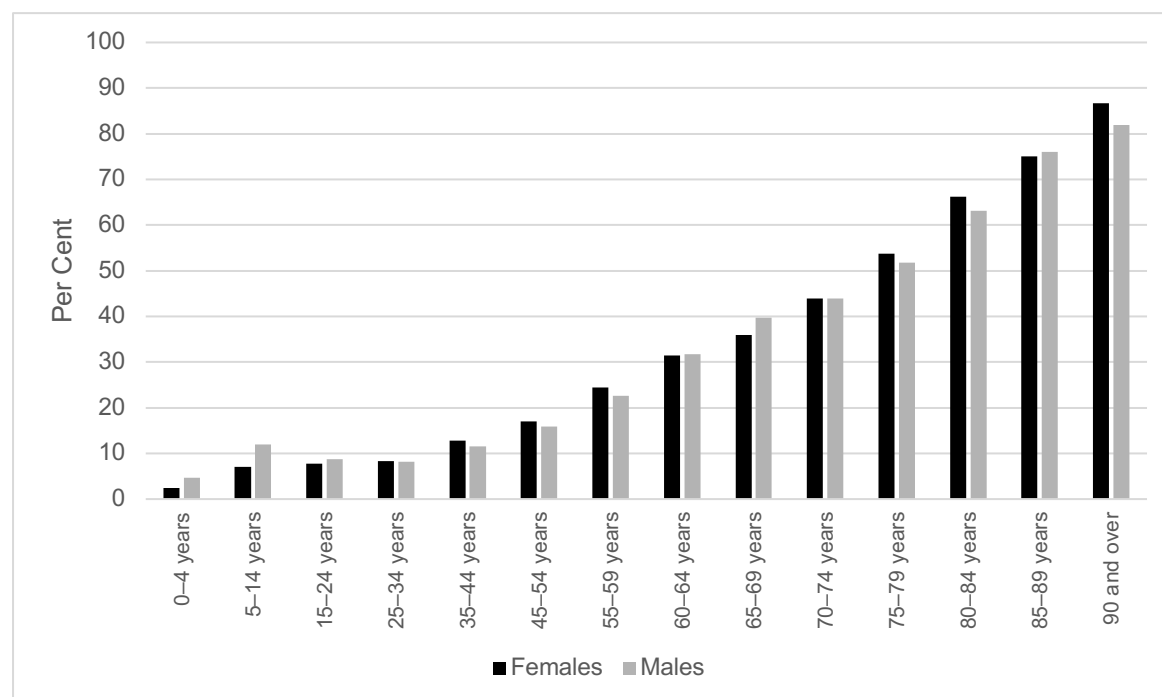
Source: Australian Bureau of Statistics, Survey of Disability and Carers (2015)

People with a disability can have one or more conditions that contribute to their limitations in daily living, which are classified as profound (always need assistance), severe (sometimes needs assistance), moderate (has difficulty), or mild (uses aid or equipment). The most common conditions causing disability are physical, including musculoskeletal diseases, cancer, diabetes and diseases of the nervous system. While mental and behavioural conditions, including autism, intellectual disability and mental illnesses are less common, individuals with these conditions are more likely to participate in the NDIS.

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[2] Not all these individuals will be eligible for services under the NDIS. To access the NDIS individuals have to usually need support because of a permanent and significant disability and be aged under 65 when they apply.

Figure 1-3: Percentage of Underlying Condition by Disability Severity and NDIS Participation
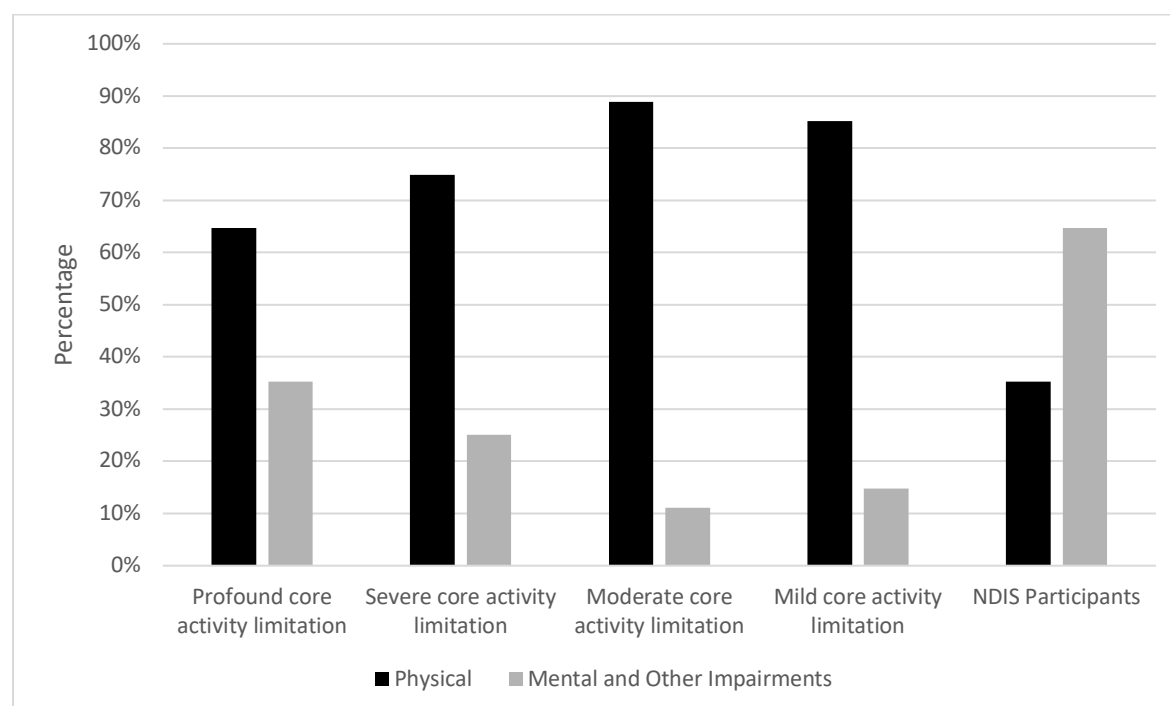
Source: Australian Bureau of Statistics, Survey of Disability and Carers (2015)

Note: Each category adds to 100 per cent, and shows the distribution of underlying condition by disability severity and NDIS participation.

The greater proportion of people with mental health and other conditions using the NDIS is driven by people with autism, who currently represent 30 per cent of all participants (National Disability Insurance Agency 2019). This is significantly higher than anticipated, and represents one of the ongoing risks to the NDIS's financial sustainability. The availability of additional supports under the NDIS may have driven more people to seek a diagnosis and uncovered previously unknown unmet need. In Chapter 4, the Timing of an Autism Diagnosis, this hypothesis is tested using the impact of the introduction of another Government program, the Helping Autism Package, on rates of autism diagnosis.

Disabling conditions are linked to both non-modifiable (age, gender and genetics) and modifiable (activity levels, social and environmental factors) risk factors (AIHW 2018). The leading cause of disability in Australia is chronic disease (Bauer, Briss et al. 2014, AIHW 2018).

Figure 1-4: Proportion with a limitation in daily living by Chronic Condition
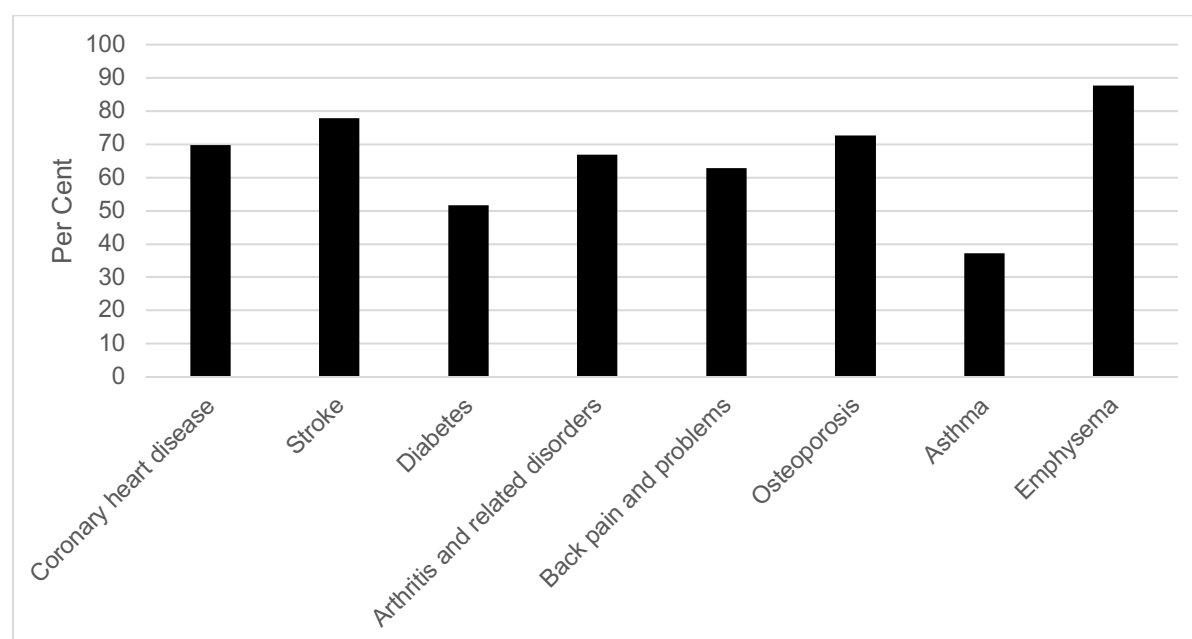
Source: Australian Institute of Health and Welfare (2018)

In Figure 1.4 the prevalence of disability by chronic condition is shown. Arthritis is the most prevalent chronic condition in Australia, affecting over two million people. Of these, 66.9 per cent report having a limitation in daily activity (AIHW 2018).

In Figure 1.5 the distribution of people with and without a disability across equivalised household income quintiles is shown, with a higher concentration of people with disability in lower income households.

As in health (Marmot 2005) there is a strong socio-economic gradient in disability (Dolk, Pattenden et al. 2001, Minkler, Fuller-Thomson et al. 2006, White and Edgar 2010). This is due to the impact of socio-economic status on the probability of acquiring a disability (Dolk, Pattenden et al. 2001), as well as the impact of having a disability on socio-economic status. There is a higher incidence of chronic disease among lower socio-economic groups, related to higher rates of modifiable risky behaviour (Hosseinpoor, Bergen et al. 2012, Korda, Paige et al. 2014, Backholer, Spencer et al. 2016). There is also evidence that disability is related to early life circumstances, such as birth weight, that is associated with the socio-economic status of mothers (Dolk, Pattenden et al. 2001). As a result, people from lower socio-economic groups are more likely to acquire a disabling condition.

Figure 1-5 Distribution of Disability by Equivalised Household Income
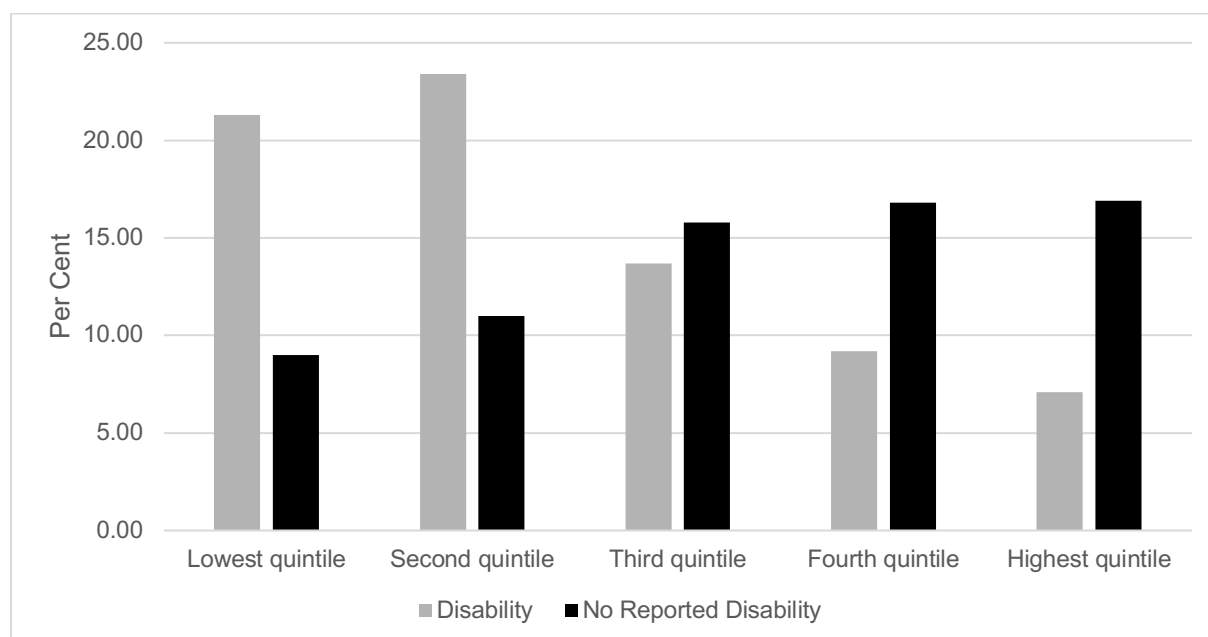
Source: Australian Bureau of Statistics, Survey of Disability and Carers (2015)

Note: Those with missing income data not shown, which are 25.4 per cent of people with a disability and 30.4 per cent of people with no reported disability. Bars of people with a disability add to 74.6 per cent and bars of people without a disability add to 69.6 per cent.

Acquiring a disability influences socio-economic status because it can limit the ability to participate in education and employment.   For children, disability can influence the ability to accumulate human capital and long-term economic participation. For adults, acquiring a disability may result in discrimination and reduced incentives to participate in the labour market. In Figure 1.6 the labour force participation of people with a disability in Australia is shown. The labour force participation rate of those with a disability is 53.4 per cent, significantly below those without a disability of 83.2 per cent.

There is also an impact on employment outcomes for informal carers of people with a disability, with significantly lower rates of labour force participation observed. An extensive economic literature has evolved in an effort to disentangle the endogeneity of the decision to care and the causal impact of caring on labour supply (Heitmueller 2007). This is discussed further below, and explored in detail in Chapter Five: The Impact of an Autism Diagnosis on Maternal Labour Supply.

Figure 1-6: Labour Force Participation Rate by Disability Severity
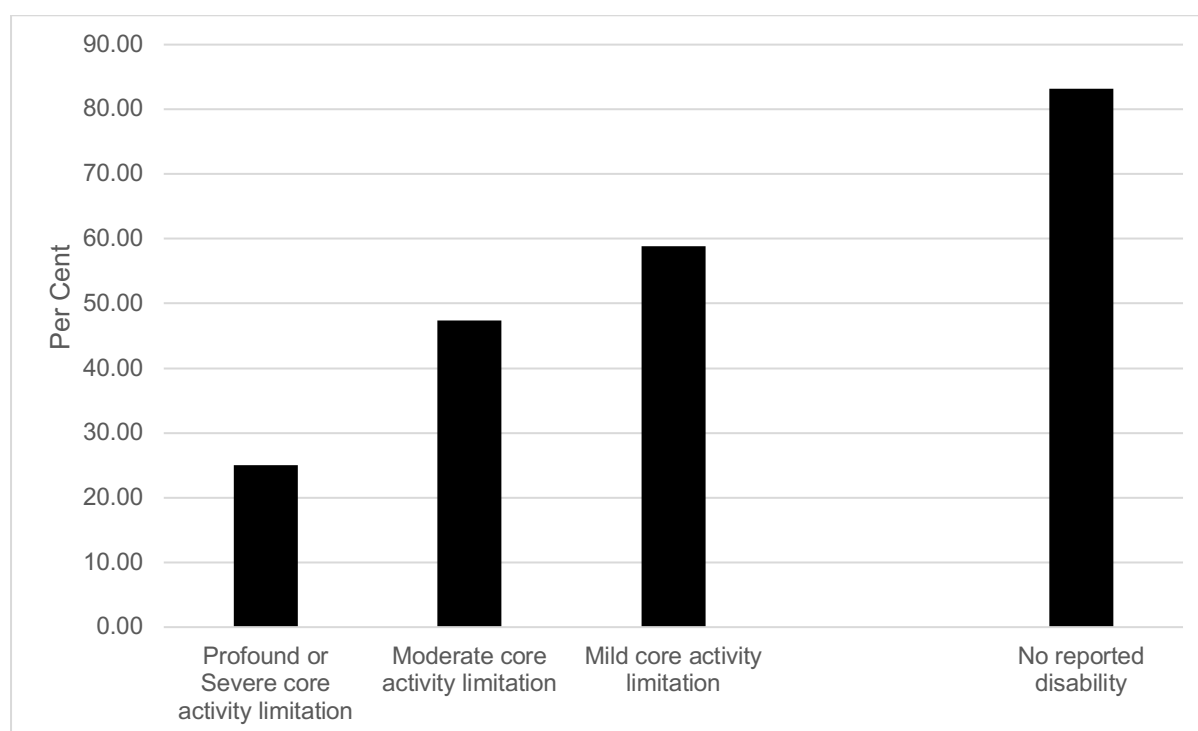
Source: Australian Bureau of Statistics, Survey of Disability and Carers (2015)

Disability has many determinants, and impacts individual functioning and wellbeing in a variety of ways. However, access and use of services and supports for an individual with a disability can influence these outcomes. In the next section we discuss the market for disability services and supports, starting with the determinants of demand, which is the main focus of the thesis, before exploring the supply side of the market.

1.2.3 The market for disability services and supports

Disability care includes services and supports to assist with self-care activities, including washing, toileting and eating, communication, such as speech pathology or hearing, and mobility, which can include assistance getting in and out of bed or moving about the home (WHO 2011). People with a disability may rely on or demand a number of services and supports to assist with the activities of daily living (Haveman and Wolfe 2000). This is in addition to the health care services that a person with a disability may demand to treat their condition (WHO 2011).

As with health care there are a number of market imperfections that may impact both the supply and demand of disability services and warrant the intervention of Government. However, the market for disability services and supports differs from the

market for other health care services in a number of critical ways (Norton 2000, Dejong, Palsbo et al. 2002). First, medical care services are often provided for a short period to treat an acute episode of illness (Norton 2000). In contrast, disability care is provided over a long time period with disabilities often lasting the remainder of a person's life (Productivity Commission 2011). As a result, even though costs for disability care may be lower in a given time period than treatment of an acute condition, because they accumulate over time, they often represent a larger ongoing burden for households and the community (Norton 2000, Bannenberg, Karlsson et al. 2019). Second, medical care is generally delivered in a highly specialised setting such as a hospital (Norton 2000). Disability care and support is predominantly delivered in the community, with a limited role for residential care services (Pestieau, Cremer et al. 2012). Third, medical care is almost exclusively provided by specialised staff and there is a limited role for informal carers (Pestieau, Cremer et al. 2012), such as family and friends (Norton 2000). In contrast, informal carers are the largest source of disability care (Haveman and Wolfe 2000). This impacts the labour supply of caregivers, and can increase the negative impact on the socio-economic status of households from the onset of disability (Heitmueller 2007, Leigh 2010). Finally, whereas medical health insurance is provided through universal public or private health insurance, disability care insurance is limited in the private sector (Norton 2000, Francesca, Ana et al. 2011, Bannenberg, Karlsson et al. 2019) and services are often heavily rationed in the public sector.

Within disability care there are also differences between the markets for different types of services and supports. Disability care services and supports are supplied by informal providers, formal providers, or with the help of assistive technology. Informal care from family or friends is generally low-skilled care and is provided in the community (Bannenberg, Karlsson et al. 2019). Formal providers include private providers, charities and government bodies, and generally require approval to access or direct payment for services (WHO 2011, Carrieri, Di Novi et al. 2017, Bannenberg, Karlsson et al. 2019). Assistive technology, such as wheelchairs or communication aids, also either require approval under government-funded programmes or involve a private cost to people with a disability (Kaye, Yeager et al. 2008). Below services and supports are categorised into two groups: informal care; and formal care and assistive

technology. This reflects the differences and synergies between different care and support types.

The mix of services and supports relied on by a person with a disability and where they are provided, will depend on their needs, their preferences, the availability, and cost of different services and supports. In the next section, the determinants of demand for services and supports are discussed, before the supply side of the market for disability services is explored.

1.2.4 The Demand for Disability Services and Supports

The demand for disability services and supports can be conceptualised as a household decision (Bannenberg, Karlsson et al. 2019). This allows the needs and wants of the person with a disability, alongside the resource constraints of the household, to be factored into the model. The quantity demanded for disability services and supports is determined by price (McTaggart 2007), but as with other goods and services, the level of demand is influenced by preferences, income and the availability, price and quality of substitutes and complements (McTaggart 2007). Demand refers both to the quality and quantity of services.

To help explore the demand for disability related services and supports we adapt the household utility function proposed by Stabile, Laporte, Coyte (2006)[3] for long term care, where households choose a mix of disability services and supports to maximise the utility function given by:

Equation 1-1

$$U(X, L, A | C)$$

Where X represents other goods and services, L leisure time and A the ability to perform activities of daily living. Household preferences (C) are influenced by a number of unobservable characteristics and beliefs (psychological traits or previous experiences), but also vary across observable factors, including education level and cultural background (Andersen 1968). Along with the consumption of other goods and leisure time (X,L), there is also variation in the utility derived from the ability to perform

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[3] Note our model simplifies the original by removing the constraint on access to publicly funded formal care but extends the model to include assistive technology.

activities of daily living (A) due to differences in preferences – or wants (C). For example, for some people with a disability the ability to drive may be associated with a large increase in utility while for others there may be no or minimal impact - they may not need to drive to access work or leisure activities or there maybe someone else in the household who can drive them.

The ability to perform activities (A) is assumed to be a function of a person's disability needs and their use of services and supports:

Equation 1-2

$$A = A(F_{Public}, F_{Private}, IC, AT | D)$$

Where F_{Public} is publicly funded formal care, $F_{Private}$ is privately funded formal care, IC is informal care and AT is assistive technology. D is the disability care needs of the recipient. Households under this utility maximisation framework are assumed to choose the optimal level of $A*$ where the marginal benefit equals the marginal cost of its production (Stabile, Laporte et al. 2006).

Assuming care types are perfect substitutes, then higher needs will increase the demand for all care types (Stabile, Laporte et al. 2006). However, care types are unlikely to be perfect substitutes, with more complex and intensive needs requiring more formal than informal care (Kemper 1992, Bolin, Lindgren et al. 2008). Families for example, may struggle to provide a person with a disability 24-hour care if required, but may be able to provide assistance getting dressed or preparing food. Likewise, for an individual with paraplegia, assistive technology in the form of a wheelchair will be required for mobility support. In shallow formal care markets that are likely to exist in rural and regional areas, individuals may not have the same access to formal care providers and therefore will demand a greater combination of informal care and assistive technology.

In maximising the ability of a person with a disability to perform activities households also face a resource constraint (Bannenberg, Karlsson et al. 2019):

Equation 1-3

$$Px * X + (P_{Formal} - S_{Formal})F_{Public}(P_{Formal} - S_{Formal})F_{Public} + P_{Formal}F_{Private}$$
$$+ (P_{AT} - S_{AT})(P_{AT} - S_{AT})AT + WIC = V + W(T - L)$$

Px is the unit cost of other goods and services (X), P_{Formal} is the unit cost of formal care (F), S the unit public subsidy for formal care, V is the non-wage income of the household, W is the unit cost of time (or wage rate), and T is the total time available for leisure, care giving and labour market activities.

Assuming positive marginal utility from consumption, an increase in households' wage and non-wage income will unambiguously increase demand for formal services and assistive technologies that improve welfare of the person (Stabile, Laporte et al. 2006). However, in Equation 1.3, a higher wage income influences informal care in two ways – firstly it increases the available resources ($W(T - L)$)and therefore acts to increase demand for informal care. Secondly, it increases the cost of informal care (W), potentially reducing quantity demand. This important relationship is discussed in more detail in the next section on supply of disability services and supports.

In summary, the household chooses the levels of public and private formal care, informal care, assistive technology, market goods and leisure to maximise household utility, given the disability care needs of the person with a disability to perform activities of daily living (Equation 1.2) and the resource constraints (Equation 1.3). The resulting Lagrangian and first order conditions are provided at Appendix 1,2, and provide useful insights into the demand for disability services and supports which we summarise below.

Focusing on the impact of an increase in the cap on publicly-funded services (S_{Formal}) where households are currently consuming the maximum level of services provides insights relevant to the implementation of the NDIS. Households often supplement their allocation of publicly-funded care with other care types, such as informal care or privately funded formal care. As a result, an increase in the publicly-funded care will have an income and substitution effect. This is because the increase in publicly available care is analogous to an increase in the household's non-wage income, which will lead to an increase in other care types alongside the consumption of leisure and market goods. Adding to this positive effect, care types are often complements. For

example, accessing formal care services for autism may require informal carers to provide transport or supervision. Therefore, an increase in government services may lead to a corresponding increase in informal care. This relationship may undermine the objectives of the NDIS to improve the labour market participation of informal carers. In Chapter 5: Maternal Labour Supply, we explore this potential relationship.

The increase in publicly-funded care will however also increase the relative price of other care types. This will lead to a substitution away from other care types, including informal care and privately funded formal care, rather than an increase in total care received. The concern over this substitution has led to specific rules within the design of the NDIS that consider maintaining a household's existing reliance on informal care.

While this theoretical model is useful in understanding relationships, empirically identifying those factors that impact on the demand for different types of services and supports and how they relate to each other is not straightforward. A major challenge in conducting empirical research of demand for disability services and supports is the identification of the causal effect where endogeneity is a persistent problem (Bonsang 2009). The joint determination of different types of services and supports makes things challenging, and the simultaneity of demand and supply causes additional issues. Poor specification of supply-side factors of the market commonly leads researchers to estimate a reduced form equation of those factors that influence where demand and supply are in equilibrium - it is often not possible to separately estimate what impacts demand versus supply. These issues make modelling causal relationships problematic, and lead researchers to instead focus on estimating associations to inform policy deliberations.

One way to avoid issues of identification is to focus on unmet need rather than service use. Sometimes considered the true measure of disability (Desai, Lentzner et al. 2001), the incidence and distribution of unmet need is often used to judge the effectiveness of disability care systems. While need might be regarded as exogenously determined – independent of supply effects, there are however additional issues in the measurement of unmet need, which is often more subjective in nature than actual service use (García-Gómez, Hernández-Quevedo et al. 2015). These issues are explored in Chapter 3 of the thesis, which investigates the determinants of

unmet need for disability services in Australia. Next, we consider those factors that determine the supply of disability care.

1.2.5 Supply of Long Term-Care

Providers of disability care services and supports include governments, quasi-government bodies, not-for-profit organisations, for-profit organisations, assistive technology manufacturers and informal carers (Francesca, Ana et al. 2011). The level of supply from these entities includes decisions around both the quality and quantity of supply (Bannenberg, Karlsson et al. 2019). As outlined above, the heavy reliance on informal care means that the provision of disability care differs from other health care services. Reflecting this, the supply of informal care is first discussed, before a discussion on the supply of formal care and assistive technology.

1.2.5.1 Informal Care

The decision to provide informal care forms part of the household utility maximisation and complex family bargaining processes (Bannenberg, Karlsson et al. 2019). However, the decision to provide informal care can be considered from the perspective of the caregiver, who may or may not be in the same household as the person with a disability. The supply of informal care is not determined by the price of care, as by definition there is no payment, but by the utility derived by the carer from the improved outcomes for the person with the disability and utility derived by the carer in the process of giving care (Brouwer, Exel et al. 2005, Laferrère and Wolff 2006).

Thus, we can consider the follow utility function for the carer:

Equation 1-4

$$U_{IC} = g_i(U_{Outcome} + U_{Process}) \geq U(w,t,c)$$

Where the utility from providing informal care (U_{IC}) is a function of the utility the person with a disability receives from receiving informal care ($U_{Outcome}$) and the direct utility the carer receives from providing informal care ($U_{Process}$). For any given level of utility, the amount of care provided will depend on the cost of supply, which will be influenced by the informal carers wage (*w*) and other costs associated with providing care ($U(w,t,c)$). The cost of providing informal care can therefore be understood as the opportunity cost of time, which includes time in the labour market. An increase in the

wages of carers therefore increases the price of providing informal care, and is likely to reduce the amount of informal care supplied (Carmichael, Charles et al. 2010).

There is significant literature on the impact of caring on labour force outcomes, including the decision to participate (extensive margin), the level of participation (intensive margin) and wages (Heitmueller 2007, Heitmueller and Inglis 2007, Leigh 2010). This literature is inconclusive and often inconsistent – with large differences in estimates of the effects of caring. Increasingly, it appears that the extent of the negative effect of caring on labour market outcomes is often upwardly biased due to the endogeneity of the caregiving choice and labour force participation (Heitmueller 2007). It is likely that there are unobservable factors which increase the probability of someone choosing to care and reduce their labour market participation. For example, lower motivation for formal work, which makes it hard to estimate the true effect of caring on labour force participation and wages.

1.2.5.2 Formal Care and Assistive Technology

The supply of formal care and assistive technology is determined by price, but the level of supply is driven by factors affecting the marginal costs of production as well as technology (McTaggart 2007). The determinants of supply of formal care and assistive technology are first discussed before the alternative price setting mechanisms used to fund disability care systems, and how these affect the quality and quantity supplied are explored.

The impact of price on supply depends on its price elasticity, which is determined by the time to produce goods and services and the availability of the factors of production. Production lead times in the assistive technology market and government regulations in the formal care market influence the time to produce goods (Oishi, Mitchell et al. 2010, Francesca, Ana et al. 2011). For example, providers often need to be registered to provide services in order to safeguard the wellbeing of people with a disability (Haveman and Wolfe 2000). These regulations reduce the responsiveness of supply to changes in prices for services.

Factors of production which influence price elasticity for disability services and supports include the availability of labour and land, and capital costs. Disability care is labour-intensive and the more formal care workers are available (higher level of

unemployment) the quicker suppliers can respond to changes in price and hence provide more services. Where there are fewer formal care workers, such as in rural areas, it may be hard for suppliers to increase the hours of care provided (Fujisawa and Colombo 2009, Francesca, Ana et al. 2011). This leads to inelastic supply, such that, even a large increase in price may not influence supply.

The level of supply provided at any given price will depend on the cost of production and the available technology. Higher wages will shift the supply curve left for the provision of formal care and assistive technology, reducing the amount of supply at any given price. Improvements in technology that make the provision of formal care more productive or reduce the cost to produce assistive technology will shift the supply curve out, increasing the amount supplied at any given price.

1.2.5.3 Setting Prices

A variety of methods for setting price and paying for disability care have been developed. In markets where the government is the main purchaser of services, block funding, case mix or fee-for-service are widely used (Haveman and Wolfe 2000, Bannenberg, Karlsson et al. 2019). In the private disability care market, fee-for-service is more common.

Block funding grants are the most common and involve the government providing a set budget to providers that then have to manage demand. This assists government rationing services and limits overall funding. However, it does not encourage efficiency or quality, as providers receive the same funding regardless of the levels supplied and these systems rarely offer user choice. Through the use of contractual mechanisms, governments can try and ensure an optimal level of quantity and quality is provided, however, this can be difficult and costly to monitor (Le Grand 2007).

Under case-mix, set amounts are paid based on defined groups linked with an individual's disability type and severity (Turner-Stokes, Sutch et al. 2012, Fries, James et al. 2019). Case-mix payments have the benefit of reflecting the cost of services without incentivising over-servicing and can therefore drive more efficient provision. Where case-mix systems incorporate user choice of providers it is likely to further drive more efficient provision (Turner-Stokes, Sutch et al. 2012). However, while applicable for some disability services (such as rehabilitation) case-mix funding has largely

developed in the episodic hospital setting and does not easily facilitate people with a disability having choice over the type of care and assistance they receive. As a result, it may not lead to optimal quality and quantity of service provision – for example, it may lead to too much of one type of service, and too little of another, if the care bundle is a one size fits all.

Fee-for-service as the name implies provides a fee for each service provided. Combined with user choice it effectively introduces choice and competition into the market for disability services (Productivity Commission 2011). As with other health care markets, the impact of choice and competition in the market for long-term care is ambiguous, due to market imperfections (Knapp, Hardy et al. 2001). Social care markets do not share the same level of market imperfections as healthcare; however, they do have a number of deviations from the 'perfect market' paradigm:

- Measuring outcomes and success is difficult in social care markets (Knapp, Hardy et al. 2001);

- Quality is multi-dimensional and assessment of quality is inherently subjective and influenced by the relationship between carers and users (Malley and Fernández 2010);

- Third-party agents are often required due to an historical unwillingness to include users in decision making, and the inability of some users to actively participate due to their needs (Knapp, Hardy et al. 2001);

- The absence of private insurance markets to cover costs of social care means that Governments, as third-party payers, dominate the financing of the sector.

- There is inherent asymmetry of information, as providers have more information than purchasers about service quality and how it impacts on individual users, complicating the agency relationship.

- Consumption is not discretionary, as users rely on the services providers for their day to day living needs (Knapp, Hardy et al. 2001); and

- The experience nature of the good means assessing quality before consuming services is difficult and the heavy reliance on services for day-to-day needs

increases the negative consequences of making a poor decision. This contributes to the high transaction costs for users contemplating a change of provider.

Together, these market characteristics impede the operation of the free market and make standard predictions about the impact of choice and competition tenuous. As with other health and social care markets, institutional history and design matter, with the impact of user choice and competition depending on the specific features of the market (Propper 2010). In particular, the price setting mechanism and the ability of users to accurately observe price and quality will determine whether competition leads to optimal or suboptimal outcomes (Dranove and Satterthwaite 2000). Propper et al. (2006) outlines that if the price setting mechanism does not allow for divergent prices based on patient severity, then providers may provide high-need users with sub-optimal quality and lower costs (skimping) and provide low-need users with excessive quality and higher costs (creaming). This is particularly relevant in the disability market as many disabilities are experienced on a continuum and concurrently with other conditions, creating significant variation in severity.

1.2.6 Financing Disability Care and Support

While the unit cost of disability care is generally low compared to acute health care, it is provided over a long period of time so that the total costs of care can be high (Bannenberg, Karlsson et al. 2019). Financing this care and support generally involves a mixture of private out of pocket and government expenditure, with a small role for private insurance.

1.2.6.1 Private Insurance Market

The risk of having a child with a disability or acquiring a disability later in life is often random and creates large and long-term care needs. In such circumstances, there is a strong rationale for the pooling of risks across individuals (National Disability Insurance Agency 2019). Despite this, the private insurance market has not developed into a major source of financing in the long term disability care market due to a number of market characteristics and imperfections (Brown and Finkelstein

2007)[4]. Factors which undermine the development of more comprehensive long-term disability care markets include asymmetry of information, uncertainty around costs, low demand, and the availability of attractive substitutes (Norton 2000). These are discussed below.

Asymmetry of information in the long-term disability care market leads to the well-known issues of adverse selection and moral hazard (Norton 2000). Adverse selection occurs because those with a high risk of need or existing need for long-term care are more likely to maintain their insurance policy (Norton 2000, Finkelstein and McGarry 2006). Moral hazard arises because those with insurance are likely to use more services than they require because they are covered (Norton 2000). As a result, those with existing conditions or underlying health problems are often excluded from long-term care insurance.

Individual insurers face significant uncertainty around the future costs of long-term care, including the level and severity of dependency and the costs of providing care. This leads to higher premiums and pressure to lower benefits, reducing demand for policies (Brown and Finkelstein 2007).

On the demand side, myopia about the future risk of needing long-term disability care, unattractiveness of existing products, the availability of informal care and bequest motives have been identified as factors leading to low take-up (Norton 2000). For young and healthy individuals, the risk of requiring disability care is so remote that it is not deemed necessary to seek cover.

Even amongst the large proportion of people expressing demand for long-term disability care insurance, the available products have been found not to meet the demanded quality. In particular, the lack of informal care cover reduces demand for available products (Bolin, Lindgren et al. 2008, Productivity Commission 2011). The availability of informal care more generally has also been found to crowd out demand for private long-term care insurance (Bannenberg, Karlsson et al. 2019). Stronger

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[4] There is a lack of research on the lack of long-term disability care insurance for the working age population, and in this section, we draw heavily on research focused on the long-term care insurance of the elderly.

family ties, as measured by proximity to children and stated relationship strength, have both been found to be associated with a reduced demand for long-term care insurance for the aged (Bolin, Lindgren et al. 2008) .

Further undermining the development of private insurance markets is the existence of government programmes (Norton 2000). While government programmes have developed in response to the lack of a private insurance market, they also aim to address the significant access and equity concerns with a reliance on private provision. As a result of these issues, private long-term disability insurance has a relatively minor role in the financing of long-term disability care in most countries, with government schemes playing a much larger role (Francesca, Ana et al. 2011).

1.2.6.2 Government Schemes

Government plays a large role in the financing of long-term disability care in most countries, with either social insurance or tax based systems dominating (Francesca, Ana et al. 2011). The decision on how much to finance disability supports and services can be considered within the framework of a social welfare function which includes a weighting for equity between individuals (Cullis, Jones et al. 2009). While the decision on how to fund disability services and supports is separate to how much to fund, the two are linked.

Social insurance based systems are popular in many European countries and rely on compulsory universal insurance for long-term care (Francesca, Ana et al. 2011). In return for making compulsory contributions, which may or may not be age based, individuals are effectively insured for long-term care expenses after assessment (Doetinchem, Carrin et al. 2010). These compulsory contributions could be classified as a form of taxation but they have the benefit of ring fencing funding, as well as incentivising the social insurers to minimise long-term care costs through investing in early intervention (Rothgang 2010). The NDIS, while relying on taxation for its financing, is designed around these principles of social insurance.

In a tax based system long-term care is funded by different levels of government from general taxation revenue, and is often augmented with co-payments for services to dissuade low-value use and raise revenue for services (Francesca, Ana et al. 2011). Services are provided either directly by government or through non-government

organisations. Under these systems it is common for heavy rationing of services to result in long waiting times and large levels of unmet need. Coverage can be universal or means tested, depending on the system (Francesca, Ana et al. 2011). While tax-based systems are administratively simple, they can result in shortages of funding, due to competition from other programmes for government spending. In addition, governments often have short term fiscal priorities and are not incentivised to minimise the long-term costs of disability through investing in early intervention.

1.2.7 The economic impact of disability policies

Government policies to fund disability services and supports have wide ranging economic impacts (Haveman and Wolfe 2000). These include: the incentives to work facing people with a disability, their carers and providers; the market for services and supports; and the level of aggregate government spending. Government policies therefore directly impact the distribution of income and welfare across households. In this final section the labour supply and welfare impacts of disability policies are outlined.

1.2.7.1 Labour Supply Impacts

The provision of care services and income support payments to people with a disability and their carers have the capacity to increase and decrease labour supply (Powers 2001, Krueger and Meyer 2002, Campolieti 2004, David and Duggan 2007, Chen and Van der Klaauw 2008, Jones 2008, Borghans, Gielen et al. 2014, French and Song 2014, David, Duggan et al. 2016, Kostøl, Mogstad et al. 2019). Income support payments for people with a disability and their carers will generally reduce labour supply, as they increase the reservation wage. A number of studies have measured the impact of increases in disability support payments, and confirmed that these policies lead to a reduction in labour supply (Gruber 2000, David and Duggan 2007, Jones 2008).

The effect of an increase in the number of care services has a more ambiguous effect on labour supply. An increase in provision of publicly funded services will have an income effect reducing the labour supply (David and Duggan 2007). At the same time however, the provision of care service may facilitate labour force participation for a person with a disability that would otherwise not be possible. For example, aids or

equipment that allow a person with a disability to complete specified work tasks may have the same effect as reduction in the reservation wage on labour supply. For carers, the provision of additional formal care services may reduce the need for informal care if the two are substitutes (Bonsang 2009) and increase carer labour supply. However, in some circumstances disability care and informal care are likely to be complements, in which case an increase in disability care supports can be expected to reduce labour supply (Bremer, Challis et al. 2017). For example, an increase in available speech pathology services for children might require a carer to accompany the child to receive the service (Powers 2001). As a result of these competing effects the labour supply impacts of expanding disability supports and services is often ambiguous.

1.2.7.2 Welfare Impacts

Government disability policies are aimed at reducing the inequalities experienced by people with a disability, as a result they involve a redistribution of resources toward households that include people with a disability. Whether this redistribution can be viewed as improving overall welfare will depend on the social welfare function, the efficiency of taxation policies and the effectiveness of government policies to address needs of people with a disability (Cullis, Jones et al. 2009).

Under a classical utilitarian approach, the welfare of society is measured by the aggregate of individual utilities, but where an individual's own utility may also depend on the utilities of others. Increased spending on disability services and supports is deemed to be welfare enhancing only if the associated increase in utility is greater than the welfare loss due to increased taxation or reduced spending on other programs (Hurley 2000).

Rather than maximise total utility across individuals, the Rawlsian social welfare function focuses on maximising the utility of individuals with the lowest level of welfare (Stark, Jakubek et al. 2014). This approach is built on the ethical foundation of a veil of ignorance. Rawls argues that if individuals were to select the distribution of resources for each individual before knowing their own position in society (i.e., before they were even born and if they could be born as anyone), they would choose an allocation which provided more resources for the least well off in society (given there

is a chance they may be born as this person). Under this approach, an increase in spending on disability services and supports could be viewed as welfare enhancing if it improved the welfare of the least well off in society, or those in greatest need.

However, many scholars argue that this view is not an accurate reflection of Rawls principles, as it effectively ignores his first theory of justice which is that each person has an equal right to basic liberties enjoyed by others. Rawls famously ignored health in his list of basic liberties (Rawls 1982), but it is possible to apply his principle and conclude that everyone has the right to an equal access to disability services based on need (Bommier and Stecklov 2002). While this does not assist in determining whether an increase in disability funding is welfare improving or not, it does provide a metric by which to measure the performance of such policies in ensuring equity of access to available services.

Breaking from the utilitarian based understanding of welfare, the Sen Capability approach is instead concerned with individual functionings and capabilities. A functioning is the outcome or activity of interest, such as being housed, or clothed. A capability is the ability or opportunity to achieve that functioning. An increase in funding for disability support services would be considered to have improved welfare if it aligns with community preferences (of what the basic set of functionings should be available) and enhances the capabilities of the population such that more individuals could have these basic functionings (Sen 1993).

1.2.8   Conclusion

Having a disability affects individuals in a number of ways and across a number of domains in their life. These impacts can be positive and negative, but in many cases require additional services and supports to undertake activities of daily living. How we understand disability and the rights of people with a disability have and continue to be transformed, which is influencing the design and funding of disability supports and services around the world. This is no more so than in Australia with the establishment of the NDIS, where choice and competition alongside a significant expansion in funding supports has transformed the disability sector.

The thesis sets out to better understand some of the key features of the economics of disability in Australia in the lead up to these reforms. In doing so, it provides insights into how reforms can be best implemented and evaluated in the future.

1.3 Data

A number of data sets exist in Australia that contain information on people with a disability. The Household Income Labour Dynamics in Australia (HILDA) is a large panel survey which includes detailed questions on disability in waves 4, 9, 13 and 17. However, the measure of disability severity is linked to ability to participate in paid employment and not core activity limitation and therefore does not align with accepted WHO definitions of disability. There is also no measure of unmet need for disability services, a key area of interest. In addition, when research for this thesis was being undertaken, there were no questions related to whether the respondent received formal or informal services, or used assistive technology[5]. These limitations led to the decision not to use HILDA in the analysis, and instead focus on a richer cross-sectional survey and another panel survey focused on children. These are discussed below.

The two main data sets are utilised throughout the thesis. The first is the Survey of Disability and Carers (SDAC) which is undertaken by the Australian Bureau of Statistics throughout Australia. It has three main target populations, including people with a disability and their carers. While the survey is cross sectional and does not include information on local areas to allow the modelling of either individual or regional fixed effects, it is rich in the detail on the person's disability, how it affects their day-to-day life and the socio-economic status of households. This allows for the study of socio-economic inequalities in the use of different combinations of services and supports by people with a disability (Chapter 2) and changes in reported unmet needs for disability supports (Chapter 3).

The second data set used is the Longitudinal Survey of Australian Children (LSAC) which is a panel data set of two cohorts of Australian children undertaken by the Australian Government. Beginning in 2003, when children were aged 0-1 (the 2004 Birth Cohort) and 4-5 (the 2000 Birth Cohort) there is a new wave conducted every two

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[5] In the final two waves, 17 and 18, released after the primary research was completed this changed with questions now included on whether respondents received service under the NDIS.

years. The sample is representative of children from rural and urban areas across all the states and territories in Australia. Once again, it is a rich data set that allows the examination of a broad range of research questions. Importantly, LSAC identifies 330 children who are diagnosed with autism, which allows the study of the time to diagnosis (Chapter 4) and the impact of a diagnosis on maternal labour supply (Chapter 5).

1.4 Thesis Overview

The implementation of the NDIS has not been without its criticisms, especially around the nature of supports covered and the difficulty in navigating the system (Tune D, 2019). As one of the biggest social reforms of a generation in Australia, understanding and measuring the impact of the NDIS will provide important evidence of its value to people with a disability, their families and broader society. The thesis adds to the evidence on the Economics of Disability in Australia prior to the full roll out of the NDIS, using the best available data. Below we describe the contribution of each chapter.

1.4.1 Chapter 2 – Inequalities in Access to Disability Service and Supports in Australia

This chapter adds to the existing literatures on the use of informal and formal care, with the inclusion of assistive technology and gender in the analysis. Our findings, while largely descriptive, highlight important inequalities in the use of assistive technologies and heterogenous impacts of gender which have not previously been explored. Using the 2009, 2012 and 2015 Australian Bureau of Statistics SDAC, this chapter evaluates the extent of horizontal inequity, or unequal use of formal care, informal care and assistive technology for equal need, prior to the introduction of the NDIS.

A multinomial logit model is used to describe what factors are associated with the choice of different combinations of services and supports. Using concentration curves and concentration indices, the level of inequality across different levels of household education in access to combinations of services and supports is described, and the factors contributing to any observed inequality are identified through a decomposition of the concentration indices.

1.4.2 Chapter 3 – Unmet Need for Disability Services in Australia

In Chapter 3, the incidence and determinants of both subjective and objective measures of unmet need for disability services in Australia and how these have changed over time is described. We add to the literature by providing more evidence of the important difference in these measures, and how they may vary across time and geography due to institutional settings and expectations.

Again, utilising the 2009, 2012 and 2015 SDAC, this chapter evaluates the rationale for the NDIS and estimates the extent of horizontal inequity in unmet need prior to its introduction. Both probit and linear probability models are used to explore the distribution of unmet need for disability services with changes across time decomposed using an Oaxaca decomposition. In recognition of the heterogeneity between children and adults, separate sub-group analysis is undertaken, finding some important differences between the two groups.

1.4.3 Chapter 4 – Factors Influencing Timing of Autism Diagnosis in Two Cohorts of Australian Children

Earlier diagnosis of children with autism is likely to be critical to long-term outcomes, but is often delayed. No studies in Australia have identified those factors associated with the timing of diagnosis. This chapter adds to the literature by investigating the determinants of the timing of autism diagnosis in a representative sample of Australian children.

Utilising LSAC time to event analysis (i.e., survival analysis) is used to identify demographic and clinical characteristics associated with age of diagnosis. Analysis on both the full sample population and the sub sample of those end up receiving a diagnosis is undertaken. The results provide the most comprehensive picture so far on the possible factors associated with timing of autism diagnosis.

1.4.4 Chapter 5 – Impact on Maternal Labour Supply of a Child's Autism Diagnosis

Theoretically, a mother may respond to having a child with autism by either increasing labour force participation to fund additional services or decreasing labour force participation to provide additional care (Gould 2004). Existing empirical research finds

a strong negative relationship between having a child with autism and maternal labour supply (Parish, Seltzer et al. 2004, Montes and Halterman 2008, Cidav, Marcus et al. 2012, McCall and Starr 2016). However, previously no studies have utilised panel data to identify the impact of diagnosis or investigated the impact of changes in the level of subsidised services.

Using LSAC, the impact of diagnosis on maternal labour supply is analysed using a fixed effects model, finding a strong negative association. A difference-in-difference model is utilised to explore the impact of increased services, and finds some evidence of a negative effect on maternal labour supply. This research highlights the importance of complementary policies which support mothers of children with autism to also engage with the labour market, as this reduction in labour supply will likely reduce their life long earning potential.

1.4.5 Chapter 6 – Policy Implications

Finally, the thesis concludes with a summary of the policy implications of our research for the future operation of the NDIS and directions for further research on the economics of disability.

2 Inequalities in Access to Disability Service and Supports in Australia

2.1 Introduction

The extent of inequalities in the use of disability services and supports is one way to evaluate the success of a social care system. Specifically, whether systems conform to Rawlsian principles of social justice so that access to services is based on need and not socio-economic status (Bommier and Stecklov 2002). In this chapter, inequalities in the use of different combinations of informal, formal and assistive technology across education levels, prior to and during the initial phases of the roll-out of the NDIS are investigated, using the widely employed concentration index. Sub-group analysis is undertaken to allow for heterogenous patterns of use across different household types and gender. This allows us to comment on whether higher income and more educated households were, as is often claimed, better able to navigate the disability services and supports system before the NDIS, accessing more formal care services and assistive technology (Manne 2011, Productivity Commission 2011).

Three rich cross-sectional data sets: the 2009, 2012 and 2015 Australian Bureau of Statistics (ABS) Survey of Disability and Carers (SDAC) are utilised, focusing on the population aged under 65 years of age who are eligible for services under the NDIS.

2.1.1 Nature of Services and Supports

People with disabilities often rely on one or a combination of different types of services and supports including formal care, informal care and assistive technology to meet their daily living needs. Formal care includes care received from private organisations, government or charities (Kemper 1992, García-Gómez, Hernández-Quevedo et al. 2015). Informal care includes care received from friends and relatives, which is not paid (Kemper 1992, García-Gómez, Hernández-Quevedo et al. 2015). The types of care received cover self-care services such as feeding and washing, and mobility services like transport, communication services, including speech pathology (formal only), and emotional services, for example, counselling. Assistive technology refers to equipment or systems that help with moving around the home or community, communication or other daily tasks, for example a wheelchair, or hearing aid.

A number of approaches to modelling the use of different types of services and supports have been proposed, focused primarily on the interaction of formal and informal care use, and have not covered the use of assistive technology (Bolin, Lindgren et al. 2008, McMaughan Moudouni, Ohsfeldt et al. 2012)[6]. In the discussion below we attempt to incorporate assistive technology into these different approaches as it is becoming a more important part of the disability market for services and supports. A key consideration in these approaches is whether decisions to use formal and informal care are made sequentially or simultaneously, which depends on whether they are considered complements or substitutes[7].

The hierarchical compensatory model assumes the choice between informal and formal care is made sequentially on the assumption that they are substitutes and there is a clear order of preference (Broese van Groenou and De Boer 2016). Individuals are likely to prefer informal care by family members, followed by care from friends and neighbours. When these types of care are not available or adequate, formal care is used. It is not clear how assistive technology fits within the hierarchical compensatory model. Assistive technology could be preferred to formal or informal care as it provides greater independence[8]. Alternatively, assistive technology could be preferred less than formal or informal care because it does not provide any utility from social contact. Through including assistive technology in the analysis, more information will be provided on how it fits within the preference set of people with a disability. Other models have considered the decision to use formal and informal care as occurring simultaneously due the care types being both compliments and substitutes (Van Houtven and Norton 2004, Bremer, Challis et al. 2017).

As with the hierarchical compensatory model, the demand for formal care services is impacted by the availability of informal care, with individuals more likely to seek formal care when informal care is inadequate (Van Houtven and Norton 2004). However, informal care has been found to complement formal care in some circumstances, for example in accessing hospital or doctor services (Bolin, Lindgren et al. 2008).

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[6] These models have not included consideration of assistive technology.
[7] A substitute is a good that can be used instead of another good; a complement is a good that is more likely to be used if another good is used.
[8] For example, if home modifications allow an individual to wash himself or herself independently this would be considered preferential to either informal or formal care.

Complicating this relationship further, there is evidence of reverse causality, with the supply of informal care by family members and friends influenced by the availability and cost of formal care (Arber, Gilbert et al. 1988, Bonsang 2009, Paraponaris, Davin et al. 2012, Ilinca, Rodrigues et al. 2017). A number of studies have used bivariate probit models, that allow for the joint determination of informal and formal care to address these issues. However, omitted variables which are related to need, will likely upwardly bias the strength of any causal relationship found between formal and informal care, limiting the usefulness of such models. This is especially true in the absence of an exogenous measure of supply for both formal and informal care (Mozhaeva 2019). Studies looking at aged care have used proximity of female children as an instrumental variable for informal care (Van Houtven, 2008) however, such a measure was not available in the current study, and given our study population includes children and young adults, would not be relevant for the study population. In addition, exogenous variables which influence the supply of formal care are difficult to find. Including assistive technology in the analysis further adds to this complexity because it is also a potential complement and substitute to both informal and formal care (Hoenig, Taylor et al. 2003, Mortenson, Demers et al. 2012, Anderson and Wiener 2013).

As a result of these concerns, an attempt to model the nature of the relationship between informal, formal and assistive technology using a tri-variate probit model is not made in this paper. Instead, we describe the level of inequality in the combination of care types using multinomial logit models, before quantifying this inequality using concentration indices. This allows us to better understand pre-existing inequalities in use, which may influence the future distribution of services under the NDIS.

2.1.2 Socio-economic Inequalities

A number of need, and non-need factors are known to influence the use of services and supports. While differences based on need factors, such as type and severity of disability may be considered equitable (Andersen and Newman 1973), differences based on non-need factors, such as age, gender, location and socio-economic characteristics may be considered inequitable (Andersen and Newman 1973). In particular, we are interested whether socio-economic characteristics impact service use.

People from lower socio-economic groups are expected to be heavier users of services and supports. This is due to the higher incidence of disability amongst lower socio-economic groups and the impact of having a disability on socio-economic status (Kavanagh, Krnjacki et al. 2015). However, once greater need is controlled for, individuals with higher socio-economic status are expected to be more likely to use formal care services and assistive technologies.

Along with being better able to meet any direct out of pocket or associated costs (Van Houtven and Norten (2004)), higher socio-economic groups are better able to navigate complex systems and successfully advocate for services and supports due to higher levels of education and better native language skills (Bass and Noelker 1987). These households may also be more likely to recognise the effectiveness of interventions and supports in improving the functioning and wellbeing of the person with a disability. In addition, carers in higher socio-economic households potentially have bigger opportunity costs providing informal care due to higher earning capacity in the labour market (Heitmueller and Inglis 2007). All these factors culminate in an expectation that after for controlling for need, people with a disability in higher socio-economic households will be heavier users of services.

There are a number of correlated measures of socio-economic status, including income, occupation, and education (Braveman, Cubbin et al. 2005). In this chapter we have chosen to use highest education in the household to measure socio-economic status. This reflects that many people with a disability rely on family members to advocate for service on their behalf (Grossman and Magaña 2016). Higher educated households are likely to have developed more skills and abilities to navigate complex bureaucratic structures and to advocate for services. In addition, household education is less likely to reflect unobserved differences in need than other potential measures of socio-economic status, including income and individual education. Income could reflect in part unobserved differences in need because having a disability impacts household and individual income due to a reduction in the capacity to work, which is positively correlated with need (Meyer and Mok 2013). This will mean that the impact of socio-economic factors is potentially underestimated because lower income households use more services due to higher unobserved needs.

Individual education is another common measure of socio-economic status (Winkleby, Jatulis et al. 1992). However individuals with disabilities acquired early in life are less likely to have completed formal education (AIHW 2019). This means individual education potentially measures unobserved differences in need and because a person's ability to acquire education is correlated with need it is unlikely to truly reflect the socio-economic status of the individual's household. There will however be many cases where the person with a disability has the highest educational qualification in the household, for example, where they live alone or live with young children.

2.1.3 Existing Evidence

There is limited evidence on inequality in the use of disability services and supports by working age people with a disability. This contrasts to the extensive evidence of inequality in healthcare use across the population after controlling for need, with lower utilisation among the poor (Morris, Sutton et al. 2005, van Doorslaer, Masseria et al. 2006, Fleurbaey and Schokkaert 2011, Devaux 2015, Terraneo 2015, Cookson, Propper et al. 2016, Brekke, Holmås et al. 2018). A number of studies have also found that education is a significant source of inequality in health care use (Alberts, Sanderman et al. 1997, Terraneo 2015). As noted, levels of education are linked directly with higher income, which facilitates greater service use. In addition, higher levels of education are associated with a greater ability to navigate the health system and access services. The relationship is however, not uniform across countries, indicating that there are interactions between individual needs, population characteristics, and the health and welfare systems operating in countries that lead to different levels of inequality in service use (Eikemo, Huisman et al. 2008, Terraneo 2015).

A small but growing body of literature has examined the inequality in long-term care use by the aged population, and has similarly found evidence of inequalities in service use (Van Houtven and Norton 2004, Bolin, Lindgren et al. 2008, Bonsang 2009, Gannon and Davin 2010, McMaughan Moudouni, Ohsfeldt et al. 2012, García-Gómez, Hernández-Quevedo et al. 2015, Mery, Wodchis et al. 2016, Ilinca, Rodrigues et al. 2017). Again, higher levels of education have been associated with increased use of formal care services (Larsson and Silverstein 2004, Ilinca, Rodrigues et al. 2017). The composition of the household (including marriage status, and gender composition) has been found to influence the use of services and supports (Illinca, Rodrigues et al,

2017). For example, a number of studies have found that female children are more likely to provide informal care services to parents during old age, reducing the reliance on formal care services (Arber, Gilbert et al. 1988, Paraponaris, Davin et al. 2012). This is consistent with women undertaking a larger amount of informal caring across society. While in the context of disability services the presence and gender of children may not be as relevant, the composition of household is still expected to be a factor in care decisions.

Gender of the person with a disability is also a potential factor associated with the use of services and supports. From the broader health care literature, we know that women are heavier users of health services than men (Bertakis, Azari et al. 2000, Redondo-Sendino, Guallar-Castillón et al. 2006, Merrill and Fowers 2019). There is also some evidence in the existing disability service literature that men are less likely to rely on paid care than females (Arber, Gilbert et al. 1988, Bonsang 2009). This could be due to preferences differing across gender, or males being more likely to have a potential female carer in the household, thereby relying more on informal rather than formal care.

While existing research has allowed for the impact of gender and household composition on services use and found important differences, studies have not undertaken sub-group analysis to allow for heterogeneity across these groups. This current limitation is addressed in this paper through including sub-group analysis of single versus multi-member households and female versus male people with a disability.

As noted above, there is no research exploring inequalities in the use of assistive technology. Either identified research has not considered assistive technology (Bolin, Lindgren et al. 2008, Bonsang 2009, Oliva-Moreno, Peña-Longobardo et al. 2019) or its presence has been considered as part of the home environment (Paraponaris, Davin et al. 2012). Therefore, an important contribution of this paper is gaining a better understanding of the socio-economic differences in the use of assistive technology. This is particularly important, given the ongoing expansion of new assistive technologies, making them a more important component of the services and supports for people with a disability.

In this chapter, inequality in the reliance of different care combinations is estimated using the widely employed concentration index (Brinda, Attermann et al. 2016, Ataguba 2019). This allows the decomposition of the factors that contribute to any inequality in the use of different combinations of formal care, informal care and assistive technology. In the next section, background to the institutional setting of disability care services in Australia and the changes being introduced through the NDIS is provided. The data and methods used for the empirical analysis are then described. Results are presented in the following section before the findings and their implications are discussed.

2.2   Institutional Background

Historically, disability services have been delivered by Australia's eight state and territory governments under largely block funding arrangements which resulted in restrictions in services and supports. Providers, people with disabilities and their families argued that the nature of formal supports varied considerably, dependent on geographic location, the type of disability, how it was acquired and the ability to agitate for services (Manne 2011, Productivity Commission 2011).

The NDIS aims to address existing inequities in access and service use through greater provision and the expansion of choice and competition policies into the provision of disability services. It is argued that choice and competition policies are more equitable because they remove advantages afforded to those that can better navigate the system and advocate for services under traditional public service models of service provision (Le Grand 2007).

However, under the NDIS Act (2013) the level of informal care support is explicitly considered in the formulation of individual care plans. In practice, this means an individual currently receiving informal care for some limitation may be less likely to receive support for formal care or assistive technology under the NDIS. Conversely, individuals currently receiving formal care are more likely to receive support for formal care under the NDIS. It follows that if the distribution of care and support services was inequitable before the NDIS, the NDIS may inherit these inequities hindering its ability to improve equity of access to disability services and supports.

This chapter makes two contributions to understand the impact of the NDIS. The first is to provide a baseline to judge the impact of the NDIS in removing or reducing any

inequities in the use of services and supports. The second is to evaluate whether assessing eligibility for formal services and supports on the basis of pre-existing informal care use is administratively fair for all users, or likely to entrench pre-existing inequities.

2.3 Data

In this chapter we use data from the 2009, 2012 and 2015 Survey of Disability, Ageing and Carers (SDAC) which are representative surveys of people with a disability and carers (ABS, 2013)[9]. The SDAC provides rich, periodic snapshots of people living with disabilities in Australia. It covers an individual's health and disability status and includes detailed information on the use of services, demographic and socio-economic status.

Dwellings are selected at random using a multi-stage area sample, which ensures that within a selected geographic region all sections of the population are represented, including those without a disability. A larger number of households are sampled from areas with higher proportions of people with a disability to ensure that there is a sufficient number of people with disability in the final sample.

The SDAC defines someone as having a disability if they report a limitation, restriction or impairment that is expected to last for at least six months and restricts everyday activity. This is consistent with the WHO definition of a disability outlined in chapter one. SDAC collects data from people with and without a disability, across both households and health establishments. In the latest survey 79.7 per cent of households contacted responded and 90.9 per cent of health establishments. The survey includes people with and without a disability, and as a result we exclude much of the sample to focus on individuals with a core activity limitation.

The SDAC collected data from 72,075 people in 2009; 77,570 in 2012; and 75,211 in 2015. Given our focus, we restrict our sample to individuals with a core activity limitation (excludes 74.9 per cent of the sample in 2009, 74.4 per cent in 2012 and 72.5 per cent in 2015) and aged between 15 and 64 (excludes a further 18.9 per cent of sample in 2009, 19.4 per cent in 2012 and 21.6 per cent in 2015). In addition, we

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[9] Australian Bureau of Statistics. Disability, Ageing and Carers, Australia: Summary of Findings, 2012. Canberra: Australian Bureau of Statistics; 2013 Nov. Report No.: 4430.0.

do not include individuals living in supported accommodation (such as nursing homes and group homes) in order to focus on those living in the community with a disability (excludes 0.1 per cent of sample in 2009, 0.1 per cent in 2012 and 0.03 per cent in 2015). Our final sample for analysis is 4,331 from 2009, 4,710 from 2012 and 4,401 from 2015.

2.4 Variables

2.4.1 Care Received

The SDAC includes detailed information on the use of formal and informal care and the use of aids or equipment, the nature of that assistance and its frequency. Individuals are asked whether they receive any organised services to help with self-care, mobility, communication or emotional needs. Organised care is categorised as any care received from a government organisation, private non-profit organisation and private commercial organisation. We categorise organised care as formal care. Individuals are separately asked if anyone in the household or a family or friend outside the household assists with self-care, mobility, communication or emotional tasks. We categorise this as informal care. We construct a series of binary variables to indicate whether any informal care, formal care or assistive technology is used and the different possible combinations of care used.

2.4.2 Need Characteristics

The social model of disability views unmet need as the true measure of disability (Oliver 1996), however, we focus on inequality of access to care services. We therefore take a medical or impairment view of disability. We control for an individual's main impairment, using categories of sensory and speech, intellectual, mental, physical and other impairments. This information comes from a question asking what types of restrictions and impairments an individual has and their main impairment. Having a physical main impairment is used as the reference group.

Covariates are included to indicate the severity of a person's disability being profound, severe or moderate using dummy variables; with a mild disability the reference. This is determined in the survey by the extent of assistance an individual requires with a core activity limitation. If an individual always needs help with a core activity this is classified as having a profound disability, whereas if they only sometimes need assistance this is considered a severe limitation.

2.4.3 Non-Need Characteristics

Non-need characteristics include predisposing and enabling characteristics that impact both the demand for and ability to access services and supports (Andersen 1968). The most important of these in the current study is education, which in the context of disability services can be viewed as impacting both the preference for and ability to benefit from different services and supports.

