University of Southampton

Faculty of Social Sciences

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Access to healthcare and assistive technologies for people with physical disabilities in Cambodia

by

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Abstract

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Access to healthcare and assistive technology, including assistive products such as orthoses and wheelchairs, for people with disabilities is a fundamental human right, as stated in the United Nations Convention of the Rights of People with Disabilities. Evidence suggests that people with disabilities face barriers to accessing health and rehabilitative care in Low- and Middle-Income Countries. The overarching aim of this thesis is to investigate access to healthcare services and assistive products for people with physical disabilities in Cambodia. This three-paper thesis seeks contribute to the limited literature on this topic. The first two papers, in Chapters 4 and 5 apply quantitative methods using data from the Cambodian Socio-Economic Survey and from a patient database of service users from three Prosthetic and Orthotic clinics in Cambodia. Chapter 4 seeks to understand differences in access to health services between people with and without physical disabilities using a two-stage Hurdle Model. Chapter 5 follows on from this by investigating a specific population group, orthosis users, and their access to Prosthetic and Orthotic services. In this study, descriptive statistics have been used to examine change in use over time, and survival analysis has been used to investigate differences in orthotic device replacements. The final empirical chapter, Chapter 6, adopts a qualitative design to explore pathways to physical rehabilitation services, and the barriers and facilitators for orthosis and wheelchair users. In this thesis, there are some key findings. Firstly, poverty impacts access to health and physical rehabilitation services for people with disabilities in Cambodia. Secondly, gender and disability intersect to create differences in access between men and women. Thirdly, use of prosthetic and orthotic services has changed over time, with administrative data providing an effective way of studying this change. Lastly, several facilitators of access to physical rehabilitation services were found, including social support networks, community health workers and individual agency. The finding from the thesis indicate that people with disabilities in Cambodia have differential access to health and physical rehabilitation. The findings in this thesis have important policy implications as understanding where people with disabilities are seeking healthcare and the significant barriers to health and rehabilitation is vital for designing patient-centred services in Cambodia and other low- and middle-income countries.

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Research Thesis: Declaration of Authorship

Print name: Charlotte Owen

Title of thesis: Access to healthcare and assistive technologies for people with physical disabilities in Cambodia

I declare that this thesis and the work presented in it are my own and has been generated by me as the result of my own original research.

I confirm that:

1. This work was done wholly or mainly while in candidature for a research degree at this University;
2. Where any part of this thesis has previously been submitted for a degree or any other qualification at this University or any other institution, this has been clearly stated;
3. Where I have consulted the published work of others, this is always clearly attributed;
4. Where I have quoted from the work of others, the source is always given. With the exception of such quotations, this thesis is entirely my own work;
5. I have acknowledged all main sources of help;
6. Where the thesis is based on work done by myself jointly with others, I have made clear exactly what was done by others and what I have contributed myself;
7. None of this work has been published before submission

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Definitions and Abbreviations

AFO	Ankle-Foot Orthosis
AT	Assistive Technology
CBR	Community-Based Rehabilitation
CDs	Communicable Diseases
CSES	Cambodian Socio-Economic Survey
DPO	Department of Prosthetics and Orthotics
EA	Enumeration Areas
FO	Foot Orthosis
GATE	Global Cooperation on Assistive Technology
HEF	Health Equity Fund
HICs	High Income Countries
ICF	International Classification of Functioning, Disability and Health
ICRC	International Committee of the Red Cross
IDPoor	Identification of Poor Households Program
IO	International Organisation
IP	Informal Provider
KAFO	Knee-Ankle-Foot Orthosis
LMICs	Low- and Middle-Income Countries
MOH	Ministry of Health
MOSVY	Ministry of Social Affairs, Veterans and Youth Rehabilitation
MSC	Modern Service Clinic
MSPD	Moderate or Severe Physical Disability
NCDs	Non-Communicable Diseases
NGO	Non-Governmental Organisation
NIS	National Institute of Statistics
NSPP	National Social Protection Policy

OD	Operational District
OOP	Out-of-Pocket
PWDF	People with Disabilities Foundation
PIS	Participant Information Sheet
PO	Prosthetist and Orthotist
P&O	Prosthetic and Orthotic
PSU	Primary Sampling Units
PWP GT	Prentice, Williams and Peterson Gap-Time
SDGs	Sustainable Development Goals
SFAB	Steenbeek Foot Abduction Brace
rATA	Rapid Assistive Technology Assessment tool
UHC	Universal Health Coverage
UN	United Nations
UNCRPD	United Nations Convention of the Rights of People with Disabilities
WHO	World Health Organisation

Chapter 1 Introduction

1.1 Background

Access to health services is a fundamental human right and realising this right should be a target of all countries. However, previous research has shown that people with disabilities[1] in Low- and Middle-Income Countries (LMICs) do not have the same access to health services, including curative, rehabilitative, preventive and health promotion, compared to people without disabilities (Bright & Kuper, 2018; Vergunst *et al.,* 2019; WHO, 2022a). Therefore, removing and reducing the barriers which prevent equal access to health services are necessary for increasing equity in health for people with disabilities. The Sustainable Development Goals (SDGs) are a set of seventeen goals which provide a framework for ending global poverty and reducing inequality (UN, 2018). The third SDG aims to improve health and wellbeing for all, including vulnerable populations such as people with disabilities. Specifically, Target 3.8 aspires to achieve Universal Health Coverage (UHC) of essential healthcare services, affordable medicines and vaccines for all (WHO, 2020a).