In each survey, each household member is asked to record their highest level of qualification, including categories such as completing high school and a university degree. This allows us to generate a measure of the highest education in the household. English-speaking background is also expected to influence the ability of individuals to navigate the disability care system, and therefore access formal care supports. A dummy variable is used with the value of one if from a non-English speaking background, and zero if from an English-speaking background.

Household income is only reported in deciles in the survey, and this measure is converted into a continuous variable using the mid-points of the bounded deciles to then allow calculation of equivalised household income. For the top unbounded decile we estimate income based on the size of the ninth decile and the lower bound of the upper decile using the technique outlined in the 2018 paper by Donnelly and Pop-Eleches (Donnelly and Pop-Eleches 2018). Using the modified OECD scale, these estimates are then converted to equivalised household income, with the main householder given a weight of 1 and subsequent householders a weight of 0.5 and children a weight of 0.3. These estimates are converted to real income using quarterly consumer price index data from the ABS. Log income is used in the analysis to account for the likely diminishing marginal impact of income on influencing care use.

A number of variables are constructed to explore the impact of household composition on the mix of formal and informal care. Previous studies have shown the importance of daughters, for example, in the use of aged care services, indicating that the availability and gender of potential carers plays an importance role in service use (Van Houtven and Norton 2004, Bolin, Lindgren et al. 2008, Bonsang 2009, Kehusmaa, Autti-Rämö et al. 2013). We generate variables to indicate the presence and gender of a spouse in the household, and presence and gender of other adults in the household.

Individuals living in areas where there are more services such as city areas, are more likely to be able and willing to access formal support services due to their proximity to these services. A dummy variable indicating that an individual lives in a city area is included alongside controls for state of residence. Unfortunately, due to data access restrictions we do not have a more disaggregated area break down which would allow stronger conclusions to be made. A full list of variables used in the analysis is listed in Appendix 2.1.

2.5 Empirical Approach

The objective is to identify the factors associated with the distribution of the combination of formal and informal care and assistive technology used (for example, informal care and assistive technology or formal care and informal care) across socio-economic status. There are eight potential combinations of care: no care; informal care only; formal care only; assistive technology only; informal and formal care; informal and assistive technology; formal and assistive technology; and all care types. Because the data used is cross sectional it is not possible to account for potentially important unobservable characteristics that may affect the choice of care combinations, including personal and family preferences and attitudes. The available data also does not include adequate information to control for the supply of formal care either directly or by proxy. Due to these data limitations, we are unable to make any strong causal statements. Rather we provide a detailed descriptive analysis of differences in the choice of care combinations across education levels and between sub groups.

2.5.1 Multinominal Logit

A number of approaches have been applied to model the choice between informal and formal care, reflecting the complexity of the issue at hand (Van Houtven and Norton 2004, Solé-Auró and Crimmins 2014, Carrieri, Di Novi et al. 2017). For example, in the most recent study Carrieri et al use a bivariate probit model to try and account for potential endogeneity between formal care and informal care. However, this approach would make the examination of any inequity in the choice of different combinations of care difficult, which is our primary interest.

Consequently, we have adopted a multinominal logit model to better capture the complex choices across care types. The multinominal logit model is expressed in

Equation 2.1 (Solé-Auró and Crimmins 2014), categorising individuals as receiving no care (j=1); or a combination of informal, formal and assistive technology (j=2,…,8). The base case is no care (j=1).

Equation 2-1

$$P(Y_i = j) = \frac{\exp{(Z_{ji})}}{1 + \sum_{k=1}^{J} \exp{(Z_{ki})}} \; ; j = 1, \dots, 8$$

Where z_{ji} is vector of need, and non-need factors (both predisposing and enabling) that are associated with each combination of care types.

This approach provides an exploration of the factors associated with the probability of receiving different mixes of formal care, informal care and assistive technology, as compared to receiving no care. As already noted, this model does not estimate a causal relationship between covariates and the probability of choosing different care options because it does not account for the endogeneity inherent in these choices and the impact of supply side factors. To ease the interpretation of the model, using the margins command in Stata after the multinominal logit regression, we calculate the predictive margins for each level of education across care types.

In addition, the multinominal logit is underpinned by the independent alternatives assumption (iia). In our case this requires that if an individual relies on all care and you removed this option the individual would not be more or less likely to choose any of the other options. This is unlikely to be the case as the individual would be unlikely to choose not care. We therefore run a robustness check, excluding no care from the analysis (see Appendix 2.6) and find consistent results[10].

2.5.2 Concentration Index

Second, an assessment of the level of any inequality in service use is undertaken, using the widely applied concentration index (García-Gómez, Hernández-Quevedo et

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[10] Alternatives such as nested logit models or multinominal probit models can be used in cases where the iia assumption is not supported. The nested logit models allows for a hierarchical approach but in our case results in having the same choice at the end of two branches, and theoretically would still breach the iia assumption. The multinominal probit model is appropriate as it does not rely on the iia assumption, but is computationally intensive and did not converge for our eight choice model.

al. 2015, Brinda, Attermann et al. 2016, Ataguba 2019). Concentration curves and the concentration index are utilised to represent the distribution of service use across socio-economic status, and to identify the most salient factors associated with that distribution (Rodrigues, Ilinca et al. 2014). The concentration curve (depicted in Figure 2.1 below) represents the inequality in the use of services and supports (O'donnell, Van Doorslaer et al. 2007).

Figure 2-1: Concentration Curve
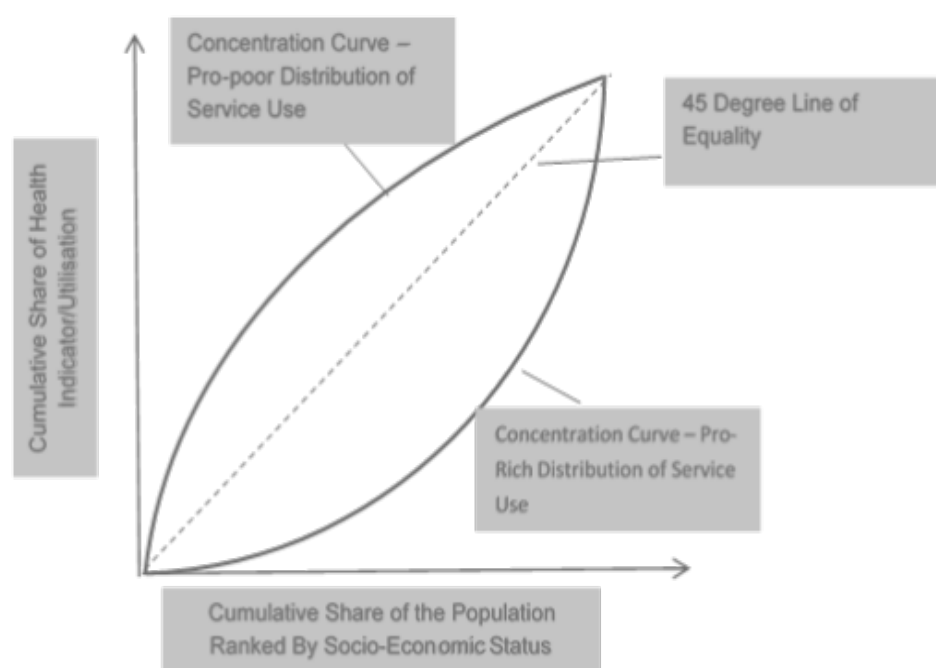
The concentration curve shows the cumulative proportion of service use (the horizontal axis in Figure 2.1) against the fractional socio-economic status rank of the population (the vertical axis in Figure 2.1). The 45-degree line indicates a scenario where the care type is equally distributed across income groups. If the concentration curve lies above or below the 45-degree line of equality, then the care type use is more heavily concentrated amongst low (pro-poor) or high socio-economic (pro-rich) groups. In addition to providing an overall summary measure of inequality represented by the concentration curve, the concentration index can be usefully decomposed into

the factors that contribute to a given level of observed inequality (O'donnell, Van Doorslaer et al. 2007).

A number of concentration indices have been proposed in the literature to suit the underlying properties of the variable being studied, including whether it is binary or continuous, and differing views on inequality (O'Donnell, O'Neill et al. 2016). In this study the Erreygers concentration index is used, which accounts for the binary nature of using different combinations of services and supports and measures absolute inequality (Erreygers 2009).

Equation 2-2

$$CCIi = \frac{4 * \mu}{CT_{max} - CT_{min}} * \frac{2}{\mu} \text{cov}(\text{CT}, \text{r})$$

Where CT is the combination of care received including formal and informal care and assistive technology and all the combinations of these, including receiving no care. In the case of binary variable CT_{max} is 1 and CT_{min} is 0.   μ is the proportion receiving different combinations of care i, and r is the fractional rank of the highest educational status in the household. The Erreygers concentration index is calculated for each of the eight care type combinations.

The index lies between -1 and +1, with a negative value indicating a pro-poor distribution, 0 reflecting perfect equality and a positive value associated with a pro-rich distribution (Wagstaff 2005). An Erreygers concentration index of 1 indicates that the top 50 per cent of educated households received all that particular combination of care and those in the bottom 50 per cent of education households received none of that care combination.

Differences in the combinations of care types accessed may reflect levels of need, for example, those with higher needs being more likely to require a combination of formal and informal care, alongside assistive technology. Indirect standardisation adjusts for differences in need across socio-economic groups facilitating the comparison of inequality across heterogeneous groups, and the measurement of the level of horizontal inequality   (O'donnell, Van Doorslaer et al. 2007).

There are a number of steps involved in indirect standardisation. First the association of need (N_k) and non-need (NN_j) factors with each combination of care (CT_i) is estimated.

Equation 2-3

$$\Pr(CT_i = 1) = F(\propto + \beta_k N_{ik} + \gamma_j NN_{ij})$$

Where $F(z) = \dfrac{e^z}{1 + e^z}$ is a cumulative logistic distribution to account for the binary variable for each care combination (CT_i).

Disability type and disability severity are categorised as need factors. Income, individual or household education, region of residence, household composition, age and gender are all considered non-need factors. The parameter estimates, individual values of the need variables and sample means of the non-need variables are then used to obtain the predicted values of each care type based on each individual's need.

Equation 2-4

$$\Pr(\widehat{CT_i} = 1) = F(\hat{\propto} + \hat{\beta}_k N_{ik} + \hat{\gamma}_j NN_{ij})$$

Estimates of indirectly standardised care for each individual is then calculated as the difference between observed and need expected care, plus the mean of need expected care type.

Equation 2-5

$$\widehat{CT}_i^{IS} = CT_i - F(\hat{\propto} + \hat{\beta}_k N_{ik} + \hat{\gamma}_j NN_{ij}) + \frac{1}{n}\sum_{n=1}^{n} F(\hat{\propto} + \hat{\beta}_k N_{ik} + \hat{\gamma}_j NN_{ij})$$

The final step is to calculate the Erreygers concentration index as outlined in Equation 2.2 for the standardised measure of care.

Decomposition of the Erreygers concentration index provides further information on those factors that determine the degree of inequality observed. Wagstaff and colleagues developed a decomposition technique that can be applied to the Erreygers concentration index (Wagstaff, van Doorslaer et al. 2003). First, a linear regression model (which approximates the non-linear model) is estimated relating access to each

care type with a set of covariates. The previously calculated concentration index is then expressed as a sum of the contributions of each of these covariates and an error term.

Equation 2-6

$$CI = \sum_k (\frac{\beta_k \hat{X}_k}{\overline{CT}}) CI_k + \frac{GC_\varepsilon}{\overline{CT}}$$

Where X_k is the mean of all covariates (represented by both N_k and NN_i in equation 2.4), CI_k is the concentration index for regressor X_k and GC_e is the generalised concentration index for the error term.

The importance of each factor will relate to how much each combination of care type is associated with it and how much it is unequally distributed in relation to household education. For example, if being married is a strong predictor of informal care use, and if more educated households are more likely to be married then being married will have a positive and pro-educated contribution to the overall corrected concentration index for informal care.

2.6 Results

2.6.1 Descriptive Statistics

Descriptive statistics across the pooled sample and by sub-groups are in Table 2.1. Further descriptive statistics by survey year are provided in Appendix 2.2. The most common care combination is receiving no care, accounting for 26 per cent of the sample. This contrasts with the 17 per cent of the sample that received all care types. The descriptive statistics show differences in the pattern on care use across gender and household composition. As expected, people with a disability in single households are less likely to rely on informal care than people living in multi-member households. Single males are more likely to report receiving no care than any other group. The descriptive statistics also show females in single and multi-person households are more likely to receive a combination of all care types than males.

Table 2-1: Descriptive Statistics

	Single Male	Multi-Male	Single Female	Multi-Female	ALL
Care Combination					
No Care	0.34	0.27	0.24	0.23	0.26
Informal Care Only	0.07	0.16	0.07	0.17	0.14
Formal Care Only	0.06	0.02	0.06	0.02	0.03
Assistive Technology Only	0.19	0.15	0.14	0.12	0.14
Informal and Formal Care Only	0.06	0.09	0.09	0.09	0.09
Informal Care and Assistive Technology	0.09	0.14	0.12	0.16	0.14
Formal Care and Assistive Technology	0.07	0.02	0.09	0.02	0.03
All Care	0.13	0.15	0.19	0.18	0.17
Need Characteristics					
Physical Impairment	0.63	0.58	0.64	0.62	0.61
Sensory and Sight Impairment	0.08	0.12	0.07	0.08	0.09
Intellectual Impairment	0.05	0.08	0.04	0.04	0.05
Mental Impairment	0.14	0.11	0.15	0.12	0.12
Other Impairment	0.09	0.12	0.10	0.15	0.13
Profound	0.07	0.13	0.10	0.12	0.11
Severe	0.16	0.22	0.20	0.23	0.22
Moderate	0.30	0.21	0.30	0.23	0.24
Mild	0.47	0.45	0.40	0.42	0.43
Non-Need Characteristics					
15 to 24 year	0.02	0.12	0.01	0.09	0.09
25 to 34 years	0.07	0.10	0.06	0.10	0.09
35 to 44 years	0.17	0.14	0.11	0.18	0.16
45 to 54 years	0.30	0.24	0.26	0.26	0.26
55 to 64 years	0.44	0.39	0.56	0.37	0.41
Real Household Equiv. Income ($AUD)	533.00	684.70	525.80	666.90	645.8
Individual Education					
Not Completed High school	0.24	0.21	0.21	0.19	0.21
Completed High school	0.34	0.35	0.33	0.38	0.36
Trade Qualification	0.31	0.33	0.27	0.27	0.29
Bachelor Degree or above	0.11	0.11	0.19	0.15	0.14
Household Education					
Not Completed High school	0.24	0.06	0.21	0.06	0.09
Completed High school	0.34	0.26	0.33	0.25	0.27
TAFE (Trade Qualification)	0.31	0.44	0.27	0.43	0.41
Bachelor Degree or above	0.11	0.25	0.19	0.26	0.24
Language Other Than English	0.02	0.08	0.04	0.08	0.07
Female Spouse	0.01	0.57	-	-	0.20
Male Spouse	-	-	0.02	0.54	0.24
Female Other Adult	-	0.48	-	0.34	0.17
Male Other Adult	-	0.37	-	0.43	0.19
City	0.56	0.59	0.63	0.63	0.61
N	1282	4829	1403	5988	13502

Potentially explaining some of these differences, men and women in single-person households have lower disability severity than men and women in multi-person household. 30.3 per cent [95% CI: 28.8 to 32.9 per cent] of men in single households have a moderate disability compared to 21.2 [95% CI: 20.1 to 22.4 per cent] of men in multi-person households.

2.6.2   Multinominal Regression Results

Here we present sub-group analysis to explore differences in the impact of education across different household types and gender. The detailed results for the full sample and the sub-group analysis are provided in Appendix 2.2.

The results show us what the average predicted use of each care type would have been if all the survey respondents had a given level of education assuming the other characteristics of the respondents are as reported. These other characteristics include need factors such as disability type and severity.

Figure 2.2 presents the results for No Care. It shows that while there is no significant education gradient for a pooled sample, within subgroups there is a clear gradient for males and single females. For males, higher educated households are less likely to receive No Care than lower educated households. Single males without a high school qualification have the highest predicted probability having No Care (37.5 per cent [95% CI: 31.1 to 42.8 per cent]). This contrasts to single females with a bachelor degree who have the lowest predicted probability of receiving No Care (21.7 per cent [95% CI: 17.3 to 26.1 per cent]).

There are also gender and education differences in the predictive probability of receiving of combination of All Care types presented in Figure 2.9. Apart from single males, higher levels of education in the household are associated with a higher probability of receiving all care types across the pooled sample and sub-groups. Amongst the most educated households with a bachelor degree, single males have the lowest probability of receiving a combination of All Care types (11.7 per cent [95% CI: 6.54 to 16.9 per cent]). This compares to single females with a bachelor degree who have the highest probability of receiving All Care types (25 per cent [95% CI: 19.7 to 30.3 per cent]). Males living in multi-person households where no one has completed high school are the least likely to receive All Care types (9.1 per cent [95% CI: 6.2 to 11.9 per cent]). This compares to females living in the same household type

who have a significantly higher probability of receiving All Care types (16.0 per cent [95% CI: 12.4 to 19.6 per cent]). This gender difference across education levels indicates that men may not be receiving an equitable level of care.

In Figure 2.3 the results for informal care are shown. Females and males living in single-person households are less likely to receive only informal care than males and females in the multi-person households. This may reflect the impact of household structure on the care received by people with a disability which has been found in other studies (Bolin, Lindgren et al. 2008, Bonsang 2009). Single females with a bachelor qualification have the lowest predicted probability of receiving only informal care (3.82 per cent [95% CI: 1.2 to 6.4 per cent]). This contrasts to the predicted probability of relying on only informal care for females in multi-person households where the highest level of education is a bachelor qualification of 14.3 per cent [95% CI: 12.5 to 16.0 per cent]. The interaction of household type and education demonstrates the impact of inter-household relationships on the care types received by people with a disability.

We present the findings for receiving Aids Only in Figure 2.5. It shows single males are the most likely to rely on aids only. Amongst both single males and males in multi-person households there is a clear education gradient in the predicted probability of using aids only. University educated males living alone having the highest predicted probability (21 per cent [95% CI: 14.6 to 27.3 per cent]). This may reflect a preference amongst these groups to be self-reliant, or having an inability to access other forms of care and support due to poor social networks. There is no clear education gradient for the use of aids amongst females.

Figure 2-2: No Care

Figure 2-3: Informal Only

Figure 2-4: Formal Only
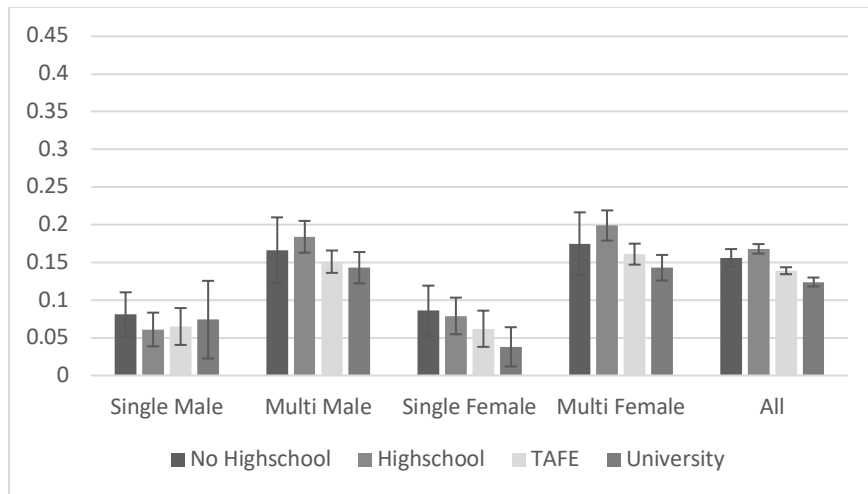
Figure 2-5: Assistive Technology Only
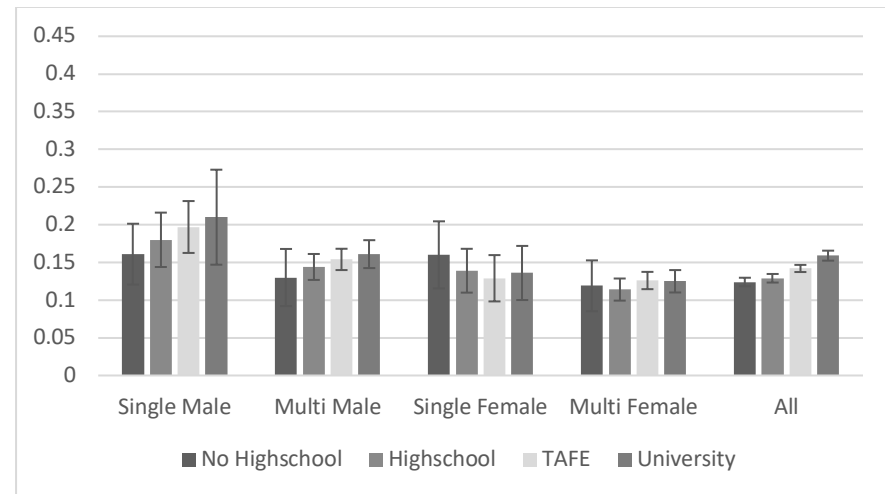
Figure 2-6: Informal and Assistive Technology
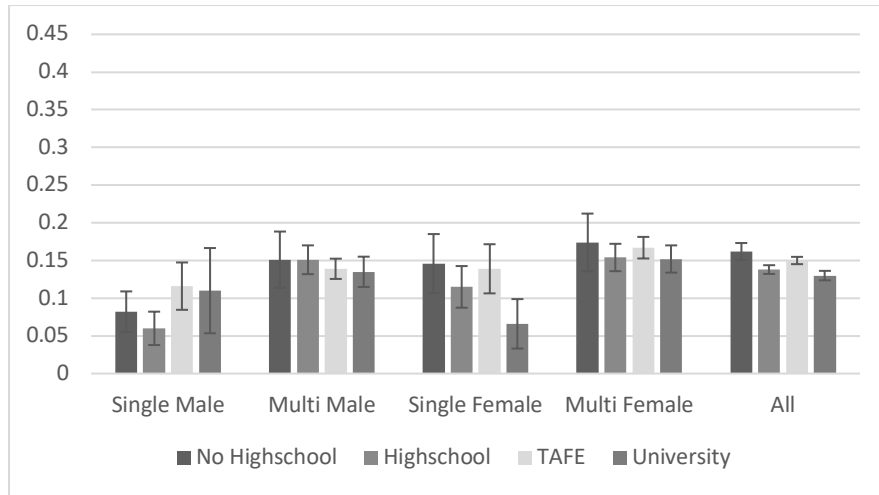
Figure 2-8: Formal Care and Assistive Technology
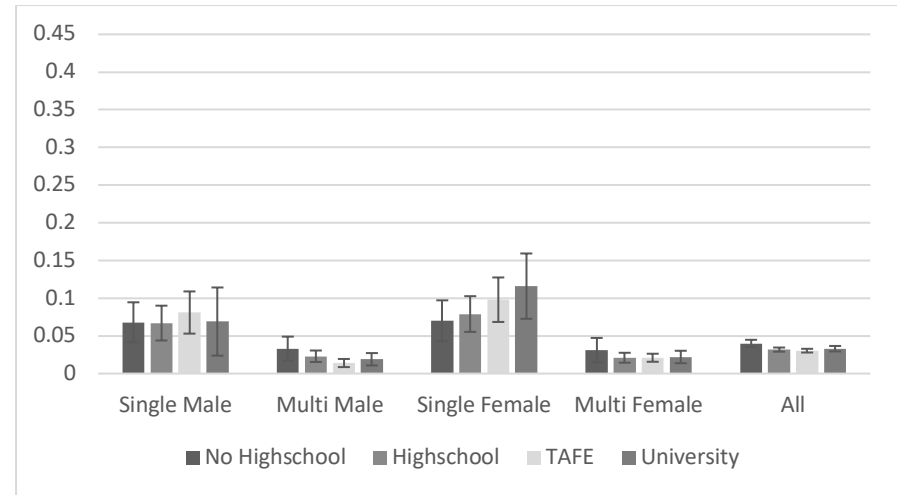
Figure 2-7: Informal and Formal Care
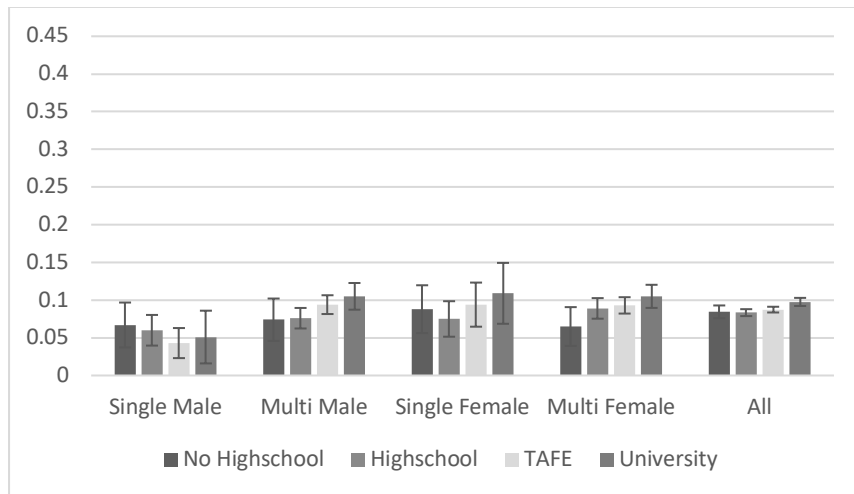
Figure 2-9: All Care
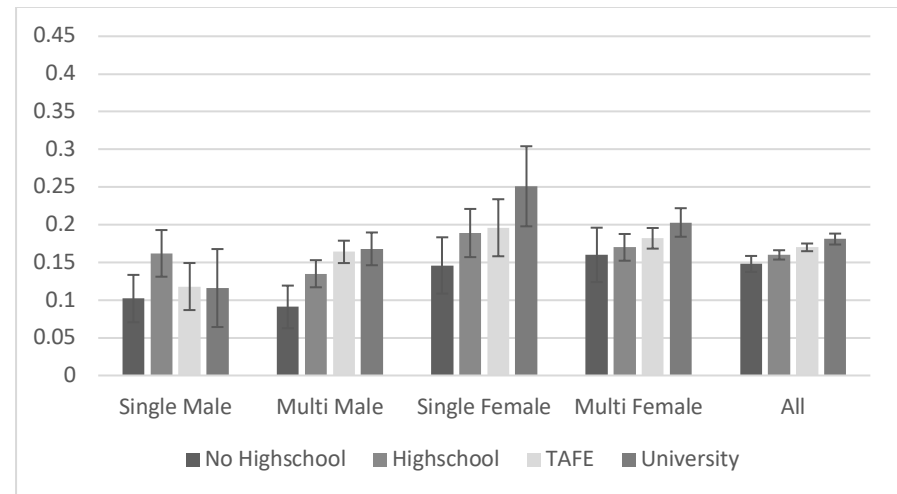
2.6.3 Concentration Indices

While the multivariate analysis points to a level of inequality in the use of different care combinations based on highest level of education in household, this can be further tested using the unstandardised (CI) and need standardised (HI) concentration indices. Results are presented in Table 2.3[11]. Sub-group analysis undertaken by household type and gender is presented in Appendix 2.3. The need standardised concentration indices (HI) for the probability of using no care, only formal care, only informal care and a combination of formal care and assistive technology are negative. This means that after controlling for need, lower educated households are more likely to rely on these combinations of services and supports.

Table 2-2: Concentration Indices

	CI	HI
Care Combinations		
No Care	0.004	-0.019***
	(0.009)	(0.005)
Formal Care Only	-0.021***	-0.018***
	(0.003)	(0.003)
Informal Care Only	-0.020***	-0.014***
	(0.007)	(0.005)
Assistive Technology Only	0.034***	0.006
	(0.007)	(0.004)
Formal Care and Assistive Technology	-0.020***	-0.014***
	(0.004)	(0.003)
Informal Care and Assistive Technology	-0.017**	-0.007
	(0.007)	(0.005)
Informal and Formal Care Only	0.016***	0.022***
	(0.006)	(0.004)
All Care	0.024***	0.036***
	(0.007)	(0.004)

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$
Robust Standard Errors in Parenthesis

In contrast, the need standardised concentration indices (HI) for using a combination of informal and formal care and all care types are positive. Approximately 2.7 per cent of all care services would need to be redistributed from the highest to lowest educated household to have equality (Koolman and Doorslaer 2004). Indicating that controlling

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[11] Corresponding concentration curves are at Appendix 2.4.

for need, individuals in higher educated households are more likely to rely on a combination of informal and formal care and all care types.

The associated decompositions are presented graphically in Figures 2.10 and 2.11 to facilitate interpretation. The contributions of each variable are a function of its concentration index and the elasticity of its impact on the combination of care. We summarise the factors into eight main areas, including income, household composition, age and gender, need variables, household education and regional variables. The sum of the bar sizes on each side of the origin indicate the degree of inequality for each measure – so that a balanced distribution of care across household education levels would be reflected as perfectly equal contribution bars on the left and right side of the origin. The full decomposition results are at Appendix 2.5.

Figure 2.10 shows the decomposition of the non-need standardised concentration indices. Need factors contribute to pro-low household education inequality across the majority of combinations of services and supports, excluding no care and assistive technology only (i.e., the minimal care combinations). This reflects a higher concentration of need for support in lower educated households.

Figure 2.11 shows the decomposition of the need standardised concentration indices[12]. Household education directly explains pro-higher household education inequality in the use of a combination of all care types and informal and formal care. The level of contribution is largest for informal and formal care, with education accounting for 70.6 per cent of the pro-higher education inequality. Household education also directly explains the pro-lower household education inequality in access to combinations of formal care only, formal care and assistive technology and no care (i.e., care combinations not requiring informal care from household members). Lower education households are less likely to rely on informal care, driven by a negative elasticity of accessing these care combinations due to education. Having another person in the household, including a spouse, is concentrated amongst higher educated households. However, there is a negative elasticity of formal care use from

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[12] There is some residual impact of need factors due to the use of linear regression to decompose the binary outcome only approximating the relationship.

household composition. This results in household composition being a large contributor to the pro-lower education household inequality in accessing formal care only and a combination of formal care and assistive technology.

As anticipated, higher household income and wealth is concentrated amongst higher educated household. As a result, income contributes to the pro-higher education inequality in the probability of using a combination of all care types. This is driven by a positive elasticity of relying on a combination of all care types due to income.

Figure 2-10: Decomposition of Concentration Index (CI)
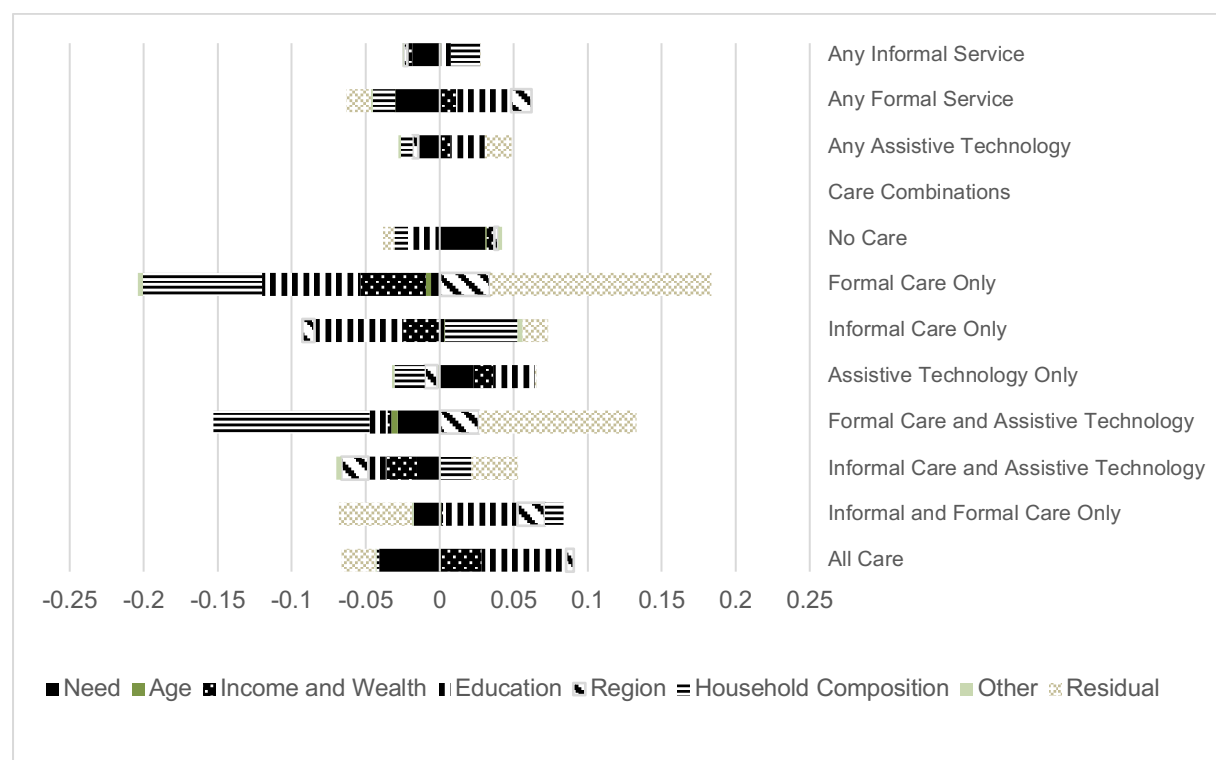
Figure 2-11: Decomposition of Need Standardised Concentration Index (HI)
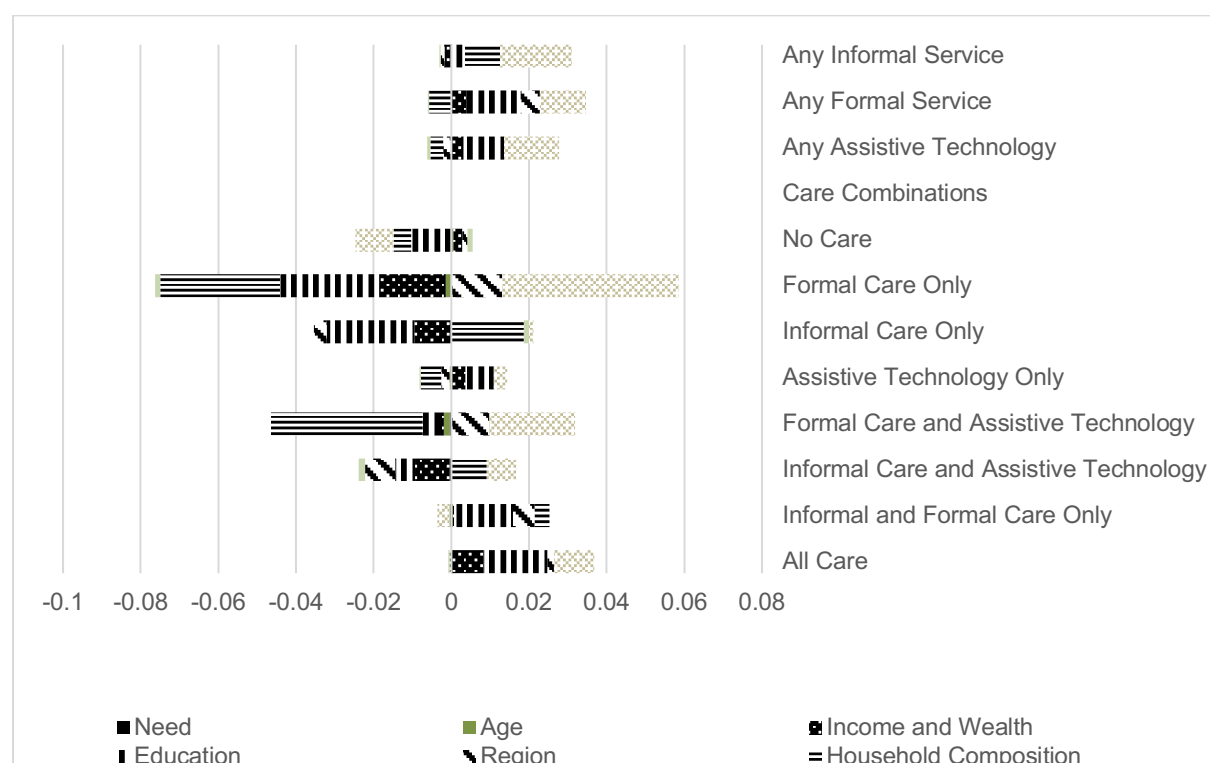
2.6.4 Extensions

To extend the analysis we calculated the unstandardised (CI) and standardised (HI) concentration index using the alternative measures of socio-economic status, individual education and income. The results are presented in table 2.3 and show broadly consistent results across care types using the different measures of socio-economic status.

Using real log household income there is less inequality across the care types than using household or individual education. Using individual level education, we find some variation across care types, with greater inequality in the use of informal care only. In order to achieve equality using household education 1.05 % of informal care only would need to be transferred from the lowest to the highest educated households. This compares to 2.62% of informal care only using individual education.

Table 2-3: Concentration Indices with Different Measures of Socio-Economic Status

	Household Education		Real Log Household Income		Individual education	
	CI	HI	CI	HI	CI	HI
No care	0.004	-0.019***	0.018**	-0.008	0.034***	-0.013***
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.00)
Formal Care Only	-0.021***	-0.018***	-0.009***	-0.007**	-0.005*	-0.005*
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Informal Care Only	-0.020***	-0.014***	-0.019***	-0.013***	-0.058***	-0.035***
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
Assistive Technology Only	0.034***	0.006	0.034***	0.005	0.059***	0.015***
	(0.01)	(0.00)	(0.01)	(0.00)	(0.01)	(0.00)
Formal Care and Assistive Technology	-0.020***	-0.014***	-0.010***	-0.005*	-0.003	0.000
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Informal Care and Assistive Technology	-0.017**	-0.007	-0.012*	-0.005	-0.032***	-0.014***
	(0.01)	(0.01)	(0.01)	(0.00)	(0.01)	(0.00)
Informal and Formal Care Only	0.016***	0.022***	-0.008	0.004	-0.010*	0.010**
	(0.01)	(0.00)	(0.01)	(0.00)	(0.01)	(0.00)
All Care	0.024***	0.036***	0.006	0.024***	0.014*	0.037***
	(0.01)	(0.00)	(0.01)	(0.00)	(0.01)	(0.00)

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$
Robust Standard Errors in Parenthesis

2.7 Discussion

The NDIS represents the most significant reform to disability services in Australia's history. The scheme recognises that people rely on a combination of formal care, informal care and assistive technology, and explicitly takes into account an individual's access to informal supports in approving funding for formal care and assistive technology. As a result, understanding pre-existing inequalities in the reliance on different combinations of services and supports is important.

Available data does not allow us to construct any exogenous measure of supply of formal care services, making any causal analysis problematic. This included not being able to access detailed regional breakdowns beyond state and territory of residence, which if available could have been used to undertake analysis using local area fixed effects. As such, the analysis did not attempt to draw causal associations about the

impact of socio-economic factors on the choice between different combinations of services and supports.

Using cross-sectional analysis this chapter has still been able to assess the extent to which the previous system adhered to Rawlsian principals where access to services is based on need and not socio-economic status, measured by household education. Individuals living in higher educated households are less likely to receive No Care and are more likely to rely on a combination of All Care types. This indicates that there was a level of inequality in the access to services before the NDIS. There were also important gender differences with males in low educated households the most likely group to receive No Care and the least likely group to receive a combination of All Care types.

Single person households were less likely to rely on a combination of care including informal care than multi person-households. This supports the hypothesis that availability of potential carers in the household is associated with access to informal care. It also provides some support for the objectives of the NDIS in considering access to informal care in decisions regarding the overall levels of support provided under the scheme.

Overall, there was pro-low education inequality in the reliance on informal care only, which may reflect an inability of these households to access either formal care or assistive technology. However, lower educated households were also more likely to rely on only formal care and formal care and assistive technology. This presents an inconclusive picture, which may reflect complex relationships due to substitution that have not been captured in the current analysis.

In the context of the transition to the NDIS, the pre-existing inequalities in relying only on informal care are of greatest concern. Under the new scheme, there is a risk that an individual is assessed as not requiring formal care or assistive technology because they currently rely on informal care that may reflect existing inequalities in access based on socio-economic status. Such a scenario would not align the NDIS with the idea of equal access based on equal need.

As the transition towards the NDIS is finalised, caution is required in assessing an individual's need for formal care services and assistive technology based on their current use of services and their ability to access informal care system.

3 Unmet Need for Disability Services in Australia

3.1 Introduction

The National Disability Insurance Scheme (NDIS) shares an objective with most health and welfare systems: ensuring that individuals with a disability receive the assistance they need to undertake activities of daily living. As we have explored in Chapter 2, this is often judged by whether the system delivers Rawlsian principles of equity in service and support utilisation based on identified need (Bommier and Stecklov 2002, García-Gómez, Hernández-Quevedo et al. 2015). However, service and support utilisation measures may fail to account for differences in individual preferences, the quality of services or unobserved need (Allin, Grignon et al. 2010). Focusing instead on unmet need can address some of these issues (Allin, Grignon et al. 2010, García-Gómez, Hernández-Quevedo et al. 2015, Gibson, Grignon et al. 2019). In this chapter we explore the nature of unmet need and how it changed in response to the initial launch of the NDIS. We pay particular attention to the difference between subjective and more objective measures of unmet need as the literature has shown important differences (García-Gómez, Hernández-Quevedo et al. 2015). The determinants of subjective and objective unmet need are estimated, before decompositions to explain changes over time is performed.

3.1.1 Defining Unmet Need

Unlike measures of service and support utilisation, unmet need allows us to capture any systematic under-utilisation by particular groups relative to their need (Aragon Aragon, Chalkley et al. 2017). Individuals with disabilities often need additional assistance to participate in activities of daily living and achieve their life goals (WHO 2011). These can be in the form of self-care services such as: help to get dressed or prepare food; mobility services that include help to use public transport; communication services, which may include speech pathology and assistance to talk; and emotional services that cover support for anxiety or depression. As explored in Chapter 2, in order to meet these needs individuals generally rely on a mix of informal care, formal care and assistive technology.

At a basic level unmet need can be thought to arise when an individual does not receive a service or support that could have improved their heath or wellbeing (Culyer and Wagstaff 1993). However, under scarcity, some unmet need maybe justified in order to maximise society wide health and wellbeing (AIHW 2007, Allin, Grignon et al. 2010). Notwithstanding that there may always be a level of unmet need that is 'efficient' under a traditional welfare perspective, understanding the factors associated with the probability of having unmet need is important in assessing the effectiveness of the health and welfare system.

An important distinction exists between objective and subjective unmet need (Shea, Davey et al. 2003, Allin, Grignon et al. 2010, Vlachantoni, Shaw et al. 2011, García-Gómez, Hernández-Quevedo et al. 2015). Objective unmet need requires a professional assessment that an individual did not receive care in line with professional standards (Koolman 2007, Vlachantoni, Shaw et al. 2011). This is difficult and costly to measure in the context of large surveys, and alternatives have been developed in the literature. The most widely used measure categorises an objective unmet need as a person requiring additional assistance to participate in activities of daily living but receiving no services (García-Gómez et al., 2015). Almost by definition, any objective measure relies on a defined set of conditions and services, and may not capture individual differences in needs driven by different life goals or low quality services (Allin, Grignon et al. 2010).

Subjective unmet need relies on an individual's assessment on whether their needs are being met (García-Gómez et al., 2015). In surveys, it generally involves respondents being asked whether their needs for assistance are fully met, partially met or not met at all. As a measure, subjective unmet need has the benefit of capturing any deficiencies in the quality of services received and individual differences in needs (Allin, Grignon et al. 2010). However, subjective unmet need is likely to be influenced by external factors such as changing values and the availability of services (Bickenbach 2014),(García-Gómez, Hernández-Quevedo et al. 2015)[13]. Individual differences in subjective need may also be driven by an individual's life goals. The

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[13] For example, if we consider views on mainstream schooling for children with a disability. Today if a child with a disability does not attend a mainstream school it is considered an unmet need. Twenty years ago this would not have been the case. This may lead to biased results, and make it a poor measure of health and the welfare system performance in terms of meeting objectives across time.

latter sits within with the broader disability rights agenda, which is closely aligned to Capability Approach of Amartya Sen and Martha Nussbaum (Bickenbach 2014). This is consistent with the belief that services should focus on individual capabilities to achieve functioning.

Importantly for those interested in equity, subjective unmet need may incorporate differences across groups in what is considered a possible set of functionings. Someone with a lower level of education may not be aware of the relationship between receiving mental health supports and their potential functionings, and therefore not consider receiving no services an unmet need. As a result subjective measures may downwardly bias the level of horizontal inequity in unmet need (García-Gómez, Hernández-Quevedo et al. 2015).

3.1.2 Existing Evidence

Previous measures of subjective unmet need for people with a disability have estimated prevalence rates as low as 2 per cent in the adult population, with a disability in Spain (García-Gómez, Hernández-Quevedo et al. 2015) and up to 20 per cent among the elderly experiencing limitations in daily living in the United States (Desai, Lentzner et al. 2001). When more objective measures have been utilised based on receipt of services, higher rates of unmet need have been recorded ranging from 25 per cent in Spain (García-Gómez, Hernández-Quevedo et al. 2015) up to 40 per cent in the United States (Shea, Davey et al. 2003).

Subjective unmet need is widely used in studies of equity of access to health services (Koolman 2007, García-Gómez, Hernández-Quevedo et al. 2015). Individuals reporting a subjective unmet need have been found to use more health care services than those that don't report unmet needs (Zuckerman and Shen 2004, Mollborn, Stepanikova et al. 2005) even after controlling for health status. This raises concerns about bias of the measure capturing unobservable characteristics that influence health service utilisation, such as attitudes about the importance of services and health literacy that are not captured in other variables (Allin, Grignon et al. 2010).

Furthermore, there is evidence that subjective measures may reflect higher perceived needs and desired functioning of higher socio-economic groups, and therefore mask potential inequities. When comparing objective and subjective unmet need García-

Gómez, Hernández-Quevedo et al. 2015 find that more objective measures of unmet need are associated with greater inequity. Despite these concerns, subjective unmet need remains the most widely used measure of unmet need, as it is included in most surveys of health and disability service use.

While high levels of unmet need for disability services have been reported in the Australian context (AIHW 2002, AIHW 2007), differences across objective and subjective measures have not been explored. Cebulla and Zhu (2015) used Australian panel data and found evidence of high levels of subjective unmet need for disability services. Using a fixed effects model to control for unobservable characteristics, they found that higher educational attainment was associated with greater subjective unmet need, and greater access to assistance when required. However, they relied on a general measure of unmet need for assistance, rather than a specific measure related to an individual's disability and did not control for the severity or type of a disability.

The analysis in this chapter is the first to compare the incidence and determinants of both subjective and objective measures of unmet need for disability services in Australia and explore how these have changed over time. The study period, 2009 to 2015, includes the announcement and launch of the NDIS, which as noted in the Introduction is significantly expanding available supports for people with a disability in Australia. Using data from a national representative sample before the NDIS was announced, through to the commencement of the roll-out we explore the demography and socio-economic characteristics associated with objective and subjective measures of unmet need for disability services. The focus on children as well as adults again extends the literature which to date has focused largely on adults (Allin, Grignon et al. 2010, García-Gómez, Hernández-Quevedo et al. 2015).

Throughout this chapter we will refer to the years 2009 and 2012 as 'pre-NDIS' and 2015 as 'post-NDIS'. Since the NDIS was only in its pilot phase in 2015 (but the

scheme had been announced and was widely anticipated) we are only meaningfully measuring the announcement effect of the NDIS[14].

In the next section we outlined the empirical approach to exploring the determinants of unmet need. The data and variables used in the analysis, including their limitations, are then outlined. Differences in the unconditional probability of reporting both an objective and subjective unmet need across time are then reported. Regression models are fitted for sub-groups of both children and adults and then a decomposition over time is undertaken using the estimates.

3.2 Empirical Approach

The objective is to understand the determinants of subjective and objective unmet need before and during the implementation phase of the NDIS. First the demographic and socioeconomic factors associated with subjective and objective unmet for each of the survey years is modelled, for children and adults. The following regression model is estimated:

Equation 3-1

$$\mathrm{Y_{nit}} = \alpha_{nt} + \beta_{nt}\, X_{\mathrm{int}} + \varepsilon_{\mathrm{ni}}$$

Individuals either have an unmet need for disability needs (Y=1) or do not (Y=0). The index i represents an individual with a disability, n the type of unmet need (subjective or objective) and t the time period (pre-NDIS or post-NDIS). The main model uses linear probability estimates due to ease of interpretation, and these are consistent with the results from a probit model, which are reported at Appendix 3.5-3.7.

X is a vector measuring both the need (N_i), and non-need (NN_i) characteristics on the probability of reporting unmet need (Y_i). The parameters represent the impact of changes in the explanatory variables on the probability of having an unmet need.

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[14] The NDIS was announced in July 2011 but only launched outside specific trial sites in July 2016, after the last 2015 survey used in this chapter.

Following Garcia-Gomez (2015) who focuses on factors associated with unmet need for long-term care services in Spain, we control for a wide range of need and non-need variables. This includes English speaking background, highest educational level in household, household income and marriage status[15].

In order to explore changes in subjective and objective unmet need before and after the launch of the NDIS we use the regression estimates and the averages of the variables to adapt a threefold Blinder-Oaxaca decomposition. This decomposition accounts for the fact that any change over time will therefore be due to either differences in the mean values of the explanatory variables or their coefficients across the two periods (Jann 2008). The decomposition can be written as:

Equation 3-2

$$\Delta \bar{Y} = \bar{X}'_{Post} \hat{\beta}_{Post} - \bar{X}'_{Pre} \hat{\beta}_{Pre}$$

$\hat{X}_{Pre}$ is the mean vector of characteristics and $\hat{\beta}_{Pre}$ is the vector of coefficients prior to the introduction of the NDIS. $\hat{X}_{Post}$ is the mean vector of characteristics and $\hat{\beta}_{Post}$ is the vector of coefficients after the introduction of the NDIS.

This can be expressed as three terms:

Equation 3-3

$$\Delta \bar{Y} = \underbrace{\left(\hat{X}_{Post} - \hat{X}_{Pre}\right)' \beta_{Pre}}_{Endowment} + \underbrace{\left(\hat{\beta}_{Post} - \hat{\beta}_{Pre}\right)'^{\hat{X}_{Pre}}}_{Co-efficient} \underbrace{\left(\hat{\beta}_{Post} - \hat{\beta}_{Pre}\right)' \hat{X}_{Pre}}_{Co-efficient}$$

$$+ \underbrace{\left(\hat{X}_{Post} - \hat{X}_{Pre}\right)' \left(\hat{\beta}_{Post} - \hat{\beta}_{Pre}\right)'}_{Interaction}$$

The first term is the endowment effect and quantifies the difference due to group differences in the determinants, for example, changes due to a higher prevalence of people with more severe disabilities assuming no change in the relationship between having a severe disability and unmet need. The second term measures the impact of

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[15] As with the analysis in Chapter 2, we are treating these variables as exogenous in this model. However, we again acknowledge that there may be some reverse causality (e.g. unmet need affecting marital status, or household income). For robustness we also estimate the model excluding potentially endogenous variables.

differences in the coefficients. This would include the impact of any change in the relationship between having a severe disability and reporting an unmet need, assuming no change in the number of people reporting having a severe disability. Finally, the third term is the interaction effect which accounts for the correlation differences in the determinants and coefficients which occur at the same time.

If the NDIS and the prospect of greater access to services led to more people seeking diagnosis this would be captured in the endowment effect. However, changes in the number of people with a specific disability reporting having an unmet need due to higher expectations would be captured in the coefficient effect.

These three effects are represented in Figure 3.1. The $\Delta \bar{Y}$ from an increase in β (from β Pre to β Post) and an increase in X (from X Pre to X Post) is made up of the Endowment Effect (E(βPost) =E(βPre)), the Co-efficient Effect (C), and the Interaction Effect (I).

Figure 3-1: Components of the Oaxaca Decomposition
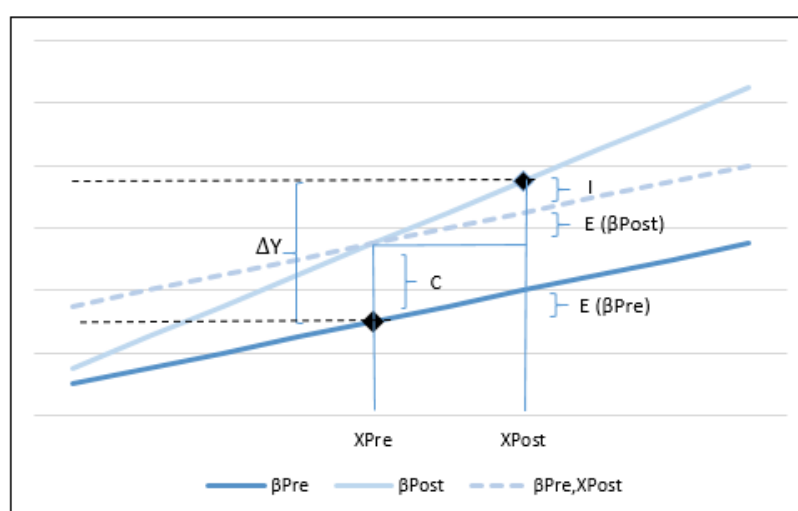
3.3 Data and Variables

The study uses data from the 2009, 2012 and 2015 Surveys of Disability, Ageing and Carers (SDAC) conducted by the Australian Bureau of Statistics (ABS). The SDAC is a nationally representative study of disability covering a wide range of conditions (ABS, 2013). Data from the household component of the survey is used in the analysis. Dwellings in the household component were selected at random using a multi-stage

area sample to ensure all sections of the population living within geographic scope were included – both those with and without a disability. A larger number of households were selected from areas known to have a higher representation of people with a disability to improve the sample of people in the target population. While the survey has been conducted in 1981, 1988, 1993, 1998, 2003, 2009, 2012 and 2015, only the 2009, 2012 and 2015 surveys are used due to methodological changes after the 2003 survey that altered the identification of carers and the preference to use data from immediately prior to and after the launch of the NDIS. At the time of the 2015 survey only 3.5 per cent of the expected 450,000 to be covered by the NDIS were enrolled in the scheme. Any change therefore is unlikely due to be correlated with actual services received under the NDIS, but rather the announcement or anticipation effect of changes in the service levels.

The SDAC provides detailed information about the health and disability status of individuals and information regarding the use of services and self-reported unmet needs. Demographic and socio-economic information about the household is also covered by the survey. Consistent with the International Classification of Functioning, Disability and Health (World Health Organization 2011) SDAC defines someone as having a disability if they report a limitation, restriction or impairment that has or is expected to last for at least six months and restricts everyday activity. The sample focuses on the target population of the NDIS, which are individuals aged 0-65 years old with a disability and core activity limitations[16]. Core activity limitations are categorised as requiring assistance with emotional, communication, self-care or mobility activities. While all the individuals in the sample are eligible to apply for funding under the NDIS, they would not all meet the administrative criteria to receive funding.

The 2009 Survey covered 72,075 individuals, of whom 5,837 aged between 0-65 report having a core activity limitation requiring assistance. The 2012 Survey covered 77,570 individuals, of whom 6,061 aged between 0-65 report having a core activity limitation requiring assistance[17]. The 2015 Survey covered 74,862 individuals, of whom 6,010 aged between 0-65 report having a core activity limitation requiring

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[16] However, we undertake analysis for the over 65 population in robustness tests.
[17] The sample framework for these surveys was discussed in Chapter 2.

assistance. People residing in supported accommodation (such as nursing homes or group homes) who do not complete a detailed interview are excluded from the sample. Insufficient information is collected on these individuals (for example no information on subjective unmet need, number of services received, education or income) for use in the detailed analysis. The final pooled sample for analysis includes 13,502 adults and 2,023 children (aged under 15 years).

SDAC provides a rich array of data on people with a disability, however, it is not a panel survey creating limits to the empirical analysis that can be undertaken and the inferences that can be drawn[18]. Furthermore, the detailed unit record data released by the ABS for 2009 and 2012 only includes high level information on location (rural versus city by state) further limiting the inferences which can be drawn from any analysis as local area fixed effects cannot be controlled. The variables of interest are listed at Appendix 3.1 and explored below.

3.3.1 Unmet Need

The SDAC uses a measure of subjective unmet need based on an individual's assessment. Respondents are asked separately "do you need more help from family or friends" and "do you need more help from organised services" in relation to a core activity limitation. Core activity includes mobility, self-care and communication. The need for additional services can be daily, weekly, monthly, yearly or less than once a year. If they answer yes to these questions, they are classified as having a subjective unmet need.

SDAC does not include an objective measure of unmet need determined by an independent third party. Instead, like a number of other studies, an individual is defined as having objective unmet need where they have a limitation in daily living and receive no assistance for that limitation (Kemper, Weaver et al. 2008, García-Gómez, Hernández-Quevedo et al. 2015). For example, if an individual reports having both a communication and self-care limitation, and receives assistance for their communication limitation but not self-care limitation then they are categorised as having an unmet need.

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[18] There is currently no Australian panel data set specifically covering people with a disability.

3.3.2 Need Variables

The social model of disability views these unmet needs as the true measure of disability as they reflect the extent to which an individual is limited in their participation in society (Oliver 1996). While not rejecting this social model of disability, the interest in this chapter is exploring for whom these needs are not met and whether there are inequities based on the underlying disability (medical condition or impairment), how that disability was acquired, socio-economic status and their location.

In the main specification, both main impairment type (sensory, physical, mental or intellectual) and any secondary impairment types are included. Dummy variables control for the severity of the disability being profound, severe or moderate, with a mild disability as the reference group. In supplementary specifications which include an individual's main condition causing the disability such as stroke, cerebral palsy or mental illness and the core activity which an individual needs support such as mobility, communication, self-care and emotional are also controlled to explore the sensitivity of the results (see Appendix 3.3 and 3.4).

3.3.3 Non-Need Characteristics

Age, sex and educational attainment are included as non-need variables (Wagstaff and Van Doorslaer 2000, García-Gómez, Hernández-Quevedo et al. 2015). 5-year age groups are constructed for children (0-15) and 10-year age groups for adults (15-65), each interacted with gender. As we did in Chapter 2, education is measured using highest level of educational attainment in the household, rather than individual level education[19].   Non-English-speaking background (0 if country of origin is English speaking, 1 if country of origin is non-English speaking) is also controlled for, with individuals from non-English speaking backgrounds potentially less able to navigate the complicated system and access services. For the adult sample we also include marriage status.

Given differences in the provisions of services prior to the NDIS across and within states dummy variables are included for state of residence (with Queensland used as

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[19] Educational attainment for a person with a disability is linked to both type and severity of the disability, and when that disability was acquired. In addition, if an individual acquires a disability after they have attained a certain level of education then the socio-economic impact conferred by that education may be impacted.

the reference) and rural or city residency. We also control for whether an individual was likely to have had access to insurance based on how their disability was acquired (e.g., people that acquired their disability through a motor or work accident were generally covered by no-fault insurance schemes prior to NDIS).

Log household equivalised income is included in an extended model with other potentially endogenous variables. As the data reports, household income in deciles we first convert this to a continuous variable using the approach outlined in Donnelly et al 2016, where mid-points are taken for bounded deciles and the top (open ended) decile is estimated based on the size of ninth decile and the lower bound of the top decile[20]. These estimates are then converted to equivalised household income using the OECD modified scale, which gives the main householder a weight of 1, subsequent householders a weight of 0.5, and children a weight of 0.3.

[20]

Table 3-1: Descriptive Statistics

	Adults			Sig. Diff.	Children			Sig. Diff.
	2009	2012	2015		2009	2012	2015	
	Mean	Mean	Mean		Mean	Mean	Mean	
Subjective Unmet Need	0.099	0.097	0.174	YES	0.343	0.328	0.458	YES
Objective Unmet Need	0.253	0.254	0.266	NO	0.581	0.596	0.589	NO
Need Variables								
Severity								
Profound	0.103	0.117	0.117	NO	0.403	0.408	0.401	NO
Severe	0.220	0.213	0.216	NO	0.354	0.344	0.326	NO
Moderate	0.256	0.236	0.229	YES	0.041	0.043	0.046	NO
Mild (Ref)	0.421	0.434	0.439	NO	0.201	0.204	0.226	NO
Main Impairment								
Physical (Ref)	0.683	0.570	0.573	YES	0.166	0.152	0.118	YES
Intellectual	0.047	0.059	0.056	YES	0.430	0.385	0.394	NO
Sensory and Sight	0.097	0.093	0.086	NO	0.264	0.243	0.224	NO
Mental	0.101	0.112	0.106	NO	0.090	0.139	0.079	YES
Other	0.073	0.166	0.154	YES	0.049	0.082	0.007	NO
Additional Impairment								
Physical	0.106	0.169	0.181	YES	0.098	0.107	0.118	NO
Intellectual	0.062	0.072	0.054	YES	0.494	0.389	0.343	YES
Sensory and Sight	0.118	0.114	0.116	NO	0.196	0.200	0.225	NO
Mental	0.101	0.132	0.208	YES	0.127	0.128	0.317	YES
Other	0.458	0.383	0.507	YES	0.196	0.167	0.215	NO
Non-Need								
Lowest Quintile	0.197	0.189	0.209	NO	0.108	0.080	0.082	NO
Second Quintile	0.227	0.203	0.183	YES	0.234	0.192	0.147	YES
Third Quintile	0.172	0.158	0.150	YES	0.188	0.177	0.194	NO
Fourth Quintile	0.128	0.108	0.126	YES	0.201	0.171	0.174	NO
Highest Quintile	0.108	0.097	0.090	YES	0.146	0.164	0.167	NO
Missing	0.169	0.245	0.242	YES	0.123	0.215	0.236	YES
Housing-Tenure: Rent	0.393	0.451	0.471	YES	0.441	0.429	0.453	NO
City	0.599	0.623	0.602	YES	0.652	0.656	0.597	YES
Carer	0.157	0.249	0.285	YES				
Insurance	0.337	0.300	0.307	YES	0.017	0.009	0.013	NO
Language-Other Than English	0.069	0.068	0.080	YES	0.033	0.028	0.019	NO
Married	0.481	0.434	0.415	YES				
Bachelor Degree	0.227	0.235	0.246	NO	0.242	0.304	0.329	YES
Certificate	0.393	0.385	0.438	YES	0.426	0.426	0.453	NO
N	4,331	4,769	4,402		632	671	720	

3.4 Results

3.4.1 Descriptive Statistics

Descriptive statistics are presented in table 3.1, and additional characteristics are presented at Appendix 3.2. The table indicates where sample means are significantly different across the three surveys at a 95% confidence interval. The level of subjective unmet need is significantly higher in both adults and children in the 2015 survey compared to the 2012 survey. 9.7 per cent (95% CI: 8.8 to 10.5 per cent) of the adult sample reported a subjective unmet need in the 2012 survey which increased to 17.4 per cent (95% CI: 16.2 to 18.5 per cent) in the 2015 survey. 32.8 per cent (95% CI: 29.2 to 36.3 per cent) of children in the 2012 survey reported a subjective unmet need, which increased to 45.8 per cent (95% CI: 42.1 to 49.5 per cent) in the 2015 survey. In comparison, there was no significant change in the measure of objective unmet need across the three surveys in either the adult or child samples.

Apart from the measure of subjective unmet need, the samples appear relatively comparable across the survey years. This includes measures of disability severity where 11.7 per cent (95% CI: 10.7 to 12.6 per cent) of adults and 40.1 per cent (95% CI: 36.5 to 43.7 per cent) of children are reported as having a profound disability in the 2015 survey results. There are differences however in additional impairment types across the three surveys with the percentage of individuals reporting a mental impairment increasing from 13.2 per cent (95%CI: 12.3 to 14.1 per cent) in the 2012 survey to 20.8 per cent (95% CI: 19.6 to 22.0 per cent) in the 2015 survey for adults and we see a similar increase for children.

3.4.2 Unconditional Determinants of Unmet Need

Unconditional probabilities of reporting objective and subjective unmet need (full results at Appendix 3.3) across adults and children are presented in Figure 3.2 across main impairment, income deciles and disability severity for both adults and children.

Figure 3-2: Unconditional Probability of Unmet Need
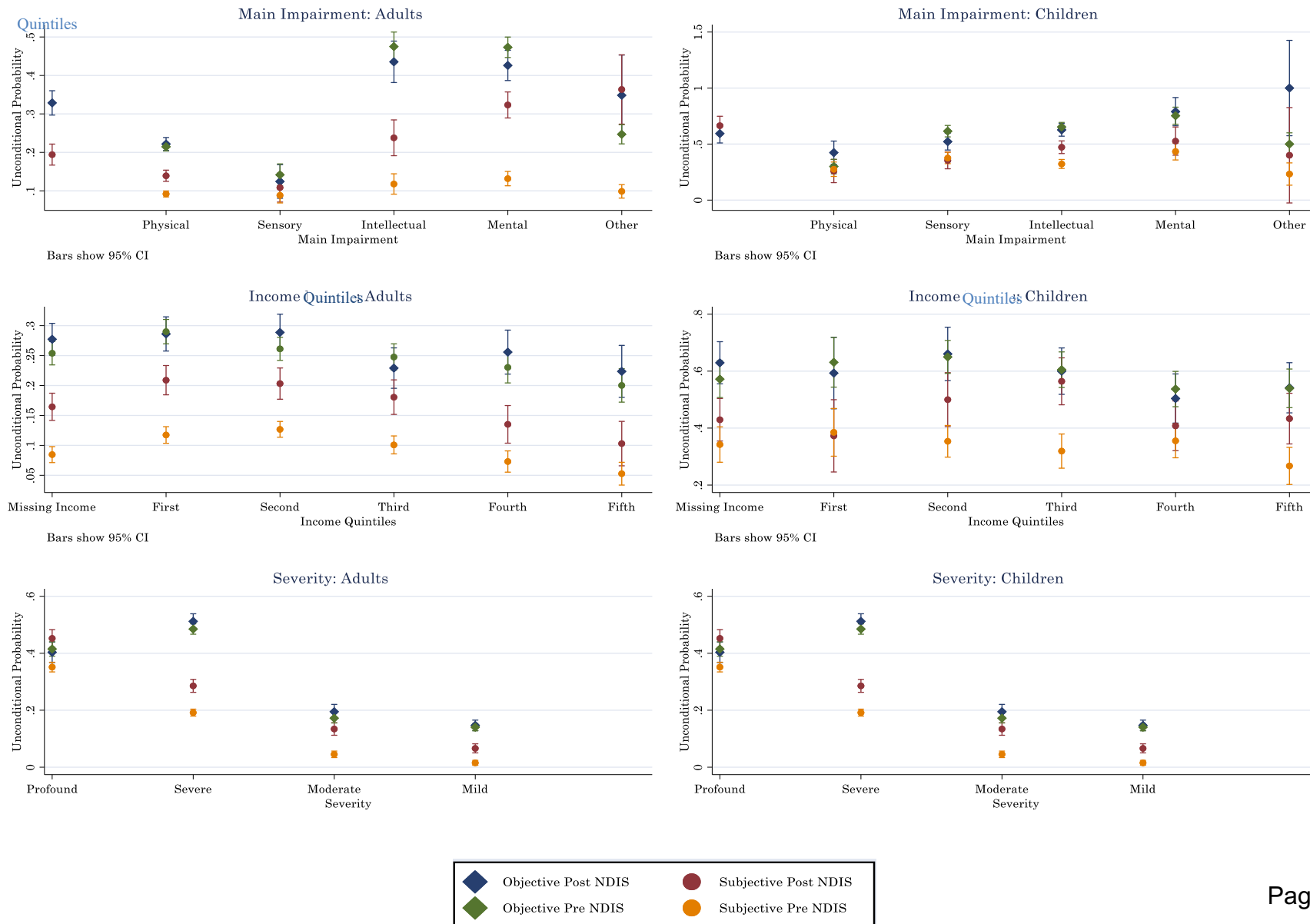
Prior to the launch of the NDIS, the biggest differences between subjective and objective measures of unmet need across main impairment types was for adults with intellectual and mental impairments. An increase in reported subjective unmet need after the launch of the NDIS narrowed this gap.

Across income quartiles a slight income gradient is observed for adults reporting a subjective unmet need, which steepened after the introduction of the NDIS due to individuals in the lower income quintiles becoming more likely to report a subjective unmet need. This is consistent with the existing hypothesis that people on low incomes are less likely to report an unmet need because they are unaware of the potential for certain services (Aragon Aragon, Chalkley et al. 2017). The expansion of services under the NDIS and significant public discussion around existing levels of unmet need, may have influenced subjective measures of unmet need amongst this group. There is no clear gradient evident for children for subjective or objective unmet need.

The graphs for severity in Figure 3.2 show no significant difference in the objective and subjective measures of unmet need for adults and children with a profound disability. Across measures of disability severity, we note the largest discrepancy amongst individuals with severe disability, with this group less likely to report a subjective unmet need despite having an objective unmet need.

3.4.3 Conditional Probability: Adults

Regression results from the linear probability models for adults are presented in Figure 3.3 below. The full regression results, including those from the probit specifications can be found in Appendix 3.4. The results from the extended model are discussed below, and are consistent with the base model.

Figure 3.3 shows that prior to the launch of the NDIS, having a mental impairment reduced the probability of reporting a subjective unmet need by 3.6 percentage points (95% CI: -1.20. to -5.98 percentage points) compared to having a physical impairment. However, after the commencement of the NDIS having a mental impairment increased the probability of reporting a subjective unmet need by 14.1 percentage points (95% CI: 9.45 to 18.93 percentage points). In contrast, objective unmet need fell for individuals with a mental impairment from 24.9 percentage points (95%CI: 21.09 to

28.85 percentage points) prior to the implementation of the NDIS to 14.9 percentage points (95% CI: 9.72 to 20.20 percentage points) after the schemes launch. Individuals with a mental impairment were more likely to report having an unmet need after the launch of the NDIS, but less likely to receive no services for an identified core activity limitation. This seemingly conflicting result represents the most significant change between the two periods.

Figure 3-3: Extended LPM Adults
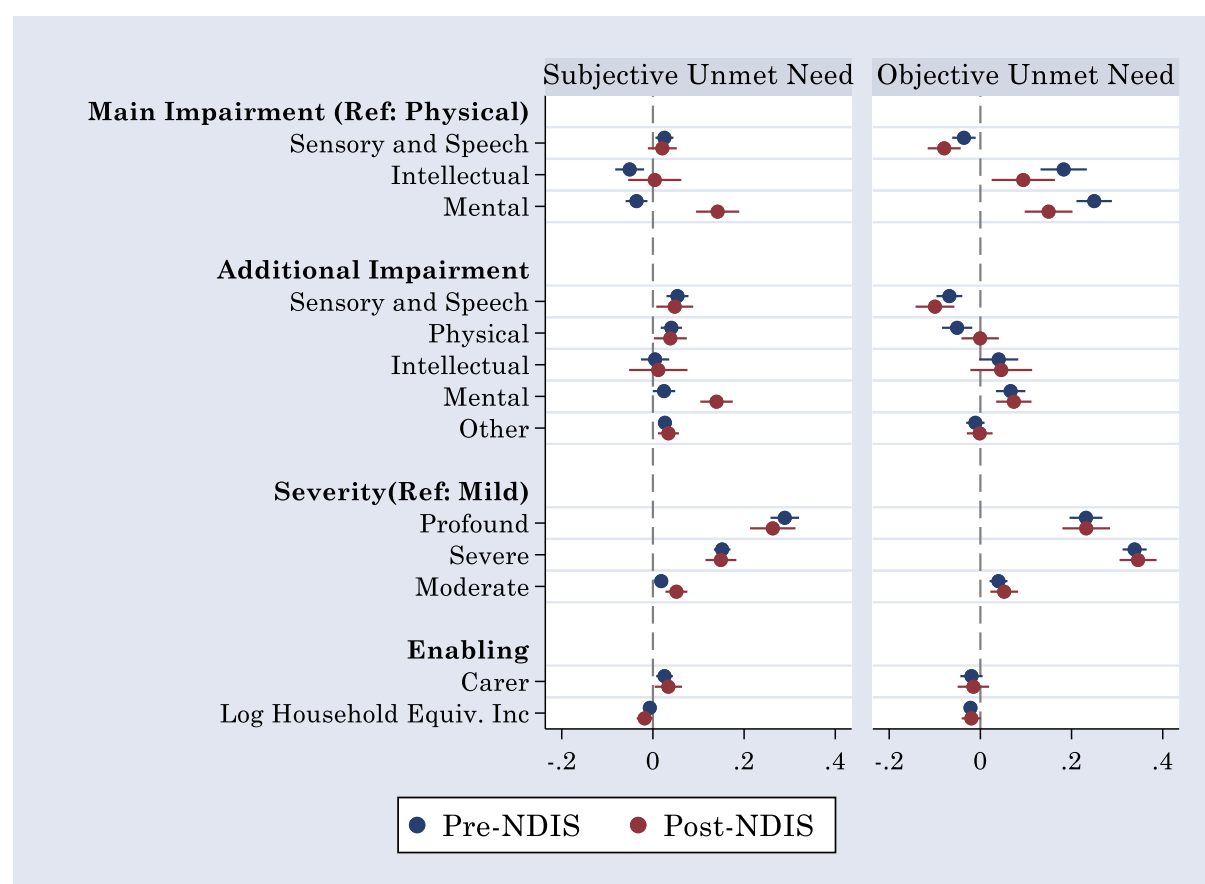
Lines show 95% Confidence interval

Highest education level in the household was not significantly associated with the probability of reporting either subjective or objective unmet need. There was however a small association between household income and the probability of reporting both subjective or objective unmet need. The co-efficient of -0.02 on the natural log of real income implies that a large relative increase in income is required to decrease the probability of people reporting an unmet need. Income would need to increase by

around 300 per cent to reduce the probability of reporting unmet need by 1 percentage point.

Having a carer increased the probability of having a subjective unmet need prior to the introduction of the NDIS by 2.50 percentage points (95% CI: 0.72 to 4.38 percentage points) and post introduction of the NDIS by 3.39 percentage points (95% CI: 0.40 to 6.37 percentage points). There was no significant impact of having a carer on objective unmet need prior or post implementation of the NDIS.

3.4.4 Conditional Probability: Children

Full linear probability and probit regression results for the children's sample are at Appendix 3.6 and 3.7. In Figure 3.4 we present the regression results from the extended linear probability model.

Figure 3-4: Extended LPM Children
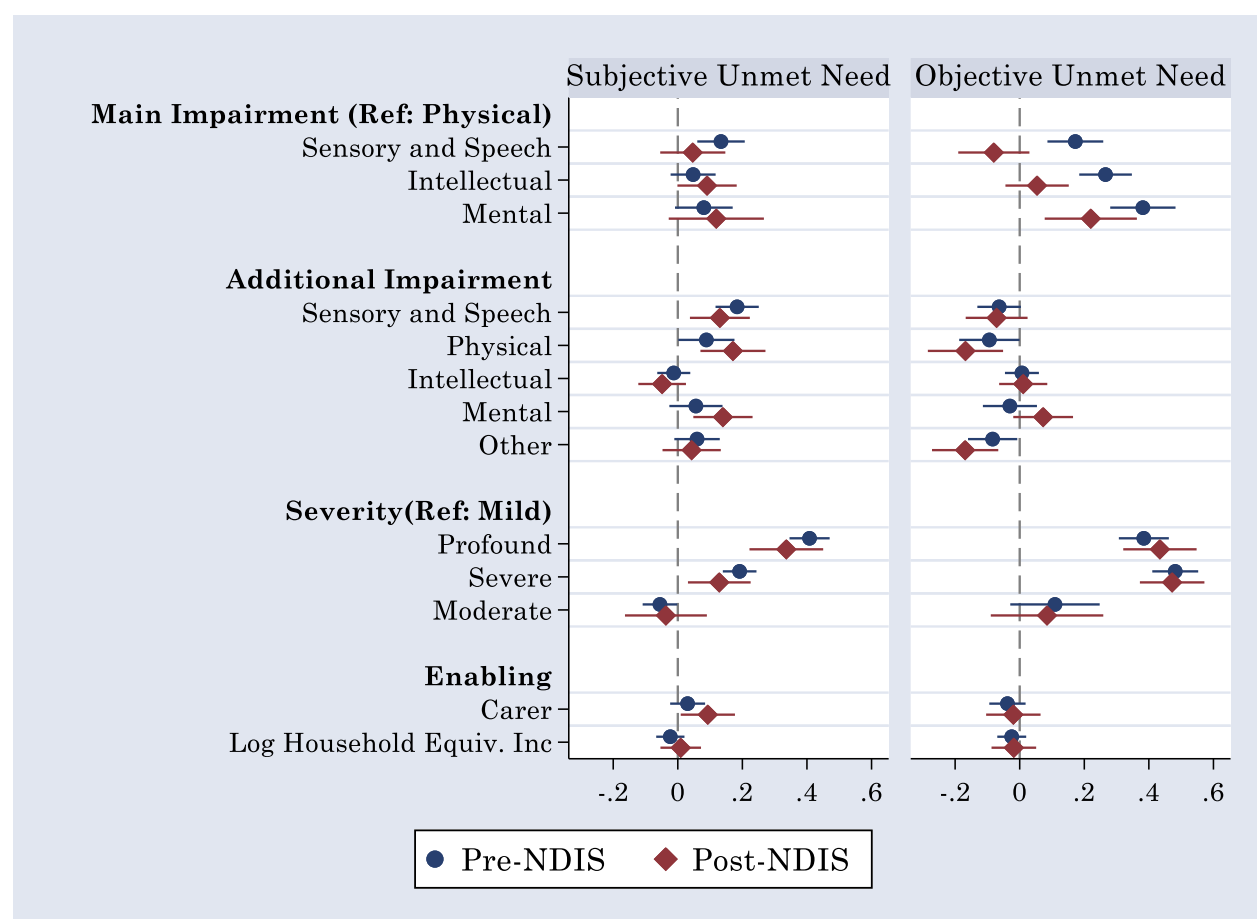
Lines show 95% Confidence interval

There were only minor changes across the coefficients before and after the NDIS for children apart for objective unmet need by main impairment. Compared to having a physical main impairment, having an intellectual disability increased the probability of having an objective unmet need by 26.72 percentage points (95% CI: 18.58 to 34.87 percentage points) before the NDIS and 4.59 percentage points (95% CI: -5.3 to 14.53 percentage points) after the NDIS. Having a sensory and speech impairment increased the probability of having a subjective unmet need by 17.27 percentage points (95% CI: 8.64 to 25.90 percentage points) before the NDIS reduced the probability by 8.75 percentage points (95% CI: -20.00 to 2.5 percentage points) after the NDIS commenced its pilot phase.

3.4.5   Decomposition of Changes in Subjective Unmet Need

The decomposition explains changes in subjective unmet need over time. The summary results from the decomposition of the change in subjective unmet need for adults and children is presented in Table 3.2 with robust standard errors in parenthesis. Full results including probit specifications are in Appendix 3.8. Similar results are observed across the extended and base models, and the extended model is discussed below.

For adults. subjective unmet need was 7.59 percentage points (95% CI: 6.31 to 8.87 percentage points) higher after the introduction of the NDIS. 5.7 percentage points (95% CI: 4.17 to 6.71 percentage points) of the increase is explained by changes in the relationship between the covariates and the probability of reporting a subjective unmet need (the coefficient effect). The detailed results in Appendix 3.8 show that the largest single contributor to this increase relates to people reporting either a main or secondary mental health impairment. 3.01 percentage points (95% CI: 2.28 to 3.75 percentage points) of this increase in subjective unmet need is due to people with a mental health impairment being more likely to report an unmet need (the coefficient effect for mental health). Only 0.2 percentage points is due to an increase in the number of people reporting having a mental health impairment (the endowment effect). 1.01 percentage points (95% CI: 0.64 to 1.39 percentage points) is due to the simultaneous increase in the probability of individuals with a mental health impairment reporting a subjective unmet need and the number of individuals with a mental health impairment (the interaction effect). Overall, therefore, over half of the observed

increase in subjective unmet need observed between before and during the initial pilot phase of the NDIS is due to people with mental health conditions.

Table 3-2: Summary of Decomposition Results

	Adults		Children	
	Base Model	Expanded Model	Base Model	Expanded Model
Post NDIS	0.174***	0.174***	0.458***	0.458***
	(0.01)	(0.01)	(0.02)	(0.02)
Pre-NDIS	0.098***	0.098***	0.335***	0.335***
	(0.00)	(0.00)	(0.01)	(0.01)
Difference	**0.076***	**0.076***	**0.123***	**0.123***
	(0.01)	**(0.01)**	**(0.02)**	**(0.02)**
Endowments	0.008***	0.009***	-0.003	0.000
	(0.00)	(0.00)	(0.02)	(0.02)
Coefficients	0.058***	0.057***	0.064**	0.046*
	(0.01)	(0.01)	(0.03)	(0.03)
Interaction	0.011*	0.009	0.062***	0.076***
	(0.01)	(0.01)	(0.02)	(0.02)

Robust standard errors in parentheses

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

In the period after the commencement of the pilot phase of the NDIS subjective unmet need was 12.3 percentage points (95% CI: 7.8 to 16.8 percentage points) higher for children with 7.6 percentage points (95% CI: 0.03 to 12.1 percentage points) of the change due to the simultaneous changes in the relationship between variables and unmet need and changes in the sample characteristics (the interaction effect). A change in the relationship between covariates and the probability of reporting a subjective unmet need is responsible for 4.66 percentage points (95% CI: -0.00 to 10.04 percentage points) of the observed increase (the coefficient effect).

3.5 Discussion

Previous studies of unmet need for disability services have focused on the aged population or have not accounted for differences between subjective and objective unmet need (García-Gómez, Hernández-Quevedo et al. 2015). This chapter has

extended the current literature by including both working age adults and children, and by seeking to explain drivers in changing unmet need over time.

Unmet need can be considered an alternative measure of disability as it measures the gap between an individual's level of functioning and their desired level of functioning. Our findings do not indicate meaningful differences in unmet need across education or income. We do however highlight an important consideration in the widespread use of subjective measures of unmet need in the literature. Following the commencement of the pilot phase of the NDIS, we observed an increase in subjective unmet need for disability services. Subjective unmet need amongst adults for disability services increased by 7.7 percentage points and amongst children by 13 percentage points. This increase could be considered counter-intuitive – shouldn't unmet need have gone down as services expanded under the NDIS? However, it is consistent with Sen's capabilities approach to disability, where unmet need may have increased due to higher expectations created by the NDIS. It illustrates that subjective unmet need measures are effective at responding to changes in what society might consider as the basic rights of the types of capabilities and functionings an individual with a disability may expect and that this may have changed with the planned implementation of the NDIS. However, it also highlights that not all people with disabilities may have the same expectation of what needs should be reasonably met by access to public funds and therefore the comparability of subjective needs across people with a disability may not be equal.

There was no significant change in objective unmet need measures between the surveys despite the expansion of services provided under the NDIS between the 2012 and 2015 surveys. However, at the time the 2015 SDAC Survey was conducted only 16,000 people had approved plans under the NDIS, out of a total projected client group of more than 450,000 (NDIS, 2015). Further research using the 2018 and 2021 SDAC when released would allow a better assessment on whether the NDIS has had an impact on objective unmet need.

Decomposition of the increase in subjective unmet need shows that amongst working age adults over 50 per cent of this change was driven by people with mental impairments. In addition to raised expectations and higher number of people with a mental health condition, this may reflect a reduction in stigma associated with having

a mental health condition (Reavley and Jorm 2011) and receiving treatment over the study period. Alternatively, press reports surrounding the NDIS, which highlighted possible gaps for people with mental health conditions may have driven anxiety around access to services and influenced the measure of subjective unmet need. Detailed decomposition results amongst children were not conclusive, which may reflect the small sample size for this cohort. In addition, there had been an expansion in supports for children with autism prior to the role out of this NDIS, with the Helping Children with Autism package that commenced in 2008. Therefore, any change in perceptions may have already occurred in this cohort that is much more likely to report unmet need.

Due to our reliance on cross-sectional data and the lack of detailed local area information, we were unable to control for either individual or local area unobserved effects that would have allowed stronger conclusions from our analysis. As further SDAC surveys are released, this information may become available, allowing for more sophisticated analysis to control for local area fixed effects. Nevertheless, evaluations of the NDIS's progress in addressing unmet need for disability services need to take care in the measures chosen and interpretation. The extent to which subjective measures reflect the change in perceptions of need created by the expansion of services may negate the otherwise positive impact of the NDIS on meeting the needs of people with a disability.

Caution is required in studies using subjective measures of unmet need to make cross-country comparisons, given potential for external factors such as perceived availability of services and different perceptions of what should be made available for people with disabilities for different conditions have the potential to bias measures. One option to address this is to also include vignettes in such surveys – describe a consistent set of hypothetical people with a disability and their access to services and get the respondents to answer questions on whether these people have unmet needs (Briggs, A,H., Belozeroff, V. et al, 2019). This will allow comparisons across respondents and for researchers to recalibrate an individual's own answers considering their individual thresholds for what constitutes an unmet need. Where possible more objective measures of unmet need should also be used alongside subjective measures when making comparisons.

4 Factors Influencing Timing of Autism Diagnosis in Two Cohorts of Australian Children

4.1 Introduction

Due to be fully rolled-out in July 2020 and costing around AUD $22 billion per year, 30% of the current participants of the NDIS have autism (National Disability Insurance Agency 2019). The number of participants with autism is much higher than was expected but is consistent with the experience globally where rates of autism have been rising (Elsabbagh, Divan et al. 2012). Whether higher rates of autism are due to higher underlying prevalence or external factors, such as changes in diagnostic criteria, increasing awareness and additional supports available to children with a diagnosis is a matter of ongoing debate (Bent, Barbaro et al. 2017, Masi, DeMayo et al. 2017). At the same time that rates of autism diagnosis have been rising, there has been a relatively small reduction in the average age of diagnosis. This is of concern because early interventions have been shown to be effective and thus, delays in obtaining an autism diagnosis can affect a person's functioning for life. In this chapter, factors influencing the path to an autism diagnosis are investigated in an attempt to better understand potential external drivers of increased rates of autism and also inform policies aimed at reducing the age of diagnosis, including addressing any inequalities in access to a diagnosis.

4.1.1 Autism

Autism is characterised by difficulties with social interactions, and the presence of repetitive behaviours (American Psychiatric Association 2013). These can impact the child's ability to attend and engage in school, and in later life participate in the labour market and live independently (Järbrink and Knapp 2001). The earlier a person is diagnosed with autism the earlier they can access interventions which may improve their functioning, and reduce the long term impact of autism on their life (Clark, Vinen et al. 2018). However, despite evidence that autism can be reliably diagnosed from around two years of age (Cox, Klein et al. 1999, Charman and Baird 2002, Moore and Goodson 2003, Pierce, Gazestani et al. 2019) the average age of diagnosis in most countries remains around starting school age.

The process of diagnosis requires a family (or someone else in contact with the child like a teacher) to first identify a potential issue with a child's development and then

navigate a complex system of appointments with specialists (Howlin and Asgharian 1999, Goin-Kochel, Mackintosh et al. 2006, Falkmer, Anderson et al. 2013). This creates the possibility that children are diagnosed later, or not at all. In particular, we might expect to see differences in detection across families associated with individual and social differences in resources, capacities and preferences (Jo, Schieve et al. 2015, Hrdlicka, Vacova et al. 2016). Any resulting delay or absence in interventions will create avoidable inequities in outcomes. Identifying factors that influence the rate of autism diagnosis can provide the basis for targeted interventions to increase awareness access and take-up of diagnostic services.

A number of studies have investigated either the factors associated with the prevalence of autism or age of diagnosis, with limited research examining both simultaneously (see Appendix 4.1 for a full summary of identified studies, discussed in detail below). This is largely due to data restrictions, with population representative samples allowing a study of prevalence but not including enough detail to determine the age of autism diagnosis. In contrast, autism only samples often include the age of diagnosis but it is not possible to study the prevalence or probability of an autism diagnosis as everyone has, by definition, been diagnosed. There are very few longitudinal surveys that follow children prior to an autism diagnosis which can be used to understand early observable characteristics which are associated with a later autism diagnosis.

In this chapter, we utilise a sample from the Longitudinal Survey of Australian Children (LSAC), a nationally representative panel data set following children up to the age of 12 that includes information on the age of autism diagnoses. Two studies have previously used LSAC to report on the prevalence and age of autism diagnosis across the 2004 and 2000 Birth Cohorts (Randall, Sciberras et al. 2016, May, Sciberras et al. 2017). The most recent study found a prevalence of autism of 3.9 per cent (95% CI: 3.2 to 4.5) in the 2004 Birth Cohort and a prevalence of 2.4 per cent (95% CI: 1.6 to 2.9 %) in the 2000 Birth Cohort at age 11 (May, Sciberras et al. 2017). The age of diagnosis was 5.62 in the 2004 Birth Cohort versus 5.34 in the 2000 Birth Cohort. While the study compared the characteristics between children diagnosed and not diagnosed with autism across the cohorts it was limited in reporting cross sectional summary statistics.

This chapter extends the literature by using panel data to undertake multivariate survival analysis on the age at autism diagnosis. This allows us to investigate those factors that are associated with a quicker diagnosis, while also allowing for these factors to change over time. Uniquely, we include a measure of parental concern with child development at age one to investigate the association between so called 'red flags' for autism (Raising Children's Network 2018) and the probability and timing of diagnosis[21].

Through comparing two cohorts of Australian children aged four years apart, factors within different population groups that may be driving higher prevalence of autism reported elsewhere are highlighted (May, Sciberras et al. 2017). The association of time varying and fixed characteristics, including: income; English speaking status; education; and family composition with the timing of diagnosis are investigated. Further, using census data measures of local access to medical services are constructed to explore whether supply side factors are associated with the timing of diagnosis. Finally, the association between the introduction of new support services for children with autism and the rate of autism diagnosis is explored. This may add to our existing understanding about the causes of the rising prevalence of autism and the role of incentives in obtaining a diagnosis.

4.1.2 Constraints

Any analysis of autism is limited because the true sample at risk with 'underlying undiagnosed autism' is unobservable. As a consequence, it is not possible to determine underlying prevalence[22]. For example, it is not clear how much of any difference in diagnosis between girls and boys is due to lower underlying rates of autism and how much is due to differences in perceptions and presentation of symptoms (Lai, Lombardo et al. 2017). To account for this limitation, we undertake the analysis on the full sample where every child is assumed to be 'at risk' of an autism diagnosis and compare this to the sub-sample of children that are observed to be diagnosed during our sample window. This allows us to comment on those factors

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[21] In the first year of life red flags for autism include little or no smiling, eye contact, gestures such as pointing, and not responding to own name (Raising Children Network. 2018).

[22] While we cannot determine underlying prevalence, we do investigate whether girls and children from low SES groups are more likely to have poor social development questionnaire scores at age 11 and not be diagnosed with autism to understand the potential scope of the problem (see Appendix 4.3).

that are associated with underlying prevalence as well as conditional on having autism the rate of diagnosis. Furthermore, with the autism only sample it allows for us to control for the different presentation of symptoms by including a variable indicating autism severity (once diagnosed) and how this relates to the timing of the diagnosis.

There is also the risk of mis-diagnosis due to the nature of an autism diagnosis, which does not involve a clinical test but rather an assessment that behaviours and traits are consistent with a diagnosis. However,

First, in the background section, we provide an overview of the known causes of autism including its increasing prevalence and the existing literature on the time to autism diagnosis. We also provide some relevant background on access to services for autism in Australia. We then outline the data used in the analysis before detailing the methods used. The following section includes the results, before a discussion of the results and its potential policy implications are presented.

4.2 Background

4.2.1 Causes of Autism

There has been a significant increase in the number of children diagnosed with autism across the developed world (Matson and Kozlowski 2011, Elsabbagh, Divan et al. 2012). According to the Australian Bureau of Statistics (ABS) Survey of Disability and Carers the rates of autism in children aged 5 to 14 have increased from 1.3 per cent in 2009 (ABS 2010), to 2.8 per cent in 2015 (ABS 2016). In the United States the rates of autism have increased from 1 in 150 in 2000, to 1 in 59 in the latest estimates (Baio J 2018). Similar increases have been observed globally (Elsabbagh, Divan et al. 2012). Various hypothesis exist about what is driving this increase, including changes in diagnostic criteria[23], increased availability of supports for children with an autism diagnosis, greater awareness and higher underlying prevalence (L. Matson and Kozlowski 2011).

Complicating the understanding of the rise in the rates of autism, is that the exact cause of autism remains unknown. Increasingly, it is thought to have a genetic basis

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[23] Diagnostic criteria changes occurred in 1987 which significantly increased the concept of autism by adding Pervasive development disorder (PDD-NOS) and then again in 2013 when discrete disorders including Autistic Disorder, Asperger's, Pervasive Developmental Disorder) were replaced with a single diagnostic term: Autism Spectrum Disorder.

(Tordjman, Cohen et al. 2017). However, even in families that experience multiple occurrences of autism the genetic basis for the disease is largely heterogeneous (Happé, Ronald et al. 2006, Yuen, Thiruvahindrapuram et al. 2015). Underlying autism therefore can be treated as plausibly exogenous. However, this is not the case with seeking a diagnosis, which is influenced by factors known to impact access to health care services more generally (Mandell, Novak et al. 2005, Liptak, Benzoni et al. 2008, Jo, Schieve et al. 2015, Brett, Warnell et al. 2016). In this chapter, we describe differences and changes in the prevalence and timing of autism diagnosis, not the prevalence of underlying autism which is unobservable. Below, we outline the existing literature which has explored the prevalence and timing of autism diagnosis. As the review highlights, researchers have largely explored only the prevalence or timing of autism of diagnosis - not both together.

4.2.2 Previous Empirical Research

A higher prevalence of autism diagnosis has been associated with being male (Werling and Geschwind 2013, Christensen, Baio et al. 2016, Lai, Lombardo et al. 2017); higher education levels of parents (Croen, Grether et al. 2002); higher socio-economic status of household (Mandell, Novak et al. 2005, Goin-Kochel, Mackintosh et al. 2006); and coming from a Caucasian background (Mandell, Listerud et al. 2002, Rosenberg, Landa et al. 2011, Valicenti-McDermott, Hottinger et al. 2012). Research on regional differences has found mixed evidence of an association between health care provision and the probability of diagnosis (Fountain, King et al. 2011, Kalkbrenner, Daniels et al. 2011).

A British study using data from the Born in Bradford Cohort which comprises 13,857 children born between 2007 and 2011 examined the association between socio-economic status and prevalence of having an autism diagnosis in children aged 5-8 years old (Kelly, Williams et al. 2017). They found that boys were 3.88 times (95% CI: 2.36 to 6.36) more likely to be diagnosed than girls. Children of mothers educated to A level or above were 2.05 times (95% CI: 1.34 to 3.14) more likely to be diagnosed with autism than children of mothers that had not completed A levels. Once maternal education was controlled for, there was no significant contribution from household income or local area deprivation in the prevalence of a diagnosis.

Looking at the time to diagnosis as distinct from the prevalence of an autism diagnosis, a 2012 systematic review found that the mean age of diagnosis for autism ranged from 3 to 10 years of age across 42 studies (Daniels and Mandell 2014). This range is attributable to random variation across areas and differences in diagnostic protocols, as well the utilisation of different data sets including a reliance on administrative versus primary data collection. Studies have highlighted the important role of socio-economic status in the timing of autism diagnosis (Fountain, King et al. 2011, Hrdlicka, Vacova et al. 2016). In addition, autism severity (Daniels and Mandell 2014), having older siblings (Rosenberg, Landa et al. 2011, Frenette, Dodds et al. 2013, Mishaal, Ben-Itzchak et al. 2014) and parental concerns about symptoms (Daniels and Mandell 2014) have all been associated with earlier diagnosis. Some studies also identified geographic variation in age of diagnosis, indicative of the role that community resources and local policies have in diagnosis (Fountain, King et al. 2011, Kalkbrenner, Daniels et al. 2011, Hoffman, Weisskopf et al. 2017).

A large study based in California used multi-level analysis to model the individual and community level factors associated with age of diagnosis across ten cohorts of children from 1992 to 2001 (Fountain, King et al. 2011). In addition to finding a large increase in the prevalence of autism diagnosis over the period, there was also a reduction in the average age of diagnosis from 4 1/2 years to 3 1/2 years. A low level of education was associated with an approximate two-month delay in diagnosis in 1992, which reduced over time to less than a one-month delay by 2001. This may point to a reduction in the impact of socio-economic factors, as the symptoms of autism became more widely known and access to diagnostic and treatment services became more widely available. In terms of the type symptoms, difficulty with communication (often associated with more severe forms of autism) reduced the average age of diagnosis by between two to almost eight months across the study period. An older sibling in the household reduced the age of diagnosis by up to 3.4 months.

As far as we are aware only one study has simultaneously looked at both prevalence of autism and the timing of diagnosis, using time to event analysis (Parner, Schendel et al. 2008). The study used Danish Medical Birth Registry linked to the Danish National Psychiatric Registry and included 407,458 children born between January 1, 1994 and December 31, 1999 in an attempt to describe changes across birth cohorts. It found that the relative risk of having autism for a child born in 1998-99 compared to

a child born in 1994-95 at age three was 1.69 (95% CI: 1.24-2.31). This decreased at age 11 to 1.23 (95% CI: 1.11-1.37). The findings highlight that changes in the age of diagnosis of autism over time have an impact on the observed risk for a reported diagnosis at different ages. Increasing prevalence rates therefore observed in other studies at particular ages, may in part be driven by earlier diagnosis rather than underlying increases in prevalence. The study was limited in not being able to control for other covariates including socio-economic indicators that may explain some of the changes in diagnosis over time. This chapter extends the literature by including such factors.

4.2.3 Autism Diagnosis in Australia

Across Australia, autism diagnosis guidelines vary but generally involve at least two professionals including a paediatrician and one of either a psychologist or speech pathologist. Gold standard diagnostic practices involve a parental and teacher questionnaire, alongside direct observation of the child in a clinical and non-clinical setting (Whitehouse AJO 2018). However, these procedures and guidelines are open to clinical interpretation which could lead to different patterns of diagnosis. A diagnosis provides children access to a number of Government funded programs at school and in the community.

The Australian Government introduced a major change in the supports provided to children with autism in 2008. The *Helping Children with Autism* package was introduced in October 2008, providing up to $12,000 in supports over two years for children under the age of seven diagnosed with autism (Bent, Dissanayake et al. 2015). For older children, access to specific services under Australia's public health insurance system, Medicare, were available for the first time. The package also included access to rebates for diagnostic services under Medicare.

The *Helping Children with Autism* package was overtaken by the launch of the National Disability Insurance Scheme (NDIS) in July 2013, which provides any reasonable and necessary early and ongoing interventions for children diagnosed with autism. This was a significant increase in available supports, with average support packages of over $35,000 per year (National Disability Insurance Agency 2019). The number of NDIS recipients with autism is much higher than expected, and an important

contribution of this chapter is to provide preliminary evidence on whether the increasing availability of supports is associated with increasing prevalence.

4.3 Data

The Longitudinal Survey of Australian Children (LSAC) is a representative sample established in 2004, and has followed two cohorts of children in a bi-annual survey. The first six waves are utilised in this study. The children were recruited using a two-stage clustered (by postcode) design following random sampling from Medicare registrations, which covers nearly all Australian children.

LSAC is a rich data set covering a child's socio-economic status, health and disability characteristics and school performance. Questions are administered through interview and self-completed questionnaires. The birth cohort (2004 Birth Cohort) were less than one year old in 2004, and consisted of 5,107 children. There has been an attrition rate of 26.3 per cent in the birth cohort over the six waves, leaving a sample of 3,764 in wave six. The kindergarten cohort (2000 Birth Cohort) were aged between 4 and 5 years old in 2004, and consisted of 4,983 children. This initial sample reduced to 3,537 children in wave 6, an attrition rate of 29.01 per cent. Individuals from both cohorts are excluded from the sample if they left the panel before wave 4 (2010) when questions related to autism were first asked.

The 2006 and 2011 Australian Census data on the number of medical professionals working in a local area is also used. The Australian Census is conducted every five years and completed by all Australian households. It asks about place of residence but also place of work, and therefore allows a measure of the number of general practitioners and specialists working in a statistical local area per thousand of population to be constructed. There are 358 spatial SA3 statistical areas in Australia generally with populations of between 30,000 to 130,000 persons. While smaller geographical areas are reported by the ABS, SA3s are chosen because they are built around functional areas of regional towns and cities, including related suburbs and transport hubs within major urban areas. Using the un-confidentialised version of LSAC, this information is linked using local area codes.

4.4 Variables

4.4.1 Autism Diagnosis and Severity

LSAC asks the primary caregiver through an interview whether their child has a set of ongoing conditions, from which they can select the category: autism, Asperger's or other autism spectrum. Parents are also asked in each wave the age of autism diagnosis and the severity of the child's autism. Direct questions on a child's autism diagnosis, including age of diagnosis and severity (mild, moderate and severe) were asked from wave four of the LSAC onwards, when the 2004 Birth Cohort were aged 6-7 years and the 2000 Birth Cohort were aged 10-11 years. This information is then used to indicate whether a child had an autism diagnosis in an earlier wave of the survey.

As noted, autism is defined as severe, moderate or mild. Severe autism refers to children that are non-verbal and often have confounding disabilities. Moderate autism captures children with frequent and restrictive behaviours that require substantial support in social interaction. Mild autism encapsulates children with severe deficits in their verbal and non-verbal skills that have difficulty in changing actions or focus and require support. The severity of autism reported by parents can change (see Appendix 4.2 for details on number of changing observations) and we use the most severe reported level in the analysis.

4.4.2 Birth Cohort

A categorical variable indicates whether the child was in the 2004 Birth Cohort to control for differences across the two birth cohorts. The 2004 Birth Cohort observes children until they are aged 12 years old and the 2000 Birth Cohort children until they are aged 16. This study is limited to children age 0 to 12 years of age to aid comparison between the two cohorts. Consistent with rising global prevalence rates of autism the prevalence of autism is expected to be higher in the younger 2004 Birth Cohort.

4.4.3 Need Characteristics

LSAC collects rich information on a child's health and disability status over time, including the presence and nature of disabilities, and age-appropriate development questions. A categorical variable indicating whether a child has another disability is

generated, with zero indicating no co-morbid disability and one indicating a co-morbid disability. It is not clear how the presence of co-morbid disabilities, such as intellectual disabilities, impact a family also seeking an autism diagnosis (Daniels and Mandell 2014). On the one hand, having a co-morbid disability may bring a child into more contact with health professionals and be associated with a higher probability of an autism diagnosis, and therefore be associated with an increased hazard rate (Shattuck, Durkin et al. 2009). On the other hand, a co-morbid disability may mask or overshadow the autism symptoms and delay time to diagnosis, reducing the hazard rate of diagnosis (Rosenberg, Landa et al. 2011).

Information on a child's development includes both parental and teacher reports. The 2004 Birth cohort parents were asked during wave one, when the children were aged between 6 to 18 months, whether there were any concerns with development, and parents responded 'no', 'yes some' and 'yes significant'. A categorical variable is generated to indicate any concerns with development, with 0 no concerns and 1 some or significant concerns. A number of studies document the behavioural manifestations of autism in the first year of life (Zwaigenbaum, Bryson et al. 2005). There is also evidence that parental concerns about their child's development at six months is associated with a higher probability of an autism diagnosis at age three (Sacrey, Zwaigenbaum et al. 2015). Parental concerns with development at age one is therefore expected to be associated with a higher hazard rate in both the full sample and the autism sub-sample. As already outlined, gender also plays an important role in autism and we include a dummy variable to indicate the gender of the child with male=1 and female=0.

In further analysis, differences in mean parent and teacher reported Strengths and Weakness Questionnaire (SDQ) scores across groups are investigated (Appendix 4.3 and Appendix 4.4). The SDQ consists of 25 items that cover five domains: emotional symptoms; conduct problems; hyperactivity; peer problems; and prosocial problems. The LSAC includes parent and teacher reported SDQ scores for children from the age of four (wave one for the 2000 Birth Cohort and wave three for the 2004 Birth Cohort), however, response rates are lower than other parts of the survey. Previous studies have found a correlation between SDQ scores and autism, however, because almost half of children are diagnosed before SDQs are observed, including them as controls in this research would create potential issues of reverse causality. The results in

Appendices 4.3 and 4.4 demonstrate this with a significant deterioration in children's parental scores after a formal diagnosis.

4.4.4 Non-Need Characteristics

Categorical variables are used to control for a number of socio-economic characteristics including: household income; the level of maternal education (Bachelor, Certificate and High School or below); ethnic background; presence of an older sibling; number of parents in the household; and maternal labour force status.

Income quintiles are generated from the self-reported household income data by first adjusting for inflation using quarterly consumer price index data from the Australian Bureau of Statistics and the date of interview. Household equivalent income is then generated using the modified OECD equivalence scale. Points are allocated to each person in the household (1 point for the first adult, 0.5 to each additional person who is 15 years and over, and 0.3 to each child under the age of 15). This is then used to generate income quintiles.

Given that free diagnostic services are available in Australia's public health system; household income may not have a large impact on the demand for autism diagnosis. However, the public system involves long wait times, especially for less severe cases of autism (Bent, Barbaro et al. 2017). These wait times can be shortened through accessing private diagnostic services, but this routinely costs families up to $3000. As a result, prevalence rates amongst high- and low-income families are expected to be similar, but differences in the time to diagnosis are likely to remain.

Socio-economic characteristics such as education, and cultural background of families are expected to be associated with the demand for diagnostic services, increasing the prevalence and reducing the age of diagnosis. Consistent with the broader health care literature education is also likely to positively impact utilisation, leading to a higher rate of diagnosis (Dunlop, Coyte et al. 2000, Blackwell, Martinez et al. 2009). Stigma and a lack of awareness about autism symptoms in culturally diverse families may result in reduced demand for diagnostic services and lower the rate of diagnosis amongst some ethnic groups (Bernier, Mao et al. 2010).

Household composition is also controlled for, including single parent households (0 if coupled and 1 if single parent) and the presence of an older sibling in the household (0 if no older sibling; 1 if an older sibling is present). Single parent households may

be associated with an increase in the rate of diagnosis if poor childhood development increases parental stress and the probability of divorce. Conversely, children of single parent families may experience a delay in diagnosis independent of household income due to the lack of parental time. Parents with older siblings might more readily recognise the signs of autism or poor development, increasing their demand for diagnostic tests.

A maternal labour supply variable is constructed from hours worked in the previous fortnight, with 0 indicating zero hours worked, and 1 indicating greater than 0 hours worked. Children of working mothers may receive a diagnosis earlier due to the additional financial resources available to the household to access a diagnosis in the private system. They are also more likely to attend formal day care where experienced care workers may pick up on deficiencies in social functioning indicative of autism. However, mothers of poorly developing children have been found to be less likely to participate in the labour market (Zwaigenbaum, Bryson et al. 2005) therefore, a higher rate of autism diagnosis may be observed among non-working mothers. This relationship is explained by the additional caring needs of poorly developing children, but there remains a risk of reverse causality with mothers seeking a diagnosis of autism to justify non-participation in the labour market. The impact of maternal labour supply on a child receiving an autism diagnosis is ambiguous and further explored in more detail in Chapter 5 of the thesis.

In addition to socio-economic characteristics, we control variations due to the state and region of residence and access to doctor services that may affect the ability of children to access diagnostic services. Dummy variables for each state of Australia and living in a regional area are included in the analysis. The state of residence may influence the timing of diagnosis due to differences in the clinical guidelines and the number and type of medical professionals needed for diagnosis. In addition, families living in rural areas may not have access to professionals in their local area, necessitating long and costly trips to city areas to seek a diagnosis. Because this increases the price of an autism diagnosis, we would expect lower rates of autism in rural areas

Differences in local area access to doctor services are controlled for by linking census data on the number of GPs per thousand population in local SA3 areas. While smaller geographical areas are reported by the ABS, SA3s are chosen because they are built

around functional areas of regional towns and cities, including related suburbs and transport hubs within major urban areas and thus are likely to better reflect access. Even controlling for state and region of residence, local area proximity to health services is likely to influence the timing of an autism diagnosis, with individuals living in areas with greater access to doctor services likely to get an autism diagnosis sooner (Hoffman, Weisskopf et al. 2017).

Finally, a control is included for the introduction of the *Helping Children with Autism* package in 2008 (0 before its introduction and 1 after its introduction*)*. Children in the 2000 Birth Cohort were aged eight and children in the 2004 Birth Cohort were aged 4 when the package was introduced. The package increased the available supports for children diagnosed with autism and for families seeking a diagnosis. The *Helping Children with Autism* package is expected to have increased demand for an autism diagnosis, and therefore be associated with a higher rate of diagnosis.

4.5 Empirical Approach

To model the likelihood of receiving an autism diagnosis and the timing of that diagnosis simultaneously, time-to-event analysis is utilised, incorporating the information on each study child from the first six waves of LSAC. This has the benefit over other approaches of using all the available information about children and families across time. A number of studies looking at autism diagnosis have previously used time-to-event analysis, including one of the only studies to explore both the prevalence and timing of diagnosis through using a population wide sample (Parner, Schendel et al. 2008).

In addition to accounting for the skewed nature of age of diagnosis and the resulting distribution of error terms (Cleves, W. Gould et al. 2010), time-to-event analysis can handle cases where children with autism remain undiagnosed at the end of the study period (right censored). Because the study period ends prior to the children reaching adolescence, some children will remain undiagnosed in our full and autism sub-samples. This is especially important for modelling the diagnosis of girls because evidence indicates that they are more likely to be diagnosed in adulthood (Gould and Ashton-Smith 2011). While many of the factors likely to influence non-diagnosis such as gender, can be controlled, unbiased estimates require that there are not unobservable factors influencing the probability of non-diagnosis (right censoring). It

is likely the such factors exist, however through including controls identified in the literature these are minimised.

A continuous measure of a child's age, using months, is used as the time scale, allowing comparisons across the two cohorts at the same age. Kaplan-Meier survival analysis provides a useful descriptive analysis of time-to-diagnosis. It has the benefit of not imposing any functional form on the rate of diagnosis, and allows the exploration of differences across groups. The Kaplan-Meier estimates the survivor function ($s(t)$) at any time by:

Equation 4-1

$$\hat{S}(t) = \prod\nolimits_{age|t_{age} \leq t} \left(\frac{sc_{age} - aut_{age}}{sc_{age}} \right)$$

We calculate a separate 'survivor' function for each group of covariates used in the main analysis (for example: male and female, and state of residence), and then compare the expected number of autism diagnosis in each group at time t_{age} using the log rank test.

Equation 4-2

$$\chi^2 = \frac{(O_{2-} E_2)^2}{Var(O_{2-} E_2)}$$

$$H_0 : No\ difference\ between\ survival\ curves$$

While a useful descriptive tool, a limitation of this approach is that the Kaplan-Meier estimator does not allow multiple factors to be controlled simultaneously.

We address this limitation by using the Cox Proportional Hazard model, that allows multiple factors to be considered simultaneously. While most commonly used in studies investigating time to death, the Cox Proportional Hazard model is widely used in other time-to-event studies, including time-to-employment and time-to-diagnosis (Mode, Evans et al. 2016, Kausto, Pentti et al. 2017, Sato, Viswanath et al. 2019, Lublóy, Keresztúri et al. 2020). It is a semi-parametric regression model that estimates the hazard function, or the conditional probability of receiving an autism diagnosis. As a functional form, it has the benefit of allowing the baseline hazard to vary freely over

age (the time scale) and thus the shape of the hazard function can be increasing, decreasing, or constant at different ages. This is important in the timing of an autism diagnosis where we expect to see peaks in diagnosis, for example, around school starting age. Below is the standard Cox Proportional Hazard model:

Equation 4-3

$$h(t|x_j) = h_0(t) \exp(x_j \beta_x)$$

Where the hazard function at age *t* for individual *j* is a function of the baseline function and the explanatory variables x. While it is common to assume that the hazard related to any explanatory variable is proportional to the baseline hazard over all ages (constant hazard ratio across ages) we explain below, why in our current analysis this make little sense.

The proportional hazard can be tested by interacting the covariates with survival time and testing whether they are significant. When the proportional hazard assumption is violated, a model that allows the hazard ratio to vary across age may be more appropriate. This is especially important where a higher hazard of diagnosis at young ages may naturally infer a lower hazard of diagnosis at older ages due to a lower prevalence of undiagnosed cases remaining in this population - this may be so strong that the direction of the relationship may even reverse (Parner, Schendel et al. 2008). For example, if educated mothers are getting their children diagnosed at younger ages at such a higher rate, their hazard of diagnosis at older ages may even be lower than less educated mothers.

Thus, we estimate a model that allows hazard ratios for the explanatory variables to vary between the younger years (under 5 years of age) and the older years (over 5 years of age). We choose the age of five as the dividing line, as this approximates the statutory school starting age in most Australian jurisdictions. In Equation 4.4 we outline the Cox model which estimates the change in the hazard in the period over the age of 5 years old:

Equation 4-4

$$h(t|x_j) = h_0(t) \exp(x_{jt} \beta_x * t_1 + x_{jt} \delta_x * t_2) \exp(x_j \beta_x + z_j \delta_x * t_2)$$

Where the time varying covariates are represented by x_{jt} and t_1 and t_2 refers to time period before and after the age of five respectively. Thus β_x and δ_x tells us the hazard ratio before age 5 and after age 5 respectively. We also test whether there is a significant change is the hazard ratio from under the age of 5 to over the age of 5. We choose the age of five as the dividing line as this approximates the statutory school starting age in most Australian jurisdictions.

The analysis is undertaken both unconditional (on the whole child population) and conditional on receiving an autism diagnosis (by age 12). The unconditional analysis considers all children to be 'at risk 'of an autism diagnosis up to the age of 12. Results thus reflect both the underlying genetic variation in the rates of autism and its presentation between groups, and any differences due to health care access based on need and non-need characteristics. The unconditional model also accounts for the fact that some individuals are likely to be still undiagnosed at the end of the study period. However, as noted, if there are unobservable factors influencing the probability of not being diagnosed the results will be biased.

The conditional estimation uses the sub-sample that receives an autism diagnosis in our study window (up to age 12), and excludes the influence of associations due to a genetic variation of autism between groups. Because it does not account for the fact that individuals with autism may be undiagnosed at the end of the study period it is limited in the conclusions which can be drawn, especially about the changes over time when the number undiagnosed by age 12 may be very different. However, alongside the unconditional analysis, it provides additional information on factors associated with an earlier or later autism diagnosis conditional on a child having autism. Importantly, we can control for the severity of symptoms and therefore account for differences in the presentation of autism across groups.

4.6 Results

4.6.1 Descriptive Statistics

Descriptive statistics of our study sample are presented in table 4.1. Across the 2000 and 2004 Birth Cohorts, 319 children are diagnosed with autism before the age of 12. The average age of diagnosis is 5.3 years [95% CI: 5.0 to 5.6 years of age]. 49.5 per cent [95% CI: 44.0 to 55.0 per cent] of children diagnosed have mild autism, 40.8 per cent [95% CI: 35.3 to 46.2 per cent] have moderate autism and 9.7 per cent [95% CI:

6. to 13.0 per cent] have severe autism. Children with mild and moderate autism are diagnosed later than average at 5.6 years [95% CI: 5.2 to 6.0 years] and 5. years [95% CI: 4.9 to 5.9 years] respectively. This compares to children with severe forms of autism who are on average diagnosed at 3.5 years [95% CI: 2.7 to 4.2 years].

While boys make up 50.02 per cent [95% CI: 49.03 to 51.02 per cent] of the sample not diagnosed with autism at age 12, they represent 80.25 per cent [95% CI: 75.85 to 84.64 per cent] of those diagnosed with autism.

Table 4-1: Descriptive Statistics

	No Autism		Autism		
	N	%	N	%	Mean Age of Diagnosis
Male	4196	0.50	256	0.803	5.23
Female	4163	0.50	63	0.20	5.71
2004 Birth Cohort	4230	0.51	198	0.62	5.34
2000 Birth Cohort	4129	0.49	121	0.38	5.31
Need					
Mild Autism			158	0.49	5.6
Moderate Autism			130	0.41	5.44
Severe Autism			31	0.10	3.46
Other Disability	405	0.05	64	0.20	4.64
Concerns with Development at Age One (Birth Cohort Only)	249	0.06	35	0.18	5.08
Predisposing					
Bachelor Degree	2725	0.33	115	0.36	5.69
Certificate Qualification	2792	0.33	117	0.37	5.19
High school or below	2842	0.34	87	0.27	5.02
Older Sibling	188	0.59	141	0.44	5.26
Mother Non-English Speaking	49	0.15	29	0.09	4.62
Mother in Labour Force during Pregnancy	203	0.64	0	0.62	5.63
Enabling					
Enabling					
Household Equiv. Income – 1st Quintile (bottom)	72	0.23	67	0.21	5.34
Household Equiv. Income – 5th Quintile (top)	35	0.11	32	0.10	5.36
Mother's Birth Age	30.4 years		29.8 years		
GPs per thousand population	3.07		3.01		
N	8,359	0.96	319	0.04	5.32

Boys are diagnosed earlier, with an average age of diagnosis of 5.23 years [95% CI: 4.89 to 5.57 years] compared to girls who are diagnosed on average at 5.70 years [95% CI: 4.93 to 6.48 years].   Children of parents with concerns regarding their development at age one is diagnosed marginally earlier at 5.08 years [95% CI: 4.04 to 6.12 years] than other children.

Mothers with a child diagnosed with autism are more likely to have a bachelor's degree than mothers who do not have a child diagnosed with autism (36.05 per cent [95% CI: 30.75 to 41.34 per cent] versus 30.41 per cent [95% CI: 29.49 to 31.31 per cent]). However, for children that end up being diagnosed, those with mothers that have a bachelor degree are, on average, diagnosed later at 5.69 years [95% CI: 5.17 to 6.21 years] than children with mothers that do not have a bachelor degree at 5.11 years [95% CI: 4.73 to 5.50 years]. While there was variation in the number of GPs per 1000 population (see Appendix 4.5 for maps illustrating variation), there was no significant difference between the sample with and without an autism.

The Kaplan Meier estimates for median survival times are reported in table 4.2 for children that are diagnosed before 12 years of age. Survival curves for gender, birth cohort and concerns with development are presented in Figure 4.1. The survival curves in Figure 4.1 below show that within the full sample, males (1a), children from the 2004 Birth Cohort (1c) and children from the 2004 Birth Cohort with developmental concerns at age one (1e) are at higher risk of diagnosis. Despite this, within the autism sub-sample there are no differences in the rate of diagnosis across these groups.

Table 4-2: Kaplan Meier Estimates

	Percent Diagnosed	N	Median Age	Log Rank Test Statistic (χ2)
Male	5.7%	255	6.00	
Female	1.5%	62	4.99	6.81**
2004 Birth Cohort	4.5%	197	4.99	
2000 Birth Cohort	2.8%	120	4.99	7.34***
Need				
Other Disability	27%	128	3.00	
No Other Disability	2.3%	189	6.00	49.31***
Concerns with Development (Birth Cohort Only)	12.4%	35	4.99	
No Concerns with Development (Birth Cohort Only)	4.0%	163	4.99	0.03
Mild Autism		157	4.99	
Moderate Autism		129	4.99	
Severe Autism		31	3.00	24.16***
Predisposing				
Bachelor Degree	4.2%	119	6.00	
Certificate Qualification	4.4%	129	4.99	
High school or below	2.4%	69	4.00	2.40
Older Sibling	2.6%	133	4.99	
No Older Sibling	5.1%	184	4.99	0.15
Mother English Speaking	3.9%	288	4.99	
Mother Non-English Speaking	2.2%	29	4.00	0.09
Mother in Labour Force during Pregnancy	3.6%	198	6.00	
Mother not in Labour Force during Pregnancy	3.8%	119	4.00	3.96**
Enabling				
Household Equiv. Inc.– First Quintile (bottom)	3.4%	39	7.00	
Household Equiv. Inc.– – Second Quintile	4.1%	52	4.00	
Household Equiv. Inc.– – Third Quintile	4.0%	52	4.99	
Household Equiv. Inc.– – Fourth Quintile	3.0%	40	4.00	
Household Equiv. Inc.– – Fifth Quintile (top)	2.6%	34	6.00	
Missing Combined Income	4.4%	100	4.99	10.64*
Single Mother	8.4%	73	4.99	
Couple	3.1%	244	4.99	4.42**

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Figure 4-1: Time to Autism Diagnosis Curves (Kaplan Meier)
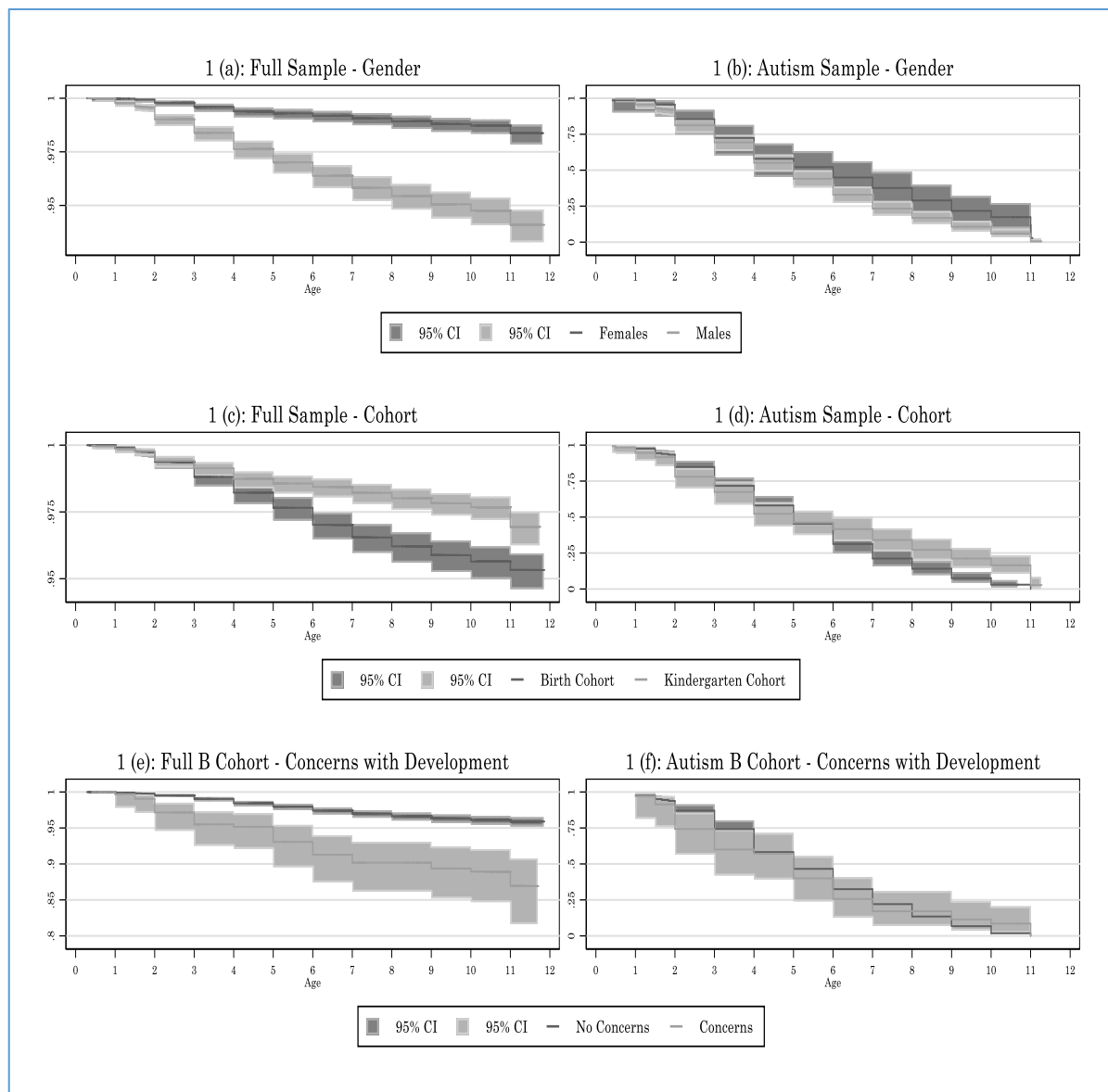
4.6.2 Time-To-Event Regression Results

Full Sample

The results in table 4.3 allow the hazard rate to vary across age with the sample split between diagnosis under the age of five and diagnosis after the age of five[24]. We

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[24] The Cox Proportional Hazard model that did not allow the hazard rates to vary across age violated the proportional hazard assumption for a number of covariates.

report results for the combined sample, as well as for the 2000 and 2004 Birth cohorts, with robust standard errors shown in parenthesis[25]. Under the age of five, being male is associated with a 3.22 times higher hazard rate of receiving an autism diagnosis [95% CI: 2.19 to 4.74]. After the age of five the hazard rate does not significantly increase.

Children in the younger 2004 birth cohort have a 1.39 times higher rate of autism diagnosis under the age of five [95% CI: 0.97 to 2.00] compared to the older cohort and the hazard rate over the age of five is not significantly higher than this. These children are more likely to be diagnosed, but this is not explained by a change in when they are being diagnosed on average. Having another disability is associated with a significantly higher hazard rate of 15.19 before the age of five [95% CI: 11.04 to 20.90], which drops to 4.04 for children aged over five years old [95% CI: 2.61 to 6.24]. Children with another disability are both more likely to be diagnosed, and diagnosed earlier.

Within the younger 2004 Birth Cohort we find that concerns with development at age one is associated with higher rates of diagnosis both under the age of five and over the age of five. The rate of diagnosis over the age of five for children where parents had concerns had age one is 2.11 times higher [95% CI: 1.17 to 4.03] than if parents did not have concerns with development at age one.

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[25] Full results are in Appendix 4.7 alongside results of the Cox Proportional Hazard model not allowing for time varying covariates at Appendix 4.6.

Table 4-3: Full Sample Time Varying Cox Proportional Hazard Model

		Combined			2004 Birth Cohort			2000 Birth Cohort		
		0 - 5 yrs	5 - 12 yrs	Sig. Diff	0 - 5 yrs	5 - 12 yrs	Sig. Diff	0 - 5 yrs	5 - 12 yrs	Sig Dif
	Male	3.22***	3.51***		3.79***	3.20***		2.64***	4.05***	
		(0.64)	(0.73)		(1.00)	(0.81)		(0.80)	(1.52)	
	2004 Birth Cohort	1.39*	1.55**							
		(0.26)	(0.29)							
	Helping Autism	1.73***			1.31			1.31		
		(0.32)			(0.00)			(0.55)		
Need	**Need**									
	Other Disability	15.19***	3.97***	***	15.06***	3.76***	***	13.17***	4.03***	***
		(2.47)	(0.88)		(3.16)	(1.10)		(3.46)	(1.39)	
	Concerns with Development				1.61*	2.11**				
					(0.42)	(0.66)				
Predisposing	Mother Bachelor Degree	1.46*	3.02***	**	2.12***	3.04***		0.77	3.53***	***
		(0.29)	(0.84)		(0.57)	(1.09)		(0.26)	(1.62)	
	Mother Certificate	1.29	1.77**		1.64*	1.83*		0.97	1.75	
		(0.24)	(0.47)		(0.43)	(0.63)		(0.27)	(0.74)	
	Older Sibling	0.53***	0.47***		0.51***	0.54***		0.59**	0.38***	
		(0.08)	(0.08)		(0.10)	(0.12)		(0.15)	(0.11)	
	Mother Working	0.55***	0.53***		0.54***	0.56**		0.56**	0.48**	
		(0.09)	(0.10)		(0.12)	(0.13)		(0.14)	(0.15)	
	Mother English Speaking	1.14	2.30**		0.98	2.97**	*	1.33	1.78	
		(0.28)	(0.84)		(0.29)	(1.59)		(0.58)	(0.96)	
Enabling	Single Mother	1.30	2.82**	**	1.62	3.66**	**	0.79	1.35	
		(0.34)	(1.13)		(0.52)	(1.86)		(0.36)	(0.58)	
	GP per thousand population	1.02	0.89		0.97	1.00		1.08	0.66**	***
		(0.04)	(0.08)		(0.07)	(0.10)		(0.07)	(0.01)	
	N	41020			24539			16481		
	State of Residence	MAIN ONLY			MAIN ONLY			MAIN ONLY		
	Household Income	YES			YES			YES		
	Link Test	OK			OK			OK		

Robust Standard Errors in Parenthesis; * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Children with mothers who have a bachelor degree have a 1.46 times higher rate of autism diagnosis under the age of five[26] [95% CI: 1.00 to 2.15], which doubles to 3.02 times after the age of five [95% CI: 1.81 to 5.51]. Across the cohorts, we see a stronger association between education and early diagnosis in the younger 2004 Birth Cohort. Children of mothers with a bachelor degree from the 2004 Birth cohort have a hazard rate of 2.12 under the age of five [95% CI: 1.25 to 3.60]. This compares to children of mothers with a bachelor degree from the older 2000 Birth Cohort who had a hazard rate of 0.77 under the age of five [95% CI: 0.40 to 1.48].