UHC is defined as "*all people and communities can use the promotive, preventive, curative, rehabilitative and palliative health services they need without fear of financial hardship*" (WHO, 2020a, pg 6). This includes access to health promotion services such as information campaigns, vaccination programmes, physical rehabilitation services and provisions of Assistive Technology (AT). However, the SDGs do not explicitly mention access to assistive products as an essential service. AT encompasses assistive products and their systems and services (WHO-UNICEF, 2022). Assistive products are used to maintain and improve individual functioning and can enable independence (WHO-UNICEF, 2022). They include physical products such as prosthetics, orthotics, wheelchairs, mobility aids, hearing aids and digital products such as communication software or apps (WHO-UNICEF, 2022). For people with disabilities, access to assistive products can be an important enabler of empowerment, inclusion and social participation in society (Tebbutt *et al.,* 2016).

The United Nations Convention on the Rights of People with Disabilities (UNCRPD) states the fundamental rights of people with disabilities in areas such as healthcare, employment and education. Article 25 and 26 of the UNCRPD state that people with disabilities must have access to appropriate health and rehabilitation services, including access to affordable and high-quality

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[1] The internationally accepted term 'people with disabilities' is used throughout this document, as opposed to the UK accepted definition of 'disabled people' because of the LMIC focus of this research

assistive products. Consequently, a lack of access to services is a clear infringement upon a person's human rights (Bright & Kuper, 2018). In LMICs, there is an unmet need for physical rehabilitation and assistive products (Tebbutt *et al.,* 2016). A multi-country study of LMICs conducted by Eide *et al.* (2019) found that 31.5% to 67% of respondents reported needing an assistive product. Another study by Danemayer *et al.* (2022) found a similar need for assistive products, where 60% of respondents reported needing one of five assistive products (hearing aids, limb prostheses, wheelchairs, glasses and personal digital assistants). For many other types of assistive products, such as orthoses, the unmet need is unknown as there is extremely limited data available on how many people could benefit from or currently use an orthotic device globally. Without this data, prevalence of assistive products within populations cannot be studied which is important for the planning of health and rehabilitation services. This indicates a need for more prioritisation placed on collecting data and producing evidence about the need and use of assistive products globally, including LMICs.

In 2014, the Global Cooperation on Assistive Technology (GATE) was established to improve access to high-quality and affordable assistive products and comply with the UNCRPD (Khasnabis *et al.,* 2015; Tebbutt *et al.,* 2016). This initiative focuses on research and innovation with research priorities including the costs and economic impact of AT, service provision models and human resources within the AT sector (Layton *et al.,* 2018). This research will explore health service use by people with physical disabilities and use of Prosthetic and Orthotic (P&O) services by orthosis and wheelchair users. Previous research that has explored access to P&O services has failed to include orthosis and wheelchair users, with the majority focusing solely on prosthetic users or both prosthetic and orthotic users. It is hypothesised in this thesis that people who use orthoses or wheelchairs are likely to be different to those who use prosthetics. For example, previous research indicates that men are much more likely to be amputees and access P&O services for prosthetics in LMICs compared to orthosis users (Barth *et al.,* 2020; Dickinson *et al.,* 2022).

Defining disability is complex and multifaceted, as noted by the number of definitions and models which provide different perspectives on disability (Mitra, 2006; Palmer & Harley, 2012). Understandings of disability are not universal, with different cultures and societies having different perceptions of disability (McEwan & Butler, 2007). Models of disability are typically Western-centric and have mostly been created in HIC contexts. As a result, significant attention to historical and cultural differences must be considered before applying these models to LMICs to ensure that understanding the experiences of people with disabilities is accurate (McEwan & Butler, 2007). A dominant long-standing view of disability centres around the medical model which refers to disability in relation to impairments which cause the loss of bodily and social functioning (Palmer &

Harley, 2012). Treatment for individuals with disabilities are focused on removing the cause or fixing the impairment, which are ultimately the root cause of disability (Haegele & Hodge, 2016). The medical model of disability has an individualistic focus that segregates people into diagnostic categories; therefore, is regarded as a problem to be managed by individuals and medical professionals (Mitra, 2018). To oppose the dominance of the medical model, the social model situates disability as a consequence of social, economic and environmental barriers present in society which denies people with disabilities access to equal opportunities (Braathen *et al.,* 2015). Within the social model, impairments are not considered an important part of disability, whereas disability is argued to be socially produced through inaccessible societies (Palmer & Harley, 2012). The social model does not deny that some impairments and illnesses can have disabling consequences and appropriate interventions and rehabilitation can benefit some (Oliver, 2004). More precisely, the model aims to show the structural and societal barriers faced by individuals which limit empowerment.

A third model to understand disability is the capability approach[2]. Advocated within the capability approach is a person's ability to function, meaning what a person is capable of doing or achieving versus what a person actually does or achieves (Mitra, 2006). Disability is understood as limited functioning or capabilities that interact with different personal factors relating to the individual, such as personal characteristics including type of impairment, assets and income and their surrounding environment including social, economic and cultural (Mitra, 2006). A key component of the capability approach is choice. This means that whether a person is disabled is subjective to what the individual wishes to do or achieve (Burchardt, 2004). Whilst the capability approach may be useful in theory, very limited frameworks for data collection have been developed utilising this approach, with limited research operationalising this approach (Trani *et al.,* 2011a; Bickenbach, 2014).