The helping autism package was associated with a 1.73 times higher rate of autism diagnosis [95% CI: 1.20 to 2.49]. However, the association is not significant within the 2000 and 2004 sub-sample analysis, which could be explained by the lack of variation in the age that the helping autism package was introduced within each cohort. An undiagnosed child with a mother in paid employment has a 0.55 times lower rate of diagnosis [95% CI: 0.40 to 0.75] under the age of five compared to a child of a mother not in paid employment. The number of GPs per thousand of population was not associated with a significantly higher rate of autism diagnosis in the pooled sample. The only significant association was a lower rate of diagnosis in the older 2000 Birth Cohort over the age of five.

Autism Sample

Table 4.4 presents selected results of the Autism sub-sample Cox Proportional Hazard model which allows hazard ratios to vary over age[27]. Utilising only the sample of children with autism focuses on the factors associated with the timing of autism diagnosis for those who end up being diagnosed by age 12 and also allows us to consider the role of the severity of the autism in the timing of the diagnosis.

As expected, children with severe autism are diagnosed at twice the rate of children with mild autism both under the age of five and over the age of five. Male children diagnosed with autism did not have a significantly higher rate of diagnosis under the age of five than female children. Over the age of five, however, male children with autism had a rate of diagnosis 1.86 times higher [95% CI: 1.23 to 2.77] than female

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[26] The reference group is children of mother's that have a highest qualification of high school or below.
[27] Full results are at Appendix 4.9 alongside results of the Cox Proportional Hazard model not allowing for time varying covariates at Appendix 4.8. .

children. Potentially milder female cases of autism are taking longer to identify than milder male cases.

There is no significant difference in the rate of diagnosis between the two cohorts under the age of five, however, children over the age of five in the younger 2004 Birth Cohort have a 1.64 higher rate of diagnosis [95% CI: 1.13 to 2.35]. Children with co-morbid disabilities have a 2.99 times higher hazard rate of autism diagnosis under the age of five [95% CI: 2.24 to 3.99]. Over the age of five the hazard rate for children with co-morbid disabilities is significantly lower and not significant and is likely due to the fact that most of the obvious cases have already being diagnosed at this point.

Within the younger 2004 Birth Cohort concerns with development at age one was not significantly associated with the timing of diagnosis, with hazard rates close to one indicating low associations. Within the 2000 Birth Cohort, a one unit increase in the number of GPs per thousand population in the SA3 area increases the rate of a diagnosis by 1.21 times each year under the age of five [95% CI: 1.13 to 2.35]. There was no significant association in the timing of diagnosis within the autism sample of a mother's labour force participation and the timing of diagnosis, with hazard rates of close to one.

Table 4-4: Autism Sample Time Varying Cox Proportional Hazard Model

		Combined			2004 Birth Cohort			2000 Birth Cohort		
		0 - 5 yrs	5 - 12 yrs	Sig. Diff.	0 - 5 yrs	5 - 12 yrs	Sig. Diff.	0 - 5 yrs	5 - 12 yrs	Sig. Diff.
	Male	1.34	1.85***		1.54	1.86**		1.28	2.20*	
		(0.26)	(0.38)		(0.43)	(0.49)		(0.38)	(0.00)	
	2004 Birth Cohort	0.95	1.64***	**						
		(0.17)	(0.30)							
	Helping Autism	1.38*			1.27			1.04		
		(0.24)			(0.33)			(0.45)		
Need	Other Disability	2.99***	1.16	***	3.81***	1.04	***	3.39***	1.9*	
		(0.44)	(0.21)		(0.72)	(0.25)		(1.01)	(0.65)	
	Concerns with Dev.				0.79	1.21				
					(0.19)	(0.32)				
	Severe Autism	2.18***	2.45***		3.35***	2.36***		1.55	5.27***	*
		(0.48)	(0.73)		(0.88)	(0.67)		(0.61)	(3.09)	
	Moderate Autism	0.96	0.95		0.92	0.88		1.04	0.99	
		(0.15)	(0.14)		(0.20)	(0.16)		(0.29)	(0.33)	
Predisposing	Mother Bachelor Degree	0.76	0.995		1.15	1.24		0.39**	0.84	
		(0.15)	(0.20)		(0.30)	(0.31)		(0.17)	(0.46)	
	Mother Certificate	1.01	0.91		1.21	1.00		1.02	1.19	
		(0.18)	(0.20)		(0.31)	(0.27)		(0.28)	(0.54)	
	Older Sibling	1.06	0.84		0.97	0.75		1.36	0.72	
		(0.15)	(0.12)		(0.18)	(0.14)		(0.38)	(0.25)	
Enabling	Mother's Labour Force Status	0.85	0.91		0.82	1.15		1.05	0.52**	*
		(0.14)	(0.13)		(0.17)	(0.19)		(0.31)	(0.14)	
		(0.34)	(0.27)		(0.39)	(0.29)		(0.71)	(0.98)	
	GP per '000	1.07**	0.97		0.97	0.90		1.21***	1.09	
		(0.04)	(0.07)		(0.06)	(0.08)		(0.06)	(0.19)	
	N	1017			727			290		
	State of Residence	YES			YES			YES		
	Household Income	YES			YES			YES		
	Mother's Age	YES			YES			YES		
	Proportional Hazard.	OK			OK			OK		

Robust Standard Errors in Parenthesis; * $p < 0.10$, ** $p < 0.05$, *** $p < 0$.

4.6.3 Robustness Checks

Mean parental and teacher SDQ scores and percentage of children with abnormal[28] SDQ scores at ages five and eleven are compared across three groups: children diagnosed under the age of five; children diagnosed over the age of five; and children never diagnosed (results are presented at Appendix 4.3 and Appendix 4.44). A higher SDQ indicates more developmental and behavioural issues.

Across the Birth Cohorts, the mean parental and teacher SDQ scores of children diagnosed is lower in the 2004 Birth Cohort than the 2000 Birth Cohort at both age five and eleven, indicating that children with less severe behavioural issues were diagnosed in the younger cohort.

Comparing males and females, similar mean parental SDQs are observed across all the groups. However, large differences are apparent in teacher reported SDQs for girls diagnosed over the age of five. The average teacher reported SDQ for girls diagnosed over the age of five is 7.70 (95% CI: 5.52-9.87) which is almost half the average parental reported SDQ for the same group of children [13.13 (11.07-15.19)] at age five. This gap narrows by the age of eleven, however, it indicates that while parents of children undiagnosed at age five are picking up on behavioural issues early in girls, they are not being picked up by their teachers.

Finally, mothers with and without a bachelor's degree are compared, and the findings are consistent with better educated mothers being more likely to get a diagnosis for their child if they are concerned about their child's development at age 5. Children diagnosed over the age of five with higher educated mothers are much less likely to have abnormal parent reported SDQ scores [9.72% (95% CI: 3 % to 17%)] than abnormal teacher reported SDQ scores [18.18% (95% CI: 8 % to 29%)] at age five. These parents are not picking up on issues that teachers are and this is potentially creating a delay in diagnosis. Children with lower educated mothers diagnosed over the age of five are more likely to have abnormal parent reported SDQ scores [25.5%

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[28] What constitutes abnormal differs across age and gender groups, and is based on population groupings that place 80 per cent in the normal range, 10 per cent in the borderline range and 10 per cent in the abnormal range (Kremer, P; de Silva et al, 2015).

(95% CI: 17 % - 35%)] than abnormal teacher reported SDQ scores [16.92% (95%CI: 8% - 26%)] at age five. These parents are noticing issues with development at age five, but have not yet sought a diagnosis.

4.7 Discussion

Through using panel data and time-to-event analysis we have been able to shed new light on the factors that impact the rate of autism diagnosis. Consistent with the existing literature, the analysis of two representative cohorts of Australian children has found an increasing rate of autism diagnosis across time. The prevalence of autism diagnosis amongst the full sample increased by fifty per cent from the younger to the older cohort of Australian children. This was within a very short time period, with just 4 years age difference between the two cohorts, and was much larger than earlier studies comparing similarly spaced cohorts (Parner, Schendel et al. 2008). However, amongst the autism sample, there was no evidence of a faster rate of diagnosis within the younger 2004 Birth Cohort under the age of five. This indicates that after controlling for need and socio-economic factors there has not been an increase in the rate of early diagnosis across the cohorts of children. This could also be explained by a proportionate increase in more severe autism cases being diagnosed earlier, and a disproportionate increase in less severe autism cases being diagnosed later. However, our analysis of SDQ scores did not find any such increase across cohorts.

Associations were found for need and non-need factors and the rate of autism diagnosis. Need factors, including gender, having a co-morbid disability, autism severity and parental concern with development were associated with a higher rate of autism diagnosis. However, differences in non-need factors and between the full and autism sample point to some important policy considerations.

Boys were diagnosed at over three times the rate of females in the full sample. However, undiagnosed males within the autism sample were also diagnosed at a 1.5 times higher rate than females. This supports the theory that while males may have a higher genetic propensity for autism, the rates and timing of diagnosis may also be influenced by differences in the presentation of autism symptoms and the greater ability of females to 'mask' autistic traits (Daniels and Mandell 2014).

There was a large difference in parent and teacher reported social development scores at age 5 for girls diagnosed after the age of five with autism. 30.05 per cent of parents report abnormal social development at age five for this group of undiagnosed girls, compared to only 3.7 per cent of teachers. These are girls that may benefit from earlier diagnosis and interventions, and greater attention needs to be paid when parents identify developmental issues with their daughters. Policies that educate parents, teachers and practitioners on the signs of autism in girls may help reduce the time to diagnosis and give girls earlier access to interventions.

Also, of policy interest, parental concern with development at age one in the 2004 Birth Cohort is associated with a doubling of the risk of an autism diagnosis, but it has no impact on the rate of diagnosis amongst the autism group. This supports the existing research that shows development delays are associated with an autism diagnosis but indicates that opportunities for early diagnosis are potentially being missed. Policies that provide greater follow-up and screening of children identified at age one may lead to earlier diagnosis and treatment.

The *Helping Children with Autism* package, that reduced the cost of an autism diagnosis and increased the available supports following a diagnosis, was associated with an increase in the rate of autism diagnosis. The age of diagnosis may be reduced further with policies that provide more financial support for diagnosis or greater access to diagnostic services in the public system. It also provides preliminary support for the view that the higher prevalence of autism within the NDIS maybe driven in part by the increase in available supports. Future analysis including controlling for timing variations in the roll-out of the NDIS across local areas would allow this hypothesis to be tested.

Socio-economic characteristics, including maternal education, were strongly associated with higher risk of an autism diagnosis within the full sample. Changes in the relationship across time and between the cohorts, is indicative of more educated mothers seeking an autism diagnosis earlier in the younger 2004 Birth cohort. This may reflect a larger increase in awareness around autism symptoms and treatments within more educated mothers across the study period. In particular, higher educated mothers may have been better able to navigate the new system of supports introduced with the *Helping Children with Autism* package.

Children of non-working mothers had much higher rates of autism diagnosis within the full sample. However, there was no difference in the timing of the diagnosis amongst the autism sample. This supports existing research that mothers of poorly developing children may be less likely to participate in the labour market (Frijters, Johnston et al. 2009), rather than non-working mothers using an autism diagnosis as justification for non-participation.

Time-to-event analysis requires that censoring is non-informative, so that study children lost to follow-up are not more or less likely to receive an autism diagnosis. It may be that those who received an autism diagnosis were more likely to be lost to follow-up and this may slightly influence our results. Robustness tests find that people from lower socio-economic groups were more likely to drop out of the sample (see Appendix 4.10). Therefore, the autism rates in this group may have been higher and this may have masked some socio-economic inequalities in access to an autism diagnosis. And while LSAC provided detailed longitudinal information on children we were limited in the ability to undertake important sub-group analysis due to the sample size of those with autism.

Diagnosing children earlier with autism and giving them access to intervention services may help reduce the long-term costs of disability. This chapter's findings support a policy focus on educating parents and medical professionals on the signs of autism in girls and following up on children when parents raise concerns to help reduce the average age of diagnosis. Future research, using larger samples of children could extend the analysis by comparing heterogeneous groups, including boys and girls, and be able to better identify early predictors of future autism diagnosis.

5 The impact on Maternal Labour Supply of a Child's Autism Diagnosis

5.1 Introduction

Autism is a complex condition with a predominantly genetic basis, causing difficulties with social and emotional development (Baird, Cass et al. 2003). While these difficulties may be present from birth, they are generally only observable from around 2 years of age, with an average age of diagnosis around 4-5 years. With diagnosis, a number of potential treatments and interventions are recommended such as speech pathology, special education and psychological services which improve long-term functioning of children with autism (Brett, Warnell et al. 2016). However, seeking such services and supports requires greater time and financial commitments from parents, and in addition, parents may perceive that additional informal care could improve their child's outcomes. The extra time commitment is often imposed on mothers, reducing their labour supply and impacting a wide variety of social and economic outcomes, including pay equity between men and women (Blau and Grossberg 1990, OECD 2017), the development of children (Blau and Grossberg 1990, Frijters, Johnston et al. 2009) and macro-economic growth (IMF 2013).

In the previous chapter the factors influencing the timing of an autism diagnosis were explored. In this chapter we investigate how having a child diagnosed with autism influences decisions around maternal labour supply. This is important given the increase in the number of children diagnosed with autism globally (Elsabbagh, Divan et al. 2012, Taylor, Jick et al. 2013, Boat 2015, AIHW 2016) and the larger potential social and economic implications.

5.1.1 Potential Impacts of an Autism Diagnosis on Maternal Labour Supply

Research has consistently found that maternal labour supply is negatively impacted by the number of children present in the household (Browning 1992). However, the additional impact of a child with a disability is theoretically and empirically more ambiguous (see Appendix 5.1 for full review of studies examining the impact of having a child with a disability on maternal labour supply). A child with a disability may increase the demands on a mother's time, reducing the probability of labour force participation. Furthermore, indirect effects may arise due to the lower availability

and/or higher costs of childcare (childcare providers may be reluctant to take on children with higher needs) strengthening the negative impact on maternal labour supply. On the other hand, a mother may increase her labour force participation to purchase additional specialised services for a child with a disability.

In developed countries evidence indicates that the dominate effect of having a child with a disability is to reduce maternal labour supply (Powers 2003, Gould 2004, Yamauchi 2012). However, emerging evidence from developing countries, finds the opposite effect where the presence of disabled children increases maternal labour supply (Gupta 2013, Amador and Pinilla-Roncancio 2015).

Gould (2004) disentangles these competing effects through a static model of labour supply that categorises a child's disabilities based on their relative time and financial component using a simplified model as described below:

Mother's choose hours worked (h) and specialist care for the child (m) to:

Maximise $U(c,l)$

Subject to $w+y \geq c+m$

$t=h+e+l$

$w=w(x,h,u)$

$e=e(m,z)$

$h \geq 0$

$m \geq 0$

Utility (U) is a function of leisure (l) and consumption (c), subject to time (t) and financial constraints. Rather than assuming that mothers derive direct utility from child welfare or development, it is assumed that mothers are responsible for providing the minimum amount of care (e) given the severity of the child's disability (z) and the specialist care provided to the child (m). In reality mothers are also likely to get direct positive utility from their child's welfare and development, increasing the amount of care they provide.

A woman works so that her total income that comprises wages (w) and exogenous income (y) is equal to or greater than her current consumption (c) and expenditure on specialised services for her disabled child (m). Paternal income is assumed to be exogenous; a likely unrealistic assumption given the known relationship between paternal and maternal labour force decisions.

Time (t) is split between working (h), time spent caring for a child (e) and leisure (l). Total wages are assumed to be a function of personal attributes (e.g., education, age and experience, denoted by x), hours worked and the uncertainty or predictability of the time requirement of the disability (u). Higher uncertainty lowers a mother's productivity and wage, which may act to either increase or decrease hours worked (h). The amount of time spent caring for the child (e) is a function of the amount spent on specialised care (m) and the severity of the illness (z).

The minimum requirements of each child can be explained as a function of maternal care (e) and specialist medical care (m), a level of severity (z) and the level of predictability or care needs (u). The child's needs are met if total care (a function of maternal care and specialist medical care) exceeds the disability specific threshold (z) (i.e., $f(e,m) >= z$) and the time dependent needs are met (i.e., $u >= u^*$).

Gould assumes a Cobbs Douglas production function for total care ($f(e,m)$) so that maternal care and specialist care are substitutes. This is a strong assumption, as maternal care and specialist care are likely to be complements as well as substitutes. For example, for a child with autism to access specialist care, such as speech pathology, requires parental time. However, the requirement that time dependent needs (u) are met, means the model effectively accounts for this interaction, by moving the isoquant line of the production function up and down as the demand for or access to specialist services changes.

The model produces three clear predictions. First that having a child with a time intensive illness reduces maternal labour supply. Second, a child with a financially intensive illness positively affects maternal labour supply. Third, a child with an illness that has an unpredictable time component negatively impacts wages, and depending on the type of disability, will either increase or decrease work hours.

Under Gould's model, an autism diagnosis as distinct from having a child with autism symptoms, may change a mother's constraints through a number of mechanisms.

Firstly, the perception of their child's needs changes, increasing the minimum care requirements, which may lead to either an increase in maternal care or specialist care. Furthermore, diagnosis to the extent that it leads to greater use of external services may increase the unpredictable time component of having a child with autism (if booking consistent appointment times for specialised care is difficult or there is significant travel time required) and so is predicted to reduce wages and decrease work hours. Indirect effects may arise due to the lower availability and/or higher costs of childcare strengthening the negative impact on maternal labour supply.

The impact on maternal labour supply of policies that subsidise additional services for children with autism is also ambiguous. Greater uptake of subsidised services reduces the caring time required and maternal labour supply may increase. However, there is a potentially negative impact on maternal labour supply due to the income effect from a reduction in costs associated with privately funded services and more time and flexibility required to facilitate access to the additional services.

Few empirical studies have looked specifically at the impact of having a child with autism on maternal labour supply (Montes and Halterman 2008, Cidav, Marcus et al. 2012, McCall and Starr 2016) and all have found that maternal labour supply is negatively impacted by having a child with autism. Existing research is however limited to comparing mothers of children with autism to mothers of children without autism at a point in time. As such, before this chapter, there were no studies investigating the impact of the autism diagnosis itself on maternal labour supply as distinct from the impact of a child's poor social and emotional development. This is important because we know that poor development reduces maternal labour supply (Frijters et al, 2009), and these studies are likely to have confounded the impact of diagnosis and poor childhood development.

Empirically estimating the effect of a diagnosis on maternal labour supply is difficult. Of concern is the possible presence of unobservable characteristics correlated with autism diagnosis and female labour force participation, which may bias any estimates (Frijters et al, 2009). For example, if women who are less likely to participate in the labour market are more likely to seek an autism diagnosis (or seek one earlier) to justify their non-participation then the estimates maybe biased upwards.

On the other hand, if a mother's labour force participation impacts on general childhood development due to reduced time for caring (Frijters et al, 2009), then children of working mothers may show earlier and more pronounced symptoms of autism, leading to a higher probability of diagnosis. This chapter attempts to address these issues using individual fixed effects and thus observing the change in labour force participation within individual women before and after the diagnosis of a child with autism. In addition, for the first time we allow for a heterogeneous relationship between autism severity and labour force participation.

Utilising the Longitudinal Survey of Australian Children (LSAC), one of the largest longitudinal studies on children in the world, we observe 197 children from birth who go on to have an autism diagnosis before the age of 12 and their mothers' labour supply both before and after the diagnosis. We also take advantage of the introduction of the *Helping Children with Autism* package in 2008 to explore the impact on maternal labour supply of subsidising additional services for children with autism.

5.1.2 Institutional Background

Historically, in Australia, the states and territory governments were responsible for providing services and supports, including diagnosis, education supports and psychological services, for children with autism. There was no role for the national Australian Government, with no support private diagnosis through Australia's public insurance scheme Medicare, with no rebate included on the schedule. Due to different systems and heavy rationing of services across jurisdictions, this led to large differences in individual access to services (PC, 2011).

In response to rising rates of autism diagnosis and strong evidence of the importance of early intervention, the national Australian Government introduced the *Helping Children with Autism* package in October 2008, providing up to $12,000 worth of services and supports for children with autism aged 0-7. Rebates under Australia's universal health care system Medicare were also added in July 2008 for a limited number of specialist psychological and allied health services for all children with autism. The policy represented a significant increase in subsided supports for children with autism.

Broader reforms commenced in 2013 with a new National Disability Insurance Scheme (NDIS) launched in four trial sites. The NDIS was scheduled to be fully rolled out by

July 2020, to provide people with disabilities, including autism, access to 'reasonable and necessary' supports and services. People with autism currently account for 30 per cent of all participants in the NDIS.

5.2 Empirical Strategy

5.2.1 Autism Diagnosis

An empirical model of the impact of autism diagnosis on maternal labour supply needs to account for the unobservable factors that are likely to influence both autism diagnosis and maternal labour supply. For example, women with particular traits, for example, who have a stronger locus of control, may be more likely to be engaged in the workforce but also more likely to seek an autism diagnosis earlier.

We use two approaches to control for these unobservable characteristics: fixed effects and propensity score matching. A fixed effects model treats the subjects as their own controls, and allows us to observe the change in a mother's labour market behaviour before and after their child's autism diagnosis. Fixed effects do not require all variables that influence having autism and labour force participation to be observed, however, it does not account for any change in time-variant unobservable characteristics. In addition, it is impossible to estimate the impact of time invariant characteristics such as race, gender or autism symptoms – as they are incorporated into the time invariant individual fixed effect. In order to estimate these effects a random effects model could be used, but requires individual specific effects to be uncorrelated with the independent variables. As noted, this is a strong assumption unlikely to be met in this study.

Our second approach to control for observed confounding is with propensity score matching. We create comparable treatment and control groups based on a large number of observable characteristics, with the hope that by balancing observable characteristics we will also reduce unobservable differences between groups that drive labour force outcomes. However, if unobservable differences between groups remain and these influence labour market outcomes then this will bias our results. We provide the estimates from our fixed effects model as our base case, and provide random effects estimates for comparison, and propensity score matching estimates as a robustness check (see Appendix 5.3 and 5.4).

A fixed effects model allows estimation of the causes of labour force changes within a person by removing the time-invariant characteristics, isolating the net effect of changes in explanatory variables (Kohler, Ulrich, Frauke Kreuter, *Data Analysis Using Stata*, 2nd ed., p.245). Equation 5-1 below sets out our basic specification:

Equation 5-1

$$\mathbf{LFP_{it} = \delta AS_{it} + \beta X_{it} + a_i + u_{it}}$$

In Equation 5.1 we define LS_{it} as a mother's labour supply at the time of the interview. Two measures of labour supply are used – whether in paid work and average hours usually in paid work. Analysis of hours in paid work is undertaken using the full sample and a sub-sample of respondents that ever report working.

AS_{it} indicates the mother's child has an autism diagnosis. The heterogeneous impacts of autism severity on maternal labour supply are first ignored, consistent with the existing literature, AS_{it} taking the value of 0 or 1 to indicate whether a child has an autism diagnosis. Subsequently, the heterogeneous impacts of autism severity are incorporated, with AS_{it} instead treated as a factor variable taking the value of 0 for no diagnosis; 1 for mild autism diagnosis, 2 for moderate autism diagnosis and 3 for severe autism diagnosis.

X_{it} is a vector of characteristics that vary across individuals or time. In the fixed effects models these include number and age of siblings in the household, age of mother, and relationship status (a full set of variables is at Appendix 5.2). We also include a variable indicating underlying autism in the random effects model (this in effect controls for behavioural issues that may impact labour participation and be present prior to a diagnosis). Household level fixed effects are denoted by a_i and capture the effect of all time invariant characteristics that are associated with a family unit. Unobserved characteristics that change over time, influence labour supply and are related to the variables of interest (i.e., an autism diagnosis) may bias the estimates.

5.2.2 Additional Supports and Services

To test the hypothesis that increasing services and supports under the *Helping Children with Autism* package increased labour force participation a difference-in-difference model is used. In particular we estimate:

Equation 5-2

$$LFP_{it} = \beta_1 + \beta_2 AS_i + \beta_3 HA_t.AS_i + \beta_4 X_{it} + U$$

As above, in Equation 5.2, LFP_{it} indicates labour force participation at time t. AS_i indicates being in the treatment group and having a child with an autism diagnosis prior to the introduction of the *Helping Children with Autism* package. HA_t indicates the period after when the *Helping Children with Autism* package was implemented. β_3 is the difference in difference estimator and measures the difference in changes over time between the treatment and control groups. We also control for a vector of covariates X_{it}, which influence labour force participation but not the treatment.

Ideally, there would be two groups of children diagnosed with autism prior to the introduction the *Helping Children with Autism* package, and only one group would have had access to the package. The *Helping Children with Autism* was, however, implemented nationally and so all children under 7 with autism had access to the package. We use the implementation date to the *Helping Children with Autism* package of 1 October 2008 as our 'treatment' start date. The treatment group consists of mothers of children diagnosed with autism before the introduction of the *Helping Children with Autism* package. This ensures that the composition of the treatment group is stable across the panel.

A standard difference-in-difference approach requires the parallel trends and common shock assumptions to hold. Women need to be returning to work in the treatment and control groups at the same rate before the introduction of the package for us to be able to assume that this would have continued without the policy. Otherwise, the estimation of a causal effect may be biased, with the underlying differences post treatment being misinterpreted as the impact of the implementation of the *Helping Children with Autism* package. To explore the robustness of the results a number of alternative control groups were explored including: all women who do not have children with autism; women who do not have children with autism matched on other characteristics; women with children that have ADHD; and women with children that have physical disabilities. Graphs illustrating the labour force participation over time of these groups (see Appendix 5.8) support selection of women without children with autism matched on other characteristics as the best control group.

5.3 Data and Variables

The first six waves of LSAC are utilised, which has followed two cohorts of Australian children biennially since 2004. Children were randomly sampled from Medicare registrations (which has near universal coverage) using a two-stage clustered (by postcode) design. The sample was representative of Australian children within the target ages; notwithstanding that data collection costs meant some very remote postcodes were excluded. In addition to extensive information on study children, LSAC collects information about the study child's family, including health; immigration; work; disability; age; relationships and educational attainment.

The 2004 Birth Cohort were aged less than 12 months and the 2000 Birth Cohort were aged 4-5 years during wave 1 in 2004. The 2004 Birth Cohort is used in the analysis as we can observe the labour force participation of almost all these mothers before and after their child is diagnosed with autism, compared to only half of the mothers in 2000 Birth Cohort. The 2004 Birth Cohort initially consisted of 5,107 children in wave 1 that fell to 3,764 by wave 6, an attrition rate of 26.29 per cent, creating an unbalanced sample.

We exclude observations where biological mothers are not present (244 observations across the six waves) and where labour force participation is missing (a further 27 observations across the six waves). In addition, we exclude participants that drop out of the survey before wave 4 and therefore never answer the question on autism, leaving a sample of 4,339 mothers in wave 1 and 3,697 in wave 6.

Information on disabilities was collected from wave 1 onwards, with specific questions on autism asked from wave 4 onwards. Due to inclusion of questions on when autism was diagnosed, we can infer whether a child had autism diagnosed during an earlier wave. For example, a B cohort study child reports having autism in wave 4, when they are 6-7 years of age, but also reports diagnosis occurred at 2 years of age. We record that child having an autism diagnosis from wave 2 onwards (when the child was aged 2-3 years old).

Respondents also classify their child's autism as mild, moderate or severe. When controlling for the heterogeneous effects of underlying autism severity we use the first recorded autism severity. As such, if in wave 4 a child is reported to have mild autism and in wave 5 a child is reported to have moderate autism, we classify this child as

having underlying mild autism. Thirty of the 197 children identified with autism change their self-reported autism severity, with 19 increasing the severity between waves (i.e., from mild to moderate or moderate to severe) and 11 reducing the severity during waves (i.e., from moderate to mild or severe to moderate).

5.4 Results

5.4.1 Descriptive Statistics

Summary statistics for the 2004 Birth Cohort are presented in Table 5.1. Within the 2004 Birth Cohort 4.8 per cent report having had an autism diagnosis. Figure 5.1 shows the increasing incidence of autism across the two cohorts of LSAC, which is consistent with the international trends. The average age of autism diagnosis is 5.3 years (95% CI: 4.9 years to 5.6 years), with the majority diagnosed with mild autism (63.9 per cent). Mothers with children that have an autism diagnosis are 5.9 percentage points (95 per cent CI: 1.7 to 7.6) more likely to have a bachelor degree or above than other mothers.

In the sample, across all the waves, mothers of children diagnosed with autism have rates of participation in paid work 11.9 percentage points (95%CI: -9.1 to -14.8) lower than mothers of children that do not receive an autism diagnosis. This is compared to fathers of children diagnosed with autism where on average there is no significant difference in the labour force participation compared to other fathers.

Table 5-1: LSAC Descriptive Statistics

	Children with Autism Diagnosis			Children without Autism Diagnosis		
	N	Mean	SD	N	Mean	SD
Maternal LFP	1106	0.55	0.50	23500	0.67	0.47
Paternal LFP	996	0.95	0.21	22211	0.95	0.22
Maternal Labour Force When Pregnant	195	0.66	0.47	4122	0.66	0.47
Maternal Hours Worked	1106	14.79	17.29	23500	16.79	16.36
Paternal Hours Worked	1106	35.38	22.23	23505	38.97	20.53
Maternal Age at Birth	197	30.68	5.16	4140	31.83	5.19
Paternal Age at Birth	187	31.24	10.00	3977	33.24	8.68
Mother Bachelor Degree	197	0.40	0.49	4141	0.35	0.48
Mother Certificate	197	0.38	0.49	4141	0.34	0.47
Mother Never Completed High school	197	0.04	0.20	4141	0.04	0.19
Father Bachelor Degree	175	0.30	0.46	3804	0.30	0.46
Father Certificate	175	0.44	0.50	3804	0.45	0.50
Father Never Completed High school	175	0.05	0.22	3804	0.05	0.22
Mother English Speaking Background	197	0.91	0.28	4140	0.86	0.35
Father English Speaking Background	179	0.91	0.29	3945	0.85	0.35
Male Study Child	197	0.80	0.40	4142	0.50	0.50
Indigenous Study Child	197	0.03	0.16	4142	0.04	0.19
Disabled Sibling	197	0.09	0.32	4142	0.06	0.27
Number of Siblings	197	0.71	1.07	4142	0.96	1.04
Other Disability Study Child	1106	0.21	0.41	23505	0.04	0.19
Multiple Birth	197	0.03	0.16	4141	0.03	0.18
Intensive Care at Birth	197	0.20	0.40	4141	0.16	0.37
Smoked During Pregnancy	175	0.21	0.41	3654	0.15	0.36
Drank During Pregnancy	176	0.38	0.49	3649	0.39	0.49
Average Age at Diagnosis (years)	197	5.33	2.61			
Severe Autism	197	0.06	0.23			
Moderate Autism	197	0.31	0.47			
Mild Autism	197	0.63	0.48			

Figure 5-1: Number of Children Diagnosed with Autism by Wave and Severity[29]
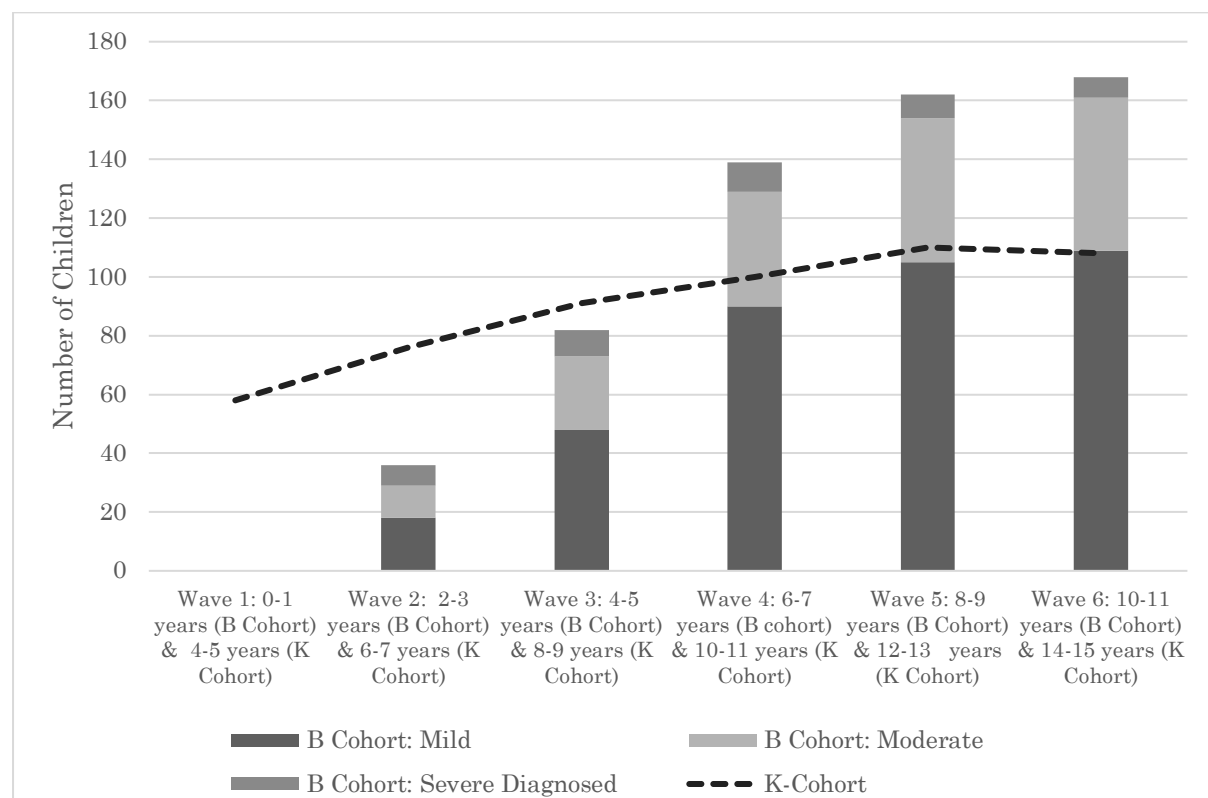
Figure 5.2 shows the average labour force participation by age of the youngest child in the household (a strong predictor of labour force participation for mothers). We observe a gap over time developing between the labour force participation of mothers with a child that develops autism and other mothers. Such a trend is absent for fathers.

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[29] B Cohort referes to the 2004 Birth Cohort and the K Cohort refers to the 2000 Birth Cohort

Figure 5-2: Maternal and Paternal Labour Supply

Maternal

Labour Force Participation vs *Age of Youngest Child in Household*

Legend: No Autism — Autism

Paternal

Labour Force Participation vs *Age of Youngest Child in Household*

Legend: No Autism · · Autism
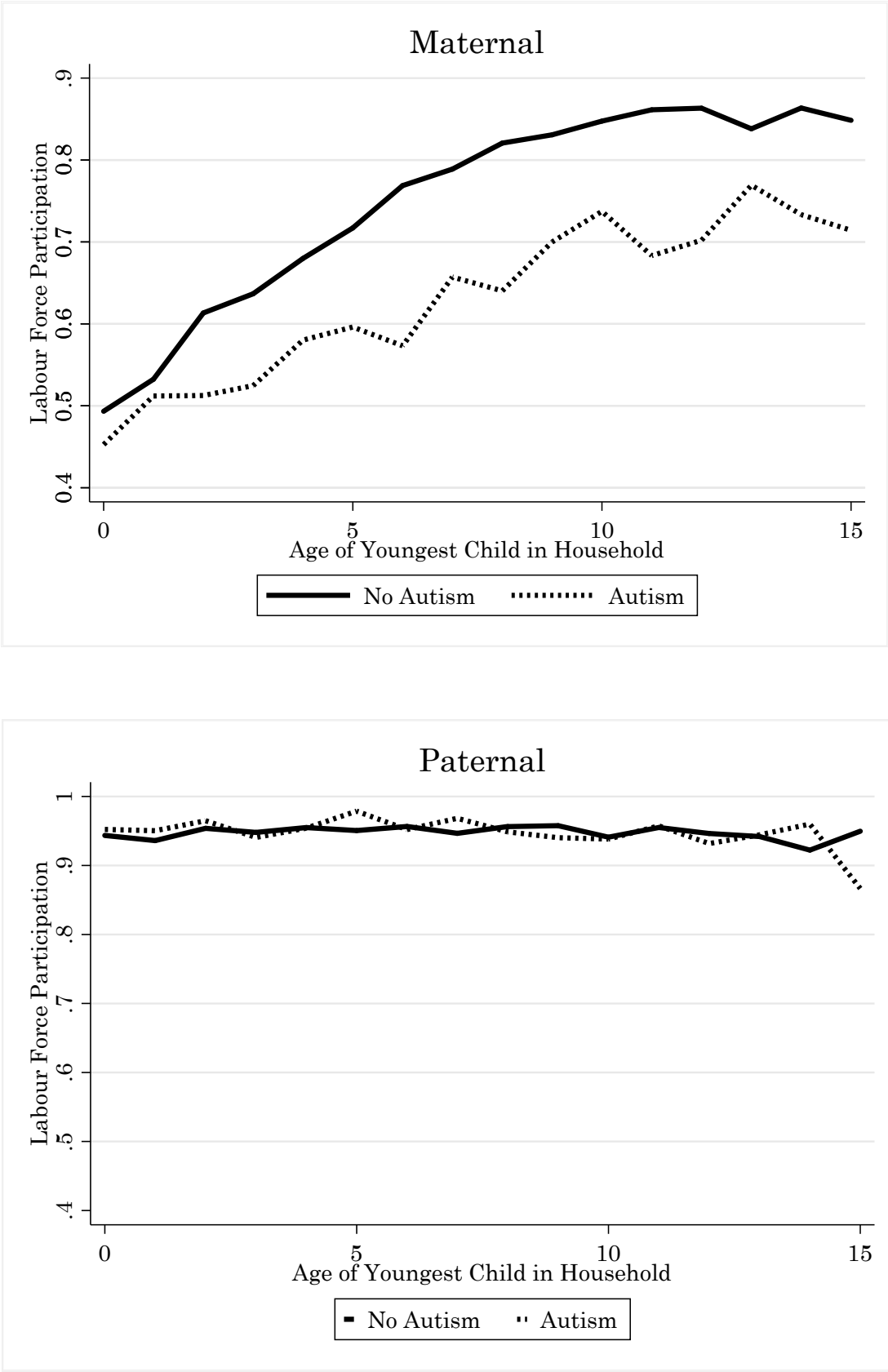
Table 5-2: Maternal Labour Supply[30]

	Model 1 - Fixed Effects	Model 1 - Random Effects	Model 2 - Fixed Effects	Model 2 - Random Effects
Underlying Autism		-0.056* (0.029)		
Autism Diagnosis	-0.134*** (0.030)	-0.128*** (0.030)		
Underlying Mild Autism				-0.068* (0.036)
Underlying Moderate Autism				-0.013 (0.051)
Underlying Severe Autism				-0.117 (0.132)
Mild Autism Diagnosis			-0.077** (0.036)	-0.072** (0.036)
Moderate Autism Diagnosis			-0.221*** (0.056)	-0.209*** (0.055)
Severe Autism Diagnosis			-0.383*** (0.119)	-0.364*** (0.119)
Mother's Age	0.074*** (0.018)	0.056*** (0.005)	0.074*** (0.018)	0.056*** (0.005)
Mother's Age Squared	-0.000*** (0.000)	-0.001*** (0.000)	-0.000*** (0.000)	-0.001*** (0.000)
Other Disability	-0.047*** (0.013)	-0.051*** (0.012)	-0.046*** (0.013)	-0.049*** (0.012)
Age of Youngest Child	0.029*** (0.003)	0.028*** (0.002)	0.029*** (0.003)	0.029*** (0.002)
Number of Siblings	-0.039*** (0.009)	-0.056*** (0.005)	-0.040*** (0.009)	-0.056*** (0.005)
Disabled Sibling	-0.013* (0.007)	-0.022*** (0.006)	-0.013* (0.007)	-0.021*** (0.006)
English Speaking Background	0.000 (.)	0.126*** (0.015)	0.000 (.)	0.125*** (0.015)
Bachelor Degree	0.189*** (0.030)	0.184*** (0.013)	0.189*** (0.030)	0.184*** (0.013)
Certificate	0.112*** (0.020)	0.102*** (0.012)	0.112*** (0.020)	0.102*** (0.012)
Never Completed High School	0.067 (0.217)	0.175*** (0.026)	0.067 (0.218)	0.176*** (0.026)
Single Mother	-0.037*** (0.014)	-0.064*** (0.011)	-0.036*** (0.014)	-0.063*** (0.011)
Constant	-1.555*** (0.574)	-0.967*** (0.095)	-1.556*** (0.574)	-0.970*** (0.095)
State Controls	YES	YES	YES	YES
Local Area Controls	YES	YES	YES	YES
Time Fixed Effects	YES	YES	YES	YES
Observations	24596	24596	24596	24596

*Significant at the * 0.1 ** 0.05 *** 0.01 levels.*

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[30] See Appendix 5.6 for a sensitivity analysis, including use of samples from propensity score matching, exclusion of mothers of children with a disability and use of a balanced panel.

5.4.2 Impact of Autism Diagnosis on Maternal Labour Force Participation

Table 5.2 presents the results from our estimation of the impact of an autism diagnosis on maternal labour supply with clustered standard errors reported in parentheses[31].

As expected and consistent with the existing literation there is a negative relationship on average between an autism diagnosis and maternal labour force participation. The Model 1 results, which do not control for the heterogeneous impact of autism severity, show that an autism diagnosis is associated with a 13.4 percentage point (95%CI: -19.3 to -0.1) reduction in labour force participation. The results from model 2 find that the average reduction in labour force participation for mothers with children diagnosed with mild autism is a 7.7 percentage points (95%CI: -14.8 to -0.01); moderate autism is 22.1 percentage points (95%CI: -33.1 to -11.0); and severe autism 38.3 percentage points (95%CI: -61.0 to -15.0).

While the results from the fixed and random effects estimations are broadly consistent, the Hausman specification test is rejected suggesting that the random effect model is inconsistent. After controlling for the impact of an autism diagnosis there remains a small residual impact of underlying autism (the impact on labour participation of mothers prior to actually receiving a formal diagnosis of autism). The results for paternal labour force participation (see Appendix 5.5) indicate a small but non-significant negative impact from having a child diagnosed with autism, suggesting that mothers respond rather than fathers.

5.4.3 Impact of Autism Diagnosis on Hours Worked

Table 5.3 reports the results of the fixed effects estimation of hours worked for mothers and fathers. Results using matched samples and random effects can be found in Appendix 5.8. Model 1 results show a negative average impact on maternal labour supply of 3.9 hours a week (95%CI: -5.9 to -1.9) and on paternal labour supply of 2.3 hours a week (95%CI: -4.9 to 0.4) following an autism diagnosis. Model 2 results suggests that maternal hours work reduce by 2.38 hours per week (95%CI: -4.7 to 0.0) after a mild diagnosis, 6.2 hours per week (95%CI: -9.8 to -2.5) subsequent to a

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[31] The Hausman specification test cannot be undertaken with clustered standard errors, however undertaking the test with robust standard errors we can reject the null hypothesis that the two estimates are equivalent (p=0.000).

moderate diagnosis and 10.9 hours per week (95%CI: -19.2 to -2.7) following a severe diagnosis on average over subsequent waves.

Paternal hours worked increase by 0.5 hour a week (95%CI:-2.4 to +3.4) after a mild diagnosis, decrease by 6.5 hours a week (95%CI:-11.4 to -1.5) after a moderate diagnosis and by 14.9 hours a week (95%CI:-22.4 to +3.4) after a severe diagnosis.

Table 5-3: Impact of Autism Diagnosis on Hours Worked

	Model 1 – Maternal Fixed Effects	Model 2 - Maternal-Fixed Effects	Model 1 Paternal- Fixed Effects	Model 2- Paternal Fixed Effects
Autism Diagnosis	-3.89***		-2.29	
	(1.00)		(1.36)	
Mild Autism Diagnosis		-2.38		0.50
		(1.21)		(1.48)
Moderate Autism Diagnosis		-6.20***		-6.52**
		(1.87)		(2.53)
Severe Autism		-10.97**		-14.97
		(4.21)		(10.76)
Age	3.34***	3.35***	-2.14***	-2.13***
	(0.57)	(0.57)	(0.32)	(0.31)
Age Squared	-0.02***	-0.02***	0.00	0.00
	(0.00)	(0.00)	(0.00)	(0.00)
Other Disability	-1.39***	-1.35***	-0.51	-0.44
	(0.38)	(0.38)	(0.55)	(0.55)
Age of Youngest Child	1.20***	1.20***	-0.36**	-0.36**
	(010)	(0.10)	(0.13)	(0.13)
Number of Siblings	-1.62***	-1.63***	1.10**	1.07**
	(0.28)	(0.28)	(0.41)	(0.41)
Disabled Sibling	-0.53*	-0.52*	-0.55	-0.54
	(0.22)	(0.22)	(0.30)	(0.30)
Education Controls	YES	YES	YES	YES
State Controls	YES	YES	YES	YES
Local Area Controls	YES	YES	YES	YES
Time Fixed Effects	YES	YES	YES	YES
Observations	24601	24601	24609	24609
R2	0.158	0.158	0.055	0.056

*Significant at the * 0.1 ** 0.05 *** 0.01 levels*

5.4.4 Effect of increasing subsidised services: A Difference-in-Difference analysis

Part of the result above may have been influenced by the *Helping Children with Autism* package being implemented in 2008 (when the children in the 2004 Birth cohort were 4). To assess the potential impact of the *Helping Children with Autism* package, we need to compare the trajectory of the labour participation of the mothers of children with autism over time as their child aged against a comparable group of mothers. We only focus on the impact of the *Helping Children with Autism* package for those mothers whose child was already diagnosed with autism (100 children in the sample

of 197 diagnosed across the six waves) as the *Helping Children with Autism* package is likely to have encouraged some mothers to seek a diagnosis. When we assessed the labour force participation trends (see Appendix 5.8) for the possible control groups, a sample matched on wave one characteristics, including maternal education, perceptions of child's development and age of mother appeared to be the best at following the same trend in participation prior to the helping autism package.

Sample statistics for the treatment and control group are reported at Appendix 5.9. Results from the DID analysis of the impact of the *Helping Children with Autism* on maternal labour supply are presented in Table 5.4. In Model 1 controls are not included, and the *Helping Children with Autism* package is found to reduce the labour force participation of those mothers whose children were already diagnosed with autism prior to its introduction. Including controls for household characteristics, socio-economic status and local area effects in Model 2 maternal labour supply is reduced by 10.8 percentage points (95 CI: -0.02 percentage points to -19.3 percentage points) following the introduction of the *Helping Children with Autism* package.

Including controls for the timing of diagnosis of autism (accounting for the impact of the diagnosis itself on labour supply) in Model 3 reduces the magnitude of the impact of the *Helping Children with Autism* package. The DID estimators indicate that the *Helping Children with Autism* package reduced the maternal labour supply of mothers with children with diagnosed Autism by a much smaller 1.4 percentage points (95%CI: -11.4 to 8.5), whereas the average impact of diagnosis was 15.3 percentage point reduction (95%CI: -4.2 to – 26.4 percentage points). Robustness tests controlling for whether a child has mild, moderate or severe autism can be found in Appendix 5.10, and find the impact of the package was not significant but still highly uncertain. This potentially reflects issues with small sample sizes and the difficulty distinguishing the impact of an autism diagnosis from the impact of the *Helping with Autism* package.

Table 5-4: Difference in Difference Estimation – Fixed Effects

	Model 1 DID - Fixed Effects 1 October 2008 Start Date	Model 2 DID - Fixed Effects 1 October 2008 Start Date	Mode; 3 DID - Fixed Effects 1 October 2008 Start Date
Helping Autism	0.163*** (0.017)	-0.007 (0.025)	0.053* (0.025)
DID: Autism#Helping Autism	-0.091* (0.046)	-0.108* (0.044)	-0.014 (0.051)
Autism Diagnosis			-0.153** (0.057)
Other Disability		-0.081** (0.029)	-0.053 (0.031)
Other Household Characteristics	NO	YES	YES
Mother Socio-Economic Background	NO	YES	YES
Regional and Local Area Controls	NO	YES	YES
Observations	3042	3042	3042
R2			

*Significant at the * 0.1 ** 0.05 *** 0.01 levels.*

5.5   Discussion and Limitations

Evidence from the first six waves of the LSAC, evidence supports Gould's theoretical model of the impact of a child's disability on maternal labour force participation. In particular, independent of a child's underlying development, an autism diagnosis is found to have a large negative impact on maternal labour supply.

One explanation is that mothers respond to a diagnosis by placing greater priority on their own care of the child and therefore leave the workforce or do not return at the same rate as mothers without a diagnosis, in order to invest more time in their child's development. Another possibility is that with a diagnosis comes access to additional income-support payments alongside a number of intervention services such as behavioural and speech therapy. Because these interventions require parental involvement, such as transportation and supervision, this increases the time intensiveness component and the unpredictability of time component (giving

difficulties in having consistent times to access care) of having a child with autism. This is supported by the results showing a decline in hours worked by mothers remaining in the labour force after an autism diagnosis.

In addition, the results indicate the importance of controlling for a heterogeneous impact across autism severity. As expected, the impact on maternal labour supply is much greater the more severe the autism diagnosis and not controlling for the heterogeneous impact underestimates the impact on mothers of children with moderate and severe forms of autism. While we do not find any evidence of a corresponding average impact on paternal labour force participation, there is evidence that having a child with autism decreases paternal hours worked. Further work on the interaction of maternal and paternal labour force decisions would provide greater insights in what is underlying these average treatment effects.

Once timing of autism diagnosis is controlled for, there is evidence that the *Helping Children with Autism* package had a small negative impact on maternal labour supply for mothers of children with autism, but there is still a high degree of uncertainty in the overall impact. This may have been due to an increase in the time intensive component of having a child with autism, or an income effect due to the value of the additional supports. These results could have been impacted by anticipation of the policy being implemented and the strict cut-off used, however given the policy was announced after wave 2 and introduced before wave 3 this is less of a concern in this study.

These results have implications for policy makers implementing the NDIS. Given that one of the stated aims of the NDIS is to improve the economic participation of people with a disability and their carers work is required on understanding the mechanisms by which an autism diagnosis and increased services and supports negatively impact on maternal labour supply. This could be in the form of focus groups or the formal use of discrete choice experiments to better understand the decision-making process

Even with the use of fixed effects, the results may be biased by unobservable characteristics and reverse causality. Specifically, mothers not in the labour force may be more likely to seek an autism diagnosis in order to justify not working or because they have time to seek a diagnosis. There is perhaps some evidence for this in the results from the random effects model reported in table 5.2, which show lower labour

force participation even prior to a formal diagnosis for mothers of children with mild autism. There could also remain some mothers of children with underlying autism, particularly mild autism, who remained undiagnosed by the end of wave 6, creating a potential source of bias.

While LSAC is one of the most comprehensive and largest longitudinal studies of children in the world, our ability to carry out the analysis was limited by the small sample size and biennial collection of data. A larger sample size would have allowed analysis of differences across socio-economic groups, providing insights into the impact of disability on households with different characteristics. Annual or monthly collection of data would have allowed the use of a dynamic model of labour supply, improving the inferences we could draw from our analysis. In particular, the relationships between paternal and maternal labour supply within households. Further analysis into the timing of diagnosis and how this affects labour force participation would also strengthen our understanding.

Paid work was the only measure of labour supply which excluded other forms of work, such as voluntary work. This approach ensured the full impact of the time and uncertainty of the time commitment on labour force participation was captured., However, it is a narrow measure of the economic cost of having a child diagnosed with autism.

All mothers face a complex set of trade-offs in deciding to participate in the labour force, and the presence of a child with autism clearly increases that complexity. For policy makers keen to increase female labour force participation, a better understanding of these trade-offs is critical.

6 Chapter Six Policy Implications

Context is important in research and policy analysis, and the research in this thesis was undertaken at a time of enormous change in the services and supports provided to people with a disability in Australia. The focus, therefore, has been on research questions that will help inform the design and future evaluation of the NDIS. As Australia was only in the early stages of the rollout when this research was undertaken, it has been limited throughout by the lack of data on the NDIS, which necessitated the focus on a period immediately before its introduction. In addition, there had been an intention early in the development of the thesis to focus on the effect of supplier concentration on outcomes, but it had not been possible to pursue due to the lack of access to administrative data. Should such data become available in future it would open a number of interesting and insightful research questions, including the impact of competition and choice on outcomes which would further this field research in the Australian context and in the context of disability services.

In the absence of this data, this thesis focused on exploring the market for disability related services and supports, unmet demand, unknown demand for autism services and supports, along with the impact on labour market outcomes associated with an autism diagnosis and the provision of additional supports. While a disparate group of topics throughout we sought to understand how these issues impact different groups, including across gender, socio-economic status and geography. As we note above, in some cases our analysis and the questions we could answer were limited due to the availability of data, particularly on the supply side where it was not possible to access administrative data on the location and nature of disability providers due to privacy concerns.

In this final chapter, we review the key findings, limitations and discuss the policy implications in the context of the implementation and refinement of the NDIS in Australia. As data becomes available in the future, there will be a critical need for researchers to further investigate the impact of the NDIS on quality, cost and quantity of services supplied.

Below the areas of priority in future research are highlighted.

6.1   Addressing inequalities in access to services

The NDIS aimed to address pre-existing inequities which were highlighted by the Productivity Commission's report in access to services and supports across location, socio-economic status, type of disability and how a disability was acquired. However, at the same time, the Australian Government did not want the NDIS to replace current informal care and put in place assessment processes that ensured this would not occur. Thus, there is concern that any prior inequities in access to formal care and aids which resulted in higher use of informal care would remain with the introduction of the NDIS. We explored the scope for this to occur in our first empirical chapter.

In Chapter 2 we examined inequalities in the use of informal care, formal care and assistive technology across education, gender and household types. This included looking at the inequality in use of assistive technology, an important extension of the literature given the growing use of such technology.

The lack of an exogenous measure of supply meant that we were not able to imply causal relationships, instead providing a thorough descriptive analysis of the differences prior to the introduction of the NDIS. The future availability of such supply side measures, would allow specification using local area fixed effects that could help understand some of the drivers of variation in service use.

There was evidence of some pre-existing inequalities with higher educated households less likely to rely on No Care and more likely to rely on All Care types (formal and informal care and assistive technology). Furthermore, prior to the introduction of the NDIS people with a disability in lower educated households were more likely to rely on only Informal Care, while people with a disability in higher educated households were more likely to rely on Assistive Technology only.

The NDIS's current policy of assessing the need for formal care based on the pre-existing use of informal care could therefore entrench this inequity. Removing this consideration from the approval of supports could enhance equity outcomes for the scheme, but would need to be balanced against the increased costs of formal supports and assistive technology.

While choice and competition policies have previously been shown to reduce inequities in access, the NDIS only allows participants choice after they have applied

and been assessed for a certain care package. This is likely to reduce the positive affect of choice policies on equity, as there remains a strong link between access to services and the ability of participants or their families to navigate the system.

More broadly the research highlighted the importance of considering Assistive Technology in an assessment of a disability systems adherence to the principles of Rawlsian justice. Focusing solely on informal and formal care may miss an important component of disability supports, and source of inequality in care.

In addition to including Assistive Technology, future research should focus on the impact of the expansion in services and the change in the system under the NDIS on equity of access to disability services and supports, including through the use of the 2018 Survey of Disability and Carers Survey. Through use of the 2018 SDAC researchers can see whether there were differences based on whether individuals had access to NDIS services or not, allowing an assessment of whether the NDIS has fulfilled one of its core objectives to reduce such inequalities.

6.2 Addressing unmet need for services

In addition to addressing inequities in access, the NDIS aims to reduce the level of unmet need for disability services. Chapter 3 reported a significant increase in subjective unmet need following the announcement and the pilot phase of the NDIS. No such increase was found for a more objective measure of unmet need. This extended the literature by looking at changes in levels of subjective and objective unmet need over time.

Subjective unmet need amongst adults increased by 7.7 percentage points and amongst children by 13 percentage points. Through a decomposition of this change we found that the major source of the change in adults was due to both an increase in the number of people with mental health impairments and the probability of this group reporting an unmet need. We hypothesised that this may have been driven by greater awareness of the benefits of mental health supports and the expectation of expanded supports under the NDIS. A further testing of these hypothesis would be a useful area of research to better understand what factors influence subjective unmet need. It also highlights important issues with the sole reliance on subjective measures of unmet need in the assessment of the success or otherwise of social welfare policies.

The use of panel data set that followed the same people overtime and allowed the use of individual fixed effects would provide better evidence on what drove this change in self-reported unmet need, and whether the launch of the NDIS had changed expectations or other factors drove the change. Unfortunately, the best available panel data set of the Australian population, the HILDA survey does not include a question around subjective unmet need for disability services to allow this analysis.

Any evaluation of the NDIS's progress in addressing unmet need for disability services will need to be mindful in the measures chosen and their interpretation. Because subjective measures are likely reflecting the change is perceptions of need created by the expansion of services, they may negate the otherwise positive affect of the NDIS on expanding the capabilities and functionings of people with a disability.

6.3 Barriers to early intervention

One of the primary aims of the NDIS was to lower long-term costs of people with a disability through investing in early intervention. Autism is the largest disability group of people enrolled in the NDIS and people with autism benefit significantly from early interventions. But to access these interventions requires that children receive a diagnosis. In Chapter 4 we extended the current research of time to autism diagnosis by using time-to-event analysis which allowed us to control for both time variant and time variant characteristics and comment on both the prevalence of autism and the time to diagnosis with the sample.

While we did utilise a measure of access to diagnostic services in the analysis, the number of GPs in the local area, a better proxy would be the number of psychologists in the local area. This information was not available for the time period of the study and therefore limited the ability to control this potentially important factor in the time to diagnosis.

We found that despite parental concerns at age one being associated with a much higher rate of diagnosis of autism by age 11, it did not significantly affect the timing of diagnosis for those that received a diagnosis. This points to the possibility of reducing the age of diagnosis through greater screening of children where parents raise concerns with development at the age of one. Governments could implement this through better referral pathways from maternal nurses to specialist diagnostic teams

and provide more funding to limit wait times for diagnosis in the public system that can be excessive.

Many children do not get diagnosed until school age, when issues with behaviour are observed in the school setting by teachers and other carers. However, we also found evidence that teachers may have biased assessment of girl's behaviour leading to longer delays in diagnosis. Large differences in the parent and teacher reported social development scores at age five for girls that go on to receive a diagnosis, may point to teachers requiring more training in the signs of autism in girls, as distinct from boys, where traits are more widely known. This could be implemented through including in University courses modules that highlight key signs of autism and how these manifest differently across gender.

6.4 Managing demand for services

Containing rising costs of the NDIS is a major concern for policy makers, with increasing demand for services and supports a threat to the fiscal sustainability of the scheme. The risk that increasing services and supports drives increased demand is one that the NDIS will need to manage into the future.

In our analysis of the timing to autism diagnosis in Chapter 4 we found some evidence that the introduction of new supports for children with autism increased the rate of diagnosis, especially amongst children with more educated mothers. This may represent legitimate attempts to access services, with children previously undiagnosed seeking diagnosis. It may also however represent parents with the ability to do so, seeking a diagnosis of autism because other conditions do not attract the same level of support.

This issue also presents itself in Government decisions to list new pharmaceutical drugs, where expenditures can exceed projections due to greater demand when a treatment becomes available.

More research is required on how individuals respond to an increase in services, and whether a focus on access through diagnosis or access through identified needs leads to more sustainable expenditure. This would include supporting children based on their individual needs

6.5 Improving Labour Force Participation of Carers of People with a Disability

One of the major economic benefits of the NDIS is meant to be the increase in the labour force participation of people with a disability and their carers. This was based on the assumption that an increase in formal care supports would reduce the reliance on informal care, and therefore free these carers to increase their labour supply. Even under neo-classical economic theory however the increase in formal care represents an increase in income which could lead to a reduction in labour supply. In Chapter 5 we look at both the impact of a diagnosis and of an increase in supports on maternal labour supply, using a more nuanced model of maternal labour supply than that suggested by neo-classical theory. Under the model developed by Gould (2004) the impact on maternal labour supply of policies that subsidise additional services for children with autism ambiguous. Increases in subsidised services reduce the caring burden and maternal labour supply may increase. Alternatively, there is a negative impact due to the income effect from a reduction in costs and an increase in time and flexibility required to facilitate access to the additional services. Both these may act to reduce maternal labour supply.

In Chapter 5 we found some evidence indicating that increased access to service may in fact lead to reductions in the labour force participation of one important group of carers, mothers. First, an autism diagnosis was found to be associated with a reduction in the labour force participation of mothers. Given that the diagnosis itself only changes the care requirements to the extent of providing access to additional formal services, this leads to the possibility that more formal services under the NDIS will increase the need for informal care (they are compliments) – thereby acting to reduce rather than increase labour force participation of carers (in particular mothers). Second, some, albeit weak evidence was reported using difference in difference analysis that the expansion in services under the *Helping Children with Autism* package reduced maternal labour supply of children with autism.

While this analysis utilised a detailed panel data set, the two years between interviews creates issues with identifying the effect of a single policy change. A panel data set with more regular follow up would provide potentially greater insights through allowing the dynamic estimation of labour market participation.

There are many possible avenues for the NDIS to address the potential negative connection between increased services and labour force participation of carers of people with a disability, including the funding of support services to take people with a disability to formal intervention services but also the settings in which services are funded. For example, if early intervention services for children with autism were encouraged to be provided during school hours or directly before or after on school grounds this would reduce the need for mothers to be present. This would require NDIS funding of state government services, which while allowed under the existing intergovernmental agreements could be resisted at the Federal level.

6.6 Conclusion

The thesis set out to provide an overview of some of the main issues in the economics of disability in Australia at a time of immense change in the delivery of services. Using the best available data, we have been able to provide new insights into the different experiences of people with a disability across socio-economic groups and the affect that disability has on household units.

As the NDIS enters the final stages of its rollout, there is an opportunity for reforms to ensure that it fulfils its great promise to people with a disability in Australia. At the same time, we have provided recommendations for the design and implementation of policies in other countries that expand services and supports for people with a disability, from which future research can build.