Within health research, the capability approach is a health gap measure which measures the difference between an ideal situation, in which the whole population lives in perfect health until the age of standard life expectancy and a person's current situation (HGM, 2010). Some examples of health gap measures related to disability are disability-adjusted life years (DALYs) and years of life lost (YLLs). Several criticisms of using DALYs to measure disability have been reported (Arnesen & Nord, 1999; Metts, 2001; Allotey *et al.,* 2003; Mont, 2007; Grosse *et al.,* 2009). A significant criticism of using DALYs is the notion that the lives of people with disabilities as fundamentally less than a person without (Arnesen & Nord, 1999). DALYs can therefore be a proponent of the medical model,

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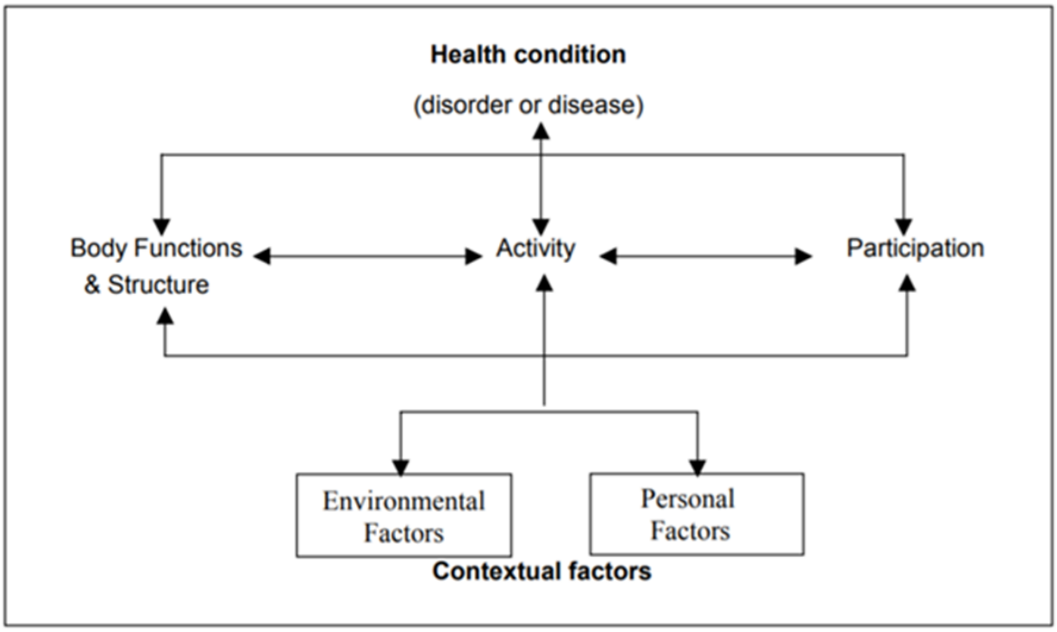
[2] First developed by A.K. Sen in 1979 to understand poverty.

rather than the capability approach, as disability is viewed as fundamentally a physical condition without any inclusion of other factors such as an individual's environment (Mont, 2007). As a result, this research utilises other methods of measuring impairment and disability.

In this thesis, the International Classification of Functioning, Disability and Health (ICF) is used to understand disability and impairment. The ICF model is based on aspects of both the medical and social models and attempts to overlap the two, stemming from the biopsychosocial model (Imrie, 2004). Furthermore, the capability approach also helps to underpin the ICF as it recognises capabilities of individuals in relation to external conditions (WHO, 2011). Figure 1.1 displays the ICF framework which shows the interaction between health conditions and contextual factors and how these impact body functions and structure, activity and participation. Health conditions are understood solely to be impairments to the body structure or functioning, and not the root cause of disability. This is particularly relevant for Chapter 5 where there is limited available information on the disability of P&O service users, as only diagnosis data was available. Activity limitations and participation restrictions refer to are the difficulties carrying out tasks or actions and challenges an individual faces in life situations (WHO, 2002). Environmental factors that can impact the development of disability include the natural and built environments, legal and social structures, and attitudes towards disability (WHO, 2002; Vanleit, 2008). This includes the availability of assistive products and technology. Personal factors are related to the individual and includes characteristics such as age, gender, education and occupation, as well as motivation and self-esteem which can impact the extent to which a person participates in society (WHO, 2011). Consequently, disability can therefore be defined as the interaction between impairments, activity limitations and participation restrictions. The ICF is arguably the most appropriate model of disability to use because it is a widely accepted framework of measuring disability within LMICS. In the context of this research, it enables impairments to be viewed in perspective to contextual factors and lived experiences, for example, access to healthcare for people with physical disabilities in Cambodia can be assessed using socioeconomic factors as well as individual functioning.

In addition, other disabilities, such as learning, behavioural, mental and psychosocial are also important to consider in the context of health equity as these disabilities can be highly stigmatised (WHO, 2022a). With the diagnoses of mental health conditions for instance anxiety and depression increasing globally (WHO, 2022b). For countries with recent conflicts and traumatic events, mental health conditions such as PTSD can also be prevalent in the population (Priebe *et al.,* 2010), including in Cambodia (Seponski *et al.,* 2019). Due to the scope of this thesis, only sensory and physical disabilities have been included in the empirical chapters. However, there is a strong need for more research that specifically focuses on other disabilities where they can be explored in-depth to improve equity in access to healthcare.

Figure 1.1. The International Classification of Functioning, Disability and Health (WHO, 2002. pg. 9)



This thesis focuses on people with physical disabilities because disability is an important topic. The most recent WHO report (2022a) on equity in health for people with disabilities estimated that 16% of the population globally have a disability, equating to 1.3 billion people. This is a slight increase from the WHO World Disability report (2011) which estimated that 15% of the global population had a disability. A lack of access to health services can cause poorer health outcomes for people with disabilities (WHO, 2022a). Poorer health outcomes are more likely to be experienced by people with disabilities, compared to those without, due to many underlying structures such as poverty, exclusion and their impairment (Wilbur *et al.,* 2018; Kuper & Heydt, 2019). As well as having the same healthcare needs such as vaccinations and sexual and reproductive health as people without disabilities, people with disabilities may require further healthcare such as specialist and rehabilitative care and assistive devices (Wilbur *et al.,* 2018). In LMICs, studies also show that people with disabilities face several barriers to healthcare services, such as financial, transport, geographic and health system barriers (Hashemi *et al.,* 2022). This is explored in more detail in Section 2.3. To improve access to health and physical rehabilitation services for people with disabilities in LMICs, more research is needed to examine the barriers that are faced. Further understanding of how characteristics such as gender and poverty interact with disability to impact access to services is also needed.