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Appendix 1.1: NDIS Timeline

	July 2013	July 2014	July 2015	July 2016	July 2017	July 2018	July 2019
NSW	Newcastle Lake Macquarie Maitland			Commence roll out across NSW		All NSW covered	
Victoria	Barwon area incl. Geelong, Colac-Otway Shire			Commence roll out across Victoria			All Victorians covered
South Australia	Children under five	Children under 13	Children under 14	Commence roll out across SA		All SA covered	
Tasmania	Young adults 15-24			Commence roll out across TAS			All Tasmanians covered
ACT		Commence roll out across ACT		All ACT covered			
NT		Barkly region		Commence roll out across NT			All NT covered
Western Australia		Perth Hills Kalamunda, Mundaring, Swan and Lower South West Area		Cockburn-Kwinana area.			
Queensland				Commence roll out across QLD			All QLD covered

Appendix 1.2: Lagrangian Optimisation

The optimisation problem can be represented by the Lagrangian function:

$$\mathcal{L} = U(X, L, A|\rho) + \lambda[V + (T - L - IC)W - PxX - (PFC - s)F - (PAT - s)AT] \qquad (4)$$

Assuming diminishing marginal utilities (and the function U(X,L,A(F,C,AT|D) is concave in respect to (X,L,F,IC,AT)) the first order conditions are given by:

$$\partial\mathcal{L}|\partial F = U_A A_F - \lambda(P_F - s) = 0 \qquad (5)$$

$$\partial\mathcal{L}|\partial IC = U_A A_{IC} - \lambda W = 0 \qquad (6)$$

$$\partial\mathcal{L}|\partial AT = U_A A_{AT} - \lambda(P_{AT} - s) = 0 \qquad (7)$$

$$\partial\mathcal{L}|\partial X = U_X - \lambda P_x = 0 \qquad (8)$$

$$\partial\mathcal{L}|\partial L = U_L - \lambda W = 0 \qquad (9)$$

$$V + (T - L - IC)W - P_x X - (P_F - s)F - (P_{AT} - s)AT = 0 \qquad (10)$$

Appendix 2.1:   Variables Used in the Analysis

Care Variables	
Receives Formal Care	Reports having received any service from a formal care organisation
Receives Informal Care	Reports having received any service from an informal care organisation
Need Variables	
Disability	Main Impairment: Physical (reference), Sensory and Sight, Intellectual, Mental or Other.
Severity	Profound Severe Moderate Mild (base line)
Age	Continuous measure converted to 15-24; 25-34; 35 to 44; 45 to 54; 55 to 64
Gender	Male, Female
Married Status	Either currently married or not currently married, with defacto classified as married.
Other adults	Presence of another adult in the household (not a spouse)
Socio-Economic	Household income deciles converted to continuous measure, and then equivalised using OECD scale and real income calculated using quarterly consumer price index figures from 2009 and 2012 survey period.
Location	State of residence: NSW, VIC, QLD (baseline), SA, NT, ACT, TAS City
Education	Highest Education Attainment in Household, Non-English-Speaking Background, Married
Cultural Background	Language other than English spoken at home

Appendix 2.2: Descriptive Statistics by Year

	2009 mean	2012 mean	2015 mean	ALL mean
Any Informal Service	0.55	0.54	0.54	0.54
Any Formal Service	0.31	0.31	0.32	0.32
Any Assistive Technology	0.49	0.50	0.47	0.48
No Care	0.25	0.26	0.27	0.26
Informal Care Only	0.15	0.14	0.15	0.14
Formal Care Only	0.03	0.03	0.03	0.03
Assistive Technology Only	0.15	0.14	0.13	0.14
Informal and Formal Care Only	0.09	0.09	0.09	0.09
Informal Care and Assistive Technology	0.15	0.15	0.13	0.14
Formal Care and Assistive Technology	0.03	0.04	0.03	0.03
All Care	0.17	0.16	0.17	0.17
Need Characteristics				
Physical Impairment	0.68	0.57	0.57	0.61
Sensory and Sight Impairment	0.10	0.09	0.09	0.09
Intellectual Impairment	0.05	0.06	0.06	0.05
Mental Impairment	0.10	0.11	0.15	0.12
Other Impairment	0.07	0.17	0.14	0.13
Profound	0.10	0.12	0.12	0.11
Severe	0.22	0.21	0.22	0.22
Moderate	0.26	0.24	0.23	0.24
Mild	0.42	0.43	0.44	0.43
Non-Need Characteristics				
Male	0.45	0.45	0.46	0.45
Female	0.55	0.55	0.54	0.55
15 to 24 year	0.07	0.09	0.10	0.09
25 to 34 years	0.09	0.10	0.09	0.09
35 to 44 years	0.17	0.15	0.15	0.16
45 to 54 years	0.27	0.26	0.25	0.26
55 to 64 years	0.41	0.40	0.41	0.41
Real Household Equiv. Income	678.20	634.00	626.50	645.80
Individual Education				
Not Completed High school	0.23	0.19	0.19	0.21
Completed High school	0.35	0.39	0.35	0.36
Trade Qualification	0.28	0.28	0.32	0.29
Bachelor Degree or above	0.14	0.14	0.14	0.14
Household Education				
Not Completed High school	0.10	0.09	0.08	0.09
Completed High school	0.28	0.29	0.24	0.27
Trade Qualification	0.39	0.39	0.44	0.41
Bachelor Degree or above	0.23	0.24	0.25	0.24
Language Other Than English	0.07	0.07	0.08	0.07
Female Spouse	0.22	0.20	0.19	0.20
Male Spouse	0.26	0.24	0.22	0.24
Female Other Adult	0.16	0.17	0.18	0.17
Male Other Adult	0.18	0.19	0.20	0.19
City	0.60	0.62	0.60	0.61
N	4331	4769	4402	13502

Appendix 2.3:   Concentration Indices by Sub-Groups

	Single Male		Multi Male		Single Female		Multi Female	
	CI	HI	CI	HI	CI	HI	CI	HI
Combination of Support Used								
No Care	0.007	-0.025	0.008	-0.016**	0.012	-0.026*	0.021*	-0.005
	(0.030)	(0.016)	(0.014)	(0.008)	(0.026)	(0.014)	(0.012)	(0.007)
Formal Care Only	-0.012	-0.009	-0.014***	-0.013***	0.008	0.010	-0.012***	-0.012***
	(0.015)	(0.013)	(0.004)	(0.004)	(0.014)	(0.011)	(0.004)	(0.004)
Informal Care Only	-0.024	-0.016	-0.051***	-0.032***	-0.036**	-0.035***	-0.034***	-0.026***
	(0.016)	(0.013)	(0.012)	(0.008)	(0.014)	(0.013)	(0.011)	(0.008)
Assistive Technology Only	0.069***	0.025*	0.062***	0.017***	0.019	-0.004	0.022**	0.006
	(0.025)	(0.015)	(0.012)	(0.007)	(0.022)	(0.013)	(0.010)	(0.005)
Formal Care and Assistive Technology	-0.011	0.004	-0.015***	-0.012**	0.012	0.024*	-0.007	-0.006
	(0.017)	(0.012)	(0.005)	(0.005)	(0.017)	(0.013)	(0.005)	(0.005)
Informal Care and Assistive Technology	0.008	0.019	-0.038***	-0.019**	-0.061***	-0.042***	-0.020*	-0.011
	(0.019)	(0.013)	(0.011)	(0.008)	(0.019)	(0.014)	(0.011)	(0.007)
Informal and Formal Care Only	-0.026*	-0.015	0.020**	0.025***	0.004	0.010	0.015*	0.019***
	(0.014)	(0.011)	(0.009)	(0.007)	(0.018)	(0.014)	(0.008)	(0.007)
All Care	-0.011	0.013	0.030**	0.040***	0.042*	0.054***	0.017	0.026***
	(0.020)	(0.013)	(0.012)	(0.007)	(0.024)	(0.013)	(0.011)	(0.006)

Robust Standard Errors in Parenthesis

Concentration Curves - Unstandardised
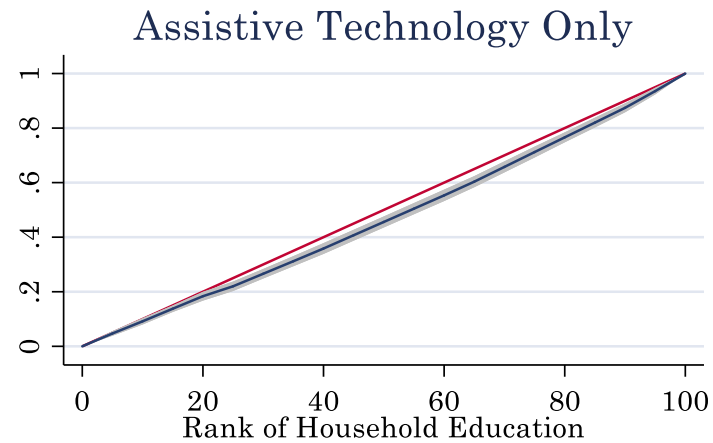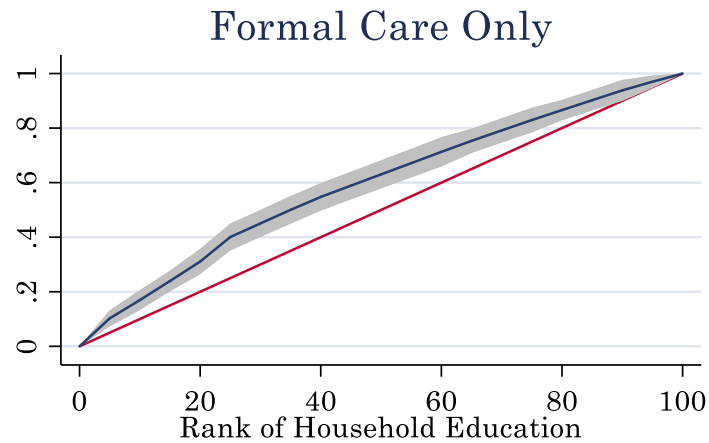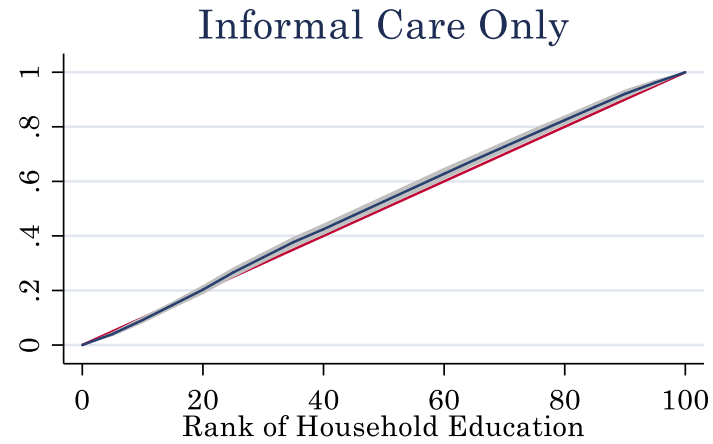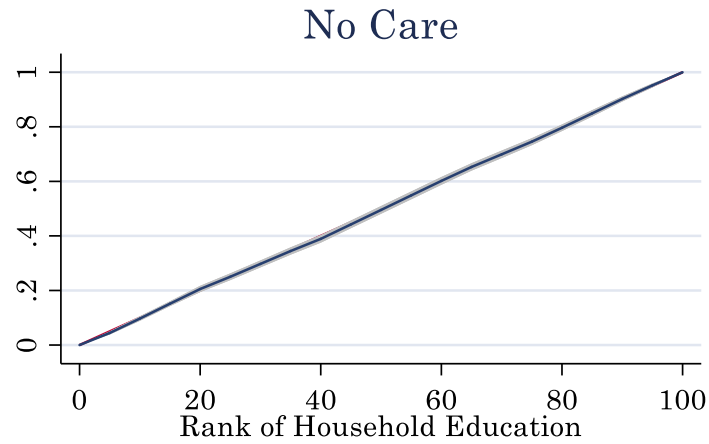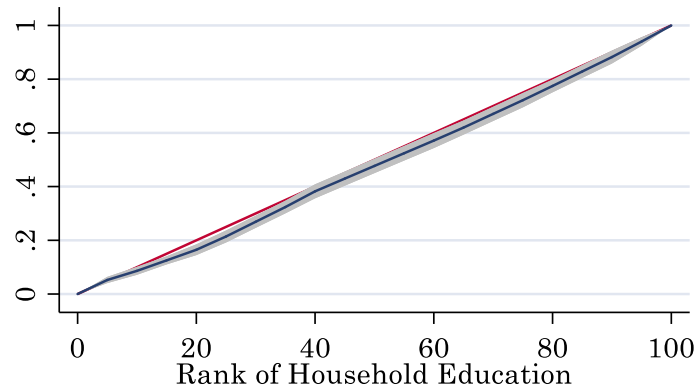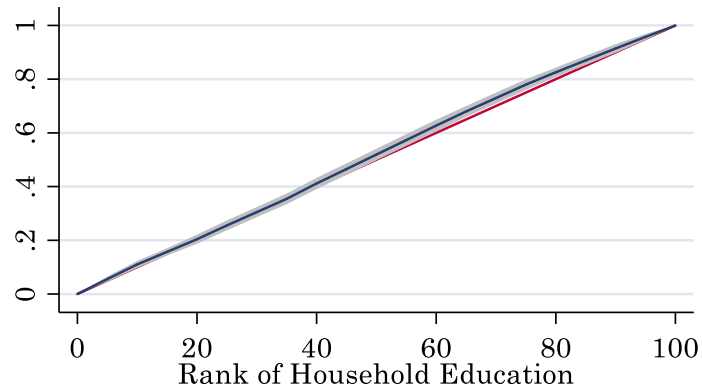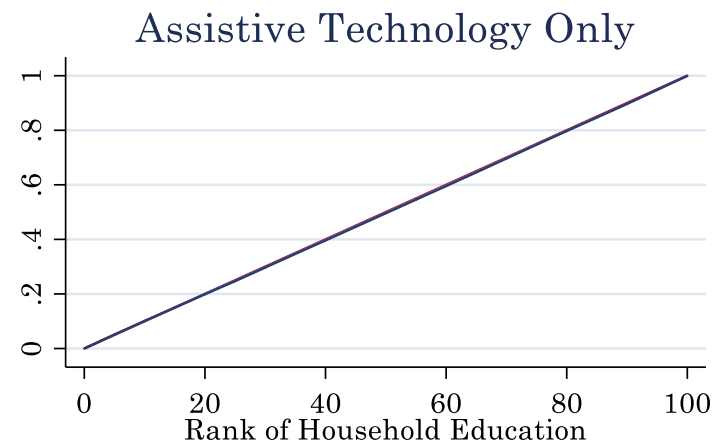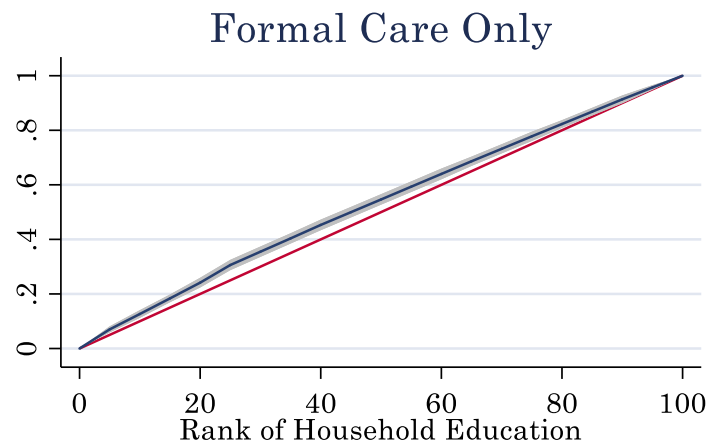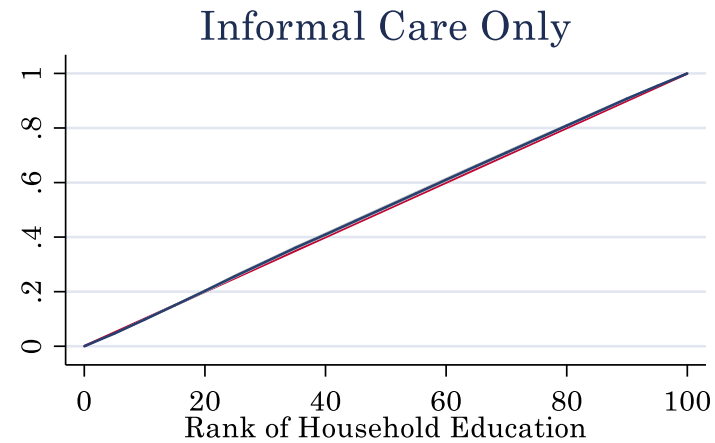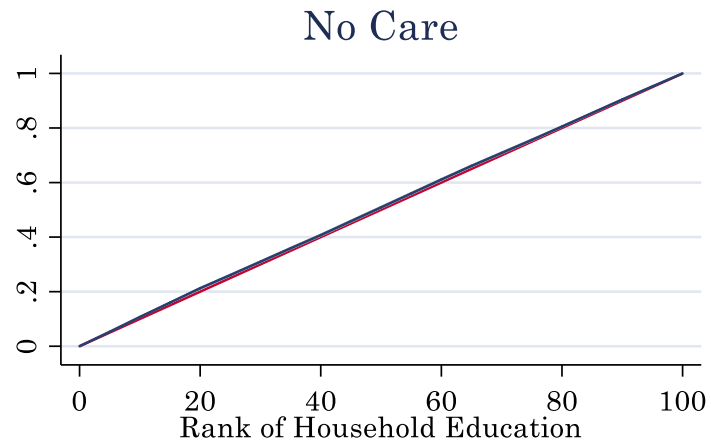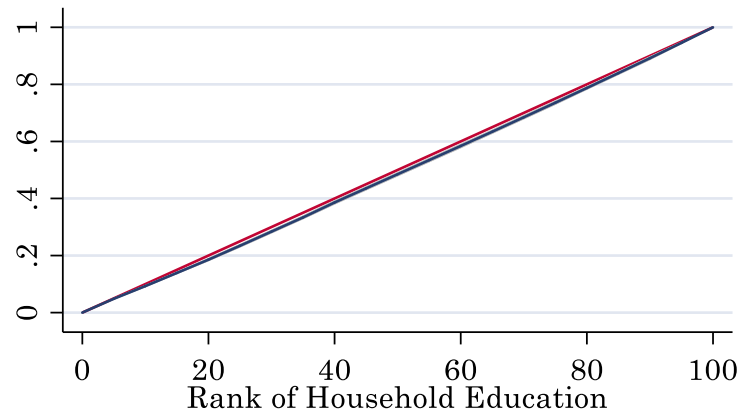
Concentration Curves - Unstandardised cont.
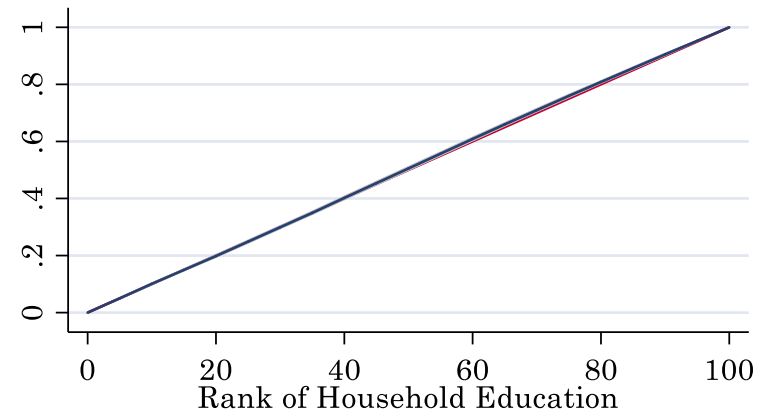
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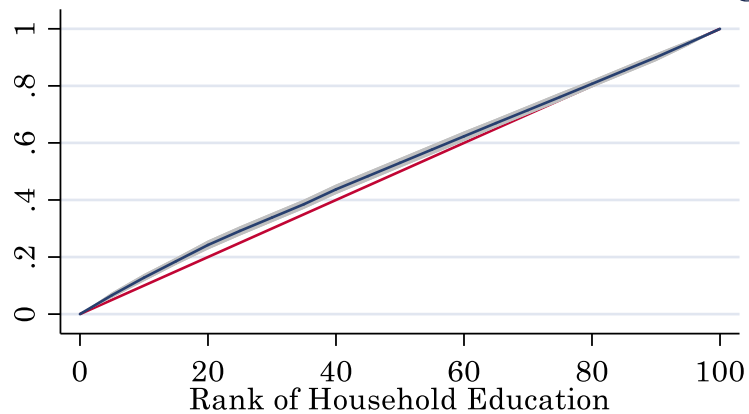
Concentration Curves - Standardised cont.
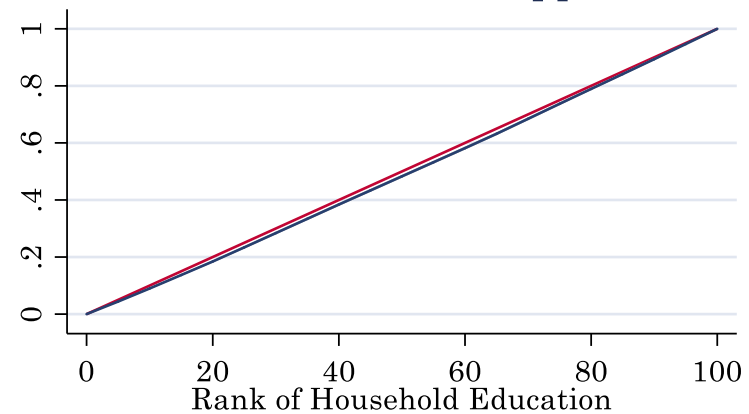
Appendix 2.5:   Full Decomposition of Unstandardised Concentration Index

	No Care	Formal Care Only	Informal Care Only	Assistive Technology Only	Formal Care and Assistive Technology	Informal Care and Assistive Technology	Informal and Formal Care Only	All Care
Need Characteristics								
Male								
(Ref: 55 to 64 years)								
15 to 34 years	-2.620E-05	-2.190E-05	-2.770E-05	6.970E-05	-1.800E-05	2.710E-05	-6.230E-05	2.210E-05
35 to 44 years	-6.430E-05	-2.320E-03	-1.660E-04	-2.040E-03	-1.650E-03	2.920E-04	1.810E-03	1.450E-03
45 to 54 years	-1.560E-04	-4.370E-05	3.840E-05	-5.890E-04	5.750E-04	5.650E-05	3.780E-04	3.460E-04
Female								
15 to 34 years	2.470E-04	-1.460E-03	5.990E-04	-1.280E-03	-3.920E-04	-1.460E-04	1.010E-03	8.630E-05
35 to 44 years	-4.980E-04	-2.690E-04	4.950E-05	1.030E-03	-2.660E-04	3.770E-04	-3.210E-04	-2.020E-04
45 to 54 years	-2.470E-04	-3.760E-05	-6.540E-06	-7.010E-04	1.600E-04	1.470E-04	6.160E-04	4.950E-04
55 to 64 years	1.370E-03	5.550E-04	-1.690E-04	1.900E-03	-2.490E-03	-3.250E-04	-2.190E-03	-1.730E-03
Main Impairment (Ref: Physical Impairment)								
Sensory and Sight Impairment	-2.710E-03	-1.090E-03	-1.320E-03	7.930E-03	-5.800E-04	-7.170E-04	-5.450E-05	-4.650E-04
Mental Impairment	1.800E-03	-4.670E-03	-1.340E-04	1.260E-04	2.790E-04	4.060E-03	-7.620E-03	-1.470E-03
Other Impairment	-3.270E-04	6.090E-04	5.400E-05	5.850E-05	9.950E-04	-7.140E-04	8.460E-04	2.730E-04
Additional Impairment								
Physical Impairment	5.860E-04	-8.870E-04	1.530E-03	3.840E-03	-2.940E-03	-3.080E-03	2.390E-03	-3.360E-03
Sensory and Sight Impairment	1.930E-03	1.490E-03	2.210E-03	-2.960E-03	-2.670E-03	-3.570E-04	1.450E-03	-2.520E-03
Intellectual Impairment	-8.200E-05	-1.460E-04	-2.370E-04	4.380E-04	-5.970E-04	1.670E-04	-4.380E-04	1.900E-04
Mental Impairment	2.630E-03	-3.700E-03	1.750E-03	1.770E-03	-4.020E-03	2.970E-03	-5.560E-03	-5.220E-03
Other Impairment	1.900E-02	6.850E-04	1.870E-03	5.830E-03	-1.340E-02	-1.160E-02	-3.890E-03	-2.110E-02
Severity (Ref: Mild)								
Profound	6.550E-03	4.500E-03	-1.290E-03	5.990E-03	-1.970E-03	-6.730E-03	-2.600E-03	-7.140E-03
Severe	-2.400E-03	-1.540E-03	1.470E-03	-2.030E-03	-3.170E-04	2.430E-03	8.590E-04	1.890E-03
Moderate	3.660E-03	-8.820E-04	-1.700E-03	1.790E-03	-3.670E-03	-2.190E-03	-1.590E-03	-2.060E-03
Non-Need Characteristics								
Real Household Equivalised Income	4.610E-03	-3.600E-02	-1.690E-02	6.510E-03	-3.820E-03	-9.970E-03	-3.890E-03	1.920E-02
Missing Income Dummy	1.960E-03	-8.570E-03	-3.340E-03	1.140E-03	-2.540E-04	-2.580E-03	-1.020E-03	3.120E-03
Rent	-1.480E-03	5.000E-04	-4.720E-03	5.510E-03	1.380E-03	-8.400E-03	5.870E-03	5.410E-03
Completed High school	1.920E-02	1.030E-02	-1.370E-02	-1.030E-03	4.720E-02	1.220E-02	-4.770E-03	-3.540E-02
Trade Qualification	-1.160E-02	-2.410E-02	-9.230E-03	7.100E-03	-2.720E-02	-1.340E-03	1.090E-02	2.430E-02
Bachelor Degree or above	-2.910E-02	-5.260E-02	-3.650E-02	2.210E-02	-3.220E-02	-2.290E-02	4.440E-02	6.820E-02
Language Other Than English	7.920E-05	1.420E-05	3.950E-04	-6.670E-05	-2.170E-04	1.680E-05	-1.380E-04	-3.060E-04
Female Spouse	-1.420E-03	-1.880E-02	6.910E-03	-4.240E-03	-1.750E-02	4.730E-03	2.170E-03	1.090E-03
Male Spouse	-2.390E-03	-2.610E-02	1.670E-02	-5.400E-03	-3.420E-02	7.830E-03	-4.420E-04	-1.700E-03
Female Other Adult	-2.900E-03	-1.830E-02	1.240E-02	-6.070E-03	-3.380E-02	5.980E-04	1.370E-02	7.140E-04
Male Other Adult	-2.370E-03	-1.720E-02	1.290E-02	-4.620E-03	-2.010E-02	7.610E-03	-2.830E-03	-1.910E-03
City	3.670E-03	3.420E-02	-8.470E-03	-9.760E-03	2.910E-02	-1.820E-02	1.730E-02	5.050E-03
NSW	3.040E-05	-2.610E-04	1.680E-04	2.750E-04	-1.550E-04	1.780E-04	-3.050E-04	-3.400E-04
VIC	-6.570E-04	1.010E-03	1.230E-04	3.210E-04	-9.670E-05	-3.380E-04	5.400E-04	4.840E-04
SA	1.190E-05	-3.540E-05	1.670E-05	-2.410E-06	-5.460E-05	3.180E-05	4.660E-06	-4.360E-05
WA	2.220E-04	1.140E-04	-2.310E-05	1.520E-04	8.680E-05	-1.340E-04	-1.240E-04	-3.020E-04
TAS	1.140E-04	-6.010E-04	-2.340E-05	1.550E-04	-1.940E-03	3.580E-04	1.340E-04	-1.840E-04
ACT	-6.390E-04	-5.330E-04	-1.660E-04	4.240E-04	-4.520E-04	-2.450E-05	7.290E-04	5.710E-04
NT	6.570E-06	2.740E-06	-1.000E-05	-3.270E-06	2.700E-05	-7.020E-06	-4.960E-06	4.280E-06
PRE-NDIS	2.350E-03	-3.540E-03	2.810E-03	-1.600E-03	2.920E-04	-3.710E-03	-1.030E-03	-4.330E-04
N	13502	13502	13502	13502	13502	13502	13502	13502

	No Care	Formal Care Only	Informal Care Only	Assistive Technology Only	Formal Care and Assistive Technology	Informal Care and Assistive Technology	Informal and Formal Care Only	All Care
Need Characteristics								
Male								
(Ref: 55 to 64 years)								
15 to 34 years	1.190E-04	-5.610E-04	2.280E-04	-3.290E-04	-1.450E-04	-6.260E-05	3.060E-04	2.500E-05
35 to 44 years	-1.270E-05	-8.440E-06	-1.050E-05	1.800E-05	-6.650E-06	1.160E-05	-1.880E-05	6.410E-06
45 to 54 years	-2.400E-04	-1.040E-04	1.880E-05	2.640E-04	-9.820E-05	1.610E-04	-9.690E-05	-5.860E-05
Female								
15 to 34 years	-3.100E-05	-8.940E-04	-6.310E-05	-5.250E-04	-6.100E-04	1.250E-04	5.480E-04	4.200E-04
35 to 44 years	-1.190E-04	-1.450E-05	-2.490E-06	-1.810E-04	5.910E-05	6.300E-05	1.860E-04	1.430E-04
45 to 54 years	-7.510E-05	-1.680E-05	1.460E-05	-1.520E-04	2.120E-04	2.420E-05	1.140E-04	1.000E-04
55 to 64 years	6.630E-04	2.140E-04	-6.440E-05	4.900E-04	-9.180E-04	-1.390E-04	-6.600E-04	-5.000E-04
Main Impairment (Ref: Physical Impairment)								
Sensory and Sight Impairment	-3.410E-05	1.200E-04	-7.050E-05	9.180E-05	-3.260E-06	-4.900E-05	-2.950E-05	1.970E-05
Mental Impairment	3.390E-05	-2.820E-04	-1.410E-05	-6.490E-05	7.020E-05	5.490E-05	1.360E-04	-3.710E-05
Other Impairment	-6.030E-05	4.710E-05	1.650E-05	1.070E-05	3.970E-05	5.310E-06	4.720E-05	-4.550E-06
Additional Impairment								
Physical Impairment	-6.690E-05	2.830E-04	-4.430E-06	1.280E-04	-2.210E-04	8.210E-05	-5.090E-05	-7.970E-05
Sensory and Sight Impairment	-1.100E-05	-9.530E-05	1.440E-05	1.160E-05	-3.200E-04	-1.220E-04	-1.110E-05	1.260E-04
Intellectual Impairment	-8.430E-06	8.280E-05	-5.570E-06	3.460E-06	-5.830E-05	-2.190E-06	4.490E-05	-1.460E-05
Mental Impairment	9.040E-05	3.130E-05	-3.040E-05	-4.660E-05	1.600E-04	-4.160E-05	-8.830E-05	2.150E-05
Other Impairment	1.930E-04	-3.230E-04	-7.270E-05	1.050E-04	9.100E-05	-3.120E-04	-3.390E-04	1.490E-04
Severity (Ref: Mild)								
Profound	-8.670E-06	-5.590E-06	1.080E-04	6.910E-07	-1.730E-04	-5.590E-05	-1.710E-05	4.460E-06
Severe	2.840E-05	-1.210E-05	-2.300E-05	-1.070E-05	-3.190E-05	1.140E-05	-2.950E-05	1.400E-05
Moderate	6.280E-06	6.680E-05	9.520E-06	2.040E-05	-1.880E-06	-5.500E-06	4.430E-05	-5.840E-05
Non-Need Characteristics								
Real Household Equivalised Income	2.220E-03	-1.390E-02	-6.420E-03	1.680E-03	-1.410E-03	-4.260E-03	-1.180E-03	5.560E-03
Missing Income Dummy	9.450E-04	-3.300E-03	-1.270E-03	2.930E-04	-9.370E-05	-1.100E-03	-3.090E-04	9.030E-04
Rent	-7.140E-04	1.930E-04	-1.790E-03	1.420E-03	5.080E-04	-3.590E-03	1.770E-03	1.570E-03
Completed High school	9.270E-03	3.970E-03	-5.230E-03	-2.650E-04	1.740E-02	5.230E-03	-1.440E-03	-1.030E-02
Trade Qualification	-5.620E-03	-9.270E-03	-3.510E-03	1.830E-03	-1.000E-02	-5.740E-04	3.290E-03	7.050E-03
Bachelor Degree or above	-1.400E-02	-2.030E-02	-1.390E-02	5.690E-03	-1.190E-02	-9.810E-03	1.340E-02	1.980E-02
Language Other Than English	3.820E-05	5.480E-06	1.500E-04	-1.720E-05	-8.000E-05	7.180E-06	-4.170E-05	-8.870E-05
Female Spouse	-6.870E-04	-7.250E-03	2.630E-03	-1.090E-03	-6.460E-03	2.020E-03	6.560E-04	3.160E-04
Male Spouse	-1.150E-03	-1.000E-02	6.340E-03	-1.390E-03	-1.260E-02	3.350E-03	-1.340E-04	-4.920E-04
Female Other Adult	-1.400E-03	-7.060E-03	4.710E-03	-1.560E-03	-1.250E-02	2.550E-04	4.140E-03	2.070E-04
Male Other Adult	-1.140E-03	-6.620E-03	4.920E-03	-1.190E-03	-7.430E-03	3.260E-03	-8.560E-04	-5.530E-04
City	1.770E-03	1.320E-02	-3.220E-03	-2.510E-03	1.080E-02	-7.780E-03	5.220E-03	1.460E-03
NSW	1.460E-05	-1.010E-04	6.370E-05	7.080E-05	-5.720E-05	7.620E-05	-9.210E-05	-9.850E-05
VIC	-3.170E-04	3.900E-04	4.660E-05	8.270E-05	-3.570E-05	-1.440E-04	1.630E-04	1.400E-04
SA	5.750E-06	-1.360E-05	6.340E-06	-6.210E-07	-2.020E-05	1.360E-05	1.410E-06	-1.260E-05
WA	1.070E-04	4.400E-05	-8.780E-06	3.910E-05	3.210E-05	-5.740E-05	-3.740E-05	-8.760E-05
TAS	5.520E-05	-2.320E-04	-8.900E-06	3.990E-05	-7.160E-04	1.530E-04	4.040E-05	-5.340E-05
ACT	-3.080E-04	-2.050E-04	-6.290E-05	1.090E-04	-1.670E-04	-1.050E-05	2.200E-04	1.660E-04
NT	3.170E-06	1.050E-06	-3.820E-06	-8.440E-07	9.960E-06	-3.000E-06	-1.500E-06	1.240E-06
PRE-NDIS	1.130E-03	-1.360E-03	1.070E-03	-4.110E-04	1.080E-04	-1.590E-03	-3.120E-04	-1.250E-04
N	13502	13502	13502	13502	13502	13502	13502	13502

	No Care	Informal Only	Formal Only	Assistive Technology Only	Informal and Formal	Informal and Assistive Technology	Formal and Assistive Technology	All Care
Real Household Equivalised Income	0.017	-0.061***	-0.016	0.010	-0.009	-0.036*	0.006	0.090***
	(0.024)	(0.022)	(0.010)	(0.019)	(0.018)	(0.021)	(0.010)	(0.023)
Missing Income Dummy	0.024	-0.031**	-0.011	0.003	-0.006	-0.024*	0.004	0.041***
	(0.016)	(0.015)	(0.007)	(0.013)	(0.012)	(0.014)	(0.007)	(0.015)
Rent	0.008	0.006	-0.001	-0.009	-0.005	0.011*	-0.001	-0.010
	(0.008)	(0.007)	(0.003)	(0.006)	(0.005)	(0.007)	(0.003)	(0.007)
Male (Ref: 55 to 64 years)								
15 to 34 years	0.007	0.038***	-0.015**	-0.061***	0.040***	-0.008	-0.004	0.002
	(0.015)	(0.014)	(0.007)	(0.014)	(0.011)	(0.014)	(0.008)	(0.015)
35 to 44 years	0.010	0.015	0.002	-0.020*	0.029**	-0.016	0.001	-0.020
	(0.015)	(0.014)	(0.006)	(0.012)	(0.011)	(0.014)	(0.007)	(0.015)
45 to 54 years	0.020*	-0.002	0.000	-0.027***	0.017	-0.017	0.000	0.008
	(0.012)	(0.012)	(0.005)	(0.010)	(0.010)	(0.011)	(0.006)	(0.012)
Main Impairment (Ref: Physical Impairment)								
Sensory and Sight Impairment	-0.125***	-0.054***	-0.005	0.213***	0.016	-0.022	-0.004	-0.021
	(0.014)	(0.014)	(0.007)	(0.007)	(0.011)	(0.014)	(0.008)	(0.015)
Intellectual Impairment	-0.079***	0.093***	0.010	-0.013	0.083***	-0.075***	-0.010	-0.010
	(0.020)	(0.014)	(0.007)	(0.019)	(0.010)	(0.018)	(0.009)	(0.016)
Mental Impairment	-0.064***	0.021*	0.024***	-0.024**	0.114***	-0.130***	0.001	0.060***
	(0.014)	(0.011)	(0.005)	(0.012)	(0.008)	(0.013)	(0.006)	(0.011)
Other Impairment	-0.013	-0.002	0.007	-0.003	0.031***	-0.061***	0.012*	0.029**
	(0.011)	(0.011)	(0.005)	(0.009)	(0.009)	(0.012)	(0.006)	(0.013)
Additional Impairment								
Physical Impairment	-0.135***	-0.053***	-0.005	0.094***	-0.012	0.025***	0.015***	0.071***
	(0.015)	(0.011)	(0.005)	(0.009)	(0.008)	(0.009)	(0.004)	(0.008)
Sensory and Sight Impairment	-0.044***	-0.018*	0.001	-0.051***	-0.013*	0.070***	0.009*	0.047***
	(0.014)	(0.011)	(0.005)	(0.011)	(0.007)	(0.011)	(0.005)	(0.010)
Intellectual Impairment	0.035*	0.027**	0.004	-0.069***	0.019**	-0.014	0.014**	-0.016
	(0.018)	(0.013)	(0.006)	(0.019)	(0.009)	(0.015)	(0.006)	(0.013)
Mental Impairment	-0.115***	-0.007	0.013***	-0.023*	0.058***	-0.024***	0.013***	0.085***
	(0.015)	(0.010)	(0.004)	(0.012)	(0.007)	(0.008)	(0.004)	(0.008)
Other Impairment	-0.122***	-0.004	-0.002	-0.014**	0.011**	0.031***	0.010***	0.088***
	(0.008)	(0.007)	(0.003)	(0.006)	(0.006)	(0.007)	(0.004)	(0.007)
Severity (Ref: Mild)								
Profound	-0.499***	0.107***	0.006	-0.118***	0.068***	0.190***	0.034***	0.212***
	(0.047)	(0.014)	(0.006)	(0.027)	(0.008)	(0.011)	(0.005)	(0.011)
Severe	-0.315***	0.114***	-0.013***	-0.135***	0.041***	0.153***	0.002	0.154***
	(0.015)	(0.007)	(0.005)	(0.012)	(0.005)	(0.007)	(0.004)	(0.007)
Moderate	-0.089***	0.008	0.000	-0.022***	0.004	0.036***	0.009**	0.054***
	(0.007)	(0.008)	(0.003)	(0.006)	(0.007)	(0.009)	(0.004)	(0.009)
Language Other Than English	0.023*	0.055***	0.002	-0.007	-0.011	0.009	-0.009	-0.063***
	(0.014)	(0.010)	(0.006)	(0.012)	(0.010)	(0.011)	(0.008)	(0.013)
City	0.010	-0.015**	0.010***	-0.015**	0.017***	-0.027***	0.009**	0.011
	(0.008)	(0.007)	(0.003)	(0.006)	(0.006)	(0.007)	(0.004)	(0.007)
ACT	-0.054***	-0.010	-0.007	0.021	0.021*	-0.000	-0.007	0.035**
	(0.017)	(0.016)	(0.008)	(0.013)	(0.011)	(0.015)	(0.008)	(0.015)
NSW	-0.003	-0.009	0.002	-0.011	0.009	-0.009	0.001	0.019**
	(0.010)	(0.010)	(0.005)	(0.009)	(0.008)	(0.009)	(0.005)	(0.010)
NT	0.032	-0.021	-0.001	-0.010	-0.012	-0.011	0.011	0.011
	(0.019)	(0.019)	(0.010)	(0.016)	(0.018)	(0.018)	(0.009)	(0.020)
VIC	-0.040***	0.002	0.006	0.010	0.013	-0.014	-0.002	0.024**
	(0.011)	(0.010)	(0.005)	(0.009)	(0.008)	(0.010)	(0.005)	(0.010)
TAS	-0.009	0.000	0.004	-0.004	-0.002	-0.016	0.016***	0.011
	(0.014)	(0.013)	(0.006)	(0.012)	(0.011)	(0.012)	(0.006)	(0.013)
WA	-0.032***	0.000	-0.002	-0.014	0.007	0.011	-0.003	0.032***
	(0.012)	(0.011)	(0.005)	(0.010)	(0.009)	(0.010)	(0.006)	(0.011)
SA	-0.013	-0.009	0.003	0.003	-0.002	-0.019*	0.006	0.031**
	(0.013)	(0.012)	(0.005)	(0.010)	(0.010)	(0.012)	(0.006)	(0.012)
Female Spouse	-0.028**	0.066***	-0.033***	-0.035***	0.016*	0.043***	-0.036***	0.007
	(0.011)	(0.011)	(0.006)	(0.008)	(0.009)	(0.010)	(0.006)	(0.011)
Completed High school	-0.031**	0.011	-0.001	0.001	0.005	-0.014	-0.004	0.034***
	(0.014)	(0.013)	(0.005)	(0.011)	(0.009)	(0.011)	(0.005)	(0.010)
Trade Qualification	-0.038***	-0.017	-0.006	0.011	0.015*	-0.005	-0.004	0.045***
	(0.014)	(0.013)	(0.005)	(0.011)	(0.009)	(0.011)	(0.005)	(0.010)
Completed High school	-0.043***	-0.031**	-0.008	0.016	0.026***	-0.022*	0.000	0.062***
	(0.015)	(0.013)	(0.006)	(0.012)	(0.010)	(0.012)	(0.006)	(0.012)
PRE-NDIS	-0.017**	-0.011*	0.003	0.007	0.002	0.014**	-0.000	0.002
	(0.007)	(0.006)	(0.003)	(0.006)	(0.005)	(0.006)	(0.003)	(0.006)
N	13502		13502		13502		13502	

	No Care	Informal Only	Formal Only	Assistive Technology Only	Informal and Formal	Informal and Assistive Technology	Formal and Assistive Technology	All Care
Real Household Equivalised Income		-0.077***	-0.019	0.024	-0.010	-0.048*	0.010	0.120***
		(0.029)	(0.014)	(0.023)	(0.024)	(0.029)	(0.014)	(0.030)
Missing Income Dummy		-0.033*	-0.012	0.015	-0.006	-0.027	0.007	0.056***
		(0.019)	(0.009)	(0.016)	(0.016)	(0.019)	(0.009)	(0.020)
Rent		0.009	-0.001	-0.004	-0.006	0.016*	-0.001	-0.013
		(0.009)	(0.004)	(0.008)	(0.007)	(0.009)	(0.004)	(0.009)
Male (Ref: 55 to 64 years)								
15 to 34 years		0.047**	-0.022**	-0.059***	0.051***	-0.011	-0.005	-0.000
		(0.019)	(0.010)	(0.017)	(0.015)	(0.019)	(0.010)	(0.019)
35 to 44 years		0.022	0.002	-0.014	0.039**	-0.022	0.001	-0.028
		(0.018)	(0.008)	(0.014)	(0.015)	(0.018)	(0.009)	(0.020)
45 to 54 years		0.004	0.000	-0.021*	0.024*	-0.020	-0.000	0.012
		(0.016)	(0.007)	(0.012)	(0.014)	(0.015)	(0.008)	(0.016)
Female								
15 to 34 years		-0.002	-0.022**	-0.088***	0.054***	0.018	-0.027**	0.067***
		(0.019)	(0.009)	(0.016)	(0.015)	(0.019)	(0.011)	(0.019)
35 to 44 years		-0.007	-0.005	-0.064***	0.041***	0.002	-0.004	0.036*
		(0.019)	(0.008)	(0.015)	(0.016)	(0.018)	(0.009)	(0.019)
45 to 54 years		-0.002	-0.005	-0.071***	0.036**	0.001	0.005	0.035**
		(0.018)	(0.007)	(0.014)	(0.015)	(0.017)	(0.008)	(0.017)
55 to 64 years		-0.005	-0.006	-0.062***	0.037**	-0.001	0.004	0.032*
		(0.017)	(0.006)	(0.013)	(0.014)	(0.016)	(0.007)	(0.017)
Main Impairment (Ref: Physical Impairment)								
Sensory and Sight Impairment		-0.105***	-0.015	0.208***	0.008	-0.046***	-0.011	-0.039*
		(0.019)	(0.010)	(0.009)	(0.015)	(0.018)	(0.010)	(0.020)
Intellectual Impairment		0.099***	0.009	-0.056**	0.100***	-0.115***	-0.017	-0.022
		(0.018)	(0.009)	(0.023)	(0.013)	(0.023)	(0.012)	(0.022)
Mental Impairment		0.010	0.028***	-0.067***	0.141***	-0.182***	-0.002	0.072***
		(0.014)	(0.006)	(0.014)	(0.010)	(0.017)	(0.008)	(0.015)
Other Impairment		-0.006	0.008	-0.009	0.041***	-0.086***	0.014*	0.038**
		(0.014)	(0.007)	(0.012)	(0.012)	(0.016)	(0.008)	(0.017)
Additional Impairment								
Physical Impairment		-0.105***	-0.017***	0.062***	-0.033***	0.008	0.011**	0.073***
		(0.014)	(0.006)	(0.010)	(0.010)	(0.011)	(0.005)	(0.011)
Sensory and Sight Impairment		-0.041***	-0.002	-0.074***	-0.026***	0.082***	0.008	0.052***
		(0.014)	(0.006)	(0.013)	(0.009)	(0.015)	(0.007)	(0.014)
Intellectual Impairment		0.041**	0.008	-0.061***	0.027**	-0.015	0.020**	-0.020
		(0.017)	(0.008)	(0.022)	(0.012)	(0.020)	(0.008)	(0.018)
Mental Impairment		-0.044***	0.009*	-0.073***	0.059***	-0.054***	0.010*	0.094***
		(0.012)	(0.005)	(0.013)	(0.009)	(0.011)	(0.005)	(0.010)
Other Impairment		-0.043***	-0.011***	-0.064***	-0.001	0.017*	0.006	0.096***
		(0.009)	(0.004)	(0.007)	(0.007)	(0.009)	(0.005)	(0.009)
Severity (Ref: Mild)								
Profound		-0.006	-0.028***	-0.341***	0.017*	0.152***	0.014**	0.192***
		(0.014)	(0.007)	(0.025)	(0.010)	(0.013)	(0.006)	(0.013)
Severe		0.053***	-0.040***	-0.287***	0.006	0.138***	-0.016***	0.146***
		(0.009)	(0.006)	(0.012)	(0.008)	(0.010)	(0.006)	(0.010)
Moderate		-0.019*	-0.007	-0.058***	-0.008	0.028**	0.006	0.057***
		(0.011)	(0.004)	(0.007)	(0.009)	(0.012)	(0.005)	(0.012)
Language Other Than English		0.077***	0.006	-0.000	-0.010	0.016	-0.010	-0.078***
		(0.014)	(0.008)	(0.014)	(0.013)	(0.015)	(0.010)	(0.018)
City		-0.017*	0.014***	-0.019**	0.026***	-0.034***	0.013***	0.017*
		(0.009)	(0.004)	(0.007)	(0.008)	(0.009)	(0.005)	(0.009)
ACT		-0.028	-0.013	0.010	0.020	-0.011	-0.013	0.035*
		(0.020)	(0.010)	(0.015)	(0.015)	(0.020)	(0.011)	(0.020)
NSW		-0.014	0.003	-0.012	0.011	-0.014	0.002	0.024*
		(0.012)	(0.006)	(0.010)	(0.010)	(0.012)	(0.007)	(0.013)
NT		-0.019	0.001	0.006	-0.014	-0.010	0.017	0.019
		(0.025)	(0.013)	(0.019)	(0.024)	(0.024)	(0.011)	(0.027)
VIC		-0.009	0.006	-0.004	0.012	-0.027**	-0.004	0.025*
		(0.012)	(0.006)	(0.011)	(0.010)	(0.013)	(0.007)	(0.013)
TAS		-0.002	0.006	-0.010	-0.006	-0.022	0.021***	0.013
		(0.017)	(0.008)	(0.014)	(0.015)	(0.016)	(0.008)	(0.018)
WA		-0.011	-0.005	-0.028**	0.004	0.008	-0.006	0.037**
		(0.014)	(0.007)	(0.012)	(0.012)	(0.014)	(0.007)	(0.014)
SA		-0.013	0.004	-0.008	-0.002	-0.029*	0.007	0.039**
		(0.016)	(0.007)	(0.012)	(0.013)	(0.016)	(0.008)	(0.016)
Female Spouse		0.083***	-0.047***	-0.059***	0.016	0.054***	-0.051***	0.004
		(0.014)	(0.008)	(0.011)	(0.012)	(0.014)	(0.008)	(0.015)
Male Spouse		0.109***	-0.038***	-0.044***	-0.003	0.048***	-0.057***	-0.017
		(0.011)	(0.007)	(0.009)	(0.010)	(0.011)	(0.007)	(0.012)
Female Other Adult		0.044***	-0.014***	-0.027***	0.029***	0.004	-0.036***	0.000
		(0.009)	(0.005)	(0.008)	(0.007)	(0.009)	(0.006)	(0.010)
Male Other Adult		0.052***	-0.016***	-0.019**	-0.011	0.033***	-0.025***	-0.012
		(0.009)	(0.005)	(0.008)	(0.007)	(0.009)	(0.005)	(0.009)
Completed High school		0.003	-0.004	-0.010	0.001	-0.024	-0.007	0.041***
		(0.017)	(0.007)	(0.013)	(0.012)	(0.015)	(0.007)	(0.014)
Trade Qualification		-0.034**	-0.013*	0.002	0.012	-0.012	-0.009	0.054***
		(0.017)	(0.007)	(0.013)	(0.012)	(0.015)	(0.007)	(0.014)

	No Care	Informal Only	Formal Only	Assistive Technology Only	Informal and Formal	Informal and Assistive Technology	Formal and Assistive Technology	All Care
Completed High school		-0.055***	-0.015*	0.004	0.027**	-0.035**	-0.004	0.077***
		(0.018)	(0.008)	(0.014)	(0.013)	(0.016)	(0.008)	(0.016)
PRE-NDIS		-0.019**	0.002	0.002	0.000	0.016**	-0.002	-0.000
		(0.008)	(0.004)	(0.007)	(0.007)	(0.008)	(0.004)	(0.008)
N		10,049	10,049	10,049	10,049	10,049	10,049	10,049

Appendix 2.9:   Single Males

	No Care	Informal Only	Formal Only	Assistive Technology Only	Informal and Formal	Informal and Assistive Technology	Formal and Assistive Technology	All Care
Real Household Equivalised Income	0.070	-0.113**	0.009	0.001	0.020	-0.061	-0.003	0.077
	(0.066)	(0.047)	(0.038)	(0.058)	(0.044)	(0.045)	(0.045)	(0.053)
Missing Income Dummy	0.079	-0.039	-0.019	-0.013	0.025	-0.050*	-0.026	0.043
	(0.048)	(0.028)	(0.030)	(0.044)	(0.026)	(0.028)	(0.030)	(0.036)
Rent	-0.025	-0.007	0.012	0.033	0.011	-0.008	0.015	-0.031*
	(0.025)	(0.015)	(0.014)	(0.022)	(0.014)	(0.016)	(0.017)	(0.018)
Male (Ref: 55 to 64 years)								
15 to 34 years	0.051	0.004	-0.015	-0.116***	0.050***	-0.012	0.005	0.032
	(0.044)	(0.027)	(0.027)	(0.044)	(0.018)	(0.029)	(0.027)	(0.035)
35 to 44 years	-0.002	0.027	-0.003	-0.063**	0.026	0.001	-0.009	0.022
	(0.036)	(0.020)	(0.019)	(0.031)	(0.018)	(0.019)	(0.021)	(0.025)
45 to 54 years	0.012	0.013	-0.001	-0.045*	0.000	-0.018	0.012	0.026
	(0.028)	(0.017)	(0.017)	(0.024)	(0.018)	(0.019)	(0.017)	(0.020)
Main Impairment (Ref: Physical Impairment)								
Sensory and Sight Impairment	-0.251***	0.016	0.014	0.215***	0.003	0.024	0.034	-0.056
	(0.050)	(0.027)	(0.031)	(0.031)	(0.034)	(0.033)	(0.032)	(0.046)
Intellectual Impairment	-0.086	0.065**	0.038	-0.043	0.067***	-0.029	-0.013	0.001
	(0.060)	(0.029)	(0.033)	(0.063)	(0.025)	(0.060)	(0.048)	(0.048)
Mental Impairment	-0.129***	0.023	0.075***	-0.060	0.101***	-0.044	0.007	0.028
	(0.050)	(0.027)	(0.025)	(0.041)	(0.020)	(0.032)	(0.029)	(0.035)
Other Impairment	-0.009	-0.033	0.023	-0.058	0.041*	0.012	0.025	-0.001
	(0.052)	(0.036)	(0.032)	(0.049)	(0.024)	(0.033)	(0.037)	(0.044)
Additional Impairment								
Physical Impairment	-0.226***	-0.022	0.007	0.135***	0.002	0.014	0.020	0.070***
	(0.038)	(0.021)	(0.018)	(0.026)	(0.017)	(0.017)	(0.017)	(0.019)
Sensory and Sight Impairment	0.038	-0.002	-0.002	-0.065*	-0.042**	0.039	-0.008	0.041
	(0.047)	(0.026)	(0.023)	(0.038)	(0.017)	(0.028)	(0.027)	(0.033)
Intellectual Impairment	0.034	-0.002	-0.003	0.004	-0.002	-0.000	0.010	-0.041
	(0.054)	(0.027)	(0.029)	(0.050)	(0.020)	(0.033)	(0.030)	(0.038)
Mental Impairment	-0.099***	0.025	0.013	-0.054*	0.033*	-0.017	0.041**	0.057***
	(0.037)	(0.016)	(0.017)	(0.032)	(0.018)	(0.020)	(0.017)	(0.020)
Other Impairment	-0.147***	-0.023	0.018	0.022	-0.002	0.036*	0.028	0.068***
	(0.026)	(0.015)	(0.017)	(0.023)	(0.014)	(0.018)	(0.018)	(0.022)
Severity (Ref: Mild)								
Profound	-0.476***	0.034	0.041	-0.110	0.035*	0.160***	0.130***	0.186***
	(0.124)	(0.033)	(0.029)	(0.088)	(0.021)	(0.027)	(0.024)	(0.034)
Severe	-0.291***	0.071***	-0.026	-0.138***	0.036**	0.150***	0.032*	0.165***
	(0.049)	(0.017)	(0.023)	(0.046)	(0.014)	(0.022)	(0.019)	(0.022)
Moderate	-0.114***	0.024	0.004	-0.013	-0.010	0.055**	0.013	0.039
	(0.026)	(0.018)	(0.016)	(0.022)	(0.017)	(0.023)	(0.018)	(0.025)
Language Other Than English	0.320***	0.033	0.048	0.080	-0.718***	0.082	0.057	0.100
	(0.079)	(0.071)	(0.060)	(0.065)	(0.079)	(0.072)	(0.047)	(0.066)
City	0.019	-0.031**	0.012	0.003	0.008	-0.037**	0.045**	-0.020
	(0.027)	(0.015)	(0.016)	(0.023)	(0.015)	(0.017)	(0.018)	(0.021)
ACT	-0.030	-0.066	-0.013	0.038	0.029	0.033	-0.093	0.102**
	(0.066)	(0.065)	(0.040)	(0.052)	(0.032)	(0.049)	(0.069)	(0.049)
NSW	0.011	-0.005	-0.009	-0.036	0.017	0.022	-0.041	0.041
	(0.037)	(0.021)	(0.022)	(0.033)	(0.022)	(0.024)	(0.026)	(0.032)
NT	0.067	0.021	-0.074	-0.091	0.006	-0.014	0.066**	0.020
	(0.065)	(0.031)	(0.062)	(0.060)	(0.038)	(0.043)	(0.033)	(0.053)
VIC	-0.056	-0.002	0.001	-0.015	0.017	-0.027	0.009	0.072**
	(0.039)	(0.022)	(0.023)	(0.034)	(0.022)	(0.026)	(0.023)	(0.031)
TAS	0.005	-0.045	0.039	-0.015	0.017	-0.029	0.033	-0.005
	(0.048)	(0.030)	(0.027)	(0.046)	(0.027)	(0.032)	(0.030)	(0.040)
WA	-0.044	-0.027	-0.004	0.027	0.025	-0.021	0.003	0.041
	(0.041)	(0.025)	(0.023)	(0.035)	(0.023)	(0.027)	(0.024)	(0.032)
SA	-0.019	-0.051	0.012	0.037	-0.005	-0.007	-0.007	0.041
	(0.042)	(0.032)	(0.025)	(0.036)	(0.027)	(0.031)	(0.029)	(0.038)
Female Spouse	0.755***	0.244***	-0.716***	0.462***	0.236***	-0.887***	-0.725***	0.631***
	(0.112)	(0.076)	(0.080)	(0.082)	(0.061)	(0.081)	(0.076)	(0.071)
Completed High school	-0.034	-0.020	0.005	0.019	-0.007	-0.022	-0.001	0.060***
	(0.034)	(0.020)	(0.018)	(0.028)	(0.019)	(0.018)	(0.018)	(0.023)
Trade Qualification	-0.049	-0.015	-0.010	0.036	-0.025	0.035	0.014	0.014
	(0.034)	(0.020)	(0.018)	(0.028)	(0.018)	(0.022)	(0.020)	(0.023)
Completed High school	-0.059	-0.007	-0.008	0.049	-0.018	0.027	0.002	0.015
	(0.045)	(0.031)	(0.024)	(0.039)	(0.024)	(0.032)	(0.027)	(0.031)
PRE-NDIS	-0.061***	0.015	0.011	0.009	0.017	0.017	-0.017	0.011
	(0.023)	(0.015)	(0.014)	(0.021)	(0.014)	(0.017)	(0.015)	(0.018)
N	1282		1282		1282		1282	

Appendix 2.10:   Males in Multi-Membered Households
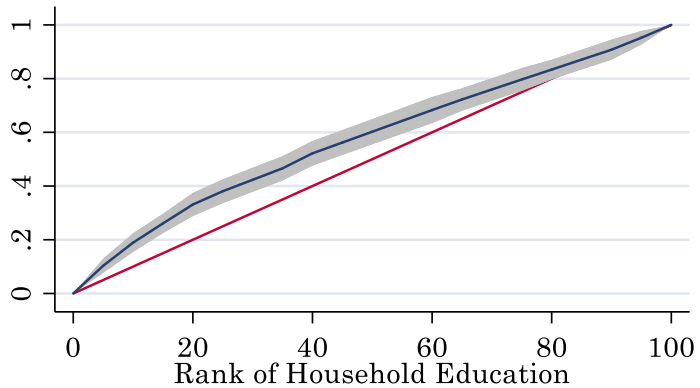
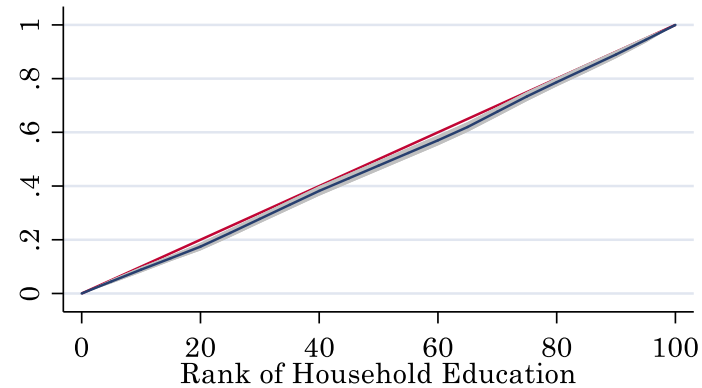|	No Care	Informal Only	Formal Only	Assistive Technology Only	Informal and Formal	Informal and Assistive Technology	Formal and Assistive Technology	All Care
Real Household Equivalised Income	-0.003	-0.081**	-0.012	0.063*	0.010	-0.093***	0.006	0.110***
	(0.043)	(0.040)	(0.014)	(0.036)	(0.033)	(0.036)	(0.016)	(0.040)
Missing Income Dummy	0.004	-0.061**	-0.019**	0.042*	0.007	-0.045*	0.005	0.067**
	(0.029)	(0.026)	(0.010)	(0.025)	(0.021)	(0.023)	(0.010)	(0.026)
Rent	0.011	0.019*	-0.001	-0.023**	0.001	0.003	-0.000	-0.010
	(0.013)	(0.011)	(0.004)	(0.011)	(0.009)	(0.011)	(0.004)	(0.011)
Male (Ref: 55 to 64 years)								
15 to 34 years	0.043**	0.030*	-0.008	-0.058***	0.016	-0.009	-0.003	-0.011
	(0.019)	(0.017)	(0.006)	(0.017)	(0.014)	(0.016)	(0.007)	(0.015)
35 to 44 years	0.036**	0.004	0.004	-0.012	0.021	-0.021	-0.001	-0.031*
	(0.018)	(0.017)	(0.006)	(0.014)	(0.013)	(0.016)	(0.006)	(0.016)
45 to 54 years	0.030**	-0.000	0.000	-0.030***	0.016	-0.010	-0.005	-0.000
	(0.014)	(0.014)	(0.005)	(0.012)	(0.011)	(0.012)	(0.005)	(0.013)
Main Impairment (Ref: Physical Impairment)								
Sensory and Sight Impairment	-0.090***	-0.051**	-0.029*	0.210***	0.027	0.005	-0.035*	-0.037*
	(0.022)	(0.023)	(0.016)	(0.011)	(0.017)	(0.020)	(0.020)	(0.022)
Intellectual Impairment	-0.088***	0.106***	-0.001	-0.011	0.089***	-0.078***	-0.013	-0.004
	(0.032)	(0.022)	(0.008)	(0.031)	(0.015)	(0.025)	(0.009)	(0.023)
Mental Impairment	-0.086***	0.049**	0.012**	-0.028	0.119***	-0.120***	-0.006	0.060***
	(0.026)	(0.019)	(0.006)	(0.024)	(0.013)	(0.022)	(0.009)	(0.018)
Other Impairment	0.002	-0.008	-0.001	0.013	0.030*	-0.071***	0.007	0.028
	(0.018)	(0.019)	(0.006)	(0.015)	(0.016)	(0.020)	(0.007)	(0.021)
Additional Impairment								
Physical Impairment	-0.110***	-0.043***	-0.006	0.103***	-0.015	0.021	0.012***	0.040***
	(0.022)	(0.017)	(0.006)	(0.014)	(0.011)	(0.013)	(0.004)	(0.012)
Sensory and Sight Impairment	-0.076***	0.001	0.007	-0.054**	-0.008	0.049***	0.010	0.071***
	(0.027)	(0.018)	(0.006)	(0.021)	(0.012)	(0.018)	(0.007)	(0.016)
Intellectual Impairment	0.024	0.028	0.004	-0.076**	0.022*	-0.004	0.013**	-0.011
	(0.029)	(0.020)	(0.007)	(0.030)	(0.012)	(0.021)	(0.006)	(0.018)
Mental Impairment	-0.152***	0.008	0.013***	-0.020	0.069***	-0.018	0.011**	0.089***
	(0.030)	(0.017)	(0.005)	(0.023)	(0.011)	(0.014)	(0.005)	(0.013)
Other Impairment	-0.093***	-0.016	-0.004	-0.027**	0.025***	0.033***	0.011**	0.071***
	(0.014)	(0.012)	(0.004)	(0.012)	(0.010)	(0.011)	(0.005)	(0.011)
Severity (Ref: Mild)								
Profound	-0.675***	0.176***	0.008	-0.037	0.091***	0.211***	0.014*	0.212***
	(0.148)	(0.038)	(0.007)	(0.065)	(0.016)	(0.026)	(0.007)	(0.022)
Severe	-0.329***	0.131***	-0.009	-0.142***	0.048***	0.154***	-0.009	0.155***
	(0.028)	(0.012)	(0.006)	(0.023)	(0.009)	(0.011)	(0.006)	(0.012)
Moderate	-0.066***	0.021	0.002	-0.032***	-0.003	0.015	-0.000	0.062***
	(0.013)	(0.014)	(0.004)	(0.011)	(0.013)	(0.015)	(0.005)	(0.016)
Language Other Than English	0.010	0.036*	-0.000	0.023	-0.038**	0.003	-0.006	-0.028
	(0.022)	(0.019)	(0.007)	(0.019)	(0.017)	(0.018)	(0.009)	(0.019)
City	-0.002	-0.030**	0.008*	-0.013	0.023**	-0.016	0.001	0.029**
	(0.013)	(0.012)	(0.004)	(0.011)	(0.010)	(0.011)	(0.005)	(0.012)
ACT	-0.041	-0.032	-0.016	0.042*	0.048***	-0.001	0.005	-0.006
	(0.029)	(0.030)	(0.017)	(0.022)	(0.019)	(0.026)	(0.010)	(0.026)
NSW	0.004	-0.020	0.006	-0.009	0.024*	-0.004	0.000	-0.002
	(0.017)	(0.016)	(0.007)	(0.014)	(0.013)	(0.015)	(0.006)	(0.015)
NT	0.064**	-0.067**	0.018*	-0.002	0.003	0.021	-0.024	-0.013
	(0.032)	(0.034)	(0.011)	(0.025)	(0.030)	(0.028)	(0.019)	(0.033)
VIC	-0.052***	-0.010	0.012*	0.028*	0.028**	-0.002	0.001	-0.004
	(0.019)	(0.016)	(0.007)	(0.015)	(0.014)	(0.016)	(0.006)	(0.016)
TAS	0.006	-0.007	0.009	-0.007	0.018	-0.014	0.003	-0.008
	(0.024)	(0.021)	(0.009)	(0.020)	(0.019)	(0.020)	(0.007)	(0.021)
WA	-0.002	-0.020	-0.002	-0.022	0.037**	0.012	-0.016	0.012
	(0.020)	(0.019)	(0.008)	(0.018)	(0.015)	(0.017)	(0.010)	(0.018)
SA	-0.030	-0.021	0.015**	-0.008	0.030*	-0.010	0.002	0.023
	(0.021)	(0.021)	(0.007)	(0.017)	(0.016)	(0.019)	(0.008)	(0.019)
Female Spouse	0.013	0.049***	-0.021***	-0.044***	0.017	0.018	-0.021***	-0.011
	(0.016)	(0.016)	(0.006)	(0.014)	(0.012)	(0.014)	(0.006)	(0.015)
Female Other Adult	0.006	0.021	-0.012**	-0.020*	0.031***	-0.001	-0.018***	-0.006
	(0.014)	(0.013)	(0.006)	(0.012)	(0.010)	(0.012)	(0.006)	(0.013)
Male Other Adult	0.016	0.019	-0.001	-0.012	0.003	-0.003	-0.003	-0.019*
	(0.012)	(0.012)	(0.005)	(0.010)	(0.009)	(0.011)	(0.005)	(0.011)
Bachelor Degree	-0.040	0.018	-0.028**	0.014	0.002	0.000	-0.011	0.044***
	(0.028)	(0.025)	(0.012)	(0.021)	(0.016)	(0.021)	(0.009)	(0.017)
Trade Qualification	-0.045*	-0.015	-0.027**	0.025	0.021	-0.013	-0.019**	0.073***
	(0.027)	(0.024)	(0.012)	(0.021)	(0.016)	(0.020)	(0.009)	(0.016)
Completed Highschool	-0.056*	-0.023	-0.031**	0.032	0.032*	-0.016	-0.015	0.077***
	(0.029)	(0.025)	(0.012)	(0.022)	(0.017)	(0.022)	(0.010)	(0.019)
PRE-NDIS	-0.013	-0.026**	0.004	0.018*	0.000	0.000	0.007	0.010
	(0.012)	(0.011)	(0.004)	(0.010)	(0.008)	(0.010)	(0.005)	(0.010)
N	4,829		4,829		4,829		4,829	

Appendix 2.11:　　　Single Female Marginal Effects

	No Care	Informal Only	Formal Only	Assistive Technology Only	Informal and Formal	Informal and Assistive Technology	Formal and Assistive Technology	All Care
Real Household Equivalised Income	0.086	-0.029	-0.062	0.082	-0.113**	-0.045	0.004	0.077
	(0.063)	(0.047)	(0.046)	(0.053)	(0.049)	(0.057)	(0.047)	(0.065)
Missing Income Dummy	0.073*	-0.030	-0.014	0.007	-0.068**	-0.007	0.012	0.028
	(0.043)	(0.031)	(0.027)	(0.038)	(0.033)	(0.035)	(0.031)	(0.041)
Rent	0.019	0.015	-0.006	-0.004	-0.038**	0.022	-0.000	-0.008
	(0.023)	(0.016)	(0.014)	(0.018)	(0.016)	(0.018)	(0.016)	(0.021)
Female (Ref: 55 to 64 years)								
15 to 34 years	0.047	-0.015	-0.002	-0.057	0.058**	0.048	-0.167**	0.089**
	(0.046)	(0.029)	(0.027)	(0.050)	(0.027)	(0.037)	(0.079)	(0.044)
35 to 44 years	-0.018	0.006	0.025	0.026	-0.018	-0.017	-0.016	0.012
	(0.036)	(0.023)	(0.020)	(0.029)	(0.029)	(0.031)	(0.026)	(0.034)
45 to 54 years	-0.023	-0.007	0.018	-0.010	0.005	0.034*	-0.001	-0.015
	(0.026)	(0.017)	(0.016)	(0.021)	(0.019)	(0.019)	(0.017)	(0.023)
Main Impairment (Ref: Physical Impairment)								
Sensory and Sight Impairment	-0.131**	-0.039	0.002	0.234***	-0.012	-0.056	-0.082	0.082
	(0.053)	(0.038)	(0.036)	(0.026)	(0.044)	(0.058)	(0.057)	(0.054)
Intellectual Impairment	-0.079	0.006	0.081***	0.074	0.058	-0.124*	-0.078	0.063
	(0.070)	(0.038)	(0.028)	(0.057)	(0.041)	(0.074)	(0.073)	(0.065)
Mental Impairment	-0.033	-0.048	0.062**	-0.009	0.066**	-0.109***	-0.012	0.084*
	(0.042)	(0.032)	(0.024)	(0.042)	(0.028)	(0.041)	(0.034)	(0.045)
Other Impairment	-0.055	-0.022	0.039	-0.060	0.031	-0.006	0.023	0.050
	(0.045)	(0.034)	(0.024)	(0.040)	(0.030)	(0.041)	(0.036)	(0.055)
Additional Impairment								
Physical Impairment	-0.133***	-0.071**	-0.019	0.097***	-0.026	0.005	0.043**	0.105***
	(0.045)	(0.034)	(0.024)	(0.027)	(0.026)	(0.026)	(0.019)	(0.026)
Sensory and Sight Impairment	-0.037	-0.007	-0.036	-0.051	-0.009	0.044	0.050	0.045
	(0.042)	(0.029)	(0.022)	(0.035)	(0.026)	(0.037)	(0.032)	(0.041)
Intellectual Impairment	0.035	0.035	-0.000	-0.204*	0.043	0.035	0.044	0.013
	(0.076)	(0.036)	(0.032)	(0.116)	(0.038)	(0.057)	(0.044)	(0.059)
Mental Impairment	-0.126***	0.001	0.044**	-0.040	0.024	-0.030	0.029	0.099***
	(0.039)	(0.017)	(0.018)	(0.031)	(0.021)	(0.022)	(0.020)	(0.025)
Other Impairment	-0.116***	0.005	-0.016	-0.020	0.005	0.021	-0.005	0.127***
	(0.022)	(0.016)	(0.015)	(0.018)	(0.017)	(0.021)	(0.018)	(0.027)
Severity (Ref: Mild)								
Profound	-0.427***	0.018	0.011	-0.050	0.028	0.117***	0.102***	0.201***
	(0.104)	(0.025)	(0.027)	(0.053)	(0.027)	(0.031)	(0.027)	(0.035)
Severe	-0.258***	0.042***	-0.033	-0.113***	0.033*	0.137***	0.031	0.160***
	(0.041)	(0.016)	(0.021)	(0.033)	(0.019)	(0.022)	(0.024)	(0.025)
Moderate	-0.102***	-0.001	-0.010	-0.017	-0.010	0.025	0.061***	0.053*
	(0.023)	(0.017)	(0.015)	(0.019)	(0.020)	(0.024)	(0.020)	(0.028)
Language Other Than English	0.016	0.016	0.039	-0.050	0.030	-0.002	-0.036	-0.012
	(0.047)	(0.030)	(0.025)	(0.054)	(0.033)	(0.041)	(0.050)	(0.053)
City	0.047*	-0.005	0.013	-0.052***	0.000	0.001	0.013	-0.017
	(0.025)	(0.015)	(0.015)	(0.020)	(0.019)	(0.020)	(0.018)	(0.024)
ACT	-0.028	-0.024	0.008	0.006	0.026	-0.065	-0.022	0.099**
	(0.050)	(0.037)	(0.030)	(0.043)	(0.036)	(0.052)	(0.038)	(0.044)
NSW	0.063*	-0.041*	0.002	-0.020	0.010	-0.005	-0.000	-0.009
	(0.032)	(0.023)	(0.020)	(0.028)	(0.025)	(0.026)	(0.023)	(0.034)
NT	0.068	-0.044	-0.016	-0.004	0.010	-0.044	0.018	0.012
	(0.059)	(0.049)	(0.048)	(0.047)	(0.049)	(0.058)	(0.041)	(0.066)
VIC	0.020	-0.016	0.021	-0.022	0.015	-0.052*	-0.007	0.041
	(0.034)	(0.022)	(0.019)	(0.030)	(0.025)	(0.031)	(0.025)	(0.033)
TAS	0.055	-0.018	-0.124**	-0.002	-0.000	0.028	-0.003	0.065
	(0.046)	(0.030)	(0.060)	(0.034)	(0.037)	(0.033)	(0.034)	(0.044)
WA	-0.045	0.014	-0.004	-0.008	0.023	0.013	-0.028	0.034
	(0.037)	(0.021)	(0.021)	(0.031)	(0.026)	(0.027)	(0.026)	(0.034)
SA	0.014	0.012	-0.022	0.001	0.011	-0.024	-0.012	0.020
	(0.041)	(0.024)	(0.028)	(0.033)	(0.031)	(0.034)	(0.028)	(0.038)
Male Spouse	0.143	0.071	-0.779***	0.157***	0.074	0.077	0.011	0.245***
	(0.093)	(0.047)	(0.079)	(0.059)	(0.057)	(0.066)	(0.080)	(0.063)
Bachelor Degree	-0.020	-0.006	0.038**	-0.020	-0.013	-0.031	0.008	0.045*
	(0.031)	(0.021)	(0.016)	(0.027)	(0.021)	(0.025)	(0.018)	(0.025)
Trade Qualification	-0.055*	-0.024	0.034**	-0.032	0.006	-0.008	0.028	0.050*
	(0.032)	(0.021)	(0.017)	(0.029)	(0.022)	(0.027)	(0.021)	(0.027)
Completed High school	-0.052	-0.048**	0.032	-0.024	0.021	-0.080***	0.046*	0.105***
	(0.035)	(0.023)	(0.020)	(0.031)	(0.027)	(0.027)	(0.027)	(0.035)
PRE-NDIS	-0.003	-0.026*	0.011	-0.014	0.005	0.001	0.008	0.018
	(0.022)	(0.014)	(0.015)	(0.018)	(0.017)	(0.018)	(0.016)	(0.021)
N	1403		1403		1403		1403	

Appendix 2.12:   Females in Multi-Membered Households

	No Care	Informal Only	Formal Only	Assistive Technology Only	Informal and Formal	Informal and Assistive Technology	Formal and Assistive Technology	All Care
Real Household Equivalised Income	0.009	-0.068*	-0.017	-0.025	0.001	0.005	0.012	0.083**
	(0.040)	(0.038)	(0.016)	(0.030)	(0.031)	(0.038)	(0.016)	(0.037)
Missing Income Dummy	0.024	-0.022	-0.005	-0.020	-0.001	-0.008	0.006	0.025
	(0.026)	(0.024)	(0.010)	(0.020)	(0.020)	(0.025)	(0.010)	(0.024)
Rent	0.015	-0.003	-0.000	-0.016*	-0.003	0.018*	-0.006	-0.005
	(0.012)	(0.011)	(0.004)	(0.010)	(0.008)	(0.011)	(0.004)	(0.011)
Female (Ref: 55 to 64 years)								
15 to 34 years	0.023	-0.010	-0.012**	-0.028**	0.017	0.002	-0.011*	0.020
	(0.016)	(0.016)	(0.006)	(0.013)	(0.012)	(0.015)	(0.007)	(0.015)
35 to 44 years	0.013	-0.009	-0.003	-0.012	0.010	0.000	-0.001	0.001
	(0.015)	(0.014)	(0.005)	(0.011)	(0.011)	(0.014)	(0.005)	(0.014)
45 to 54 years	0.030**	-0.001	-0.004	-0.010	0.001	-0.014	0.001	-0.002
	(0.013)	(0.012)	(0.005)	(0.010)	(0.010)	(0.012)	(0.005)	(0.012)
Main Impairment (Ref: Physical Impairment)								
Sensory and Sight Impairment	-0.121***	-0.068***	0.003	0.208***	0.017	-0.040	0.009	-0.008
	(0.021)	(0.026)	(0.008)	(0.010)	(0.018)	(0.024)	(0.008)	(0.027)
Intellectual Impairment	-0.053	0.114***	-0.011	-0.032	0.079***	-0.068**	0.005	-0.033
	(0.035)	(0.026)	(0.011)	(0.031)	(0.017)	(0.030)	(0.009)	(0.028)
Mental Impairment	-0.040*	0.015	0.015**	-0.024	0.121***	-0.156***	0.004	0.066***
	(0.020)	(0.018)	(0.006)	(0.017)	(0.011)	(0.021)	(0.007)	(0.017)
Other Impairment	-0.014	0.009	0.004	0.002	0.031**	-0.076***	0.007	0.036*
	(0.014)	(0.016)	(0.006)	(0.012)	(0.013)	(0.018)	(0.007)	(0.018)
Additional Impairment								
Physical Impairment	-0.132***	-0.077***	0.001	0.071***	-0.009	0.043***	0.008	0.095***
	(0.028)	(0.022)	(0.007)	(0.015)	(0.014)	(0.016)	(0.005)	(0.015)
Sensory and Sight Impairment	-0.055**	-0.028	0.005	-0.040**	-0.009	0.095***	0.005	0.028*
	(0.021)	(0.017)	(0.006)	(0.017)	(0.011)	(0.018)	(0.006)	(0.016)
Intellectual Impairment	0.050	0.032	0.013*	-0.070**	0.020	-0.031	0.009	-0.023
	(0.031)	(0.025)	(0.007)	(0.032)	(0.015)	(0.026)	(0.007)	(0.024)
Mental Impairment	-0.096***	-0.023	0.007	-0.018	0.060***	-0.024*	0.004	0.090***
	(0.025)	(0.017)	(0.006)	(0.019)	(0.011)	(0.014)	(0.006)	(0.013)
Other Impairment	-0.141***	0.008	-0.002	-0.012	0.004	0.036***	0.008*	0.099***
	(0.012)	(0.011)	(0.004)	(0.009)	(0.008)	(0.010)	(0.004)	(0.011)
Severity (Ref: Mild)								
Profound	-0.432***	0.102***	-0.006	-0.173***	0.061***	0.206***	0.015**	0.227***
	(0.064)	(0.023)	(0.007)	(0.046)	(0.014)	(0.017)	(0.006)	(0.017)
Severe	-0.310***	0.119***	-0.011*	-0.127***	0.033***	0.152***	-0.000	0.145***
	(0.020)	(0.011)	(0.006)	(0.016)	(0.008)	(0.011)	(0.005)	(0.011)
Moderate	-0.101***	-0.005	0.002	-0.016*	0.013	0.048***	0.006	0.053***
	(0.011)	(0.012)	(0.004)	(0.009)	(0.010)	(0.013)	(0.005)	(0.014)
Language Other Than English	0.029	0.083***	-0.004	-0.023	0.002	0.020	-0.005	-0.102***
	(0.019)	(0.016)	(0.007)	(0.017)	(0.014)	(0.017)	(0.009)	(0.021)
City	0.003	0.006	0.009**	-0.015*	0.017*	-0.037***	0.008	0.009
	(0.012)	(0.012)	(0.005)	(0.009)	(0.009)	(0.011)	(0.005)	(0.011)
ACT	-0.065***	0.014	-0.011	0.009	0.000	0.012	0.002	0.039*
	(0.024)	(0.024)	(0.011)	(0.018)	(0.017)	(0.022)	(0.011)	(0.022)
NSW	-0.025	0.005	0.003	-0.006	-0.002	-0.024	0.012*	0.037**
	(0.015)	(0.016)	(0.006)	(0.012)	(0.011)	(0.015)	(0.007)	(0.015)
NT	-0.004	0.018	-0.003	0.007	-0.038	-0.023	0.017	0.026
	(0.031)	(0.032)	(0.015)	(0.024)	(0.029)	(0.029)	(0.013)	(0.032)
VIC	-0.039**	0.019	0.001	0.009	0.000	-0.013	-0.003	0.027*
	(0.016)	(0.016)	(0.006)	(0.012)	(0.012)	(0.015)	(0.008)	(0.016)
TAS	-0.033	0.025	0.007	-0.002	-0.025	-0.024	0.029***	0.022
	(0.021)	(0.021)	(0.008)	(0.016)	(0.018)	(0.020)	(0.008)	(0.022)
WA	-0.048***	0.018	-0.002	-0.018	-0.021	0.017	0.009	0.044**
	(0.018)	(0.017)	(0.007)	(0.014)	(0.014)	(0.016)	(0.008)	(0.017)
SA	-0.007	0.005	-0.002	0.003	-0.030**	-0.027	0.017**	0.041**
	(0.018)	(0.019)	(0.007)	(0.014)	(0.015)	(0.019)	(0.008)	(0.019)
Male Spouse	-0.017	0.070***	-0.014***	-0.033***	-0.008	0.040***	-0.026***	-0.011
	(0.013)	(0.013)	(0.005)	(0.010)	(0.010)	(0.013)	(0.005)	(0.012)
Female Other Adult	-0.006	0.020*	0.005	-0.014	0.013	-0.010	-0.009**	0.002
	(0.011)	(0.011)	(0.004)	(0.009)	(0.008)	(0.011)	(0.004)	(0.011)
Male Other Adult	-0.016	0.041***	-0.006	-0.019**	-0.023***	0.038***	-0.011**	-0.004
	(0.011)	(0.011)	(0.004)	(0.009)	(0.008)	(0.011)	(0.005)	(0.011)
Completed High school	-0.012	0.024	-0.009	-0.005	0.023	-0.020	-0.010	0.010
	(0.026)	(0.023)	(0.010)	(0.018)	(0.015)	(0.021)	(0.009)	(0.020)
Trade Qualification	-0.010	-0.014	-0.016	0.007	0.028*	-0.007	-0.010	0.022
	(0.025)	(0.023)	(0.010)	(0.018)	(0.014)	(0.021)	(0.009)	(0.020)
Completed High school	-0.009	-0.032	-0.017	0.006	0.040***	-0.022	-0.009	0.042**
	(0.026)	(0.024)	(0.010)	(0.019)	(0.015)	(0.022)	(0.010)	(0.021)
PRE-NDIS	-0.014	-0.003	-0.001	0.005	-0.001	0.029***	-0.004	-0.011
	(0.010)	(0.010)	(0.004)	(0.008)	(0.008)	(0.010)	(0.004)	(0.010)
N	5,988		5,988		5,988		5,988	

Appendix 3.1:   List of Variables

Unmet Need Variables	
Subjective Measure	Whether individual reports having unmet core needs
Objective Measure	Reports requiring assistance with self-care and receives no self-care assistance OR Reports requiring assistance with communication and receives no communication assistance OR Reports requiring assistance with mobility and receives no mobility assistance OR Reports requiring assistance with emotional needs and receives no emotional assistance
Need Variables	
Disability	Main Condition: Intellectual, Nervous, Autism, Psychiatric, Cancer, Endocrine, Sensory, Cerebral Palsy, Heart, Respiratory, Digestive, Skin, Musculoskeletal, Kidney, Epilepsy OR Other Condition Core Needs: Emotional, Self-Care, Mobility and Communication
Severity	Profound Severe Moderate Mild (base line)
Enabling	
Socio-Economic	Household Income Quintile: 1st Quintile, 2nd Quintile, 3rd Quintile, 4th Quintile, 5th Quintile and Missing Income
Location	State of residence: NSW, VIC, QLD (reference), SA, NT, ACT, TAS City (Reference: Outside city)
Other	Carer: Whether a carer resides in the household Insurance: Whether disability was acquired in a manner giving rise to no-fault insurance cover (e.g., workplace accident or motor accident).
Predisposing	
Demographic	Age interacted with gender
Socio-Economic	Highest Education Attainment in Household, Non-English-Speaking Background, Married
Others	Whether has regular or occasional social contact

Appendix 3.2:   Full List of Descriptive Statistics

	Adults				Children			
	2009	2012	2015	Sig. Diff.	2009	2012	2015	Sig. Diff.
	Mean	Mean	Mean		Mean	Mean	Mean	
Subjective Unmet Need	0.099	0.097	0.174	YES	0.343	0.328	0.458	YES
Objective Unmet Need	0.253	0.254	0.266	NO	0.581	0.596	0.589	NO
Need Variables								
Severity								
Profound	0.103	0.117	0.117	NO	0.403	0.408	0.401	NO
Severe	0.220	0.213	0.216	NO	0.354	0.344	0.326	NO
Moderate	0.256	0.236	0.229	YES	0.041	0.043	0.046	NO
Mild (Reference)	0.421	0.434	0.439	NO	0.201	0.204	0.226	NO
Need Type								
Self-Care Need	0.165	0.165	0.169	NO	0.373	0.392	0.392	NO
Mobility Need	0.261	0.259	0.270	NO	0.440	0.402	0.428	NO
Communication Need	0.039	0.054	0.054	YES	0.524	0.511	0.499	NO
Emotional Need	0.270	0.287	0.281	NO	0.582	0.647	0.647	YES
Main Condition								
Physical (Reference)	0.064	0.064	0.085	YES	0.009	0.003	0.051	YES
Intellectual	0.062	0.072	0.054	YES	0.494	0.389	0.343	YES
Nervous	0.078	0.066	0.070	NO	0.041	0.025	0.021	NO
Autism	0.007	0.016	0.019	YES	0.147	0.247	0.265	YES
Psychiatric	0.109	0.138	0.154	YES	0.032	0.049	0.065	YES
Cancer	0.020	0.014	0.017	NO	0.005	0.007	0.008	NO
Endocrine	0.026	0.027	0.030	NO	0.017	0.019	0.017	NO
Sensory	0.062	0.060	0.059	NO	0.070	0.051	0.047	NO
Cerebral Palsy	0.005	0.005	0.006	NO	0.022	0.030	0.014	NO
Heart	0.042	0.035	0.031	YES	0.005	0.010	0.004	NO
Stroke	0.010	0.011	0.012	NO	0.000	0.000	0.003	NO
Respiratory	0.043	0.031	0.035	NO	0.055	0.039	0.046	NO
Digestive	0.018	0.020	0.017	NO	0.006	0.009	0.006	NO
Skin	0.004	0.007	0.007	NO	0.005	0.006	0.003	NO
Musculoskeletal	0.409	0.386	0.355	YES	0.021	0.019	0.014	NO
Kidney	0.008	0.009	0.010	NO	0.000	0.003	0.003	YES
Other Condition	0.034	0.040	0.051	YES	0.071	0.092	0.099	NO
Main Impairment								
Physical (reference)	0.683	0.570	0.573	YES	0.166	0.152	0.118	YES
Intellectual	0.047	0.059	0.056	YES	0.430	0.385	0.394	NO
Sensory and Sight	0.097	0.093	0.086	NO	0.264	0.243	0.224	NO
Mental	0.101	0.112	0.106	NO	0.090	0.139	0.079	YES
Other	0.073	0.166	0.154	YES	0.049	0.082	0.007	NO
Additional Impairments								
Physical	0.106	0.169	0.181	YES	0.098	0.107	0.118	NO
Intellectual	0.062	0.072	0.054	YES	0.494	0.389	0.343	YES
Sensory and Sight	0.118	0.114	0.116	NO	0.196	0.200	0.225	NO
Mental	0.101	0.132	0.208	YES	0.127	0.128	0.317	YES

	Adults				Children			
	2009	**2012**	**2015**	**Sig. Diff.**	**2009**	**2012**	**2015**	**Sig. Diff.**
Other	0.458	0.383	0.507	YES	0.196	0.167	0.215	NO
Non-Need Variable								
First Quintile (Reference)	0.197	0.189	0.209	NO	0.108	0.080	0.082	NO
Second Quintile	0.227	0.203	0.183	YES	0.234	0.192	0.147	YES
Third Quintile	0.172	0.158	0.150	YES	0.188	0.177	0.194	NO
Fourth Quintile	0.128	0.108	0.126	YES	0.201	0.171	0.174	NO
Fifth Quintile	0.108	0.097	0.090	YES	0.146	0.164	0.167	NO
Missing	0.169	0.245	0.242	YES	0.123	0.215	0.236	YES
Housing Tenure: Rent	0.393	0.451	0.471	YES	0.441	0.429	0.453	NO
ACT	0.047	0.056	0.053	NO	0.071	0.076	0.050	NO
NSW	0.239	0.229	0.214	YES	0.252	0.222	0.206	NO
NT	0.037	0.030	0.034	NO	0.017	0.034	0.043	YES
VIC	0.191	0.201	0.196	NO	0.191	0.183	0.174	NO
TAS	0.079	0.081	0.093	YES	0.079	0.072	0.097	NO
WA	0.131	0.136	0.135	NO	0.104	0.112	0.122	NO
SA	0.109	0.096	0.102	NO	0.130	0.128	0.108	NO
QLD (Reference)	0.168	0.171	0.173	NO	0.155	0.173	0.200	NO
City	0.599	0.623	0.602	YES	0.652	0.656	0.597	YES
Carer	0.157	0.249	0.285	YES				
Insurance	0.337	0.300	0.307	YES	0.017	0.009	0.013	NO
Female: 0 to 4 years old					0.047	0.079	0.046	YES
Male: 0 to 4 years old					0.101	0.092	0.088	NO
Female: 5 to 9 years old					0.153	0.134	0.161	NO
Male: 5 to 9 years old					0.310	0.264	0.310	NO
Female: 10 to 14 years old					0.128	0.146	0.124	NO
Male: 10 to 14 years old					0.259	0.285	0.272	NO
Female: 15 to 24 years old	0.035	0.046	0.045	YES				
Male: 15 to 24 years old	0.037	0.044	0.053	YES				
Female: 25 to 34 years old	0.048	0.055	0.050	NO				
Male: 25 to 34 years old	0.041	0.047	0.045	NO				
Female: 35 to 44 years old	0.095	0.084	0.088	NO				
Male: 35 to 44 years old	0.073	0.064	0.064	NO				
Female: 45 to 54 years old	0.147	0.144	0.133	NO				
Male: 45 to 54 years old	0.118	0.116	0.112	NO				
Female: 55 to 64 years old	0.229	0.219	0.225	NO				
Male: 55 to 64 years old	0.178	0.181	0.185	NO				
LOTE	0.069	0.068	0.080	YES	0.033	0.028	0.019	NO
Married	0.481	0.434	0.415	YES				
Bachelor Degree	0.227	0.235	0.246	NO	0.242	0.304	0.329	YES
Certificate	0.393	0.385	0.438	YES	0.426	0.426	0.453	NO
Social Regularly	0.754	0.739	0.700	YES				
Social Occasionally	0.222	0.231	0.269	YES				
N	4,331	4,769	4,402		632	671	720	

Appendix 3.3: Unconditional Probability of Unmet Need

	Adults									Children								
	2009			**2012**			**2015**			**2009**			**2012**			**2015**		
	Objective	Subjective	Sig Diff	Objective	Subjective	Sig Diff	Objective	Subjective	Sig Diff	Objective	Subjective	Sig Diff	Objective	Subjective	Sig Diff	Objective	Subjective	Sig Diff
Need Variables																		
Severity																		
Profound	0.415	0.339	Y	0.415	0.361	N	0.404	0.452	N	0.631	0.580	N	0.602	0.547	N	0.651	0.709	N
Severe	0.500	0.194	Y	0.471	0.189	Y	0.512	0.286	Y	0.768	0.290	Y	0.762	0.290	Y	0.736	0.387	Y
Moderate	0.168	0.048	Y	0.177	0.043	Y	0.195	0.134	Y	0.308	0.000	Y	0.448	0.034	Y	0.364	0.121	Y
Mild (Reference)	0.135	0.021	Y	0.145	0.010	Y	0.147	0.066	Y	0.205	0.031	Y	0.336	0.015	Y	0.313	0.184	Y
Need Type																		
Self-Care Need	0.421	0.302	Y	0.427	0.298	Y	0.454	0.362	Y	0.631	0.555	N	0.605	0.506	Y	0.617	0.674	N
Mobility Need	0.451	0.264	Y	0.424	0.283	Y	0.451	0.372	Y	0.669	0.529	Y	0.615	0.500	Y	0.662	0.646	N
Communication Need	0.607	0.333	Y	0.519	0.322	Y	0.544	0.402	Y	0.716	0.559	Y	0.711	0.531	Y	0.691	0.641	N
Emotional Need	0.523	0.191		0.519	0.194	Y	0.535	0.455	Y	0.688	0.481	Y	0.711	0.531	Y	0.693	0.652	N
Main Condition																		
Physical (Reference)																		
Intellectual	0.425	0.175	Y	0.455	0.152	Y	0.424	0.290	Y	0.647	0.356	Y	0.594	0.253	Y	0.591	0.393	Y
Nervous	0.241	0.110	Y	0.230	0.104	Y	0.233	0.184	N	0.308	0.346	N	0.588	0.235	N	0.600	0.333	N
Autism	0.742	0.161	Y	0.500	0.338	Y	0.619	0.381	Y	0.688	0.462	Y	0.759	0.512	Y	0.696	0.670	N
Psychiatric	0.463	0.082	Y	0.444	0.088	Y	0.434	0.312	Y	0.700	0.400	N	0.788	0.273	Y	0.787	0.447	Y
Cancer	0.395	0.116	Y	0.224	0.045	Y	0.243	0.054	Y	0.333	0.333	N	0.400	0.000	N	0.500	0.500	N
Endocrine	0.221	0.088	Y	0.225	0.070	Y	0.153	0.130	N	0.364	0.364	N	0.000	0.231	N	0.417	0.417	N
Sensory	0.119	0.104	N	0.104	0.090	N	0.100	0.088	N	0.523	0.159	Y	0.353	0.176	N	0.147	0.324	N
Cerebral Palsy	0.450	0.300	N	0.227	0.364	N	0.222	0.370	N	0.357	0.500	N	0.500	0.550	N	0.500	0.700	N
Heart	0.183	0.067	Y	0.149	0.065	Y	0.196	0.152	N	0.000	0.333	N	0.500	0.550	N	0.333	0.000	N
Stroke	0.262	0.238	N	0.155	0.047	N	0.294	0.196	N	0	0					0.000	1.000	Y

	Adults									Children								
	2009			2012			2015			2009			2012			2015		
	Objective	Subjective	Sig Diff	Objective	Subjective	Sig Diff	Objective	Subjective	Sig Diff	Objective	Subjective	Sig Diff	Objective	Subjective	Sig Diff	Objective	Subjective	Sig Diff
Respiratory	0.176	0.070	Y	0.240	0.125	Y	0.145	0.145	N	0.257	0.229	N	0.077	0.231	Y	0.242	0.091	N
Digestive	0.273	0.104	Y	0.364	0.121	Y	0.189	0.122	N	0.500	0.250	N	0.167	0.667	N	0.500	0.000	N
Skin	0.316	0.000	Y	0.202	0.082	Y	0.172	0.069	N	0.000	0.000					0.000	0.000	-
Musculoskeletal	0.206	0.088	Y	0.240	0.115	Y	0.241	0.126	Y	0.308	0.154	N	0.615	0.154	Y	0.600	0.200	N
Kidney	0.121	0.121	N	0.202	0.082	Y	0.178	0.244	N	0.000	0.000		0.500	0.000	Y	0.500	0.500	-
Other Condition	0.243	0.162	N	0.240	0.115	Y	0.229	0.112	Y	0.622	0.289	Y	0.629	0.355	Y	0.718	0.394	Y
Main Impairment																		
Physical (reference)	0.225	0.100	Y	0.203	0.083	Y	0.222	0.139	Y	0.286	0.286	N	0.314	0.265	N	0.424	0.259	Y
Intellectual	0.446	0.103	Y	0.496	0.129	Y	0.435	0.238	Y	0.658	0.349	Y	0.647	0.295	Y	0.627	0.472	Y
Sensory and Sight	0.158	0.093	Y	0.126	0.084	Y	0.124	0.108	N	0.629	0.371	Y	0.601	0.380	Y	0.522	0.354	Y
Mental	0.472	0.131	Y	0.474	0.132	Y	0.426	0.323	Y	0.719	0.474	Y	0.774	0.409	Y	0.789	0.526	Y
Other	0.206	0.051	Y	0.263	0.118	Y	0.290	0.175	Y	0.387	0.097	Y	0.564	0.309	Y	0.468	0.489	N
Additional Impairments																		
Physical	0.399	0.183	Y	0.340	0.187	Y	0.350	0.316	N	0.581	0.726	N	0.556	0.500	N	0.506	0.812	Y
Intellectual	0.425	0.175	Y	0.455	0.152	Y	0.424	0.290	Y	0.647	0.356	Y	0.594	0.253	Y	0.591	0.393	Y
Sensory and Sight	0.288	0.201	Y	0.258	0.212	N	0.269	0.322	Y	0.589	0.605	N	0.597	0.545	N	0.630	0.728	N
Mental	0.367	0.212	Y	0.380	0.219	Y	0.384	0.354	N	0.600	0.563	N	0.593	0.558	N	0.645	0.702	N
Other	0.298	0.153	Y	0.285	0.135	Y	0.299	0.227	Y	0.524	0.532	N	0.518	0.455	N	0.490	0.606	Y
Non-Need Variables																		
First Quintile (Reference)	0.282	0.122	Y	0.298	0.113	Y	0.286	0.209	Y	0.603	0.412	Y	0.667	0.352	Y	0.593	0.373	Y
Second Quintile	0.278	0.117	Y	0.244	0.137	Y	0.289	0.203	Y	0.622	0.372	Y	0.682	0.333	Y	0.660	0.500	Y
Third Quintile	0.243	0.106	Y	0.252	0.095	Y	0.229	0.181	Y	0.588	0.303	Y	0.622	0.336	Y	0.600	0.564	N
Fourth Quintile	0.241	0.083	Y	0.218	0.062	Y	0.256	0.135	Y	0.559	0.339	Y	0.513	0.374	Y	0.504	0.408	N

	Adults									Children								
	2009			**2012**			**2015**			**2009**			**2012**			**2015**		
	Objective	Subjective	Sig Diff	Objective	Subjective	Sig Diff	Objective	Subjective	Sig Diff	Objective	Subjective	Sig Diff	Objective	Subjective	Sig Diff	Objective	Subjective	Sig Diff
Fifth Quintile	0.203	0.047	Y	0.197	0.058	Y	0.224	0.103	Y	0.554	0.283	Y	0.527	0.255	Y	0.542	0.433	N
Missing	0.234	0.086	Y	0.267	0.084	Y	0.277	0.164	Y	0.538	0.372	Y	0.590	0.326	Y	0.629	0.429	Y
Housing Tenure: Rent	0.308	0.129	Y	0.309	0.127	Y	0.306	0.222	Y	0.631	0.358	Y	0.615	0.330	Y	0.644	0.479	Y
ACT	0.191	0.093	Y	0.275	0.075	Y	0.227	0.142	Y	0.556	0.356	Y	0.471	0.196	Y	0.639	0.278	
NSW	0.258	0.088	Y	0.244	0.094	Y	0.263	0.169	Y	0.616	0.415	Y	0.517	0.356	Y	0.615	0.432	
NT	0.239	0.145	Y	0.194	0.056	Y	0.240	0.127	Y	0.455	0.000	Y	0.696	0.261	Y	0.548	0.452	N
VIC	0.266	0.104	Y	0.296	0.098	Y	0.286	0.211	Y	0.579	0.331	Y	0.699	0.358	Y	0.616	0.416	Y
TAS	0.243	0.114	Y	0.275	0.117	Y	0.279	0.171	Y	0.620	0.200	Y	0.583	0.229	Y	0.571	0.529	N
WA	0.286	0.092	Y	0.213	0.114	Y	0.266	0.163	Y	0.515	0.258	Y	0.693	0.333	Y	0.568	0.500	N
SA	0.230	0.070	Y	0.234	0.085	Y	0.259	0.161	Y	0.524	0.378	N	0.558	0.395	Y	0.526	0.538	N
QLD (Reference)	0.243	0.118	Y	0.253	0.098	Y	0.265	0.175	Y	0.622	0.378	Y	0.595	0.319	Y	0.590	0.465	Y
City	0.263	0.096	Y	0.264	0.095	Y	0.270	0.179	Y	0.587	0.376	Y	0.607	0.368	Y	0.581	0.442	Y
Carer	0.328	0.171	Y	0.349	0.206	Y	0.366	0.296	Y									
Insurance	0.222	0.083	Y	0.221	0.078	Y	0.230	0.129	Y	0.364	0.273	N	0.500	0.333	N	0.667	0.333	N
Female: 0 to 4 years old										0.633	0.533	N	0.585	0.472	Y	0.545	0.455	N
Male: 0 to 4 years old										0.578	0.422	N	0.710	0.468	Y	0.571	0.508	N
Female: 5 to 9 years old										0.485	0.268	Y	0.444	0.267	Y	0.629	0.388	Y
Male: 5 to 9 years old										0.673	0.367	Y	0.633	0.356	Y	0.547	0.457	Y
Female: 10 to 14 years old										0.469	0.284	Y	0.582	0.245	Y	0.551	0.404	Y
Male: 10 to 14 years old										0.573	0.323	Y	0.607	0.288	Y	0.643	0.510	Y
Female: 15 to 24 years old	0.300	0.067	Y	0.321	0.118	Y	0.447	0.322	Y									
Male: 15 to 24 years old																		
Female: 25 to 34 years old	0.301	0.121	Y	0.312	0.081	Y	0.307	0.239	N									
Male: 25 to 34 years old	0.282	0.090	Y	0.307	0.058	Y	0.327	0.158	Y									

	Adults									Children								
	2009			2012			2015			2009			2012			2015		
	Objective	Subjective	Sig Diff	Objective	Subjective	Sig Diff	Objective	Subjective	Sig Diff	Objective	Subjective	Sig Diff	Objective	Subjective	Sig Diff	Objective	Subjective	Sig Diff
Female: 35 to 44 years old	0.274	0.097	Y	0.260	0.095	Y	0.289	0.189	Y									
Male: 35 to 44 years old	0.276	0.067	Y	0.295	0.075	Y	0.301	0.174	Y									
Female: 45 to 54 years old	0.259	0.132	Y	0.260	0.121	Y	0.244	0.193	Y									
Male: 45 to 54 years old	0.220	0.112	Y	0.220	0.106	Y	0.245	0.152	Y									
Female: 55 to 64 years old	0.229	0.092	Y	0.219	0.097	Y	0.218	0.149	Y									
Male: 55 to 64 years old	0.211	0.076	Y	0.190	0.070	Y	0.224	0.121	Y									
LOTE	0.290	0.077	Y	0.190	0.070	Y	0.306	0.178	Y	0.429	0.381	N	0.579	0.368	Y	0.571	0.286	N
Married	0.213	0.073	Y	0.288	0.127	Y	0.223	0.128	Y									
Bachelor Degree	0.237	0.091	Y	0.223	0.079	Y	0.246	0.149	Y	0.588	0.340	Y	0.529	0.319	Y	0.582	0.447	Y
Certificate	0.238	0.091	Y	0.248	0.097	Y	0.262	0.180	Y	0.569	0.338	Y	0.601	0.329	Y	0.601	0.485	Y

Y indicates Yes and N indicates No

Appendix 3.4:   Linear Probability Model: Adults

	Base Model				Extended Model			
	Subjective Unmet Pre-NDIS	Subjective Unmet Need Post-NDIS	Objective Unmet Pre-NDIS	Objective Unmet Need Post-NDIS	Subjective Unmet Pre-NDIS	Subjective Unmet Need Post-NDIS	Objective Unmet Pre-NDIS	Objective Unmet Need Post-NDIS
Need Variables								
Main Impairment								
Sensory Speech	0.02**	0.02	-0.04***	-0.08***	0.03**	0.02	-0.04***	-0.08***
	(0.01)	(0.02)	(0.01)	(0.02)	(0.01)	(0.02)	(0.01)	(0.02)
Intellectual	-0.05***	0.01	0.18***	0.09***	-0.05***	0	0.18***	0.09***
	(0.02)	(0.03)	(0.03)	(0.04)	(0.02)	(0.03)	(0.03)	(0.04)
Mental	-0.03**	0.15***	0.26***	0.15***	-0.04***	0.14***	0.25***	0.15***
	(0.01)	(0.02)	(0.02)	(0.03)	(0.01)	(0.02)	(0.02)	(0.03)
Other Impairment	0.01	0.02	0.05***	-0.03	0.00	0.02	0.05***	-0.02
	(0.01)	(0.06)	(0.01)	(0.07)	(0.01)	(0.06)	(0.01)	(0.06)
Additional Impairments								
Sensory Speech	0.06***	0.05**	-0.07***	-0.10***	0.05***	0.05**	-0.07***	-0.10***
	(0.01)	(0.02)	(0.01)	(0.02)	(0.01)	(0.02)	(0.01)	(0.02)
Intellectual	0.01	0.01	0.04**	0.05	0.00	0.01	0.04*	0.05
	(0.02)	(0.03)	(0.02)	(0.03)	(0.02)	(0.03)	(0.02)	(0.03)
Physical	0.04***	0.04**	-0.05***	0.00	0.04***	0.04**	-0.05***	0.00
	(0.01)	(0.02)	(0.02)	(0.02)	(0.01)	(0.02)	(0.02)	(0.02)
Mental	0.03***	0.15***	0.07***	0.08***	0.02*	0.14***	0.07***	0.07***
	(0.01)	(0.02)	(0.02)	(0.02)	(0.01)	(0.02)	(0.02)	(0.02)
Other	0.03***	0.04***	-0.01	0.00	0.03***	0.03***	-0.01	0.00
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
Severity (Ref: Mild)								
Profound	0.30***	0.28***	0.22***	0.22***	0.29***	0.26***	0.23***	0.23***
	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.03)	(0.02)	(0.03)
Severe	0.16***	0.16***	0.33***	0.34***	0.15***	0.15***	0.34***	0.35***
	(0.01)	(0.02)	(0.01)	(0.02)	(0.01)	(0.02)	(0.01)	(0.02)
Moderate	0.02***	0.05***	0.04***	0.05***	0.02***	0.05***	0.04***	0.05***

	Base Model				Extended Model			
	Subjective Unmet Pre-NDIS	Subjective Unmet Need Post-NDIS	Objective Unmet Pre-NDIS	Objective Unmet Need Post-NDIS	Subjective Unmet Pre-NDIS	Subjective Unmet Need Post-NDIS	Objective Unmet Pre-NDIS	Objective Unmet Need Post-NDIS
	(0.01)	(0.01)	(0.01)	(0.02)	0.00	(0.01)	(0.01)	(0.02)
Non-Need Variables Age (Ref: Male 15-24 yr old)								
Female 15 to 24 yrs old	-0.05**	0.07*	-0.10***	0.07	-0.05**	0.07*	-0.10***	0.07
	(0.02)	(0.04)	(0.03)	(0.04)	(0.02)	(0.04)	(0.03)	(0.04)
Female: 25 to 34 yrs old	-0.05**	0.02	-0.09***	-0.03	-0.04*	0.02	-0.09***	-0.03
	(0.02)	(0.04)	(0.03)	(0.04)	(0.02)	(0.04)	(0.03)	(0.04)
Male: 25 to 34 yrs old	-0.07***	-0.06	-0.07**	-0.01	-0.06***	-0.06	-0.07**	0.00
	(0.02)	(0.04)	(0.03)	(0.04)	(0.02)	(0.04)	(0.03)	(0.04)
Female: 35 to 44 yrs old	-0.05**	-0.02	-0.09***	-0.03	-0.04*	-0.02	-0.08***	-0.02
	(0.02)	(0.03)	(0.03)	(0.04)	(0.02)	(0.03)	(0.03)	(0.04)
Male: 35 to 44 yrs old	-0.07***	-0.03	-0.06**	-0.01	-0.06***	-0.03	-0.05*	0.00
	(0.02)	(0.03)	(0.03)	(0.04)	(0.02)	(0.03)	(0.03)	(0.04)
Female: 45 to 54 yrs old	-0.02	-0.01	-0.09***	-0.05	0.00	0.00	-0.08***	-0.05
	(0.02)	(0.03)	(0.03)	(0.04)	(0.02)	(0.03)	(0.03)	(0.04)
Male: 45 to 54 yrs old	-0.03	-0.04	-0.11***	-0.04	-0.01	-0.03	-0.10***	-0.03
	(0.02)	(0.03)	(0.03)	(0.04)	(0.02)	(0.03)	(0.03)	(0.04)
Female: 55 to 64 yrs old	-0.05**	-0.04	-0.10***	-0.07**	-0.03	-0.03	-0.08***	-0.06*
	(0.02)	(0.03)	(0.03)	(0.03)	(0.02)	(0.03)	(0.03)	(0.03)
Male: 55 to 64 yrs old	-0.07***	-0.06*	-0.10***	-0.04	-0.05**	-0.05	-0.08***	-0.03
	(0.02)	(0.03)	(0.03)	(0.03)	(0.02)	(0.03)	(0.03)	(0.04)
Non-English	0.00	0.00	0.02	0.04	0.00	0.00	0.03	0.04
	(0.01)	(0.02)	(0.02)	(0.02)	(0.01)	(0.02)	(0.02)	(0.02)
Bachelor Degree	0.00	0.00	-0.03***	-0.02	0.01	0.02	-0.01	-0.01
	(0.01)	(0.01)	(0.01)	(0.02)	(0.01)	(0.02)	(0.01)	(0.02)
Certificate	-0.01	0.02	-0.02**	-0.01	0.00	0.03**	-0.01	0.00
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.02)

	Base Model				Extended Model			
	Subjective Unmet Pre-NDIS	Subjective Unmet Need Post-NDIS	Objective Unmet Pre-NDIS	Objective Unmet Need Post-NDIS	Subjective Unmet Pre-NDIS	Subjective Unmet Need Post-NDIS	Objective Unmet Pre-NDIS	Objective Unmet Need Post-NDIS
Carer					0.03***	0.03**	-0.02	-0.02
					(0.01)	(0.02)	(0.01)	(0.02)
Married					-0.03***	-0.02	-0.03**	-0.02
					(0.01)	(0.01)	(0.01)	(0.01)
Log Household Equiv. Inc.					-0.01	-0.02**	-0.02***	-0.02*
					0.00	(0.01)	(0.01)	(0.01)
Missing					-0.05	-0.12**	-0.13***	-0.11
					(0.03)	(0.06)	(0.05)	(0.07)
Rent					0.02***	0.02*	0.01	0
					(0.01)	(0.01)	(0.01)	(0.01)
Insurance	-0.01	-0.01	0.00	-0.01	0.00	-0.01	0.00	-0.01
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
State (QLD Reference)								
ACT	-0.02	0.00	-0.01	-0.03	-0.02	0.00	-0.01	-0.03
	(0.01)	(0.02)	(0.02)	(0.03)	(0.01)	(0.02)	(0.02)	(0.03)
NSW	-0.02	0.00	0.00	-0.01	-0.01	0.00	0.00	-0.01
	(0.01)	(0.02)	(0.01)	(0.02)	(0.01)	(0.02)	(0.01)	(0.02)
NT	0.00	0.01	0.00	0.02	0.00	0.01	0.00	0.03
	(0.02)	(0.03)	(0.02)	(0.04)	(0.02)	(0.03)	(0.02)	(0.04)
VIC	-0.01	0.03	0.03*	0.00	-0.01	0.03	0.03*	0.00
	(0.01)	(0.02)	(0.01)	(0.02)	(0.01)	(0.02)	(0.01)	(0.02)
TAS	0.00	0.00	0.03	0.00	0.00	-0.01	0.03	0.01
	(0.01)	(0.02)	(0.02)	(0.03)	(0.01)	(0.02)	(0.02)	(0.03)
WA	0.00	-0.02	0.00	-0.01	0.00	-0.02	0.00	-0.01
	(0.01)	(0.02)	(0.02)	(0.02)	(0.01)	(0.02)	(0.02)	(0.02)
SA	-0.01	0.00	0.00	0.01	-0.01	0.00	0.00	0.01
	(0.01)	(0.02)	(0.02)	(0.02)	(0.01)	(0.02)	(0.02)	(0.02)
City	0.00	0.00	0.03***	0.00	0.00	0.00	0.03***	0.00

	Base Model				Extended Model			
	Subjective Unmet Need Pre-NDIS	Subjective Unmet Need Post-NDIS	Objective Unmet Need Pre-NDIS	Objective Unmet Need Post-NDIS	Subjective Unmet Need Pre-NDIS	Subjective Unmet Need Post-NDIS	Objective Unmet Need Pre-NDIS	Objective Unmet Need Post-NDIS
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
Constant	0.06*	0.06**	0.04	0.19***	0.09**	0.13**	0.32***	0.30***
	(0.03)	(0.03)	(0.03)	(0.04)	(0.04)	(0.07)	(0.06)	(0.08)
Mean	0.1	0.17	0.25	0.27	0.1	0.17	0.25	0.27
N	9,100	4,402	9,100	4,402	9,100	4,402	9,100	4,402
adj. R^2	0.187	0.169	0.189	0.145	0.191	0.171	0.191	0.145

Coefficient represents the percentage point increase in a one unit increase in the explanatory variable or for dummy variables going from 0 to 1.

Robust standard errors in parentheses

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Appendix 3.5:   Probit Model: Adults

	Base Model				Extended Model			
	Subjective Unmet Pre-NDIS	Subjective Unmet Need Post-NDIS	Objective Unmet Pre-NDIS	Objective Unmet Need Post-NDIS	Subjective Unmet Pre-NDIS	Subjective Unmet Need Post-NDIS	Objective Unmet Pre-NDIS	Objective Unmet Need Post-NDIS
Need Variables								
Main Impairment								
Sensory Speech	0.03**	0.01	-0.06***	-0.12***	0.03***	0.01	-0.05***	-0.11***
	(0.01)	(0.02)	(0.02)	(0.03)	(0.01)	(0.02)	(0.02)	(0.03)
Intellectual	-0.04**	0.02	0.15***	0.08***	-0.04**	0.01	0.15***	0.08***
	(0.02)	(0.02)	(0.02)	(0.03)	(0.02)	(0.02)	(0.02)	(0.03)
Mental	-0.02*	0.13***	0.21***	0.14***	-0.03**	0.12***	0.21***	0.13***
	(0.01)	(0.02)	(0.02)	(0.02)	(0.01)	(0.02)	(0.02)	(0.02)
Other Impairment	0.01	0.03	0.05***	-0.02	0.01	0.03	0.05***	-0.02
	(0.01)	(0.04)	(0.01)	(0.05)	(0.01)	(0.04)	(0.02)	(0.05)
Additional Impairments								
Sensory Speech	0.04***	0.03**	-0.06***	-0.09***	0.04***	0.03**	-0.06***	-0.09***
	(0.01)	(0.02)	(0.01)	(0.02)	(0.01)	(0.02)	(0.01)	(0.02)
Intellectual	0.01	0.01	0.03*	0.04	0.00	0.01	0.03*	0.04
	(0.01)	(0.02)	(0.02)	(0.03)	(0.01)	(0.02)	(0.02)	(0.03)
Physical	0.03***	0.03**	-0.04***	0.01	0.03***	0.02*	-0.04***	0.00
	(0.01)	(0.01)	(0.01)	(0.02)	(0.01)	(0.01)	(0.01)	(0.02)
Mental	0.02**	0.12***	0.07***	0.07***	0.01	0.11***	0.06***	0.07***
	(0.01)	(0.01)	(0.01)	(0.02)	(0.01)	(0.01)	(0.01)	(0.02)
Other	0.03***	0.05***	0.00	0.00	0.03***	0.04***	0.00	0.00
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
Severity (Ref: Mild)								
Profound	0.22***	0.22***	0.20***	0.20***	0.21***	0.20***	0.21***	0.21***
	(0.01)	(0.02)	(0.01)	(0.02)	(0.01)	(0.02)	(0.01)	(0.02)
Severe	0.16***	0.16***	0.29***	0.29***	0.16***	0.15***	0.29***	0.29***

	Base Model				Extended Model			
	Subjective Unmet Pre-NDIS	Subjective Unmet Need Post-NDIS	Objective Unmet Pre-NDIS	Objective Unmet Need Post-NDIS	Subjective Unmet Pre-NDIS	Subjective Unmet Need Post-NDIS	Objective Unmet Pre-NDIS	Objective Unmet Need Post-NDIS
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.02)
Moderate	0.06***	0.08***	0.05***	0.06***	0.05***	0.08***	0.05***	0.06***
	(0.01)	(0.01)	(0.01)	(0.02)	(0.01)	(0.01)	(0.01)	(0.02)
Non-Need Variables								
Age (Ref: Male 15-24 yr old)								
Female 15 to 24 yrs old	-0.04*	0.06*	-0.08***	0.06	-0.04*	0.06**	-0.08***	0.06*
	(0.02)	(0.03)	(0.03)	(0.04)	(0.02)	(0.03)	(0.03)	(0.04)
Female: 25 to 34 yrs old	-0.04**	0.01	-0.07***	-0.03	-0.03*	0.02	-0.07***	-0.02
	(0.02)	(0.03)	(0.03)	(0.04)	(0.02)	(0.03)	(0.03)	(0.04)
Male: 25 to 34 yrs old	-0.06***	-0.05	-0.06**	-0.01	-0.05***	-0.05	-0.05**	0.00
	(0.02)	(0.03)	(0.03)	(0.04)	(0.02)	(0.03)	(0.03)	(0.04)
Female: 35 to 44 yrs old	-0.04**	-0.02	-0.08***	-0.02	-0.02	-0.01	-0.07***	-0.02
	(0.02)	(0.03)	(0.02)	(0.03)	(0.02)	(0.03)	(0.02)	(0.03)
Male: 35 to 44 yrs old	-0.06***	-0.03	-0.05*	0.00	-0.05***	-0.02	-0.04	0.00
	(0.02)	(0.03)	(0.03)	(0.04)	(0.02)	(0.03)	(0.03)	(0.04)
Female: 45 to 54 yrs old	-0.01	0.00	-0.07***	-0.05	0.01	0.01	-0.06***	-0.04
	(0.01)	(0.03)	(0.02)	(0.03)	(0.01)	(0.03)	(0.02)	(0.03)
Male: 45 to 54 yrs old	-0.02	-0.03	-0.09***	-0.04	0.00	-0.02	-0.08***	-0.03
	(0.01)	(0.03)	(0.02)	(0.03)	(0.02)	(0.03)	(0.02)	(0.03)
Female: 55 to 64 yrs old	-0.03**	-0.04	-0.08***	-0.06**	-0.01	-0.02	-0.07***	-0.05*
	(0.01)	(0.02)	(0.02)	(0.03)	(0.01)	(0.02)	(0.02)	(0.03)
Male: 55 to 64 yrs old	-0.05***	-0.05**	-0.09***	-0.04	-0.03**	-0.04	-0.07***	-0.03
	(0.01)	(0.03)	(0.02)	(0.03)	(0.02)	(0.03)	(0.02)	(0.03)
Non-English	0.00	0.00	0.02	0.03	0.00	0.00	0.03	0.03
	(0.01)	(0.02)	(0.02)	(0.02)	(0.01)	(0.02)	(0.02)	(0.02)
Bachelor Degree	0.00	0.00	-0.03**	-0.02	0.01	0.02	-0.01	-0.01
	(0.01)	(0.01)	(0.01)	(0.02)	(0.01)	(0.02)	(0.01)	(0.02)
Certificate	-0.01	0.02	-0.02**	-0.01	0.00	0.03**	-0.01	0.00

	Base Model				Extended Model			
	Subjective Unmet Pre-NDIS	Subjective Unmet Need Post-NDIS	Objective Unmet Pre-NDIS	Objective Unmet Need Post-NDIS	Subjective Unmet Pre-NDIS	Subjective Unmet Need Post-NDIS	Objective Unmet Pre-NDIS	Objective Unmet Need Post-NDIS
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
Carer					0.02***	0.04***	-0.01	-0.01
					(0.01)	(0.01)	(0.01)	(0.02)
Married					-0.03***	-0.02	-0.03***	-0.02
					(0.01)	(0.01)	(0.01)	(0.01)
Log Household Equiv. Inc.					-0.01*	-0.02**	-0.02***	-0.02**
					0.00	(0.01)	(0.01)	(0.01)
Missing					-0.06**	-0.15**	-0.14***	-0.12*
					(0.03)	(0.06)	(0.05)	(0.07)
Rent					0.02**	0.02**	0.01	0
					(0.01)	(0.01)	(0.01)	(0.01)
Insurance	-0.01	-0.02	0.00	-0.01	0.00	-0.01	0.00	-0.01
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
State (QLD Reference)								
ACT	-0.02	-0.01	-0.01	-0.04	-0.02	-0.01	-0.01	-0.03
	(0.01)	(0.03)	(0.02)	(0.03)	(0.01)	(0.03)	(0.02)	(0.03)
NSW	-0.01*	0.01	0.00	-0.01	-0.01	0.00	0.00	-0.01
	(0.01)	(0.02)	(0.01)	(0.02)	(0.01)	(0.02)	(0.01)	(0.02)
NT	-0.01	0.01	0.00	0.02	-0.01	0.02	0.00	0.03
	(0.02)	(0.03)	(0.03)	(0.04)	(0.02)	(0.03)	(0.03)	(0.04)
VIC	-0.01	0.03*	0.02*	0.00	0.00	0.03*	0.02*	0.00
	(0.01)	(0.02)	(0.01)	(0.02)	(0.01)	(0.02)	(0.01)	(0.02)
TAS	0.00	0.00	0.03	0.01	0.00	0.00	0.03	0.01
	(0.01)	(0.02)	(0.02)	(0.03)	(0.01)	(0.02)	(0.02)	(0.03)
WA	0.00	-0.01	0.00	-0.01	0.00	-0.02	0.00	-0.01
	(0.01)	(0.02)	(0.02)	(0.02)	(0.01)	(0.02)	(0.02)	(0.02)
SA	-0.02	0.00	0.00	0.01	-0.02	0.00	0.00	0.01
	(0.01)	(0.02)	(0.02)	(0.02)	(0.01)	(0.02)	(0.02)	(0.02)

	Base Model				Extended Model			
	Subjective Unmet Pre-NDIS	Subjective Unmet Need Post-NDIS	Objective Unmet Pre-NDIS	Objective Unmet Need Post-NDIS	Subjective Unmet Pre-NDIS	Subjective Unmet Need Post-NDIS	Objective Unmet Pre-NDIS	Objective Unmet Need Post-NDIS
City	0.00	0.00	0.03**	0.00	0.00	0.01	0.03**	0.00
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
N	9,100	4,402	9,100	4,402	9,100	4,402	9,100	4,402
Adjusted R2	0.155	0.169	0.159	0.145	0.159	0.171	0.162	0.145

Marginal effects reported

Robust standard errors in parentheses

[*] $p < 0.1$, [**] $p < 0.05$, [***] $p < 0.01$

	Base Model				Extended Model			
	Subjective Unmet Pre-NDIS	Subjective Unmet Need Post-NDIS	Objective Unmet Pre-NDIS	Objective Unmet Need Post-NDIS	Subjective Unmet Pre-NDIS	Subjective Unmet Need Post-NDIS	Objective Unmet Pre-NDIS	Objective Unmet Need Post-NDIS
Need Variables								
Main Impairment								
Sensory Speech	0.13***	0.05	0.17***	-0.08	0.13***	0.05	0.17***	-0.08
	(0.04)	(0.05)	(0.04)	(0.06)	(0.04)	(0.05)	(0.04)	(0.06)
Intellectual	0.05	0.09*	0.27***	0.06	0.05	0.09*	0.27***	0.05
	(0.04)	(0.05)	(0.04)	(0.05)	(0.04)	(0.05)	(0.04)	(0.05)
Mental	0.09*	0.12	0.37***	0.23***	0.08*	0.12	0.38***	0.22***
	(0.04)	(0.08)	(0.05)	(0.07)	(0.05)	(0.08)	(0.05)	(0.07)
Other Impairment	-0.02	-0.28*	0.17***	0.28***	-0.02	-0.24*	0.17***	0.22*
	(0.05)	(0.14)	(0.06)	(0.10)	(0.05)	(0.14)	(0.06)	(0.11)
Additional Impairments								
Sensory Speech	0.18***	0.14***	-0.07**	-0.06	0.18***	0.13***	-0.06*	-0.07
	(0.03)	(0.05)	(0.03)	(0.05)	(0.03)	(0.05)	(0.03)	(0.05)
Intellectual	-0.01	-0.05	0.01	0.02	-0.01	-0.05	0.01	0.01
	(0.03)	(0.04)	(0.03)	(0.04)	(0.03)	(0.04)	(0.03)	(0.04)
Physical	0.09**	0.19***	-0.10**	-0.19***	0.09**	0.17***	-0.09**	-0.17***
	(0.04)	(0.05)	(0.05)	(0.06)	(0.04)	(0.05)	(0.05)	(0.06)
Mental	0.06	0.14***	(0.03)	0.08*	0.06	0.14***	(0.03)	0.07
	(0.04)	(0.05)	(0.04)	(0.05)	(0.04)	(0.05)	(0.04)	(0.05)
Other	0.06*	0.04	-0.08**	-0.17***	0.06*	0.04	-0.08**	-0.17***
	(0.04)	(0.05)	(0.04)	(0.05)	(0.04)	(0.05)	(0.04)	(0.05)
Severity (Ref: Mild)								
Profound	0.42***	0.39***	0.37***	0.42***	0.41***	0.34***	0.38***	0.43***
	(0.03)	(0.05)	(0.04)	(0.05)	(0.03)	(0.06)	(0.04)	(0.06)
Severe	0.20***	0.17***	0.47***	0.46***	0.19***	0.13***	0.48***	0.47***
	(0.03)	(0.04)	(0.04)	(0.05)	(0.03)	(0.05)	(0.04)	(0.05)
Moderate	-0.06**	(0.05)	0.11	0.09	-0.06**	(0.04)	0.11	0.08

	Base Model				**Extended Model**			
	Subjective Unmet Pre-NDIS	Subjective Unmet Need Post-NDIS	Objective Unmet Pre-NDIS	Objective Unmet Need Post-NDIS	Subjective Unmet Pre-NDIS	Subjective Unmet Need Post-NDIS	Objective Unmet Pre-NDIS	Objective Unmet Need Post-NDIS
	(0.03)	(0.06)	(0.07)	(0.09)	(0.03)	(0.06)	(0.07)	(0.09)
Non-Need Variables								
Age (Ref: Female: 0 to 4 yr old)								
Male: 0 to 4 years old	-0.05	0.06	0.02	0.04	-0.05	0.07	0.01	0.06
	(0.06)	(0.10)	(0.06)	(0.10)	(0.06)	(0.10)	(0.07)	(0.10)
Female: 5 to 9 years old	-0.11*	0.04	-0.07	0.16	-0.11*	0.04	-0.07	0.19**
	(0.06)	(0.09)	(0.06)	(0.10)	(0.06)	(0.09)	(0.06)	(0.10)
Male: 5 to 9 years old	-0.09	0.07	0.03	0.05	-0.09	0.07	0.03	0.08
	(0.06)	(0.09)	(0.06)	(0.09)	(0.06)	(0.09)	(0.06)	(0.09)
Female: 10 to 14 years old	-0.07	0.09	-0.03	0.06	-0.07	0.09	-0.03	0.10
	(0.06)	(0.09)	(0.06)	(0.10)	(0.06)	(0.10)	(0.06)	(0.10)
Male: 10 to 14 years old	-0.05	0.14	-0.01	0.14	-0.05	0.14	-0.01	0.17*
	(0.06)	(0.09)	(0.06)	(0.09)	(0.06)	(0.09)	(0.06)	(0.09)
Non-English	-0.03	-0.19**	-0.07	0.00	-0.03	-0.19*	-0.07	-0.02
	(0.07)	(0.09)	(0.08)	(0.11)	(0.07)	(0.10)	(0.08)	(0.11)
Bachelor Degree	-0.02	0.05	-0.07**	0.03	-0.01	0.05	-0.04	0.08
	(0.03)	(0.05)	(0.03)	(0.05)	(0.03)	(0.05)	(0.04)	(0.05)
Certificate	-0.01	0.07	-0.05*	0.06	0.00	0.07*	-0.04	0.08*
	(0.03)	(0.04)	(0.03)	(0.05)	(0.03)	(0.04)	(0.03)	(0.05)
Carer					0.03	0.09**	-0.04	-0.02
					(0.03)	(0.04)	(0.03)	(0.04)
Log Household Equiv. Inc.					-0.02	0.01	-0.02	-0.02
					(0.02)	(0.03)	(0.02)	(0.04)
Missing					-0.15	0.01	-0.18	-0.07
					(0.15)	(0.21)	(0.15)	(0.23)
Rent					-0.01	0.03	0.04	0.11***
					(0.03)	(0.04)	(0.03)	(0.04)