The first paper of the thesis in Chapter 4 includes analysis of access to different types of healthcare services for people with sensory and physical disabilities. Here a more general overview of the situation faced by people with disabilities access services in Cambodia is produced. This provides insights which help understand papers two and three in Chapters 5 and 6 as it provides background context to understand general use of health services, which can indicate why some of the findings exist in the later empirical chapters. The subsequent section introduces why Cambodia is a suitable case study for this research. This is followed by the research objectives and questions (Section 1.2) and the thesis outline (Section 1.3).

1.1.1 Cambodia as a case study

This thesis investigates and explores access to health and physical rehabilitation services, including P&O services, in Cambodia. The Kingdom of Cambodia is an ideal case study for this research for several reasons. The country has experienced rapid development since the 1990s, after decades of conflict (Karamba *et al.*, 2022). The health system in Cambodia was completely dismantled in the 1970s during the Khmer Rouge and it struggled to rebuild in the 1980s (Dunleavy, 2009). A more detailed description of the Cambodian context can be found in Chapter 3. Since the rebuilding of the health system, Cambodia has developed and diversified with both a public health care system and a private health care system (DPHI, 2016). The private sector is operated by for-profit providers and non-profit providers such as Non-Governmental Organisations (NGOs) which play an important role in the delivery of physical rehabilitation services (DPHI, 2016; Stratchan *et al.,* 2023). The private health sector also includes a wealth of Informal Providers (IPs) such as drug vendors and markets and traditional medicine (Suy *et al.,* 2019). It is important to understand how people with physical disabilities navigate the health system, as barriers are likely to be different depending on where health or rehabilitative care is sought. This makes Cambodia a valuable case study because the health system faces many challenges in delivering health and rehabilitation services due to its fragmentation.

Furthermore, the country has experienced many years of political and societal stability with significant investment and assistance from International Organisations (IOs), NGOs and foreign governments (Karamba *et al.*, 2022). This has allowed for the regular collection of rich data sources, such as national surveys and general population censuses. The government of Cambodia and global health actors have invested significant funds into the collection of surveys such as the Cambodian Socio-Economic Survey (CSES) and a General Population Census every ten years. Hence, Cambodia has suitable existing data that includes questions on the utilisation of health care services which can be used to measure access for people with and without physical disabilities.

There is limited research involving people with disabilities in Cambodia and their access to health and physical rehabilitation services. This research adds further evidence by looking more specifically at different types of healthcare available to people with physical disabilities. The overarching research objectives of this PhD will be to investigate access to healthcare services and physical rehabilitation services by examining the barriers to the health system for people with physical disabilities, with a focus on orthosis and wheelchair users. In addition to the overarching research objectives, several smaller research questions will be answered within the separate papers that comprise this PhD thesis. To answer the different research questions a multiple method approach has been adopted with a mixture of quantitative and qualitative data collection and analysis techniques being used.

1.2 Research objectives and questions

This thesis aims to provide an understanding of the barriers people with disabilities face to accessing health and physical rehabilitation services. Here, insights are offered to how the barriers to health and physical rehabilitation services differ, and between characteristics such as gender, poverty and type of impairment. Thus, the overarching objectives of this thesis are:

1. To investigate access to health services, using utilisation data, for people with physical disabilities in Cambodia
2. To understand the characteristics and use of orthotic devices from P&O services in Cambodia, and how use has changed over time.
3. To explore the barriers and facilitators to P&O services for orthosis and wheelchair users in Cambodia

Outlined below are the research questions for each empirical paper in this three-paper thesis.

Firstly, paper one (Chapter 4) aims to assess differences in healthcare seeking behaviour for people with and people with physical disabilities in Cambodia. Healthcare seeking is measured using the 2019/2020 CSES data which asks respondents whether they sought treatment or advice for an injury or illness they had in the 30 days preceding the survey.

The research questions for this paper are:

1. What individual and contextual factors are associated with healthcare utilisation after illness or injury in a period of 30 days preceding a survey in Cambodia for people with and without physical disabilities?

2. Are there differences in utilising certain types of healthcare providers after illness or injury in a period of 30 days preceding a survey between people with and without physical disabilities in Cambodia?

Paper two (Chapter 5), examines differences in the utilisation of P&O services for orthotic users in Cambodia, using data from three P&O clinics operated by the NGO, Exceed Worldwide (Exceed). This paper investigates the demographic profile of service users and frequency in attending the clinics for to replace orthoses. The third research question of this study is to assess how administrative data can be used to understanding service use in a low resource setting.

The research questions for this paper are:

1. What are the demographic characteristics of people who access orthotic services at three clinics in Cambodia?
2. Are there differences in the frequency of service use for orthotic device replacements from three P&O clinics in Cambodia between different orthotic user groups?
3. How can administrative data be best used to provide information about orthotic service use in a low resource setting?

Lastly, paper three (Chapter 6), adopted a qualitative design to explore the barriers and facilitators to accessing orthotic and wheelchair services for users of P&O services from three clinics in Cambodia. Further, this paper also aims to uncover the pathways to receiving P&O services and understand how people came to use Exceed services and any delays to receiving physical rehabilitation services.