	Base Model				Extended Model			
	Subjective Unmet Pre-NDIS	Subjective Unmet Need Post-NDIS	Objective Unmet Pre-NDIS	Objective Unmet Need Post-NDIS	Subjective Unmet Pre-NDIS	Subjective Unmet Need Post-NDIS	Objective Unmet Pre-NDIS	Objective Unmet Need Post-NDIS
Insurance	-0.06	-0.11	-0.11	0.08	-0.05	-0.09	-0.11	0.07
	(0.11)	(0.11)	(0.10)	(0.16)	(0.11)	(0.12)	(0.10)	(0.16)
State (QLD Reference)								
ACT	-0.10*	-0.20**	-0.10*	0.11	-0.11**	-0.22***	-0.09*	0.12
	(0.05)	(0.08)	(0.05)	(0.08)	(0.05)	(0.08)	(0.05)	(0.09)
NSW	0.02	-0.06	-0.03	0.06	0.02	-0.06	-0.03	0.06
	(0.04)	(0.05)	(0.04)	(0.05)	(0.04)	(0.05)	(0.04)	(0.05)
NT	-0.11*	-0.07	0.06	-0.04	-0.11	-0.09	0.08	-0.05
	(0.07)	(0.09)	(0.08)	(0.09)	(0.07)	(0.09)	(0.08)	(0.09)
VIC	-0.02	-0.12**	0.02	0.01	-0.02	-0.13**	0.03	0.02
	(0.04)	(0.05)	(0.04)	(0.06)	(0.04)	(0.05)	(0.04)	(0.06)
TAS	-0.06	0.02	0.06	-0.06	-0.06	0.00	0.07	-0.06
	(0.05)	(0.07)	(0.06)	(0.07)	(0.05)	(0.07)	(0.06)	(0.07)
WA	-0.04	0.01	-0.01	-0.01	-0.05	0.00	0.01	-0.02
	(0.04)	(0.06)	(0.05)	(0.06)	(0.04)	(0.06)	(0.05)	(0.06)
SA	0.04	0.04	-0.04	-0.04	0.04	0.04	-0.03	-0.04
	(0.04)	(0.06)	(0.05)	(0.06)	(0.04)	(0.06)	(0.05)	(0.06)
City	0.08***	-0.04	0.06**	-0.05	0.09***	-0.04	0.06**	-0.05
	(0.03)	(0.04)	(0.03)	(0.04)	(0.03)	(0.04)	(0.03)	(0.04)
Constant	0.01	0.04	0.12	0.18	0.16	-0.04	0.25	0.20
	(0.07)	(0.11)	(0.07)	(0.11)	(0.16)	(0.23)	(0.16)	(0.25)
Mean	0.34	0.46	0.59	0.59	0.34	0.46	0.59	0.59
N	1303	720	1303	720	1303	720	1303	720
adj. R^2	0.247	0.266	0.201	0.174	0.247	0.266	0.201	0.174

Standard errors in parentheses $^*\ p < 0.1,\ ^{**}\ p < 0.05,\ ^{***}\ p < 0.01$

Appendix 3.7: Probit Model: Children

	Base Model				Extended Model			
	Subjective Unmet Pre-NDIS	Subjective Unmet Need Post-NDIS	Objective Unmet Pre-NDIS	Objective Unmet Need Post-NDIS	Subjective Unmet Pre-NDIS	Subjective Unmet Need Post-NDIS	Objective Unmet Pre-NDIS	Objective Unmet Need Post-NDIS
Need Variables								
Main Impairment								
Sensory Speech	0.14***	0.04	0.16***	-0.08	0.14***	0.04	0.16***	-0.08
	(0.04)	(0.05)	(0.04)	(0.05)	(0.04)	(0.05)	(0.04)	(0.05)
Intellectual	0.07*	0.08*	0.25***	0.05	0.07*	0.08*	0.25***	0.05
	(0.04)	(0.05)	(0.04)	(0.05)	(0.04)	(0.05)	(0.04)	(0.05)
Mental	0.10**	0.11	0.35***	0.25***	0.09**	0.11*	0.36***	0.24***
	(0.04)	(0.07)	(0.05)	(0.08)	(0.04)	(0.07)	(0.05)	(0.08)
Other Impairment	-0.01	-0.26*	0.16***	0.00	-0.01	-0.23	0.17***	0.00
	(0.06)	(0.15)	(0.06)	(.)	(0.06)	(0.15)	(0.06)	(.)
Additional Impairments								
Sensory Speech	0.15***	0.13***	-0.07*	-0.07	0.15***	0.12***	-0.06*	-0.08
	(0.03)	(0.04)	(0.03)	(0.05)	(0.03)	(0.04)	(0.03)	(0.05)
Intellectual	-0.01	-0.04	0.01	0.02	0.00	-0.04	0.01	0.01
	(0.02)	(0.04)	(0.03)	(0.04)	(0.02)	(0.04)	(0.03)	(0.04)
Physical	0.06*	0.19***	-0.09**	-0.18***	0.06*	0.17***	-0.09**	-0.16***
	(0.04)	(0.06)	(0.04)	(0.05)	(0.04)	(0.06)	(0.04)	(0.05)
Mental	0.04	0.13***	(0.03)	0.08*	0.04	0.12***	(0.03)	0.08*
	(0.03)	(0.04)	(0.04)	(0.05)	(0.03)	(0.04)	(0.04)	(0.05)
Other	0.06**	0.04	-0.07**	-0.17***	0.06**	0.04	-0.07**	-0.17***
	(0.03)	(0.05)	(0.04)	(0.05)	(0.03)	(0.05)	(0.04)	(0.05)
Severity (Ref: Mild)								
Profound	0.52***	0.35***	0.34***	0.39***	0.50***	0.30***	0.35***	0.40***
	(0.05)	(0.04)	(0.03)	(0.05)	(0.05)	(0.05)	(0.04)	(0.05)
Severe	0.35***	0.16***	0.43***	0.43***	0.34***	0.12***	0.44***	0.44***
	(0.05)	(0.04)	(0.03)	(0.04)	(0.05)	(0.05)	(0.03)	(0.04)

	Base Model				Extended Model			
	Subjective Unmet Pre-NDIS	Subjective Unmet Need Post-NDIS	Objective Unmet Pre-NDIS	Objective Unmet Need Post-NDIS	Subjective Unmet Pre-NDIS	Subjective Unmet Need Post-NDIS	Objective Unmet Pre-NDIS	Objective Unmet Need Post-NDIS
Moderate	(0.06)	(0.08)	0.11*	0.09	(0.06)	(0.07)	0.11*	0.08
	(0.12)	(0.09)	(0.06)	(0.08)	(0.12)	(0.09)	(0.06)	(0.08)
Non-Need Variables								
Age (Ref: Female: 0 to 4 yr old)								
Male: 0 to 4 years old	-0.04	0.05	0.02	0.03	-0.04	0.06	0.01	0.05
	(0.05)	(0.09)	(0.06)	(0.09)	(0.05)	(0.09)	(0.06)	(0.09)
Female: 5 to 9 years old	-0.10**	0.03	-0.07	0.15*	-0.10**	0.02	-0.07	0.19**
	(0.05)	(0.08)	(0.06)	(0.09)	(0.05)	(0.08)	(0.06)	(0.09)
Male: 5 to 9 years old	-0.07	0.06	0.03	0.03	-0.07	0.06	0.03	0.07
	(0.05)	(0.08)	(0.05)	(0.08)	(0.05)	(0.08)	(0.05)	(0.08)
Female: 10 to 14 years old	-0.06	0.08	-0.03	0.05	-0.06	0.08	-0.03	0.08
	(0.05)	(0.08)	(0.06)	(0.09)	(0.05)	(0.09)	(0.06)	(0.09)
Male: 10 to 14 years old	-0.03	0.12	-0.01	0.13	-0.03	0.12	-0.01	0.16*
	(0.05)	(0.08)	(0.05)	(0.08)	(0.05)	(0.08)	(0.05)	(0.08)
Non-English	-0.03	-0.19**	-0.06	0.00	-0.03	-0.20**	-0.06	-0.01
	(0.06)	(0.10)	(0.07)	(0.10)	(0.07)	(0.10)	(0.07)	(0.10)
Bachelor Degree	-0.02	0.04	-0.07**	0.03	0.00	0.05	-0.04	0.08
	(0.03)	(0.04)	(0.03)	(0.05)	(0.03)	(0.05)	(0.04)	(0.05)
Certificate	0.00	0.06	-0.05*	0.06	0.00	0.07	-0.03	0.07*
	(0.03)	(0.04)	(0.03)	(0.04)	(0.03)	(0.04)	(0.03)	(0.04)
Carer					0.03	0.09**	-0.04	-0.02
					(0.02)	(0.04)	(0.03)	(0.04)
Log Household Equiv. Inc.					-0.02	0.01	-0.02	-0.01
					(0.02)	(0.03)	(0.02)	(0.03)
Missing					-0.15	0.01	-0.18	-0.02
					(0.14)	(0.21)	(0.15)	(0.22)
Rent					-0.01	0.03	0.04	0.11***

	Base Model				Extended Model			
	Subjective Unmet Pre-NDIS	Subjective Unmet Need Post-NDIS	Objective Unmet Pre-NDIS	Objective Unmet Need Post-NDIS	Subjective Unmet Pre-NDIS	Subjective Unmet Need Post-NDIS	Objective Unmet Pre-NDIS	Objective Unmet Need Post-NDIS
					(0.03)	(0.03)	(0.03)	(0.04)
Insurance	-0.05	-0.14	-0.12	0.08	-0.05	-0.11	-0.12	0.05
	(0.11)	(0.13)	(0.10)	(0.17)	(0.11)	(0.13)	(0.10)	(0.16)
State (QLD Reference)								
ACT	-0.10**	-0.19**	-0.11**	0.13	-0.11**	-0.21**	-0.10*	0.15*
	(0.05)	(0.09)	(0.05)	(0.09)	(0.05)	(0.09)	(0.05)	(0.09)
NSW	0.02	-0.06	-0.04	0.06	0.02	-0.06	-0.04	0.06
	(0.04)	(0.05)	(0.04)	(0.05)	(0.04)	(0.05)	(0.04)	(0.05)
NT	-0.14*	-0.08	0.05	-0.04	-0.14*	-0.09	0.07	-0.05
	(0.08)	(0.08)	(0.09)	(0.08)	(0.08)	(0.08)	(0.09)	(0.08)
VIC	-0.02	-0.12**	0.02	0.01	-0.03	-0.12**	0.03	0.02
	(0.04)	(0.05)	(0.04)	(0.06)	(0.04)	(0.05)	(0.04)	(0.06)
TAS	-0.06	0.01	0.05	-0.07	-0.06	-0.01	0.06	-0.06
	(0.05)	(0.07)	(0.06)	(0.07)	(0.05)	(0.07)	(0.05)	(0.07)
WA	-0.05	0.01	-0.01	-0.01	-0.05	0.00	0.01	-0.01
	(0.04)	(0.06)	(0.05)	(0.06)	(0.04)	(0.06)	(0.05)	(0.06)
SA	0.04	0.04	-0.04	-0.03	0.04	0.04	-0.03	-0.04
	(0.04)	(0.06)	(0.05)	(0.06)	(0.04)	(0.06)	(0.05)	(0.06)
City	0.08***	-0.05	0.06**	-0.05	0.08***	-0.04	0.06**	-0.06
	(0.03)	(0.04)	(0.03)	(0.04)	(0.03)	(0.04)	(0.03)	(0.04)
N	1303	720	1303	715	1303	720	1303	715
Adj. R2	0.247	0.2381	0.1719	0.1548	0.2487	0.2458	0.1753	0.167

Marginal Effects Reported

Standard errors in parentheses

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Appendix 3.8:   Oaxaca Decomposition – Detailed Results – Adults

	Endowments				Coefficients				Interaction			
	Base Model		Expanded Model		Base Model		Expanded Model		Base Model		Expanded Model	
	LPM	Probit	LPM	Probit	LPM	Probit	LPM	Probit	LPM	Probit	LPM	Probit
Need Variables												
Main Impairment (Ref: Physical)												
Sensory Speech	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Intellectual	0.00	0.00	0.00	0.00	0.003*	0.003**	0.003*	0.002**	0.00	0.00	0.00	0.00
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Mental	0.00	0.00	0.00	0.00	0.019***	0.011***	0.019***	0.011***	0.00	0.00	0.00	0.00
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Other Impairment	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-0.01
	(0.00)	(0.00)	(0.00)	(0.00)	(0.01)	(0.00)	(0.01)	(0.00)	(0.01)	(0.01)	(0.01)	(0.01)
Additional Impairments												
Sensory Speech	0.00	0.00	0.00	0.00	(0.00)	(0.00)	(0.00)	(0.00)	0.00	0.00	0.00	0.00
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Intellectual	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Physical	0.002***	0.002***	0.002***	0.002***	0.00	(0.00)	0.00	(0.00)	0.00	(0.00)	0.00	(0.00)
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Mental	0.003***	0.003**	0.002**	0.00	0.014***	0.007***	0.014***	0.007***	0.010***	0.013**	0.010***	0.02
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.01)	(0.00)	(0.01)
Other	0.003***	0.005***	0.002***	0.004***	0.00	0.00	0.00	(0.00)	0.00	0.00	0.00	(0.00)
	(0.00)	(0.00)	(0.00)	(0.00)	(0.01)	(0.00)	(0.01)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Severity (Ref: Mild)												
Profound	0.00	0.00	0.00	0.00	0.00	-0.008***	0.00	-0.009***	0.00	0.00	0.00	0.00
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Severe	0.00	0.00	0.00	0.00	0.00	-0.013***	0.00	-0.013***	0.00	0.00	0.00	0.00
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Moderate	-0.000*	-0.002*	0.00	-0.001*	0.008**	0.00	0.008**	0.00	0.00	0.00	0.00	0.00
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Non-Need Variable												
Age (Ref: Male 15-24 yr old)												
Female 15 to 24 yrs old	0.00	0.00	0.00	0.00	0.005***	0.003***	0.005***	0.003***	0.00	0.00	0.00	0.00
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)

	Endowments				Coefficients				Interaction			
	Base Model		Expanded Model		Base Model		Expanded Model		Base Model		Expanded Model	
	LPM	Probit	LPM	Probit	LPM	Probit	LPM	Probit	LPM	Probit	LPM	Probit
Female: 25 to 34 yrs old	0.00	0.00	0.00	0.00	0.003*	0.002*	0.00	0.00	0.00	0.00	0.00	0.00
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Male: 25 to 34 yrs old	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Female: 35 to 44 yrs old	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Male: 35 to 44 yrs old	0.00	0.00	0.00	0.00	0.00	0.003*	0.00	0.00	0.00	0.00	0.00	0.00
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Female: 45 to 54 yrs old	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	(0.00)	(0.00)	(0.00)	(0.00)	(0.01)	(0.00)	(0.01)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Male: 45 to 54 yrs old	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Female: 55 to 64 yrs old	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	(0.00)	(0.00)	(0.00)	(0.00)	(0.01)	(0.01)	(0.01)	(0.01)	(0.00)	(0.00)	(0.00)	(0.00)
Male: 55 to 64 yrs old	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	(0.01)	(0.00)	(0.01)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Non-English	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Bachelor Degree	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Certificate	0.00	0.00	0.00	0.00	0.010*	0.007*	0.010*	0.01	0.001*	0.00	0.001*	0.00
	(0.00)	(0.00)	(0.00)	(0.00)	(0.01)	(0.00)	(0.01)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Carer	0.00	0.00	0.002***	0.003***	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Married	0.00	0.00	0.001***	0.002***	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.01)	(0.01)	(0.00)	(0.00)	(0.00)	(0.00)
Log Household Equiv. Inc.	0.00	0.00	0.00	0.00	0.00	0.00	-0.06	-0.03	0.00	0.00	0.00	0.00
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.05)	(0.04)	(0.00)	(0.00)	(0.00)	(0.00)
Missing	0.00	0.00	0.00	0.00	0.00	0.00	-0.01	-0.01	0.00	0.00	0.00	0.00
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)

	Endowments				Coefficients				Interaction			
	Base Model		Expanded Model		Base Model		Expanded Model		Base Model		Expanded Model	
	LPM	Probit	LPM	Probit	LPM	Probit	LPM	Probit	LPM	Probit	LPM	Probit
Rent	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.01)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Insurance	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
State (QLD Reference)												
ACT	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
NSW	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	(0.00)	(0.00)	(0.00)	(0.00)	(0.01)	(0.00)	(0.01)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
NT	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
VIC	0.00	0.00	0.00	0.00	0.006*	0.005*	0.01	0.01	0.00	0.00	0.00	0.00
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
TAS	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
WA	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
SA	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
City	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00
	(0.00)	(0.00)	(0.00)	(0.00)	(0.01)	(0.01)	(0.01)	(0.01)	(0.00)	(0.00)	(0.00)	(0.00)

Standard errors in parentheses

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Appendix 3.9:   Oaxaca Decomposition – Detailed Results – Children

	Endowments				Coefficients				Interaction			
	Base Model		Expanded Model		Base Model		Expanded Model		Base Model		Expanded Model	
	LPM	Probit	LPM	Probit	LPM	Probit	LPM	Probit	LPM	Probit	LPM	Probit
Need Variables												
Main Impairment (Ref: Physical)												
Sensory Speech	0.00	0.00	0.00	0.00	-0.02	-0.02	-0.02	-0.02	0.00	0.00	0.00	0.00
	(0.00)	(0.00)	(0.00)	(0.00)	(0.02)	(0.01)	(0.02)	(0.01)	(0.00)	(0.00)	(0.00)	(0.00)
Intellectual	0.00	0.00	0.00	0.00	0.02	0.00	0.02	0.00	0.00	0.00	0.00	0.00
	(0.00)	(0.00)	(0.00)	(0.00)	(0.03)	(0.02)	(0.03)	(0.02)	(0.00)	(0.00)	(0.00)	(0.00)
Mental	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	(0.00)	(0.00)	(0.00)	(0.00)	(0.01)	(0.01)	(0.01)	(0.01)	(0.00)	(0.00)	(0.00)	(0.00)
Other Impairment	0.00	0.00	0.00	0.00	-0.02	-0.01	-0.02	-0.01	0.02	0.01	0.01	0.01
	(0.00)	(0.00)	(0.00)	(0.00)	(0.01)	(0.01)	(0.02)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
Additional Impairment												
Sensory Speech	0.01	0.00	0.01	0.00	-0.01	-0.01	-0.01	-0.01	0.00	0.00	0.00	0.00
	(0.00)	(0.00)	(0.00)	(0.00)	(0.01)	(0.01)	(0.01)	(0.01)	(0.00)	(0.00)	(0.00)	(0.00)
Intellectual	0.00	0.00	0.00	0.00	-0.01	-0.01	-0.02	-0.01	0.00	0.00	0.00	0.00
	(0.00)	(0.00)	(0.00)	(0.00)	(0.02)	(0.01)	(0.02)	(0.01)	(0.00)	(0.00)	(0.00)	(0.00)
Physical	0.00	0.00	0.00	0.00	0.01	0.008*	0.01	0.01	0.00	0.00	0.00	0.00
	(0.00)	(0.00)	(0.00)	(0.00)	(0.01)	(0.01)	(0.01)	(0.01)	(0.00)	(0.00)	(0.00)	(0.00)
Mental	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.02	0.01	0.02	0.02
	(0.01)	(0.01)	(0.01)	(0.00)	(0.01)	(0.01)	(0.01)	(0.00)	(0.01)	(0.01)	(0.01)	(0.01)
Other	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	(0.00)	(0.00)	(0.00)	(0.00)	(0.01)	(0.01)	(0.01)	(0.01)	(0.00)	(0.00)	(0.00)	(0.00)
Severity (Ref: Mild)												
Profound	0.00	0.00	0.00	0.00	-0.01	-0.060***	-0.03	-0.062***	0.00	0.00	0.00	0.00
	(0.01)	(0.01)	(0.01)	(0.01)	(0.03)	(0.02)	(0.03)	(0.02)	(0.00)	(0.01)	(0.00)	(0.01)
Severe	-0.01	-0.01	0.00	-0.01	-0.01	-0.052***	-0.02	-0.052***	0.00	0.01	0.00	0.01
	(0.00)	(0.01)	(0.00)	(0.01)	(0.02)	(0.01)	(0.02)	(0.01)	(0.00)	(0.01)	(0.00)	(0.01)
Moderate	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.01)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Non-Need Variables												
Age (Ref: Female: 0 to 4 yr old)												
Male: 0 to 4 years old	0.00	0.00	0.00	0.00	0.01	0.01	0.01	0.01	0.00	0.00	0.00	0.00
	(0.00)	(0.00)	(0.00)	(0.00)	(0.01)	(0.01)	(0.01)	(0.01)	(0.00)	(0.00)	(0.00)	(0.00)

	Endowments				Coefficients				Interaction			
	Base Model		Expanded Model		Base Model		Expanded Model		Base Model		Expanded Model	
	LPM	Probit	LPM	Probit	LPM	Probit	LPM	Probit	LPM	Probit	LPM	Probit
Female: 5 to 9 years old	0.00	0.00	0.00	0.00	0.02	0.01	0.02	0.01	0.00	0.00	0.00	0.00
	(0.00)	(0.00)	(0.00)	(0.00)	(0.02)	(0.01)	(0.02)	(0.01)	(0.00)	(0.00)	(0.00)	(0.00)
Male: 5 to 9 years old	0.00	0.00	0.00	0.00	0.047*	0.03	0.047*	0.02	0.00	0.00	0.00	0.00
	(0.00)	(0.00)	(0.00)	(0.00)	(0.03)	(0.02)	(0.03)	(0.02)	(0.00)	(0.00)	(0.00)	(0.00)
Female: 10 to 14 years old	0.00	0.00	0.00	0.00	0.02	0.01	0.02	0.01	0.00	0.00	0.00	0.00
	(0.00)	(0.00)	(0.00)	(0.00)	(0.02)	(0.01)	(0.02)	(0.01)	(0.00)	(0.00)	(0.00)	(0.00)
Male: 10 to 14 years old	0.00	0.00	0.00	0.00	0.051*	0.03	0.052*	0.03	0.00	0.00	0.00	0.00
	(0.00)	(0.00)	(0.00)	(0.00)	(0.03)	(0.02)	(0.03)	(0.02)	(0.00)	(0.00)	(0.00)	(0.00)
Non-English	0.00	0.00	0.00	0.00	-0.01	0.00	-0.01	0.00	0.00	0.00	0.00	0.00
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Bachelor Degree												
	(0.00)	(0.00)	(0.00)	(0.00)	(0.02)	(0.01)	(0.02)	(0.01)	(0.00)	(0.00)	(0.00)	(0.00)
Certificate	0.00	0.00	0.00	0.00	-0.02	-0.01	-0.02	-0.01	0.00	0.00	0.00	0.00
	(0.00)	(0.00)	(0.00)	(0.00)	(0.03)	(0.02)	(0.03)	(0.02)	(0.00)	(0.00)	(0.00)	(0.00)
Carer	0.00	0.00	0.01	0.01	0.00	0.00	0.03	0.01	0.00	0.00	0.01	0.01
	(0.00)	(0.00)	(0.01)	(0.00)	(0.00)	(0.00)	(0.02)	(0.01)	(0.00)	(0.00)	(0.01)	(0.01)
Log Household Equiv. Inc.	0.00	0.00	0.01	0.01	0.00	0.00	0.17	0.11	0.00	0.00	-0.01	-0.01
	(0.00)	(0.00)	(0.01)	(0.01)	(0.00)	(0.00)	(0.21)	(0.13)	(0.00)	(0.00)	(0.01)	(0.01)
Missing	0.00	0.00	-0.01	-0.01	0.00	0.00	0.03	0.02	0.00	0.00	0.01	0.01
	(0.00)	(0.00)	(0.01)	(0.01)	(0.00)	(0.00)	(0.04)	(0.03)	(0.00)	(0.00)	(0.02)	(0.02)
Rent	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.01	0.00	0.00	0.00	0.00
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.02)	(0.01)	(0.00)	(0.00)	(0.00)	(0.00)
Insurance	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
State (QLD Reference)												
ACT	0.00	0.00	0.00	0.00	-0.01	0.00	-0.01	0.00	0.00	0.00	0.00	0.00
	(0.00)	(0.00)	(0.00)	(0.00)	(0.01)	(0.01)	(0.01)	(0.01)	(0.00)	(0.00)	(0.00)	(0.00)
NSW	0.00	0.00	0.00	0.00	-0.02	-0.01	-0.02	-0.01	0.00	0.00	0.00	0.00
	(0.00)	(0.00)	(0.00)	(0.00)	(0.02)	(0.01)	(0.02)	(0.01)	(0.00)	(0.00)	(0.00)	(0.00)
NT	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
VIC	0.00	0.00	0.00	0.00	-0.02	-0.01	-0.02	-0.01	0.00	0.00	0.00	0.00
	(0.00)	(0.00)	(0.00)	(0.00)	(0.01)	(0.01)	(0.01)	(0.01)	(0.00)	(0.00)	(0.00)	(0.00)
TAS	0.00	0.00	0.00	0.00	0.01	0.00	0.01	0.00	0.00	0.00	0.00	0.00
	(0.00)	(0.00)	(0.00)	(0.00)	(0.01)	(0.00)	(0.01)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)

	Endowments				Coefficients				Interaction			
	Base Model		Expanded Model		Base Model		Expanded Model		Base Model		Expanded Model	
	LPM	Probit	LPM	Probit	LPM	Probit	LPM	Probit	LPM	Probit	LPM	Probit
WA	0.00	0.00	0.00	0.00	0.01	0.00	0.01	0.00	0.00	0.00	0.00	0.00
	(0.00)	(0.00)	(0.00)	(0.00)	(0.01)	(0.01)	(0.01)	(0.01)	(0.00)	(0.00)	(0.00)	(0.00)
SA	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	(0.00)	(0.00)	(0.00)	(0.00)	(0.01)	(0.01)	(0.01)	(0.01)	(0.00)	(0.00)	(0.00)	(0.00)
City	-0.005*	0.00	-0.005**	0.00	-0.080***	-0.058**	-0.082***	-0.053**	0.007*	0.007*	0.007*	0.007*
	(0.00)	(0.00)	(0.00)	(0.00)	(0.03)	(0.02)	(0.03)	(0.02)	(0.00)	(0.00)	(0.00)	(0.00)

Standard errors in parentheses
* $p < 0.1$, ** $p < 0.05$, *** $p < 0.$

Appendix 3.10:   Adults Main Condition Expanded Model: LPM

	Subjective Unmet Pre-NDIS	Subjective Unmet Need Post-NDIS	Objective Unmet Pre-NDIS	Objective Unmet Need Post-NDIS
Need Variables				
Main Condition (Ref: Physical)				
Intellectual	-0.02	0.08**	0.19***	0.15***
	(0.02)	(0.03)	(0.03)	(0.04)
Nervous	-0.02	0.02	0.05**	0.00
	(0.02)	(0.03)	(0.02)	(0.03)
Autism	0.04	0.09	0.23***	0.25***
	(0.04)	(0.06)	(0.05)	(0.06)
Psychiatric	-0.04***	0.15***	0.26***	0.20***
	(0.01)	(0.02)	(0.02)	(0.03)
Cancer	-0.06**	-0.10***	0.12***	0.01
	(0.02)	(0.03)	(0.04)	(0.05)
Endocrine	-0.02	0.00	0.08***	-0.05
	(0.02)	(0.03)	(0.03)	(0.04)
Sensory	0.03	0.01	-0.03	-0.05**
	(0.02)	(0.02)	(0.02)	(0.03)
Cerebral Palsy	0.06	0.04	0.03	-0.17**
	(0.07)	(0.09)	(0.08)	(0.08)
Heart	-0.02	0.04	0.03	0.00
	(0.02)	(0.03)	(0.03)	(0.04)
Stroke	-0.01	-0.04	0.06	0.01
	(0.04)	(0.05)	(0.05)	(0.07)
Respiratory	-0.03**	0.01	0.02	-0.05
	(0.02)	(0.03)	(0.02)	(0.03)
Digestive	-0.01	0.02	0.07**	0.01
	(0.03)	(0.04)	(0.03)	(0.05)
Skin	-0.05	-0.07	0.14**	-0.04
	(0.04)	(0.04)	(0.07)	(0.07)
Musculoskeletal	-0.01	0.01	0.04**	0.05**
	(0.01)	(0.02)	(0.02)	(0.02)
Kidney	0.01	0.06	0.04	-0.05
	(0.03)	(0.05)	(0.05)	(0.06)
Other Condition	0.02	0.00	0.06**	0.01
	(0.02)	(0.03)	(0.03)	(0.03)
Severity (Ref: Mild)				
Profound	0.32***	0.34***	0.23***	0.24***
	(0.02)	(0.02)	(0.02)	(0.03)
Severe	0.17***	0.19***	0.33***	0.35***
	(0.01)	(0.02)	(0.01)	(0.02)
Moderate	0.03***	0.07***	0.04***	0.05***
	(0.00)	(0.01)	(0.01)	(0.02)
Non-Need Variables				
Age (Ref: Female: 15-24 yr old)				
Male: 15 to 24 yrs old	-0.04*	0.07	-0.11***	0.09**
	(0.02)	(0.04)	(0.03)	(0.04)
Female: 25 to 34 yrs old	-0.02	0.03	-0.10***	0.00
	(0.02)	(0.04)	(0.03)	(0.04)
Male: 25 to 34 yrs old	-0.04*	-0.05	-0.09***	0.02
	(0.02)	(0.04)	(0.03)	(0.04)
Female: 35 to 44 yrs old	-0.01	0.00	-0.11***	0.00
	(0.02)	(0.04)	(0.03)	(0.04)
Male: 35 to 44 yrs old	-0.03	-0.01	-0.08**	0.02
	(0.02)	(0.04)	(0.03)	(0.04)
Female: 45 to 54 yrs old	0.03	0.02	-0.09***	-0.03
	(0.02)	(0.03)	(0.03)	(0.04)

	Subjective Unmet Pre-NDIS	Subjective Unmet Need Post-NDIS	Objective Unmet Pre-NDIS	Objective Unmet Need Post-NDIS
Male: 45 to 54 yrs old	0.02	0.00	-0.12***	-0.01
	(0.02)	(0.03)	(0.03)	(0.04)
Female: 55 to 64 yrs old	0.01	0.00	-0.11***	-0.04
	(0.02)	(0.03)	(0.03)	(0.04)
Male: 55 to 64 yrs old	0.00	-0.02	-0.12***	-0.02
	(0.02)	(0.03)	(0.03)	(0.04)
Non-English	0.00	-0.01	0.03*	0.04*
	(0.01)	(0.02)	(0.02)	(0.02)
Married	-0.03***	-0.03**	-0.02**	-0.02
	(0.01)	(0.01)	(0.01)	(0.01)
Bachelor Degree	0.01	0.02	-0.02	0.00
	(0.01)	(0.02)	(0.01)	(0.02)
Certificate	0.00	0.02*	-0.02	0.00
	(0.01)	(0.01)	(0.01)	(0.02)
Log Household Equiv. Inc.	-0.01**	-0.03***	-0.02***	-0.02
	(0.00)	(0.01)	(0.01)	(0.01)
Missing	-0.08***	-0.17***	-0.11**	-0.09
	(0.03)	(0.06)	(0.05)	(0.07)
State (QLD Reference)				
ACT	-0.01	-0.01	0.00	-0.03
	(0.01)	(0.03)	(0.02)	(0.03)
NSW	-0.01	0.00	0.00	-0.01
	(0.01)	(0.02)	(0.01)	(0.02)
NT	0.00	0.00	-0.01	0.03
	(0.02)	(0.03)	(0.02)	(0.04)
VIC	-0.01	0.03	0.03*	0.01
	(0.01)	(0.02)	(0.01)	(0.02)
TAS	0.00	-0.01	0.02	0.01
	(0.01)	(0.02)	(0.02)	(0.03)
WA	0.00	-0.02	-0.01	-0.01
	(0.01)	(0.02)	(0.02)	(0.02)
SA	-0.01	0.01	0.00	0.02
	(0.01)	(0.02)	(0.02)	(0.02)
City	0.00	0.00	0.03***	0.00
	(0.01)	(0.01)	(0.01)	(0.01)
Carer	0.03***	0.05***	-0.02*	-0.02
	(0.01)	(0.02)	(0.01)	(0.02)
Insurance	-0.01	-0.01	0.02*	-0.01
	(0.01)	(0.01)	(0.01)	(0.02)
Constant	0.11***	0.18***	0.28***	0.22***
	(0.04)	(0.07)	(0.06)	(0.08)
Mean	0.10	0.17	0.25	0.27

Standard errors in parentheses
* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Appendix 3.11:   Children Main Condition Expanded Model: LPM

	Subjective Unmet Pre-NDIS	Subjective Unmet Need Post-NDIS	Objective Unmet Pre-NDIS	Objective Unmet Need Post-NDIS
Need Variables				
Main Condition (Ref: Physical)				
Intellectual	-0.02	-0.04	-0.02	0.21**
	(0.11)	(0.08)	(0.15)	(0.08)
Nervous	-0.04	-0.14	-0.16	0.16
	(0.12)	(0.13)	(0.16)	(0.14)
Autism	0.05	0.10	0.05	0.25***
	(0.12)	(0.08)	(0.15)	(0.09)
Psychiatric	0.01	0.06	0.15	0.40***
	(0.13)	(0.11)	(0.16)	(0.10)
Cancer	-0.30*	0.14	-0.23	-0.21
	(0.17)	(0.16)	(0.25)	(0.20)
Endocrine	-0.13	-0.03	-0.44***	-0.02
	(0.14)	(0.18)	(0.16)	(0.16)
Sensory	-0.09	0.01	-0.15	-0.16
	(0.12)	(0.10)	(0.15)	(0.10)
Cerebral Palsy	0.01	0.15	(0.22)	0.08
	(0.14)	(0.13)	(0.17)	(0.20)
Heart	-0.08	-0.34*	-0.21	-0.08
	(0.14)	(0.18)	(0.24)	(0.19)
Stroke	NA	NA	NA	NA
Respiratory	-0.04	-0.19**	-0.36**	-0.03
	(0.12)	(0.09)	(0.15)	(0.11)
Digestive	0.00	-0.44***	-0.37*	0.05
	(0.20)	(0.13)	(0.21)	(0.20)
Skin	-0.17	-0.28*	-0.12	-0.49***
	(0.20)	(0.16)	(0.25)	(0.10)
Musculoskeletal	-0.12	-0.19	-0.13	0.20
	(0.13)	(0.14)	(0.17)	(0.17)
Kidney	-0.40	0.10	-0.07	0.25
	(0.25)	(0.27)	(0.29)	(0.31)
Other Condition	-0.01	-0.08	-0.02	0.29***
	(0.12)	(0.09)	(0.15)	(0.10)
Severity (Ref: Mild)				
Profound	0.49***	0.43***	0.33***	0.33***
	(0.03)	(0.06)	(0.04)	(0.06)
Severe	0.23***	0.14***	0.46***	0.40***
	(0.03)	(0.05)	(0.04)	(0.05)
Moderate	-0.02	-0.04	0.09	0.01
	(0.03)	(0.07)	(0.07)	(0.09)
Non-Need Variables				
Age (Ref: Female: 0 to 4 yr old)				
Male: 0 to 4 years old	-0.03	0.11	0.01	-0.05
	(0.06)	(0.11)	(0.06)	(0.10)
Female: 5 to 9 years old	-0.11*	0.10	-0.05	0.09

	Subjective Unmet Pre-NDIS	Subjective Unmet Need Post-NDIS	Objective Unmet Pre-NDIS	Objective Unmet Need Post-NDIS
	(0.06)	(0.10)	(0.06)	(0.09)
Male: 5 to 9 years old	-0.09	0.11	0.04	-0.02
	(0.06)	(0.10)	(0.05)	(0.09)
Female: 10 to 14 years old	-0.08	0.12	-0.02	0.02
	(0.06)	(0.11)	(0.06)	(0.10)
Male: 10 to 14 years old	-0.07	0.18*	0.01	0.07
	(0.06)	(0.10)	(0.06)	(0.09)
Non-English	-0.08	-0.21*	-0.08	0.05
	(0.08)	(0.11)	(0.07)	(0.11)
Bachelor Degree	-0.02	0.05	-0.05	0.08
	(0.04)	(0.05)	(0.04)	(0.05)
Certificate	-0.02	0.09*	-0.04	0.06
	(0.03)	(0.05)	(0.03)	(0.05)
Log Household Equiv. Inc.	-0.02	0.02	-0.02	-0.03
	(0.02)	(0.03)	(0.02)	(0.03)
Missing	-0.16	0.07	-0.12	-0.12
	(0.15)	(0.22)	(0.15)	(0.23)
Rent	-0.01	0.04	0.06**	0.12***
	(0.03)	(0.04)	(0.03)	(0.04)
State (QLD Reference)				
ACT	-0.11*	-0.21**	-0.09	0.12
	(0.06)	(0.09)	(0.06)	(0.09)
NSW	0.03	-0.01	-0.02	0.04
	(0.04)	(0.05)	(0.04)	(0.05)
NT	-0.11	-0.10	0.10	-0.05
	(0.08)	(0.09)	(0.08)	(0.09)
VIC	-0.02	-0.10*	0.03	0.02
	(0.04)	(0.06)	(0.04)	(0.06)
TAS	-0.07	0.03	0.05	-0.05
	(0.05)	(0.07)	(0.06)	(0.07)
WA	-0.07	0.01	0.02	-0.01
	(0.05)	(0.06)	(0.05)	(0.06)
SA	0.05	0.05	-0.04	-0.06
	(0.04)	(0.06)	(0.05)	(0.07)
City	0.09***	-0.03	0.06**	-0.05
	(0.03)	(0.04)	(0.03)	(0.04)
Constant	0.27	-0.07	0.43**	0.23
	(0.18)	(0.24)	(0.21)	(0.26)
N	0.34	0.46	0.59	0.59

Standard errors in parentheses
* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Appendix 3.12: Adults Area of Need Expanded Model: LPM and Probit

	Subjective Unmet Pre-NDIS	Subjective Unmet Need Post-NDIS	Objective Unmet Pre-NDIS	Objective Unmet Need Post-NDIS
Need Variables				
Need Type				
Emotional Need	0.05***	0.33***	0.31***	0.31***
	(0.01)	(0.02)	(0.01)	(0.02)
Communication Need	0.05**	-0.10***	-0.03	-0.02
	(0.03)	(0.04)	(0.03)	(0.04)
Self-Care Need	0.12***	0.06**	-0.07***	-0.01
	(0.02)	(0.03)	(0.02)	(0.03)
Mobility Need	0.15***	0.09***	-0.16***	-0.14***
	(0.02)	(0.03)	(0.02)	(0.04)
Severity (Ref: Mild)				
Profound	0.08***	0.15***	0.33***	0.29***
	(0.03)	(0.05)	(0.03)	(0.05)
Severe	-0.01	0.05*	0.43***	0.42***
	(0.02)	(0.03)	(0.03)	(0.04)
Moderate	0.02***	0.05***	0.01	0.04***
	0.00	(0.01)	(0.01)	(0.01)
Age (Ref: Female: 15-24 yr old)				
Male: 15 to 24 yrs old	-0.05**	0.03	-0.11***	0.06
	(0.02)	(0.04)	(0.03)	(0.04)
Female: 25 to 34 yrs old	-0.04**	0.01	-0.10***	-0.02
	(0.02)	(0.04)	(0.03)	(0.04)
Male: 25 to 34 yrs old	-0.04**	-0.03	-0.08***	0.03
	(0.02)	(0.03)	(0.03)	(0.04)
Female: 35 to 44 yrs old	-0.01	0.00	-0.11***	0.00
	(0.02)	(0.03)	(0.03)	(0.04)
Male: 35 to 44 yrs old	-0.03	0.00	-0.08***	0.02
	(0.02)	(0.03)	(0.03)	(0.04)
Female: 45 to 54 yrs old	0.03	0.03	-0.09***	-0.02
	(0.02)	(0.03)	(0.03)	(0.03)
Male: 45 to 54 yrs old	0.02	0.01	-0.12***	-0.01
	(0.02)	(0.03)	(0.03)	(0.04)
Female: 55 to 64 yrs old	0.01	0.01	-0.10***	-0.03
	(0.02)	(0.03)	(0.02)	(0.03)
Male: 55 to 64 yrs old	0.00	0.00	-0.11***	-0.01
	(0.02)	(0.03)	(0.02)	(0.03)
Non-English	0.00	0.00	0.04**	0.05**
	(0.01)	(0.02)	(0.02)	(0.02)
Married	-0.02***	-0.02*	-0.01	-0.01
	(0.01)	(0.01)	(0.01)	(0.01)
Bachelor Degree	0.01	0.01	-0.02**	-0.02
	(0.01)	(0.01)	(0.01)	(0.02)
Certificate	0.00	0.02	-0.02**	-0.01
	(0.01)	(0.01)	(0.01)	(0.01)
Log Household Equiv. Inc.	-0.01	-0.02***	-0.02**	-0.02**
	(0.00)	(0.01)	(0.01)	(0.01)
Missing	-0.05	-0.15***	-0.09*	-0.12*
	(0.03)	(0.05)	(0.05)	(0.07)
Rent	0.02***	0.02*	0.01	0.00
	(0.01)	(0.01)	(0.01)	(0.01)
State (QLD Reference)				
ACT	-0.02	-0.01	-0.02	-0.03
	(0.01)	(0.02)	(0.02)	(0.03)
NSW	-0.02*	-0.01	0.00	-0.02
	(0.01)	(0.02)	(0.01)	(0.02)

	Subjective Unmet Pre-NDIS	Subjective Unmet Need Post-NDIS	Objective Unmet Pre-NDIS	Objective Unmet Need Post-NDIS
NT	0.00	0.00	-0.01	0.02
	(0.02)	(0.03)	(0.02)	(0.04)
VIC	-0.01	0.02	0.01	0.00
	(0.01)	(0.02)	(0.01)	(0.02)
TAS	0.00	0.00	0.02	0.01
	(0.01)	(0.02)	(0.02)	(0.03)
WA	0.00	-0.01	-0.01	-0.01
	(0.01)	(0.02)	(0.01)	(0.02)
SA	-0.01	0.00	-0.01	0.01
	(0.01)	(0.02)	(0.02)	(0.02)
City	0.00	0.00	0.02**	0.00
	(0.01)	(0.01)	(0.01)	(0.01)
Carer	0.01	0.01	-0.03**	-0.04**
	(0.01)	(0.01)	(0.01)	(0.02)
Insurance	0.00	0.00	-0.01	0.01
	(0.01)	(0.01)	(0.01)	(0.01)
Constant	0.06*	0.14**	0.29***	0.25***
	(0.04)	(0.06)	(0.05)	(0.07)
Mean	0.10	0.17	0.25	0.27

Standard errors in parentheses
* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Appendix 3.13:   Children Area of Need Expanded Model: LPM

	Subjective Unmet Pre-NDIS	Subjective Unmet Need Post-NDIS	Objective Unmet Pre-NDIS	Objective Unmet Need Post-NDIS
Need Variables				
Impairment (Ref: Hearing and Sight)				
Emotional Need	0.08***	0.40***	0.23***	0.26***
	(0.02)	(0.04)	(0.03)	(0.04)
Communication Need	0.37***	0.16***	0.03	-0.03
	(0.03)	(0.04)	(0.04)	(0.04)
Self-Care Need	0.13***	0.09**	-0.10***	-0.16***
	(0.03)	(0.05)	(0.03)	(0.05)
Mobility Need	0.13***	0.01	-0.05	-0.07
	(0.03)	(0.05)	(0.04)	(0.05)
Severity (Ref: Mild)				
Profound	0.03	0.16**	0.34***	0.48***
	(0.05)	(0.08)	(0.06)	(0.07)
Severe	-0.09***	-0.01	0.46***	0.51***
	(0.03)	(0.05)	(0.05)	(0.06)
Moderate	-0.03	-0.02	0.09	0.06
	(0.03)	(0.05)	(0.06)	(0.08)
Non-Need Variables				
Age (Ref: Female: 0 to 4 yr old)				
Male: 0 to 4 years old	-0.06	0.03	0.00	0.02
	(0.06)	(0.10)	(0.07)	(0.11)
Female: 5 to 9 years old	-0.15***	0.04	0.06	0.10
	(0.06)	(0.09)	(0.06)	(0.10)
Male: 5 to 9 years old	-0.15***	0.04	0.06	0.10
	(0.05)	(0.09)	(0.06)	(0.10)
Female: 10 to 14 years old	-0.11*	0.04	-0.01	0.12
	(0.06)	(0.09)	(0.06)	(0.10)
Male: 10 to 14 years old	-0.12**	0.07	0.01	0.17*
	(0.05)	(0.09)	(0.06)	(0.10)
Non-English	0.01	-0.17*	-0.05	-0.07
	(0.07)	(0.10)	(0.07)	(0.12)
Bachelor Degree	-0.02	0.03	-0.03	0.05
	(0.03)	(0.05)	(0.04)	(0.05)
Certificate	-0.02	0.05	-0.03	0.05
	(0.03)	(0.04)	(0.03)	(0.05)
Log Household Equiv. Inc.	-0.02	0.01	-0.04	-0.04
	(0.02)	(0.03)	(0.02)	(0.03)
Missing	-0.15	0.06	-0.24	-0.19
	(0.14)	(0.19)	(0.15)	(0.23)
Rent	-0.01	0.04	0.04	0.11***
	(0.02)	(0.03)	(0.03)	(0.04)
State (QLD Reference)				
ACT	-0.13***	-0.16**	-0.09	0.12
	(0.05)	(0.08)	(0.06)	(0.09)
NSW	0.04	0.02	-0.03	0.06
	(0.04)	(0.05)	(0.04)	(0.05)
NT	-0.10	-0.05	0.08	-0.02
	(0.07)	(0.08)	(0.08)	(0.09)
VIC	-0.01	-0.05	0.03	0.06
	(0.04)	(0.05)	(0.04)	(0.06)
TAS	-0.04	0.01	0.06	-0.06
	(0.05)	(0.07)	(0.06)	(0.07)
WA	-0.04	0.06	0.03	0.00
	(0.04)	(0.06)	(0.05)	(0.06)
SA	0.04	0.06	-0.05	-0.05

	Subjective Unmet Pre-NDIS	Subjective Unmet Need Post-NDIS	Objective Unmet Pre-NDIS	Objective Unmet Need Post-NDIS
	(0.04)	(0.06)	(0.05)	(0.06)
City	0.08***	-0.05	0.05	-0.05
	(0.03)	(0.04)	(0.03)	(0.04)
Constant	0.25*	-0.11	0.41**	0.26
	(0.15)	(0.20)	(0.16)	(0.25)
Mean	0.34	0.46	0.59	0.59

Standard errors in parentheses
* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Appendix 4.1: Identified Studies

Title	Authors	Journal	Objective	Methods	Dep. Var.	Exp. Vars.	Findings	Sample
Autism Prevalence Trends Over Time in Denmark: Changes in Prevalence and Age at Diagnosis	Erik T. Parner, PhD; Diana E. Schendel, PhD; Poul Thorsen, PhD	Arch Pediatr Adolesc Med. 2008	To explain the changes in prevalence and time to diagnosis	Parametric survival analysis	The age-specific prevalence, hazard ratio, and relative risk by age.	Cohort of children	Higher relative risk of diagnosis at younger ages across the cohorts of children. Indicating that part of the increase in prevalence due to earlier age of diagnosis.	All children born in Denmark from January 1, 1994, through December 31, 1999 (N = 407 458).
Timing of Identification Among Children with Autism Spectrum Disorder: Findings from a Population-Based Surveillance Study	Shattuck, P; Durkin, M; Maenner, M et al	Journal American Child Adolescent Psychiatry 48:5, May 2009	What factors influence the timing of when children are identified with ASDs?	Survival Analysis Including Kaplan Meier and Log-Normal Parametric Regression	Timing of diagnosis	Sex, race, cognition, maternal age at birth, maternal education at birth, region	Difference in identification based on gender, IQ and location. Large gap between when children could be identified and when they are identified.	All eight year old children meeting the criteria for ASD within 13 catchment areas across the USA.
The association of autism diagnosis with socioeconomic status	Thomas, P; Zahorodny, W et al	Autism 16 (2) 2012	Examine the association between socioeconomic status and ASD status.	Poisson regression model	Prevalence of ASD	Sex, race, income, number of evaluations.	Higher prevalence in high SES groups	All eight-year-olds living in four selected school districts of New Jersey in 2000 or 2002.

Title	Authors	Journal	Objective	Methods	Dep. Var.	Exp. Vars.	Findings	Sample
Age of diagnosis for autism: individual and community factors across 10 cohorts	Fountain, C; King, M and Bearman, P	Journal Epidemiological Community Health (2011)	Changes in distribution of age of diagnosis	Multi-level regression using mixed effects linear regression models	Age of Diagnosis	Sex, parental socio-economic status, region, co-morbidity, race	NESB diagnosed later, more educated parents diagnosed earlier, being first born diagnosed later, higher language function associated with later diagnosis, higher number of autism diagnosis associated with earlier diagnosis and higher socio-economic status associated with earlier diagnosis.	17185 children with autism born across 10 birth cohorts in California from 1992 to 2001 diagnosed between ages 2 and 8 years.
Mapping the diagnosis of autism spectrum disorders in children aged under 7 years in Australia, 2010–2012	Catherine A Bent, Cheryl Dissanayake and Josephine Barbaro	Medical Journal of Australia (2014)	Average age of diagnosis of children diagnosed under age 7 and receiving services under helping autism package	Comparison across groups using Kruskal–Wallis and Mann–Whitney U-Tests	Age of Diagnosis	State of residence, region, gender, indigenous status, cald status	Differences across states, and by remoteness	15 074 children (12 183 boys [81%] and 2891 girls [19%]) who received support through the HCWAP between 1 July 2010 and 30 June 2012.

Title	Authors	Journal	Objective	Methods	Dep. Var.	Exp. Vars.	Findings	Sample
Age at Diagnosis of Autism Spectrum Disorders	McDermott, M; Hottinger, et al	The Journal of Paediatrics (2012)	Determinants of age of autism diagnosis	Comparison of means across groups	Age of Evaluation	Sex, Race, Maternal Education, Maternal Age, Private Health, Clinical Characteristics, First child, Family History	Children from African American and Hispanic Backgrounds evaluated later.	399 children referred for evaluation
Age of autism Spectrum Disorders is associated with child's variables and parental experience	Mishaal, R; Itzchak, E and Zachor, D	Research in Autism Spectrum Disorders (2014)	Identify the variables that may affect delayed diagnosis	Comparison of means	Age of Diagnosis	Maternal and paternal age, Socio-economic characteristics, social scores, autism severity, birth order	Nature of autism and characteristics impacted age of diagnosis but no impact of family characteristics	551 children with autism diagnosis
The association of autism diagnosis with socioeconomic status	Thomas, P; Zahorodny, W; et al	Autism (2012)	Document the associations between socioeconomic status and autism prevalence	Comparison of prevalence levels, age of diagnosis and number of evaluations using Poisson regression	Prevalence	Sex, race, local area, severity of autism.	Higher rates of ASD in higher income areas, higher number of evaluations in high income areas and lower age of diagnosis	28,823 children living in participating school districts including 593 children with autism

Title	Authors	Journal	Objective	Methods	Dep. Var.	Exp. Vars.	Findings	Sample
Predictors of the age of autism spectrum disorder diagnosis: A North Carolina Cohort	Perryman, T; Watson, L et al	Autism & Developmental Language Impairments (2018)	Investigate timing of diagnosis for African American and European American children	Survey methods to recruit 168 families in North Carolina	Age of diagnosis	Age of parent, age of child, parental social responsiveness scale, premature child, other medical concerns, place of diagnosis.	No difference from race, but positive correlation in African American sub-population with parental social responsiveness scale.	168 children diagnosed with autism
Age of diagnosis of autism spectrum disorders: is there an association with socioeconomic status and family self-education about autism?	Hrdlicka, M; Vacova, M et al	Neuropsychiatric Disease and Treatment	Associations between socioeconomic factors and age of diagnosis	Survey of participants and correlation coefficients	Age of Diagnosis	Sex, maternal and paternal age, maternal and paternal education, family socioeconomic status, sources of information, marriage status	Earlier diagnosis associated with older parents and better educated parents.	160 children, of whom 120 had confirmed autism

Title	Authors	Journal	Objective	Methods	Dep. Var.	Exp. Vars.	Findings	Sample
Explaining Differences in Age at Autism Spectrum Disorder: A Critical Review	Daniels, A and Mandell, S	Autism (2014)	Factors associated with age of diagnosis	Systematic review	Age of diagnosis	Clinical characteristics (e.g., severity/type of autism); Socio demographic (e.g., age, race, income, education); Parental concern, system and regional characteristics, cohort effects	Earlier diagnosis for more severe cases, higher socioeconomic status, greater parental concern, family use of medical services and region of residence.	42 studies over period 1994-2014
The association between socioeconomic status and autism diagnosis in the United Kingdom for children aged 5-8 years of age: Finding from the Born in Bradford Cohort	Kelly, B; William, S et al	Autism (2017)	Rates of autism diagnosis across socio economic groups	logistic regression models to estimate predicted probabilities of having an autism diagnosis.	Diagnosis	Gender, age race, child health, child's, socio-economic status	Higher rates of ASD amongst higher educated mothers, but no significant impact for neighbourhood deprivation when mother's education is controlled	13,857 children born between 2007 and 2011 in the Born in Bradford cohort

Title	Authors	Journal	Objective	Methods	Dep. Var.	Exp. Vars.	Findings	Sample
Timing of Diagnosis of ADHD and ASD	Miodovnik, A; Harstad, E et al	Pediatrics (2015)	Timing of ADHD diagnosis and age of ASD diagnosis	linear regression and logistic regression	Age of Diagnosis	Gender, race, mother's education, ASD severity, household income, other symptoms, child age	Diagnosis with ADHD before ASD delayed ASD diagnosis by three years, but no association with maternal education or family income.	1496 children with ASD
Changes in the frequency and characteristics of children diagnosed with autistic disorder in two Norwegian cohorts: 1992-2009	Romhus, S, Herder, G, et al	Scandinavian Journal of Child and Adolescent Psychiatry and Psychology (2017)	Frequency of ASD diagnosis, characteristics of children and ages when concerns raised and diagnosis made.	correlations	age of diagnosis	age of parents first concerns, IQ, genetic disorder	age of parents first concerns positively correlated with autism diagnosis timing, low IQ = earlier diagnosis and genetic disorder = later diagnosis	92 children with ASD
Age at First Identification of ASD: An Analysis of Two USA Surveys	Sheldrick, R, Maye, M et al	Journal American Academy of Child Adolescent Psychiatry (2017)	Age distributions for first identification of ASD in national parent surveys using time to event analysis	Time to Event Analysis	Age of Diagnosis	severity of autism	more severe forms of autism diagnosed earlier	95,677 in survey one and 40,242 in survey two

Title	Authors	Journal	Objective	Methods	Dep. Var.	Exp. Vars.	Findings	Sample
Brief Report: Gender and Age of Diagnosis Time Trends in Children with Autism Using Australian Medicare Data	May, T and Williams, K	Journal of Autism and Developmental Disorders	Gender and Age of Diagnosis Trends	Linear regression	Diagnosis	Aged (0-6 versus 6+) and gender	Narrowing of gap between older females and males' overtime. Increase driven by later not earlier diagnosis	73,464 children between 2008-2016 accessing Medicare ASD diagnostic items
Maternal and Neonatal Birth Factors Affecting Age of Autism Diagnosis	Darcy-Mahoeny, A; Minter, B et al	Newborn and Infant Nursing Reviews (2016)	Impact of maternal education, race, age, marriage status and neonatal birth factors on age of diagnosis	Logistic and Cox proportional hazards	Age of Diagnosis	Gender, race, marriage status and maternal age.	Children with married mothers had earlier diagnosis, African American mothers had earlier diagnosis, and no impact of gestational age on diagnosis.	664 records
Factors Affecting Age at ASD diagnosis in UK: No Evidence that Diagnosis Age has Decreased Between 2004 and 2014	Brett, D; Warnell, F et al	Journal of Autism and Developmental Disorders (2016)	Investigate whether any change in age of diagnosis and identify factors associated with earlier diagnosis	Linear regression	Age of Diagnosis	Gender, Other conditions Siblings, Socio-economic status, Diagnosis Type, Language Skills,	Earlier diagnosis associated with lower socio-economic status and greater need for support.	2134 children with ASD

Appendix 4.2: Transitions between levels of severity

First Diagnosis		Subsequent Diagnosis			
		Mild	Moderate	Severe	Total
	Mild	151	41	0	**192**
		78.65	21.35	0	**100**
	Moderate	31	70	14	**115**
		26.96	60.87	12.17	**100**
	Severe	0	9	14	**23**
		0	39.13	60.87	**100**
	Total	**182**	**120**	**28**	**330**
		55.15	**36.36**	**8.48**	**100**

Appendix 4.3: Children with Abnormal Parent SDQ Scores and Autism Diagnosis

	Diagnosed Under the Age of Five		Diagnosed Over the Age of Five		Not Diagnosed	
	Age 5	Age 11	Age 5	Age 11	Age 5	Age 11
Birth Cohort						
N	61	67	97	98	3,663	3,498
Mean SDQ	16.49	15.64	12.12	17.18	7.97	7.12
95% CI	(14.82-18.16)	(14.11-17.17)	(11.07-13.17)	(15.95-18.41)	(7.82-8.11)	(6.95-7.29)
Percentage with abnormal parent SDQ	40.98%	31.34%	16.49%	47.95%	3.34%	4.65%
95% CI	(0.28-0.54)	(0.20-0.43)	(0.09-0.24)	(0.38-0.58)	(0.03-0.04)	(0.03-0.05)
Kindergarten Cohort						
N	61	60	69	64	4,838	3,992
Mean SDQ	17.49	17.76	14.33	17.32	9.19	7.62
95% CI	(15.78-19.19)	(16.23-19.29)	(12.98-15.68)	(15.63-19.02)	(9.05-9.33)	(7.45-7.78)
Percentage with abnormal parent SDQ	42.62%	38.33%	21.74%	39.06%	7.33%	4.95%
95% CI	(0.30-0.55)	(0.25-0.51)	(0.12-0.32)	(0.27-0.51)	(0.07-0.08)	(0.04-0.06)
Males						
N	97	100	130	127	4,268	3,764
Mean SDQ	17.01	16.89	13.02	17.42	9.10	7.90
95% CI	(15.62-18.39)	(15.66-18.11)	(12.09-13.94)	(16.32-18.51)	(8.95-9.25)	(7.73-8.08)
Percentage with abnormal parent SDQ	38.14%	35.00%	15.38%	44.09%	5.00%	4.70%
95% CI	(0.28-0.48)	(0.25-0.45)	(0.09-0.22)	(0.35-0.53)	(0.04-0.06)	(0.04-0.05)
Females						
N	25	27	36	35	4,233	3,726
Mean SDQ	16.92	15.74	13.13	16.60	8.22	6.87
95% CI	(14.68-19.15)	(13.27-18.21)	(11.07-15.19)	(14.22-18.98)	(8.08-8.37)	(6.71-7.03)
Percentage with abnormal parent SDQ	56.00%	33.30%	30.05%	45.71%	6.23%	4.94%
95% CI	(0.35-0.77)	(0.14-0.52)	(0.14-0.46)	(0.28-0.63)	(0.05-0.69)	(0.04-0.06)

| | Diagnosed Under the Age of Five | | Diagnosed Over the Age of Five | | Not Diagnosed | |
	Age 5	Age 11	Age 5	Age 11	Age 5	Age 11
Bachelor Degree						
N	38	43	72	74	2,707	2,698
Mean SDQ	16.08	15.23	11.51	16.40	7.33	6.29
95% CI	(14.23-17.93)	(13.82-16.64)	(10.43-12.59)	(14.94-17.87)	(7.16-7.49)	(6.12-6.47)
Percentage with abnormal parent SDQ	34.20%	23.25%	9.72%	39.19%	2.65%	2.48%
95% CI	(0.18-0.50)	(0.10-0.36)	(0.03-0.17)	(0.27-0.50)	(0.02-0.03)	(0.019-0.03)
No Bachelor Degree						
N	84	84	94	88	5,794	4,792
Mean SDQ	17.40	17.36	14.21	17.94	9.28	8.00
95% CI	(15.90-18.91)	(15.90-18.84)	(13.02-15.40)	(16.5-19.29)	(9.16-9.41)	(7.85-8.15)
Percentage with abnormal parent SDQ	45.2%	40.5%	25.5%	48.9%	7.0%	6.1%
95% CI	(0.34-0.56)	(0.30-0.51)	(0.17-0.35)	(0.38-0.59)	(0.06-0.08)	(0.05-0.07)

Appendix 4.4: Children with Abnormal Teacher SDQ Scores and Autism Diagnosis

	Diagnosed Under the Age of Five		Diagnosed Over the Age of Five		Not Diagnosed	
	Age 5	Age 11	Age 5	Age 11	Age 5	Age 11
Birth Cohort						
N	59	55	74	80	3,237	2,952
Mean SDQ	14.10	12.01	10.70	14.19	5.58	5.43
95% CI	(12.33-15.87)	(10.27-13.76)	(9.21-12.19)	(12.63-15.74)	(5.40-5.75)	(5.23-5.62)
Percentage with abnormal teacher SDQ	37.29%	33.00%	16.21%	37.50%	4.66%	6.02%
95% CI	(0.25-0.49)	(0.20-0.45)	(0.08-0.25)	(0.27-0.48)	(0.04-0.05)	(0.05-0.07)
Kindergarten Cohort						
N	44	40	46	47	3,136	3,261
Mean SDQ	15.73	14.60	10.76	13.21	5.97	5.36
95% CI	(13.70-17.75)	(12.29-16.90)	(8.90-12.61)	(11.21-15.21)	(5.79-6.16)	(5.17-5.55)
Percentage with abnormal teacher SDQ	47.72%	37.50%	19.56%	36.17%	5.58%	6.40%
95% CI	(0.32-0.63)	(0.22-0.53)	(0.08-0.31)	(0.22-0.50)	(0.04-0.06)	(0.06-0.07)
Males						
N	82	73	93	101	3,191	3,089
Mean SDQ	15.09	13.52	11.60	14.40	6.68	6.62
95% CI	(13.50-16.69)	(11.86-15.17)	(10.30-12.90)	(13.14-15.65)	(6.49-6.87)	(6.41-6.83)
Percentage with abnormal teacher SDQ	43.90%	34.25%	21.50%	38.60%	6.30%	7.90%
95% CI	(0.33-0.54)	(0.23-0.45)	(0.13-0.30)	(0.29-0.48)	(0.05-0.07)	(0.69-0.08)
Females						
N	21	22	27	26	3,182	3,124
Mean SDQ	13.61	11.72	7.70	11.61	4.87	4.18
95% CI	(11.71-15.52)	(9.09-14.35)	(5.52-9.87)	(8.16-15.06)	(4.71-5.02)	(4.01-4.34)
Percentage with abnormal teacher SDQ	33.30%	36.30%	3.70%	3.07%	3.80%	4.60%
95% CI	(0.11-0.55)	(0.145-0.581)	(-0.039-0.11)	(0.11-0.49)	(0.032-0.045)	(0.04-0.05)
Bachelor Degree						
N	33	37	55	60	2,138	2,244
Mean SDQ	12.54	13.10	10.84	12.87	5.19	4.56
95% CI	(10.53-14.55)	(10.83-15.38)	(9.10-12.56)	(11.03-14.69)	(4.97-5.39)	(4.35-4.76)
Percentage with abnormal teacher SDQ	27.20%	37.83%	18.18%	26.66%	4.50%	45.00%
95% CI	(0.11-0.43)	(0.21-0.54)	(0.08-0.29)	(0.15-0.38)	(0.04-0.05)	(0.04-0.05)
No Bachelor Degree						
N	70	58	65	67	4,235	3,969
Mean SDQ	15.86	13.10	10.63	14.69	6.07	5.87
95% CI	(14.18-17.52)	(11.28-14.92)	(9.07-12.20)	(13.05-16.32)	(5.92-6.22)	(5.69-6.04)
Percentage with abnormal teacher SDQ	48.57%	32.76%	16.92%	46.26%	5.41%	7.26%
95% CI	(0.37-0.60)	(0.20-0.45)	(0.08-0.26)	(0.34-0.59)	(0.05-0.06)	(0.06-0.08)