The research questions for this paper are:

1. How are the pathways to health and rehabilitative care experienced and negotiated by people with physical disabilities in Cambodia?
2. How does access to assistive devices such as orthoses, wheelchairs and mobility aids impact the everyday lives of people with disabilities in Cambodia
3. What are the facilitators and barriers for people with physical disabilities to accessing P&O services and healthcare services in Cambodia?

1.3 Thesis Outline

The structure of this thesis follows a three-paper thesis structure with a total of seven chapters, including the introduction.

Chapter 2 provides a description of equity in health systems with a focus on inequity for people with disabilities. This is then followed by a discussion of the barriers to accessing health and rehabilitation services in LMICs using supply and demand-side barriers proposed by Ensor & Cooper (2004). This chapter also discusses the conceptual frameworks of access to health services chosen for use in this thesis. These conceptual frameworks are Andersen, Davidson & Baumeister's (2013) behavioural model of health service use and Levesque, Harris & Russell's (2013) model of patient-centred access to health services.

The third chapter consists of an overview of Cambodia, and its recent history which has heavily impacted the health system. It provides an overview of the structure and financing of the health system including physical rehabilitation services, and a description of the social assistance programme, Health Equity Funds (HEFs)

Chapter 4 includes the first PhD empirical paper. Here, access to healthcare for people with physical disabilities in Cambodia is investigated, as well as whether there are any differences in type of healthcare provider sought for people with and without physical disabilities. The data for this paper is from the CSES 2019/20 and the methods include a hurdle model which utilises multilevel binary logistic models and multilevel multinomial models.

The fifth chapter consists of the second empirical paper. The aim is to examine access to orthotic services in Cambodia for people with disabilities. This paper utilises administrative healthcare data from three Cambodian P&O clinics operated by the NGO, Exceed. The methodology includes descriptive analysis using crosstabulations and survival analysis such as an extended Cox proportional hazards model.

The third empirical paper (Chapter 6) adopts a qualitative design using semi-structured in-depth interviews to explore pathways to physical rehabilitation and the facilitators and barriers faced. The participants for this study were orthosis and wheelchair used from Exceed's Phnom Penh clinic. Thematic analysis was then used to organise the data into key themes.

Chapter 7 includes a summary of the findings from all three empirical chapters. The literature and methodological contributions of the thesis are also discussed. It also includes the limitations of this research, potential areas of future research, policy implications and some concluding remarks.

Chapter 2 Literature review

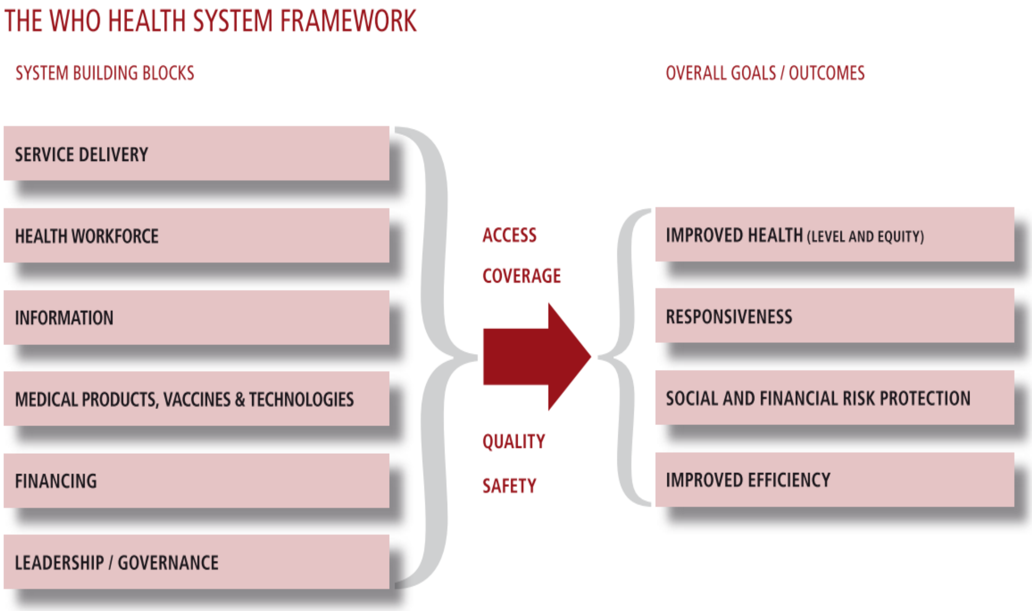
2.1 Introduction

Ensuring that health systems are accessible is crucial to ensuring healthy populations. According to the World Health Organisation (WHO) (2017a), it is estimated that half of the world's population do not have access to essential healthcare and rehabilitation. For people with disabilities, barriers to health services can be even more pronounced than for people without disabilities, causing an unmet need for healthcare services (Kuper & Heydt, 2019). In health systems it is important to provide a range of different curative, health promotion and prevention services, in addition to rehabilitation and specialist services that can provide assistive products, such as orthoses, prostheses, wheelchairs and hearing aids to improving functioning and enable independence (WHO-UNICEF, 2022). This literature review includes a description of health systems in Low- and Middle-Income Countries (LMICs) and equity in health for people with disabilities in Section 2.2. After introducing the key concepts, a discussion of barriers to healthcare, rehabilitation and assistive products encountered by people with disabilities in Cambodia and other LMICs is provided in Section 2.3. This literature will also outline the conceptual frameworks of health service access, in Section 2.4, used in the thesis, with a focus on an LMIC context.

2.2 Equity in Health Systems

The health system plays a vital role in maintaining, promoting and restoring the health of populations at a local, national and global level (WHO, 2007). The WHO (2007) define the health system as different organisations and personnel which provide different types of healthcare, such as preventative, promotive and curative, combined with other types of care including rehabilitation and specialist treatment. In LMICs, health systems at the national level are operated by a multitude of governmental agencies and departments, though these can be influenced by international organisations such as the WHO and international donors (WHO, 2007; Hafner & Shiffman, 2013). The complexity of health systems, due to the involvement of multiple stakeholders, can cause regional variations in operating. Diverse cultural contexts also mean that there can be significant differences in the delivery of healthcare services within and between countries (Smith & Hanson, 2012). Figure 2.1 displays the WHO (2007) health systems framework which contains the six system building blocks needed to improve health outcomes. Using the diagram in Figure 2.1, a strong health system would be well-performing in all the individual system building blocks, for example effective service delivery and a well-functioning health information system. On the other hand, weak health systems would struggle in some or all the building blocks of a health system. Weak health systems experience major resource constraints in areas such as human capital, financial resources and the supply of medications and equipment (Mills *et al.,* 2006). These constraints produce unequal and inequitable access to healthcare services as well as enabling patterns of ill-health, with the poorest and vulnerable populations often the most impacted (Peters *et al.,* 2008). For people with disabilities, this means being unable to access necessary health and physical rehabilitation services when needed.

Figure 2.1 The WHO Health System Framework (WHO, 2007. pg. 3)



Health systems in LMICs frequently have greater resource constraints compared to High-Income Countries (HICs), with lower public health sector use, and a greater reliance on informal care and NGOs (WHO, 2000). In LMICs, the delivery of specialist healthcare services and rehabilitation are often supported by NGOs and IOs, as governments may have limited funding to provide these services as part of public services (WHO-UNICEF, 2022). For example, the International Committee of the Red Cross (ICRC) provide substantial assistance in providing physical rehabilitation services and supplying assistive products in LMICs such as Cambodia, Tanzania and Sudan (ICRC, 2022). This causes fragmentation of the health system, due to a lack of collaboration across national and local governments, the private health sector, donors and NGOs, with the latter being heavily influenced by changing global health policy (Dean *et al.,* 2018).

Existing and new challenges provide added stress on health systems, for example, changing patterns of diseases as seen by the rise in NCDs such as Diabetes and Stroke (WHO, 2022c). This is combined with prevailing challenges from Communicable Diseases (CDs) such as Tuberculosis and

Malaria (WHO, 2007). In LMICs, the burden of road traffic injuries is also high and are a significant cause of short- and long-term impairments (Zafar *et al.,* 2018), with rehabilitation services often only able to provide limited support to road traffic accident survivors (WHO-UNICEF, 2022). Additionally, new challenges such as the COVID-19 pandemic and climate change are an emerging threat to health systems, with LMICs often being more vulnerable to the impacts of these compared to HICs (WHO, 2010; Armitage & Nellums, 2020).

The challenges faced by health systems to deliver health services in LMICs causes inequities in access to health and rehabilitation services. Equity is based on the fundamental principles of fairness and justice (Collins & Green, 2014). The 2022 WHO report on health equity for people with disabilities define health inequity as avoidable and unjust differences in health outcomes that cannot be explained by underlying differences in health condition or impairment. These health inequities faced by people with disabilities can lead to poorer health outcomes and premature death. For instance, previous research has found there is greater risk of dying prematurely for people with vision impairments, compared to those with mild or no vision impairments (WHO, 2022a). This is different to health inequalities which, to some extent, can be caused by underlying health conditions, such as the increased likelihood of people with Down Syndrome developing early onset Dementia (WHO, 2022a).

Addressing differences in health inequity for people with disabilities is important because it can enable their social and economic participation in society and support the advancement towards realising global health priorities (WHO, 2022a). To achieve equity in health, UHC is a fundamental global health priority (Kuper & Hanefield, 2018). UHC can be defined as ensuring the whole population has access to a range of health services, including curative, health promotion, prevention, rehabilitation and other specialist types of care, when needed without encountering financial hardship (WHO, 2015a). Under UHC, health services should provide quality healthcare to all, regardless of income or current economic situation (Kuper *et al.,* 2018). The services available should include access to a range of services and should be of a suitable quality to provide services across the life course (WHO, 2022a). This includes universal access to provisions of assistive products and other goods which can support functioning for people with impairments (WHO-UNICEF, 2022).

Within health systems, the provisions of healthcare and the challenges faced by people with disabilities are often overlooked (MacLachlan *et al.,* 2011). Further, resource constraints limit the ability for adequate continuums of care for people with disabilities which involve preventative care, management of health conditions and surveillance and monitoring (Dean *et al.,* 2018). The lack of availability of specialised services such as occupational therapy, rehabilitation and ear and eye care specialists further inhibits adequate care continuums for people with disabilities (Kuper & Heydt, 2019). These services may be important to people with disabilities to ensure the impact of their impairments on their livelihoods and wellbeing is limited. In some LMICs, i.e., Kenya and Malawi hearing services are not available at public facilities, therefore, NGOs provide these services to the general population that are unable to access private facilities (Kuper & Heydt, 2019). Additionally, for people with conditions such as cerebral palsy and clubfoot, timely access to physical rehabilitation are vital for ensuring optimal long-term outcomes (Morgan *et al.,* 2021; Smythe *et al.,* 2022).