Appendix 4.5: Maps of Number of GPs per '000

Number of GPs per '000
2006
2011

Number of GPs
7.5 - 9
6 - 7.5
4.5 - 6
3 - 4.5
1.5 - 3
0 - 1.5
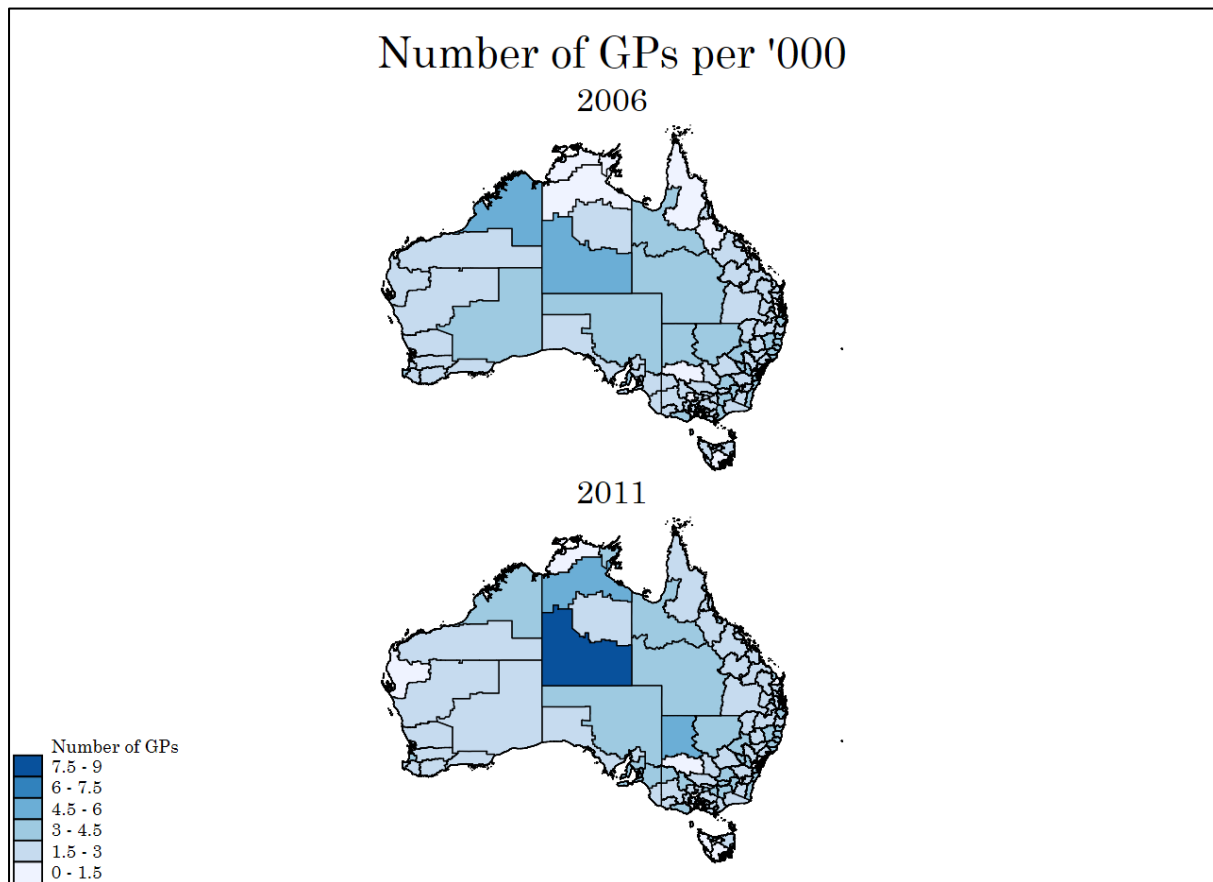
Appendix 4.6: Cox Proportional Hazard Model – Full Sample

	Combined	Proportional Hazard Test	2004 Birth Cohort	2000 Birth Cohort
Male	3.43***	0.02	3.61***	3.15***
	(0.49)		(0.64)	(0.74)
2004 Birth Cohort	1.48**			
	(0.21)			
Helping Autism	1.69**	0.02	1.30	1.37
	(0.30)		(0.33)	(0.57)
Need				
Other Disability^	9.17***	-0.27 ***	8.99***	8.41***
	(1.08)		(1.38)	(1.59)
Concerns with Development			1.87**	
			(0.37)	
Predisposing				
Mother's Ed. (ref. high school or below)				
Bachelor Degree^	2.00***	0.18***	2.51***	1.41
	(0.32)		(0.54)	(0.36)
Certificate	1.44*	0.08*	1.70*	1.16
	(0.21)		(0.35)	(0.26)
Mother's Age at Birth (ref 15-25 yrs old)				
26 to 35 years	0.55	0.01	0.55	0.59
	(0.18)		(0.25)	(0.29)
35 years plus^	1.03	0.08*	1.37	0.72
	(0.16)		(0.29)	(0.16)
Older Sibling	0.51***	0.00	0.51***	0.51***
	(0.06)		(0.08)	(0.09)
Mother English Speaking	1.49	0.09**	1.42	1.54
	(0.31)		(0.37)	(0.54)
Non-Need				
Mother's Labour Force Status	0.55***	-0.07	0.54***	0.54**
	(0.07)		(0.08)	(0.11)
Single Mother	1.90***	0.12***	2.54***	1.06
	(0.32)		(0.50)	(0.34)
Household Equiv. Inc.– First Quintile (bottom)	1.02	0.04	1.02	0.87
	(0.23)		(0.28)	(0.34)
Household Equiv. Inc.– – Second Quintile	1.38	0.06	1.25	1.36
	(0.28)		(0.33)	(0.47)
Household Equiv. Inc.– – Third Quintile	1.15	-0.02	1.22	0.95
	(0.23)		(0.31)	(0.33)
Household Equiv. Inc.– – Fourth Quintile	0.82	-0.10**	0.71	0.95
	(0.18)		(0.20)	(0.34)
Missing Combined Income	0.83	-0.05	0.76	0.94
	(0.22)		(0.25)	(0.40)
GP per thousand population	0.98	-0.03	0.98	0.96
	(0.05)		(0.06)	(0.08)
City	0.95	0.03	0.94	0.93
	(0.12)		(0.15)	(0.21)
N	41020		24539	16481
State of Residence	YES		YES	YES
Link Test	OK		OK	OK

Robust Standard Errors in Parenthesis; * p < *0.10,* ** p < *0.05,* *** p < *0.01*

Appendix 4.7: Cox Proportional Hazard Model with Time Varying Hazard Ratios – Full Sample

	Combined			2004 Birth Cohort			2000 Birth Cohort		
	0 - 5 yrs	5 - 12 yrs	Sig. Diff	0 - 5 yrs	5 - 12 yrs	Sig. Diff	0 - 5 yrs	5 - 12 yrs	Sig Dif
Male	3.22***	3.51***		3.79***	3.20***		2.64***	4.05***	
	(0.64)	(0.73)		(1.00)	(0.81)		(0.80)	(1.52)	
2004 Birth Cohort	1.39*	1.55**							
	(0.26)	(0.29)							
Helping Autism	1.73***			1.31			1.31		
	(0.32)			(0.00)			(0.55)		
Need									
Other Disability^	15.19***	3.97***	***	15.06***	3.76***	***	13.17***	4.03***	***
	(2.47)	(0.88)		(3.16)	(1.10)		(3.46)	(1.39)	
Concerns with Development				1.61*	2.11**				
				(0.42)	(0.66)				
Predisposing									
Mother Bachelor Degree^	1.46*	3.02***	**	2.12***	3.04***		0.77	3.53***	***
	(0.29)	(0.84)		(0.57)	(1.09)		(0.26)	(1.62)	
Mother Certificate	1.29	1.77**		1.64*	1.83*		0.97	1.75	
	(0.24)	(0.47)		(0.43)	(0.63)		(0.27)	(0.74)	
Mother Age at Birth: 26 - 35 yrs	0.41*	0.91		0.31	1.47		0.66	0.51	
	(0.20)	(0.44)		(0.23)	(0.96)		(0.41)	(0.41)	
Mother Age at Birth: 35 years plus	0.81	1.54	*	0.95	2.89***	**	0.71	0.683	
	(0.15)	(0.41)		(0.25)	(1.17)		(0.21)	(0.24)	
Older Sibling	0.53***	0.47***		0.51***	0.54***		0.59**	0.38***	
	(0.08)	(0.08)		(0.10)	(0.12)		(0.15)	(0.11)	
Mother English Speaking	1.14	2.30**		0.98	2.97**	*	1.33	1.78	
	(0.28)	(0.84)		(0.29)	(1.59)		(0.58)	(0.96)	
Non-Need									
Mother Working	0.55***	0.53***		0.54***	0.56**		0.56**	0.48**	
	(0.09)	(0.10)		(0.12)	(0.13)		(0.14)	(0.15)	
Single Mother	1.3	2.82**	**	1.62	3.66**	**	0.79	1.35	
	(0.34)	(1.13)		(0.52)	(1.86)		(0.36)	(0.58)	
Household Equivalent Income – First Quintile (bottom)	0.83	1.50		0.91	1.66		0.6	1.44	
	(0.25)	(0.55)		(0.35)	(0.84)		(0.30)	(0.79)	

	Combined			2004 Birth Cohort			2000 Birth Cohort		
	0 - 5 yrs	5 - 12 yrs	Sig. Diff	0 - 5 yrs	5 - 12 yrs	Sig. Diff	0 - 5 yrs	5 - 12 yrs	Sig Dif
Household Equivalent Income – Second Quintile	1.04	1.81*		1.02	1.61		0.87	2.36	*
	(0.29)	(0.63)		(0.37)	(0.79)		(0.40)	(1.10)	
Household Equivalent Income – Third Quintile	1.04	1.40		1.13	1.85		0.79	1.05	
	(0.28)	(0.50)		(0.38)	(0.88)		(0.37)	(0.55)	
Household Equivalent Income – Fourth Quintile	0.88	1.26		0.78	1.34		0.94	0.9	
	(0.25)	(0.46)		(0.29)	(0.67)		(0.44)	(0.49)	
Missing Combined Income	0.95	1.09		0.94	1.27		0.86	0.99	
	(0.35)	(0.49)		(0.44)	(0.75)		(0.48)	(0.63)	
GP per thousand population	1.02	0.89		0.97	1.00		1.08	0.66**	***
	(0.04)	(0.08)		(0.07)	(0.10)		(0.07)	(0.01)	
City	0.93			0.93			0.89		
	(0.12)			(0.14)			(0.20)		
N	41020			24539			16481		
State of Residence	MAIN ONLY			MAIN ONLY			MAIN ONLY		
Household Income	YES			YES			YES		
Link Test	OK			OK			OK		

Robust Standard Errors in Parenthesis
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Appendix 4.8: Cox Proportional Hazard Model – Autism Sample

	Combined	Proportional Hazard Test	2004 Birth Cohort	2000 Birth Cohort
Male	1.53**	0.06**	1.72**	1.52
	(0.210)		(0.320)	(0.350)
2004 Birth Cohort	1.24	0.10		
	(0.17)			
Helping Autism	1.29	-0.05	1.16	0.86
	(0.21)		(0.29)	(0.35)
Need Variables				
Other Disability^	2.19***	-0.16***	2.55***	2.39***
	(0.24)		(0.34)	(0.49)
Concerns with Dev.			0.31***	
			(0.07)	
Moderate Autism	0.43***	-0.025	0.31***	0.61
	(0.08)		(0.07)	(0.20)
Severe Autism	0.42***	0.00	0.29***	0.67
	(0.08)		(0.07)	(0.21)
Predisposing				
Mother's Ed. (ref. high school or below)				
Bachelor Degree^	0.85	0.01	1.16	0.63
	(0.13)		(0.20)	(0.19)
Certificate	0.99	-0.02	1.09	1.11
	(0.14)		(0.20)	(0.26)
Mother's Age at Birth (ref 15-25 yrs old)				
26 to 35 years	0.56*	0.09	0.35**	0.94
	(0.15)		(0.11)	(0.54)
35 years plus^	0.85	0.17***	0.61*	1.14
	(0.14)		(0.12)	(0.33)
Older Sibling	0.93	-0.06	0.88	1.11
	(0.10)		(0.11)	(0.24)
Mother English Speaking	0.77	0.04	0.72	0.75
	(0.14)		(0.16)	(0.26)
Non-Need Variables				
Mother Working	0.84	-0.07	0.91	0.77
	(0.09)		(0.13)	(0.17)
Single Mother	1.52**	-0.00	1.38*	1.77
	(0.21)		(0.22)	(0.64)
Household Equivalent Income – First Quintile (bottom)	0.87	0.05	0.93	0.69
	(0.17)		(0.23)	(0.27)
Household Equivalent Income – Second Quintile	1.05	0.04	1.21	0.86
	(0.20)		(0.29)	(0.27)
Household Equivalent Income – Third Quintile	1.15	-0.01	1.25	1.26
	(0.22)		(0.30)	(0.48)
Household Equivalent Income – Fourth Quintile	1.13	0.03	1.28	0.92
	(0.21)		(0.30)	(0.34)
Missing Combined Income	0.53**	0.04	0.71	0.32*
	(0.13)		(0.21)	(0.16)
GP per '000	1.03	-0.02	0.93	1.15***
	(0.04)		(0.05)	(0.05)
City	1.02	0.00	1.00	1.25
	(0.11)		(0.14)	(0.24)
N	1017		727	290
State of Residence	YES		YES	YES
Link Test	OK		OK	OK

Appendix 4.9: Cox Proportional Hazard Model with Time Varying Hazard Ratios – Autism Sample

	Combined			2004 Birth Cohort			2000 Birth Cohort		
	0 - 5 yrs	5 - 12 yrs	Sig. Diff.	0 - 5 yrs	5 - 12 yrs	Sig. Diff.	0 - 5 yrs	5 - 12 yrs	Sig. Diff.
Male	1.34	1.85***		1.54	1.86**		1.28	2.20*	
	(0.26)	(0.38)		(0.43)	(0.49)		(0.38)	(0.00)	
2004 Birth Cohort	0.95	1.64***	**						
	(0.17)	(0.30)							
Helping Autism	1.38*			1.27			1.04		
	(0.24)			(0.33)			(0.45)		
Need Variables									
Other Disability^	2.99***	1.16	***	3.81***	1.04	***	3.39***	1.9*	
	(0.44)	(0.21)		(0.72)	(0.25)		(1.01)	(0.65)	
Concerns with Dev.				0.79	1.21				
				(0.19)	(0.32)				
Severe Autism	2.18***	2.45***		3.35***	2.36***		1.55	5.27***	*
	(0.48)	(0.73)		(0.88)	(0.67)		(0.61)	(3.09)	
Moderate Autism	0.96	0.95		0.92	0.88		1.04	0.99	
	(0.15)	(0.14)		(0.20)	(0.16)		(0.29)	(0.33)	
Non-Need Variables									
Mother Bachelor Degree	0.76	0.995		1.15	1.24		0.39**	0.84	
	(0.15)	(0.20)		(0.30)	(0.31)		(0.17)	(0.46)	
Mother Certificate	1.01	0.91		1.21	1.00		1.02	1.19	
	(0.18)	(0.20)		(0.31)	(0.27)		(0.28)	(0.54)	
Mother's Age at Birth (ref 15-25 yrs old)									
26 to 35 years	0.41*	1.18		0.22**	1.17	*	1.22	0.90	
	(0.21)	(0.44)		(0.17)	(0.63)		(1.13)	(0.60)	
35 years plus^	0.63**	1.32	**	0.52***	0.93		0.76	1.77	
	(0.12)	(0.34)		(0.12)	(0.41)		(0.27)	(0.60)	
Older Sibling	1.06	0.84		0.97	0.75		1.36	0.72	
	(0.15)	(0.12)		(0.18)	(0.14)		(0.38)	(0.25)	
Mother's Labour Force Status	0.85	0.91		0.82	1.15		1.05	0.52**	*
	(0.14)	(0.13)		(0.17)	(0.19)		(0.31)	(0.14)	
Mother Eng. Speaking	0.68*	1.05		0.75	0.87		0.58	0.99	
	(0.15)	(0.35)		(0.21)	(0.36)		(0.27)	(0.80)	
Single Mother	1.37	1.68***		1.41	1.43*		1.27	2.42	
	(0.34)	(0.27)		(0.39)	(0.29)		(0.71)	(0.98)	

	Combined			2004 Birth Cohort			2000 Birth Cohort		
	0 - 5 yrs	5 - 12 yrs	Sig. Diff.	0 - 5 yrs	5 - 12 yrs	Sig. Diff.	0 - 5 yrs	5 - 12 yrs	Sig. Diff.
Household Equivalent Income – First Quintile (bottom)	0.7	1.14		0.91	1.14		0.25**	1.36	**
	(0.20)	(0.30)		(0.34)	(0.34)		(0.15)	(0.80)	
Household Equivalent Income – Second Quintile	0.87	1.14		1.13	1.19		0.39*	1.15	
	(0.24)	(0.31)		(0.38)	(0.40)		(0.21)	(0.60)	
Household Equivalent Income – Third Quintile	1.02	1.05		1.31	1.01		0.59	1.66	
	(0.27)	(0.27)		(0.41)	(0.31)		(0.32)	(0.98)	
Household Equivalent Income – Fourth Quintile	0.9	1.367		1.21	1.20		0.33*	(1.60)	
	(0.24)	(0.43)		(0.39)	(0.46)		(0.19)	(0.89)	
Missing Combined Income	0.48**	0.55*		0.66	0.79		0.21**	0.28*	
	(0.17)	(0.17)		(0.27)	(0.36)		(0.14)	(0.19)	
GP per '000	1.07**	0.97		0.97	0.90		1.21***	1.09	
	(0.04)	(0.07)		(0.06)	(0.08)		(0.06)	(0.19)	
City	1.05			1.03			1.24		
	(0.11)			(0.16)			(0.26)		
N	1017			727			290		
State of Residence	YES			YES			YES		

	Probability of Censoring Prior to Wave 4
Mother Bachelor Degree	-0.0802***
	(0.00965)
Mother Certificate	-0.00950
	(0.00752)
Household Equivalent Income – First Quintile (bottom)	0.0396***
	(0.0147)
Household Equivalent Income – Second Quintile	-0.0136
	(0.0156)
Household Equivalent Income – Third Quintile	-0.0204
	(0.0166)
Household Equivalent Income – Fourth Quintile	-0.0247
	(0.0177)
Missing Combined Income	0.0986***
	(0.0147)
Labour Force Pregnant	-0.0344***
	(0.00710)
Single Mother	0.0377***
	(0.00901)
Mother English	-0.0752***
	(0.00780)
2004 Birth Cohort	0.0161**
	(0.00681)
Other Disability (Wave One)	0.0208
	(0.0140)
n	10,090

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Appendix 5.1: Studies Examining Impact of Having A Child with A Disability on Maternal Labour Supply

Study	Data	Dependent Variable	Childhood Condition	Findings	Methods
Frijters, P., D. W. Johnston, M. Shah and M. A. Shields (2009). "To Work or Not to Work? Child Development and Maternal Labor Supply." American Economic Journal: Applied Economics 1(3): 97-110.	Longitudinal Survey of Australian Children	Labour Force Participation	Poor Cognitive Development	A unit increase in poor childhood development decreased maternal labor force participation by 10 per cent.	2SLS using left handiness as an instrument for poor development. Robustness checks included controls for father labor force status, income and neighborhood socioeconomic status.
Gupta, P., Das, U. and Singh, A (2013) "Child Disability and Maternal Work Participation: New Evidence from India." Economics E-Journal No: 2013-6	Indian Human Development Survey	Labour force participation and hours worked	Child with a disability	Having a child with a disability increase LFP but decrease hours worked for those participating.	Binary logistic models
Amador, D. and M. Pinilla-Roncancio (2015). The Effect of Child Disability on Parents' Labour Supply: Evidence from Colombia.	Colombian Longitudinal Survey	Probability of mother working full and part time	Child with a disability	Increase probability of working (note developing country context)	Difference in Difference
Powers, E. T. (2001). "New estimates of the impact of child disability on maternal employment." The American Economic Review 91(2): 135-139.	Current Population Survey	Labour Force Participation	Child with a disability	Child disability reduces maternal employment by 7.6 per cent amongst 'wives' and 10.8 per cent amongst single mothers.	Linear Probability - one and two stage approaches
Porterfield, S. L. (2002). "Work Choices of Mothers in Families with Children with Disabilities." Journal of Marriage and Family 64(4): 972-981.	Survey of Income and Program Participation	Probability of mother working full and part time	Child with a disability	Single mothers 14% more likely to not be in paid work.	Multinominal logit

Study	Data	Dependent Variable	Childhood Condition	Findings	Methods
	Recruited for study	Labour Force Participation	Child with cystic fibrosis, cerebral palsy, and other physical handicaps.	Single mothers - no impact. Married mothers - greater impact on low income and non-white families.	OLS
Yamauchi, C. (2012). "Children's Health and Parental Labour Supply*." Economic Record 88(281): 195-213.	Longitudinal Survey of Australian Children	Labour Force Participation of mothers and fathers, family income	Long term health problems	Parents of younger cohort had a negative relationship between long term health problems and labour force participation. Little change for K cohort.	Individual Fixed Effects
Parish, S. L., M. M. Seltzer, J. S. Greenberg and F. Floyd (2004). "Economic implications of caregiving at midlife: comparing parents with and without children who have developmental disabilities." Ment Retard 42(6): 413-426.	Wisconsin Longitudinal Survey	Parental wellbeing and maternal labour supply	Intellectual Disability	Lower Participation amongst mothers of children with developmental disabilities	ANCOVA and stratified random sampling (CVM)
Powers, E. T. (2003). "Children's health and maternal work activity estimates under alternative disability definitions." Journal of human resources 38(3): 522-556.	Survey of Income and Program Participation	Maternal Market Work	Disability	Negative impact across different measures of disability using cross sectional. No impact for married mothers using panel fixed state effects.	Pooled panel using OLS, probit and tobit. Using state fixed effects
Gould, E. (2004). "Decomposing the effects of	1997 PSID Child	Labour Force Participation	Disability	Single mothers less likely to work if child has time	

Study	Data	Dependent Variable	Childhood Condition	Findings	Methods
children's health on mother's labor supply: is it time or money?" Health Economics 13(6): 525-541.	Development Supplement			intensive illness, married mothers less likely to work and work fewer hours if their child has a severe condition with an unpredictable time component	
Autism Specific					
Callander, E. and Lindsay, D (2017). "The impact of childhood autism spectrum disorder on parent's labour force participation: can parents be expected to be able to re-join the labour force?" Autism	Longitudinal Survey of Australian Children	Labour Force Participation	Autism	No difference in labour force participation of mothers with children diagnosed with Autism during six waves before school age, significant difference after school age.	Cross sectional logistic regressions
McCall, B. P. and E. M. Starr (2016). "Effects of autism spectrum disorder on parental employment in the United States: evidence from the National Health Interview Survey." Community, Work & Family: 1-26.	National Health Interview Survey	Parental work behaviour	Autism with/without intellectual disability	ASD reduced hours mother worked by 3.73 hours per week (or 16.1 per cent). ASD reduce hours father worked by 1.94 hours per week. Propensity score matching increased the estimates for mothers (7.17 hours) and reduced for fathers.	Pooled cross sectional analysis - using linear regression (work hours) and multinomial logit (participation) - both with and without propensity score matching. Sensitivity - included/excluded disabled siblings.
Cidav, Z., S. C. Marcus and D. S. Mandell (2012). "Implications of Childhood Autism for Parental Employment and Earnings." Pediatrics 129(4): 617-623.	Medical Expenditure Panel Survey	Parental LFP, hours of work and annual earnings	Autism	ASD mothers earn 35% than children with other limitations, and 56% less than children with no limitation. ASD mothers 6 per cent less likely to be employed and work 7 hours	Logit and Tobit Models

Study	Data	Dependent Variable	Childhood Condition	Findings	Methods
				less per week on average. No impact on fathers	
Montes, G. and J. S. Halterman (2008). "Association of childhood autism spectrum disorders and loss of family income." Pediatrics 121(4): e821-826.	National Household Education Survey-After School Programs and Activities in 2005	Parental Income	Autism	ASD reduced family income by 14%	Logistic regression

Appendix 5.2: Descriptive Statistics

Variable	Description	N	Mean	95% CI	SE	Missing	Reason Missing
Labour Force Status During Pregnancy	Whether mother was in paid work during pregnancy (0 indicates NO; 1 indicates YES)	4,317	0.630	0.625 to 0.651	0.480	-22	
Mother's Labour Force Status	Whether mother is in paid work (0 indicates NO; 1 indicates YES)	24,606	0.660	0.657 to 0.669	0.003	-5	
Father's Labour Force Status	Whether father is in paid work (0 indicates NO; 1 indicates YES)	23,207	0.949	0.946 to 0.951	0.001	-1,404	1398 birth father not in household
Mother's Hours Worked	Average hours normally worked by mother	24,606	16.696	16.49 to 16.9	0.104	-5	
Father's Hours Worked	Average hours normally worked by father	21,847	43.719	43.50 to 43.93	0.110	-2,764	1398 birth father not in household
Biological Father Present	Birth father not present at time of birth (0 indicates NO; 1 indicates YES)	4,339	0.042	0.036 to 0.047	0.003	0	
Other Disability	Child has other disability not Autism	24,524	0.047	0.044 to 0.049	0.001	-87	
Mother's Age	Mother's age in years	4,337	31.780	31.63 to 31.93	0.078	-2	
Father's Age	Father's age in years	4,164	33.150	32.88 to 33.41	0.135	-175	174 birth father missing
Mum English Speaking Background	English is main language spoken at home (0 indicates NO; 1 indicates YES)	4,337	0.864	0.854 to 0.74	0.005	-2	
Dad English Speaking Background	English is main language spoken at home (0 indicates NO; 1 indicates YES)	4,124	0.857	0.846 to 0.867	0.005	-215	211 birth father not in home
Mother Bachelor Degree	Mother's highest education is a bachelor degree or above (0 indicates NO; 1 indicates YES)	24,605	0.371	0.365 to 0.377	0.003	-6	
Father Bachelor Degree	Father's highest education is a bachelor degree or above (0 indicates NO; 1 indicates YES)	23,371	0.312	0.306 to 0.318	0.003	-1,240	1137 birth father not in household

Variable	Description	N	Mean	95% CI	SE	Missing	Reason Missing
Mother Certificate or Diploma	Mother's highest education is a certificate or diploma (0 indicates NO; 1 indicates YES)	24,605	0.380	0.373 to 0.385	0.003	-6	
Father Certificate or Diploma	Father's highest education is a certificate or diploma (0 indicates NO; 1 indicates YES)	23,371	0.463	0.457 to 0.469	0.003	-1,240	1137 birth father not in household
Mother Never Completed High school	Mother never completed high school (0 indicates NO; 1 indicates YES)	24,605	0.038	0.031 to 0.0355	0.001	-6	
Father Never Completed High school	Father never completed high school (0 indicates NO; 1 indicates YES)	23,371	0.052	0.048 to 0.053	0.001	-1,240	1137 birth father not in household
Number of Siblings	Number of siblings in household	24,611	1.415	1.402 to 1.42	0.007	0	
Minimum Age of Child in Household	Age of youngest child in household	24,611	3.807	3.767 to 3.848	0.020	0	
Study Child Indigenous	Study child is indigenous (0 indicates NO; 1 indicates YES)	4,339	0.035	0.0299 to 0.040	0.002	0	
Mother Drank During Pregnancy	Whether mother reports drinking during pregnancy with study child (0 indicates NO; 1 indicates YES)	3,825	0.153	0.142 to 0.165	0.006	-514	504 non responders to wave 1.5
Mother Smoked During Pregnancy	Whether mother reports smoking during pregnancy with study child (0 indicates NO; 1 indicates YES)	3,829	0.390	0.375 to 0.406	0.008	-510	504 non responders to wave 1.5
Sex of Study Child	Study child is male (0 indicates NO; 1 indicates YES)	4,339	0.514	0.499 to 0.529	0.008	0	
Multiple Birth	Study child a multiple birth (0 indicates NO; 1 indicates YES)	4,338	0.034	0.028 to 0.039	0.003	-1	
Intensive Care After Birth	Study child admitted to intensive care after birth (0 indicates NO; 1 indicates YES)	4,338	0.164	0.153 to 0.175	0.006	-1	
Mother had maternity leave	Mother had paid maternity leave after study child's birth (0 indicates NO; 1 indicates YES)	3,133	0.259	0.244 to 0.274	0.008	-1206	504 non responders to wave 1.5
Family had Private Health Insurance	Family had private health insurance during wave 1 (0 indicates NO; 1 indicates YES)	4,337	0.493	0.478 to 0.508	0.008	-2	

Variable	Description	N	Mean	95% CI	SE	Missing	Reason Missing
Father's weekly income pre birth	$0 to $499 (0 indicates NO; 1 indicates YES)	3,216	0.078	0.068 to 0.086	0.005	-1123	504 non responders to wave 1.5 and 140 birth father not in home
Father's weekly income pre birth	$500 to $999 (0 indicates NO; 1 indicates YES)	3,216	0.395	0.378 to 0.412	0.009	-1123	504 non responders to wave 1.5 and 140 birth father not in home
Father's weekly income pre birth	$1000 to $1499 (0 indicates NO; 1 indicates YES)	3,216	0.242	0.227 to 0.257	0.008	-1123	504 non responders to wave 1.5 and 140 birth father not in home
Father's weekly income pre birth	$1500 to $1999 (0 indicates NO; 1 indicates YES)	3,216	0.100	0.090 to 0.110	0.005	-1123	504 non responders to wave 1.5 and 140 birth father not in home
Father's weekly income pre birth	$2000 and above (0 indicates NO; 1 indicates YES)	3,216	0.076	0.066 to 0.084	0.005	-1123	504 non responders to wave 1.5 and 140 birth father not in home
Mother's weekly income pre birth	$0 to $499 (0 indicates NO; 1 indicates YES)	3,626	0.245	0.230 to 0.259	0.007	-713	504 non responders to wave 1.5
Mother's weekly income pre birth	$500 to $999 (0 indicates NO; 1 indicates YES)	3,626	0.250	0.236 to 0.265	0.007	-713	504 non responders to wave 1.5
Mother's weekly income pre birth	$1000 to $1499 (0 indicates NO; 1 indicates YES)	3,626	0.100	0.090 to 0.109	0.005	-713	504 non responders to wave 1.5
Mother's weekly income pre birth	$1500 to $1999 (0 indicates NO; 1 indicates YES)	3,626	0.023	0.018 to 0.028	0.002	-713	504 non responders to wave 1.5
Mother's weekly income pre birth	$2000 and above (0 indicates NO; 1 indicates YES)	3,626	0.014	0.001 to 0.017	0.002	-713	504 non responders to wave 1.5
Number of Employees at Mother's Work Pre-Birth	Under 5 Employees (0 indicates NO; 1 indicates YES)	3,626	0.043	0.037 to 0.050	0.003	-713	504 non responders to wave 1.5
Number of Employees at Mother's Work Pre-Birth	5 to 19 Employees (0 indicates NO; 1 indicates YES)	3,626	0.102	0.092 to 0.112	0.005	-713	504 non responders to wave 1.5
Number of Employees at Mother's Work Pre-Birth	20 to 99 Employees (0 indicates NO; 1 indicates YES)	3,626	0.108	0.098 to 0.119	0.005	-713	504 non responders to wave 1.5
Number of Employees at Mother's Work Pre-Birth	100 to 499 Employees (0 indicates NO; 1 indicates YES)	3,626	0.087	0.078 to 0.097	0.005	-713	504 non responders to wave 1.5
Number of Employees at Mother's Work Pre-Birth	Over 500 Employees (0 indicates NO; 1 indicates YES)	3,626	0.232	0.218 to 0.246	0.007	-713	504 non responders to wave 1.5

Variable	Description	N	Mean	95% CI	SE	Missing	Reason Missing
Mum's Mum Bachelor Degree	Mother's Mother highest education is a bachelor degree or above (0 indicates NO; 1 indicates YES)	4,121	0.087	0.079 to 0.096	0.004	-218	
Mum's Mum Certificate or Diploma	Mother's Mother highest education is a certificate or diploma (0 indicates NO; 1 indicates YES)	4,121	0.191	0.179 to 0.203	0.006	-218	
Mum's Mum Never Completed High school	Mother's Mother never completed high school (0 indicates NO; 1 indicates YES)	4,121	0.215	0.203 to 0.228	0.006	-218	
Dad's Mum Bachelor Degree	Father's Mother highest education is a bachelor degree or above (0 indicates NO; 1 indicates YES)	4,113	0.058	0.004 to 0.051	0.065	-226	
Dad's Mum Certificate or Diploma	Father's Mother highest education is a certificate or diploma (0 indicates NO; 1 indicates YES)	4,113	0.113	0.005 to 0.103	0.122	-226	
Dad's Mum Never Completed High school	Father's Mother highest education is a certificate or diploma (0 indicates NO; 1 indicates YES)	4,113	0.152	0.006 to 0.141	0.163	-226	
Mum Professional Pre-Birth	Mum's professional occupation pre-birth (0 indicates NO; 1 indicates YES)	3,635	0.351	0.335 to 0.366	0.008	-704	504 non responders to wave 1.5
Mum Semi-Skilled Pre-Birth	Mum's semi-skilled occupation pre-birth (0 indicates NO; 1 indicates YES)	3,635	0.244	0.230 to 0.258	0.007	-704	504 non responders to wave 1.5
Mum Trade Pre-Birth	Mum's trade occupation pre-birth (0 indicates NO; 1 indicates YES)	3,635	0.042	0.036 to 0.049	0.003	-704	504 non responders to wave 1.5
Development	Parents concerned about development at age 0-1 (0 indicates NO; 1 indicates a little or YES)	4,338	0.063	0.056 to 0.070	0.004	-1	
Single Mother	Mother does not have partner (0 indicates NO; 1 indicates YES)	24,611	0.113	0.109 to 0.117	0.002	0	
Local Area Employment	Percentage working in linked area (0 to 100 per cent)	24,609	61.952	61.857 to 62.048	0.049	-2	
Underlying Autism - MILD	First Diagnosed with Mild Autism (0 indicates NO; 1 indicates YES)	24,611	0.029	0.027 to 0.031	0.001	0	

Variable	Description	N	Mean	95% CI	SE	Missing	Reason Missing
Underlying Autism - MODERATE	First Diagnosed with Moderate (0 indicates NO; 1 indicates YES)	24,611	0.014	0.012 to 0.031	0.001	0	
Underlying Autism- SEVERE	First Diagnosed with Severe Autism (0 indicates NO; 1 indicates YES)	24,611	0.002	0.002 to 0.003	0.000	0	
Metropolitan	Lives in a metropolitan area (0 indicates NO; 1 indicates YES)	24,611	0.611	0.605 to 0.617	0.003		
State of Residence	NSW (0 indicates NO; 1 indicates YES)	24,611	0.305	0.299 to 0.310	0.003	0	
State of Residence	VIC (0 indicates NO; 1 indicates YES)	24,611	0.243	0.238 to 0.249	0.003	0	
State of Residence	SA (0 indicates NO; 1 indicates YES)	24,611	0.069	0.065 to 0.072	0.002	0	
State of Residence	WA (0 indicates NO; 1 indicates YES)	24,611	0.104	0.100 to 0.108	0.002	0	
State of Residence	TAS (0 indicates NO; 1 indicates YES)	24,611	0.026	0.023 to 0.027	0.001	0	
State of Residence	NT (0 indicates NO; 1 indicates YES)	24,611	0.013	0.011 to 0.014	0.001	0	
State of Residence	ACT (0 indicates NO; 1 indicates YES)	24,611	0.024	0.022 to 0.026	0.001	0	
State of Residence	QLD - Reference	24,611	0.217	0.212 to 0.222	0.003	0	

Appendix 5.3: Estimates From Propensity Score Matching – 2004 Birth Cohort

	Cohort B Probit Marginal Effect	Standard Error
Labour Force Participation During Pregnancy	-0.005	0.012
Labour Force Participation During Pregnancy Missing	0.026	0.047
Paid Maternity Leave	-0.005	0.007
Maternity Leave Missing	-0.001	0.008
Private Health Insurance	-0.005	0.005
Private Health Insurance Missing	0.229	0.288
No Father in Household	0.020	0.041
Study Child Indigenous	-0.017*	0.007
Male Study Child	0.043***	0.005
Disabled Sibling At Birth	0.018*	0.007
Number of Siblings At Birth	-0.008**	0.003
Mother's Mother – Bachelor Degree	0.008	0.009
Mother's Mother - Certificate	-0.002	0.006
Mother's Mother – Never Completed High school	-0.001	0.006
Mother's Mum Missing Education	-0.029***	0.006
Father's Mother – Bachelor Degree	-0.001	0.009
Father's Mother - Certificate	0.002	0.008
Father's Mother – Never Completed High school	-0.001	0.007
Father's Mum Missing Education	0.103	0.102
Father English Speaking Background	0.000	0.008
Father's Age Birth	0.000	0.000
Father Age Missing	0.005	0.029
Father Pre Birth Income > $2000 per week	-0.016	0.011
Father Pre Birth Income $1500> $1999 per week	-0.003	0.015
Father Pre Birth Income $1000> $1499 per week	0.003	0.015
Father Pre Birth Income $500> $999 per week	0.012	0.016
Father Pre Birth Income $1> $499 per week	0.008	0.019
Father Pre Birth Income Missing	0.011	0.017
Father Bachelor Degree	0.002	0.007
Father Certificate	-0.001	0.006
Father High School	0.003	0.012
Father Missing Education	-0.009	0.018
Mother English Speaking Background	0.015*	0.006
Mother's Age Birth	0.000	0.001
Mother Pre Birth Income > $2000 per week	-0.008	0.022
Mother Pre Birth Income $1500> $1999 per week	-0.007	0.019
Mother Pre Birth Income $1000> $1499 per week	-0.024	0.009
Mother Pre Birth Income $500> $999 per week	-0.022	0.013
Mother Pre Birth Income $1> $499 per week	-0.026	0.012
Mother Pre Birth Income Missing	0.000	0.015
Mother Occupation Type During Pregnancy - Professional	0.027	0.030
Mother Occupation Type During Pregnancy – Semi-Skilled	0.014	0.028
Mother Occupation Type During Pregnancy – Trade	0.009	0.031

	Cohort B Probit Marginal Effect	Standard Error
Mother's Employer Pre Birth: Less Than 5 Employees	0.016	0.024
Mother's Employer Pre Birth: 5<19 Employees	0.024	0.022
Mother's Employer Pre Birth: 20<99	0.012	0.018
Mother's Employer Pre Birth: 100<499 Than 5 Employees	0.002	0.016
Mother's Employer Pre Birth: >500 Employees	0.013	0.016
Mother Bachelor Degree	0.025**	0.009
Mother Certificate	0.019**	0.007
Mother Never CompletedHigh School	0.009	0.015
Smoked During Pregnancy	0.012	0.008
Smoked During Pregnancy Missing	0.058	0.079
Drank During Pregnancy	-0.002	0.005
Drank During Pregnancy Missing	-0.026	0.014
NSW	-0.006	0.005
NT	0.007	0.022
SA	-0.011	0.007
TAS	-0.016	0.009
VIC	-0.003	0.006
WA	-0.016**	0.006
MET	0.004	0.005
Percentage Employed in Local Area	0.000	0.000
N	4339	

Standard errors in parentheses
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Appendix 5.4: Graphical Comparison Of Pre And Post Matched Samples

Graph One A shows the distribution of propensity scores before matching. Graph One B shows the distribution of propensity scores after matching. The graphs illustrate the nearest neighbour matching process has produced a more balanced sample.
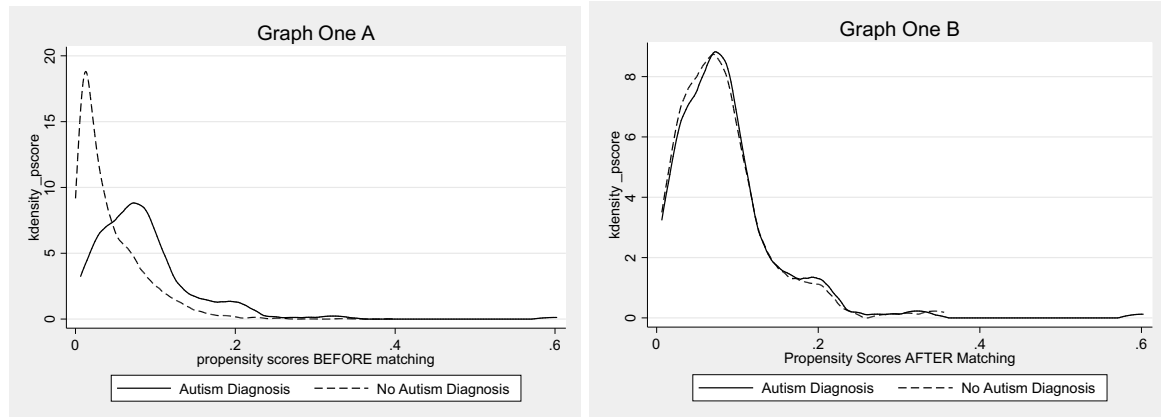
Appendix 5.5: Paternel Labour Force Participation

	Unmatched - Fixed Effects	Unmatched - Random Effects	Matched -Fixed Effects	Matched - Random Effects
Need Variables				
Underlying Mild Autism		0.009		0.012
		(0.011)		(0.012)
Underlying Moderate Autism		-0.000		0.009
		(0.023)		(0.024)
Underlying Severe Autism		-0.033		-0.032
		(0.073)		(0.073)
Mild Autism Diagnosis	0.018	0.016	0.028*	0.027*
	(0.016)	(0.015)	(0.016)	(0.016)
Moderate Autism Diagnosis	-0.019	-0.004	-0.009	0.007
	(0.027)	(0.027)	(0.027)	(0.027)
Severe Autism Diagnosis	0.039	0.039	0.057	0.052
	(0.104)	(0.099)	(0.106)	(0.100)
Non-Need Variables				
Father's Age	0.011**	0.003***	0.001	0.002
	(0.005)	(0.001)	(0.010)	(0.002)
Father's Age Squared	-0.000	-0.000***	0.000	-0.000
	(0.000)	(0.000)	(0.000)	(0.000)
Other Disability	-0.014*	-0.021***	-0.033**	-0.040**
	(0.008)	(0.008)	(0.015)	(0.016)
Disabled Sibling	-0.008	-0.012**	-0.003	-0.009
	(0.005)	(0.005)	(0.011)	(0.008)
English Speaking Background		0.019**		-0.015
		(0.008)		(0.015)
Never Completed High school	-0.076	-0.122***	-0.086	-0.108***
	(0.066)	(0.020)	(0.104)	(0.040)
Bachelor Degree	0.029	0.023***	-0.009	0.022
	(0.018)	(0.007)	(0.031)	(0.014)
Certificate	0.002	0.003	-0.006	0.002
	(0.012)	(0.007)	(0.022)	(0.014)
NSW	0.016	0.004	0.031	0.023
	(0.018)	(0.007)	(0.046)	(0.016)
VIC	0.022	0.018**	-0.004	0.033**
	(0.022)	(0.007)	(0.051)	(0.014)
SA	0.038	0.010	0.055	0.018
	(0.028)	(0.010)	(0.064)	(0.023)
WA	0.003	0.002	-0.016	0.012
	(0.026)	(0.009)	(0.030)	(0.021)
TAS	0.022	0.007	0.115	0.095***
	(0.033)	(0.014)	(0.073)	(0.023)
NT	-0.038	-0.027	-0.082	-0.049
	(0.031)	(0.019)	(0.091)	(0.052)
ACT	0.025	0.020**	0.047	0.046***
	(0.030)	(0.010)	(0.064)	(0.017)
Metropolitan Area	0.013	0.004	0.018	-0.009
	(0.011)	(0.005)	(0.026)	(0.011)
Employment in Area	0.001***	0.002***	0.003***	0.003***
	(0.000)	(0.000)	(0.001)	(0.001)
Constant	0.505***	0.798***	0.614***	0.765***
	(0.142)	(0.022)	(0.235)	(0.048)
Time Fixed Effects	YES	YES	YES	YES
Observations	23205	23205	5135	5135

Standard errors in parentheses * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Appendix 5.6:   Maternal Labour Supply: Matched Sample

	Matched - Fixed Effects	Matched - Random Effects
Need Variables		
Underlying Mild Autism		-0.052
		(0.038)
Underlying Moderate Autism		0.005
		(0.052)
Underlying Severe Autism		-0.112
	(.)	(0.133)
Mild Autism Diagnosis	-0.077**	-0.066*
	(0.037)	(0.037)
Moderate Autism Diagnosis	-0.210***	-0.195***
	(0.056)	(0.055)
Severe Autism Diagnosis	-0.373***	-0.355***
	(0.123)	(0.120)
Non-Need Variables		
Mother's Age	0.105***	0.044***
	(0.038)	(0.010)
Mother's Age Squared	-0.000**	-0.001***
	(0.000)	(0.000)
Other Disability	-0.047**	-0.052**
	(0.022)	(0.021)
Age of Youngest Child	0.020***	0.026***
	(0.007)	(0.005)
Number of Siblings	-0.062***	-0.061***
	(0.019)	(0.011)
Disabled Sibling	-0.000	-0.010
	(0.013)	(0.011)
English Speaking Background	0.000	0.129***
	(.)	(0.037)
Bachelor Degree	0.200***	0.221***
	(0.063)	(0.030)
Certificate	0.091*	0.118***
	(0.047)	(0.028)
Never Completed High School	0.373***	0.210***
	(0.040)	(0.047)
Single Mother	-0.072***	-0.095***
	(0.026)	(0.022)
Constant	-2.928**	-0.877***
	(1.148)	(0.191)
State Controls	YES	YES
Local Area Controls	YES	YES
Time Fixed Effects	YES	YES
Observations	5536	5536

Appendix 5.7: Maternal Labour Supply: Balanced Panel

	Unmatched - Fixed Effects	Unmatched - Random Effects	Matched - Fixed Effects	Matched - Random Effects
Need Variables				
Underlying Mild Autism		-0.050		-0.028
		(0.041)		(0.043)
Underlying Moderate Autism		0.013		0.036
		(0.059)		(0.058)
Underlying Severe Autism		0.002		0.003
		(0.189)		(0.192)
Mild Autism Diagnosis	-0.099**	-0.087**	-0.095**	-0.083*
	(0.041)	(0.041)	(0.042)	(0.042)
Moderate Autism Diagnosis	-0.233***	-0.217***	-0.221***	-0.200***
	(0.062)	(0.061)	(0.064)	(0.062)
Severe Autism Diagnosis	-0.454***	-0.442***	-0.438***	-0.429***
	(0.149)	(0.151)	(0.152)	(0.154)
Non-Need Variables				
Mother's Age	0.071***	0.055***	0.030	0.031**
	(0.020)	(0.006)	(0.042)	(0.013)
Mother's Age Squared	-0.001***	-0.001***	-0.000	-0.000**
	(0.000)	(0.000)	(0.000)	(0.000)
Other Disability	-0.056***	-0.056***	-0.065***	-0.059***
	(0.014)	(0.014)	(0.023)	(0.023)
Age of Youngest Child	0.028***	0.029***	0.018**	0.023***
	(0.003)	(0.002)	(0.008)	(0.005)
Number of Siblings	-0.041***	-0.055***	-0.057**	-0.054***
	(0.010)	(0.005)	(0.023)	(0.012)
Disabled Sibling	-0.012*	-0.021***	-0.009	-0.018
	(0.007)	(0.007)	(0.014)	(0.015)
English Speaking Background		0.121***		0.042
		(0.017)		(0.039)
Bachelor Degree	0.202***	0.185***	0.212***	0.239***
	(0.033)	(0.015)	(0.073)	(0.036)
Certificate	0.113***	0.095***	0.097*	0.111***
	(0.023)	(0.014)	(0.056)	(0.035)
Never Completed High School	-0.273***	0.154***	0.000	0.186***
	(0.025)	(0.036)	(.)	(0.061)
Single Mother	-0.019	-0.036***	-0.019	-0.037
	(0.016)	(0.013)	(0.032)	(0.027)
Constant	-1.111*	-0.892***	-1.248	-0.844***
	(0.594)	(0.121)	(1.254)	(0.250)
State Controls	YES	YES	YES	YES
Local Area Controls	YES	YES	YES	YES
Time Fixed Effects	YES	YES	YES	YES
Observations	20209	20209	4464	4464

Standard errors in parentheses
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

	Unmatched - Fixed Effects	Unmatched - Random Effects	Matched - Fixed Effects	Matched - Random Effects
Underlying Mild Autism		-0.049		-0.014
		(0.037)		(0.040)
Underlying Moderate Autism		-0.014		0.027
		(0.054)		(0.055)
Underlying Severe Autism		-0.105		-0.063
		(0.131)		(0.134)
Mild Autism Diagnosis	-0.096**	-0.093**	-0.101**	-0.093**
	(0.038)	(0.037)	(0.041)	(0.040)
Moderate Autism Diagnosis	-0.228***	-0.204***	-0.232***	-0.201***
	(0.070)	(0.068)	(0.071)	(0.068)
Severe Autism Diagnosis	-0.367***	-0.380***	-0.376***	-0.381***
	(0.136)	(0.128)	(0.140)	(0.131)
Mother's Age	0.072***	0.056***	0.056	0.040***
	(0.018)	(0.005)	(0.042)	(0.012)
Mother's Age Squared	-0.000***	-0.001***	-0.000	-0.001***
	(0.000)	(0.000)	(0.000)	(0.000)
Other Disability				
Age of Youngest Child	0.028***	0.028***	0.026***	0.024***
	(0.003)	(0.002)	(0.007)	(0.005)
Number of Siblings	-0.041***	-0.057***	-0.050**	-0.068***
	(0.009)	(0.005)	(0.020)	(0.011)
Disabled Sibling	-0.010	-0.021***	-0.006	-0.010
	(0.007)	(0.007)	(0.015)	(0.014)
English Speaking Background		0.128***		0.145***
		(0.015)		(0.041)
Bachelor Degree	0.189***	0.183***	0.131*	0.225***
	(0.031)	(0.013)	(0.075)	(0.032)
Certificate	0.111***	0.100***	0.059	0.109***
	(0.021)	(0.012)	(0.060)	(0.032)
Never Completed High School	0.094	0.181***	0.000	0.196***
	(0.234)	(0.026)	(.)	(0.055)
Single Mother	-0.032**	-0.061***	-0.018	-0.079***
	(0.014)	(0.012)	(0.031)	(0.026)
Constant	-1.547***	-0.966***	-1.072	-0.735***
	(0.592)	(0.097)	(1.225)	(0.213)
State Controls	YES	YES	YES	YES
Local Area Controls	YES	YES	YES	YES
Time Fixed Effects	YES	YES	YES	YES
Observations	23445	23445	4890	4890

Standard errors in parentheses
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

MATCHED ON WAVE ONE CHARACTERISTICS

	Unmatched - Fixed Effects	Unmatched - Random Effects	Matched - Fixed Effects	Matched - Random Effects
Underlying Mild Autism		-0.068*		-0.053
		(0.036)		(0.038)
Underlying Moderate Autism		-0.013		0.006
		(0.051)		(0.052)
Underlying Severe Autism		-0.117		-0.113
		(0.132)		(0.133)
Mild Autism Diagnosis	-0.077**	-0.072**	-0.084**	-0.076**
	(0.036)	(0.036)	(0.037)	(0.037)
Moderate Autism Diagnosis	-0.221***	-0.209***	-0.228***	-0.212***
	(0.056)	(0.055)	(0.057)	(0.056)
Severe Autism Diagnosis	-0.383***	-0.364***	-0.373***	-0.364***
	(0.119)	(0.119)	(0.119)	(0.120)
Mother's Age	0.074***	0.056***	0.134***	0.062***
	(0.018)	(0.005)	(0.038)	(0.010)
Mother's Age Squared	-0.000***	-0.001***	-0.001***	-0.001***
	(0.000)	(0.000)	(0.000)	(0.000)
Other Disability	-0.046***	-0.049***	-0.039*	-0.041**
	(0.013)	(0.012)	(0.022)	(0.021)
Age of Youngest Child	0.029***	0.029***	0.024***	0.027***
	(0.003)	(0.002)	(0.007)	(0.005)
Number of Siblings	-0.040***	-0.056***	-0.050***	-0.058***
	(0.009)	(0.005)	(0.018)	(0.010)
Disabled Sibling	-0.013*	-0.021***	-0.010	-0.015
	(0.007)	(0.006)	(0.011)	(0.011)
English Speaking Background		0.125***		0.074**
		(0.015)		(0.032)
Bachelor Degree	0.189***	0.184***	0.147**	0.185***
	(0.030)	(0.013)	(0.065)	(0.030)
Certificate	0.112***	0.102***	0.050	0.091***
	(0.020)	(0.012)	(0.054)	(0.029)
Never Completed High School	0.067	0.176***	1.148***	0.211***
	(0.218)	(0.026)	(0.026)	(0.048)
Single Mother	-0.036***	-0.063***	-0.032	-0.057***
	(0.014)	(0.011)	(0.026)	(0.022)
Constant	-1.556***	-0.970***	-4.195***	-1.144***
	(0.574)	(0.095)	(1.120)	(0.182)
State Controls	YES	YES	YES	YES
Local Area Controls	YES	YES	YES	YES
Time Fixed Effects	YES	YES	YES	YES
Observations	24596	24596	5575	5575

Standard errors in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Impact of Autism Diagnosis on Hours Worked

Matched Sample

	Maternal Matched Sample:- Random Effects	Maternal Matched Sample Ever Worked Random Effects	Paternal Matched Sample:- Random Effects	Paternal Matched Sample Ever Worked Random Effects
Underlying Mild Autism	0.295	1.443	0.438	-0.068
	(1.250)	(1.355)	(1.127)	(1.114)
Underlying Moderate Autism	1.746	2.588	-1.930	-1.932
	(1.639)	(1.758)	(2.055)	(2.017)
Underlying Severe Autism	-1.152	3.223	6.738	6.158
Underlying Mild Autism	(4.163)	(5.729)	(10.593)	(10.588)
Mild Autism Diagnosis	-2.097	-2.298	0.838	0.880
	(1.197)	(1.442)	(1.603)	(1.612)
Moderate Autism Diagnosis	-5.552**	-6.282**	-5.555*	-5.612*
	(1.848)	(2.170)	(2.689)	(2.735)
Severe Autism	-10.369*	-13.795*	-13.884	-13.809
	(4.195)	(6.859)	(10.383)	(10.315)
Age	1.023**	1.231**	1.275***	1.264***
	(0.341)	(0.407)	(0.126)	(0.126)
Age Squared	-0.013*	-0.016**	-0.018***	-0.017***
	(0.005)	(0.006)	(0.002)	(0.002)
Other Disability	-2.092**	-2.416**	-0.486	-0.459
	(0.660)	(0.782)	(0.921)	(0.935)
Age of Youngest Child	0.993***	1.155***	-0.424*	-0.459*
	(0.152)	(0.175)	(0.207)	(0.208)
Number of Siblings	-2.128***	-2.295***	0.704	0.708
	(0.342)	(0.408)	(0.484)	(0.481)
Disabled Sibling	-0.240	-0.321	0.315	0.402
	(0.425)	(0.537)	(0.600)	(0.634)
English Speaking Background	-2.052	-2.785	1.275***	1.264***
	(1.601)	(1.708)	(0.126)	(0.126)
Single Mother	8.596***	7.968***		
	(1.148)	(1.259)		
Constant	-19.029**	-16.132*	1.810	2.602
	(6.174)	(7.375)	(3.329)	(3.301)
Education Controls	YES	YES	YES	YES
State Controls	YES	YES	YES	YES
Local Area Controls	YES	YES	YES	YES
Time Fixed Effects	YES	YES	YES	YES
Observations	5389	4662	5389	5332

*Significant at the * 0.1 ** 0.05 *** 0.01 levels.*

Appendix 5.8: Identification Of A Control Group

A suitable control group requires the parallel trends assumption to be satisfied, and analysis of the graphs A, B, C and D we present the average maternal labour force participation across the six waves for the treatment group and the four control groups.

From the graphs we observe that the parallel trends assumption is difficult to demonstrate for our third and fourth control groups, children with ADHD and other children with identified disabilities. However, there is an approximate parallel trend for the first and second control groups, with the sample matched on wave one characteristics having the strongest approximation to a parallel trend. We therefore use the sample matched on wave one characteristics as our control group in the analysis below.
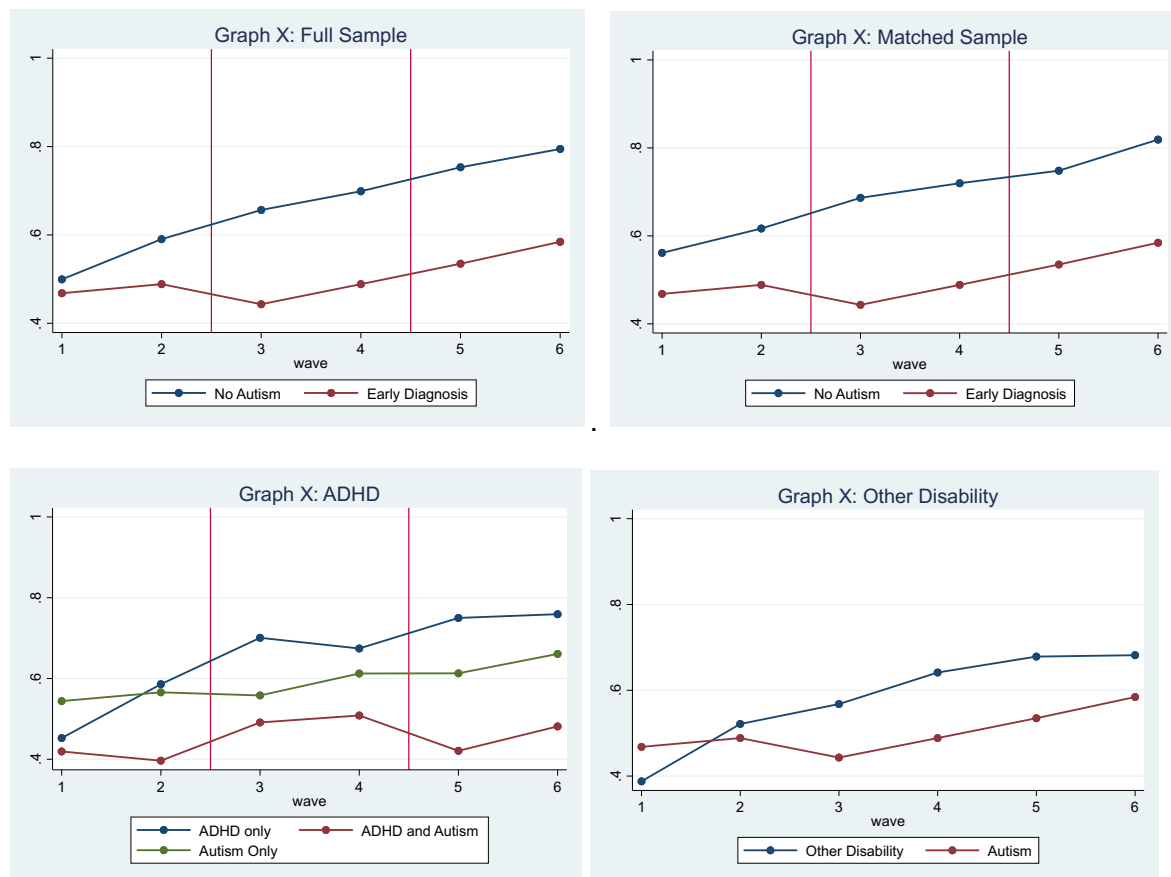
Appendix 5.9: Summary Statistics for Early Diagnosis Treatment and Control Groups

	Early Diagnosis Group: Children with Autism			Full Sample: Children without Autism			Matched Sample: Children without Autism		
	Mean	N	SD	Mean	N	SD	Mean	N	SD
Maternal LFP	0.50	556	0.50	0.67	23500	0.47	0.61	2488	0.49
Paternal LFP	0.96	501	0.20	0.95	22211	0.22	0.95	2332	0.22
Maternal Hours Worked	13.06	556	16.72	16.78	23505	16.36	15.13	2488	16.18
Paternal Hours Worked	39.58	501	19.96	41.24	22211	18.77	41.51	2332	19.57
Maternal Age at Birth	31.30	100	5.20	31.83	4140	5.19	31.56	440	5.78
Paternal Age at Birth	29.27	100	12.14	31.92	4142	10.71	30.97	440	11.86
Mother Bachelor Degree	0.38	100	0.49	0.35	4141	0.48	0.38	440	0.49
Mother Certificate	0.39	100	0.49	0.34	4141	0.47	0.38	440	0.48
Mother Never Completed High school	0.03	100	0.17	0.04	4141	0.19	0.03	440	0.16
Father Bachelor Degree	0.27	88	0.45	0.30	3804	0.46	0.30	395	0.46
Father Certificate	0.51	88	0.50	0.45	3804	0.50	0.40	395	0.49
Father Never Completed High school	0.03	88	0.18	0.05	3804	0.22	0.03	395	0.17
Mother English Speaking Background	0.88	100	0.33	0.86	4140	0.35	0.84	439	0.37
Father English Speaking Background	0.89	91	0.31	0.85	3945	0.35	0.82	413	0.38
Male Study Child	0.83	100	0.38	0.50	4142	0.50	0.83	440	0.38
Indigenous Study Child	0.01	100	0.10	0.04	4142	0.19	0.05	440	0.22
Disabled Sibling	0.07	100	0.29	0.06	4142	0.27	0.06	440	0.28
Number of Siblings	0.81	100	1.25	0.96	4142	1.04	0.95	440	0.98
Other Disability Study Child	0.28	556	0.45	0.04	23505	0.19	0.05	2488	0.22
Multiple Birth	0.05	100	0.22	0.03	4141	0.18	0.03	440	0.18
Intensive Care at Birth	0.21	100	0.41	0.16	4141	0.37	0.18	440	0.38
Smoked During Pregnancy	0.24	93	0.43	0.15	3654	0.36	0.18	383	0.38
Drank In Pregnancy	0.31	94	0.46	0.39	3649	0.49	0.39	380	0.49
Average Age at Diagnosis (years)	3.23	100	0.12						
Severe Autism	0.1	100	0.03						
Moderate Autism	0.29	100	0.05						
Mild Autism	0.61	100	0.05						

Appendix 5.10:   Difference in Difference Robustness

	MODEL 1 Early Diagnosis-Matched Sample	MODEL 2 DID - Fixed Effects 1 October 2008 Start Date	MODEL 3 DID - Fixed Effects 1 October 2008 Start Date	MODEL 4 DID - Fixed Effects 1 October Start Date
Helping Autism		0.158***	-0.010	-0.026
		(0.017)	(0.025)	(0.025)
DID: Mild Autism Diagnosis#Helping Autism		-0.066	-0.067	0.005
		(0.056)	(0.052)	(0.064)
DID: Moderate/Severe Autism Diagnosis#Helping Autism		-0.094	-0.135	0.023
		(0.089)	(0.086)	(0.086)
Mild Autism Diagnosis	-0.126*			-0.112
	(0.059)			(0.073)
Moderate/Severe Autism Diagnosis	-0.289***			-0.280***
	(0.081)			(0.079)
Other Disability	-0.045		-0.073*	-0.038
	(0.029)		(0.029)	(0.030)
Time Fixed Effects	YES	NO	NO	NO
Other Household Characteristics	YES	NO	YES	YES
Mother Socio-Economic Background	YES	NO	YES	YES
Regional and Local Area Controls	YES	NO	YES	YES
Observations	2837	3039	3039	3039

*Significant at the * 0.1 ** 0.05 *** 0.01 levels.*