People with disabilities also may have limited access to health promotion and prevention as they may be excluded from targeting, meaning that they may have limited access to this important part of the health system (WHO, 2011). Their experiences of access are also dependent on wider factors, such as health literacy, support from households and communities and government policies. A lack of access and support to health promotion and prevention can have a negative impact on health, for instance, untreated or poorly managed diabetes can lead to limb amputations and stroke (WHO, 2016). Thus, not having access to the right health information has the potential to affect a person's health or exacerbate existing health conditions and impairments. Consequently, health systems as a whole fail to address the needs of people with disabilities because of the barriers they face and inequitable access (Dean *et al.,* 2018). To address these issues, the barriers which prevent equitable access need to be identified through research and evidence.

The introduction of this thesis introduced the SDGs. The aim of goal three is to '*ensure healthy lives and promote well-being for all at all ages'* (UN, 2018). Whilst people with disabilities are not explicitly mentioned in this goal, vulnerable populations are mentioned. Target 3.8 also aspires to achieve UHC for all (UN, 2018). This is relevant for people with disabilities because this group tend to have higher health care needs and may be more vulnerable to high health expenditure or health shocks (Hashemi *et al.,* 2017). There are also additional global initiatives which aim improve access to healthcare for people with disabilities further. The Global Disability Action Plan 2014-2021 was created in response to the recommendations in the 2011 World Report on Disability. In the action plan, UHC is one of the principles underpinning the design and implementation of the plan (WHO, 2014). Furthermore, the Incheon Strategy 2012-2022 is an action plan for countries in Asia and Pacific region and outlines the Asian and Pacific Decade of Persons with Disabilities, 2013–2022 (ESCAP, 2012). The plan includes regional specific disability development goals and targets. Goal four specifically relates to the social protection of people with disabilities, the targets include: Target 4.A - increase access to health services, including rehabilitation services and Target 4.B - increase social protection programme coverage. It also includes specific goals on gender equality, with Target 6.C aiming to ensure that all women and girls have equitable access to sexual and reproductive health services. This is important for women and girls with disabilities who may face greater discrimination compared to men and boys with disabilities because of the intersection between gender and disability (WHO, 2022a). This is explored in more detail in Section 2.3.1.3

Another global initiative created by the WHO is the Rehabilitation 2030 Initiative. This initiative details the global unmet need for rehabilitation services and provides a strategic approach to strengthening health systems for rehabilitation (WHO, 2017a). The call for action was launched in 2017 and created ten priority areas for stakeholders, including incorporating rehabilitation into UHC plans and building a stronger research capacity and robust evidence (WHO, 2017a). Additionally, the WHO GATE initiative aims to increase access to high-quality assistive products (Layton *et al.,* 2018). To do this, a global research priority agenda was created through global consultations and consensus (WHO, 2017a). The GATE initiative has brought more attention to provisions of assistive products in LMICs. Individual countries have further created plans and targets to develop access to assistive products and improve access to healthcare for people with disabilities. In Cambodia, the government created National Disability Strategic Plans, with the first covering 2014-2018, to promote the enforcement of laws and legislation provided by the UNCRPD (DAC, 2014). The strategic plan also attempts to implement the goals stated in the Incheon Strategy (DAC, 2014). An updated National Disability Strategic Plans was released in 2022, however this is not currently available outside for the government.

To summarise, the number of global and regional initiatives on disability, health and rehabilitation highlight that improving access to services for people with disabilities is a pressing issue and is viewed as an important dimension to improve health for all. To do this, more research is needed to understand the barriers faced by people with disabilities. The following section will explain some of the key barriers which people with disabilities face to accessing a wide range of health and rehabilitation services in LMICs.

2.3 Barriers to health and rehabilitation for people with disabilities: empirical findings

The barriers to accessing health and rehabilitative care services for people with disabilities exist both on the demand and supply side. Demand side barriers to healthcare exist at the individual, household or community level, whereas supply barriers exist within the organisation and structure of the health system (Ensor & Cooper, 2004). The subsequent section includes an examination of the demand and supply side barriers to accessing healthcare for people with disabilities in LMICs, with a focus on Cambodia. Many of the barriers mentioned in the following section are recognised in the models of healthcare access and will be illustrated in relation to the models in full in Section 2.4.

2.3.1 Demand-side barriers

2.3.1.1 Financial barriers

The cost associated with accessing health services can impact the likelihood of people with disabilities using health and rehabilitative care. Previously, user fees were supported by global health actors, such as NGOs, IOs and government agencies such as the United States Agency for International Development and the Foreign, Commonwealth & Development Office in the UK. In the 1980s, the introduction of user fees was suggested as a potential solution to health financing in LMICs, with many countries such as Niger, Burkina Faso, Cambodia and Vietnam, reforming health systems on the principal of the financial participation of service users (Robert & Ridde, 2013). User fees for utilising healthcare services can be a significant source of funding for public and private health systems, however, they can also be significant barriers to usage (Peters *et al.,* 2008). Some studies find evidence that user fees provide much needed revenue to public health systems to improve quality and availability of medical treatments and interventions, as well as helping to regulate and reduce informal and unofficial user fees (Barber *et al.,* 2004; Ensor *et al.,* 2017). However, a documentary study conducted by Robert and Ridde in 2013 suggests that there is now limited support for introducing user fees by global health actors, with 55% of those studied opposing user fees at the point of delivery. Numerous studies have found that user fees can decrease utilisation of healthcare services, particularly for vulnerable households (e.g., Peters *et al.,* 2008; Yates, 2009; Dzakpasu *et al.,* 2014; Mladovsky & Ba, 2017).

Out of pocket (OOP) payments can cause catastrophic expenditure[3] (WHO, 2015a). The impact of this expenditure can push households into economic hardship or poverty (Shamrock *et al.,* 2016). Payments can impact households' finances considerably, with households having to reduce essential spending, borrow money or sell assets to pay for medical care (Chhun *et al.,* 2015). In Cambodia, OOP payments account for a significant proportion of revenue collection for funding healthcare (Chhun *et al.,* 2015). Research conducted by Dalal *et al.* (2017) found that from 2005 to 2010 the trend of catastrophic health expenditure in Cambodia had not improved. Furthermore, a study by the WHO (2017b) reported that people with disabilities spend, on

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[3] Catastrophic expenditure are OOP payments that exceed a fraction of total health expenditure (WHO, 2015a)

average, three or four times on medical expenses, transport and accommodation costs compared to people without disabilities in Cambodia. This is consistent with research from other LMICs, with Mitra *et al.* (2009) finding that people with disabilities have significantly higher OOP health expenditure compared to people without disabilities.

Previous research has shown that for people with disabilities the cost of living is often higher than for those without disabilities resulting from additional needs (Minh *et al.,* 2015). Studies by Mont and Nguyen (2011) and Palmer *et al.* (2016) have found that having a disability can increase the cost of living by 11% in Vietnam and 17% in Cambodia. Therefore, added health expenditure could potentially create economic hardship for households with people with disabilities, which may push them below the poverty line. A reinforcing cycle between poverty and disability could be detrimental to the health of household members as poverty and health are intrinsically linked; poverty can lead to poor health, and poor health sustains poverty (Peters *et al.,* 2008; Banks *et al.,* 2017). The disability-poverty nexus creates a reinforcing cycle between poverty and disability that can impact access to healthcare, employment, education, and social participation (Groce *et al.,* 2011).

Financial barriers to care not only exist in the form of user fees, but they also dictate the type of interventions sought. Research from Ghana found that patients who were unable to afford specific medications went periods of time without, which can exacerbate existing health conditions (Dassah *et al.,* 2018a). This was also the case for participants in a study of people with physical disabilities in Vietnam, where it was reported that there is inconsistent access to contraception, with participants switching between the contraceptive pill, condoms and traditional methods due to financial constraints of purchasing modern methods (Nguyen *et al.,* 2019). Furthermore, financial barriers also impact access to rehabilitation. In a study involving people with limb amputations in Nepal, participants reported that, while they were satisfied with the care received, the expenses associated with care seeking caused difficulties in access (Järnhammer *et al.,* 2018).

Additionally, the costs of transportation to medical facilities can be a considerable expense for people seeking healthcare, which may ultimately reduce demand (Ensor & Cooper, 2004). Donovan-Hall *et al.* (unpublished) found different financial barriers to accessing healthcare to prosthetic services in Cambodia. Despite the prosthetic and orthotic clinic reimbursing travel and accommodation costs, participants of the study stated difficulties in paying for travel to the centre upfront which caused them to delay attending the clinics. Therefore, existing research highlights the impact of financial barriers on access to health and rehabilitative care in LMICs.

2.3.1.2 Geographic barriers

Geographic barriers include distance to health facilities, the natural and built environment, the availability and conditions of road networks and transport available to individuals. Accessibility plays an important role in healthcare seeking, particularly for people with disabilities where transport and travel barriers may be amplified. In Cambodia, healthcare facilities are highly concentrated in urban areas. However, according to the most recent census in 2019, an estimated 60.6% of the population live in rural areas (NIS, 2020). Long travel times from a person's home or community to services can reduce access to services as it is widely accepted that healthcare utilisation decreases with increasing distance and travel time to nearest healthcare facilities (Blanford *et al.,* 2012; Idei & Kato, 2020). Liverani *et al.* (2017) found that for rural villagers in Kampot, Cambodia, travel time to the nearest health facility was reportedly '*too far'*, meaning that village health workers were more relied upon, although they were mostly volunteers and trained only to identify specific illnesses such as Malaria. This suggests that distance and travel times to health facilities were a barrier to utilising in-person facilities operated by allied health professionals.

Challenging landscapes and topographies, such as mountainous and rainforest regions can be problematic when accessing healthcare for people with disabilities (WHO, 2011). Additionally, seasonal variations in weather in LMICs can create further challenges. In a study by Varghese *et al.* (2015), participants reported the rainy season makes it more challenging to use wheelchairs, particularly in hilly areas. The impact of challenging landscapes was also found in a study by Vergunst *et al.* (2015) who found that for people with disabilities in rural areas, having to travel through mud or gravel made it difficult to access healthcare services. This is echoed in other studies (Idei & Kato, 2020; Palmer *et al.,* 2018). Idei & Kato (2020) conducted research on healthcare access in rural Cambodia in areas where road conditions and networks had been improved. The study showed that having private transport available such as motorcycles enabled more frequent healthcare utilisation.

People with disabilities can also be prevented from accessing care because of the inaccessibility of the built-up environment. Non-existent or uneven pavements can be hazardous to people with disabilities when walking, particularly in urban areas where the roads are more congested (WHO, 2011). LMICs, such as Cambodia, also have underdeveloped public and private transport systems which are often inaccessible to people with disabilities (King *et al.,* 2018). Despite public transport being free for people with disabilities in Cambodia (King *et al.,* 2018; Sokhean, 2019), extra fares have been reported due to the use of mobility aids, as well as being denied access outright (King *et al.,* 2018). Privately owned transport such as Tuk-Tuks are rarely built with ramps to enable wheelchair users or people with limited mobility to utilise these modes of transport (TUMI, 2019).

2.3.1.3 Individual and community barriers

At the community or individual level, various demand side barriers exist which can impact healthcare utilisation of people with disabilities in LMICs. Individual characteristics such as age and gender impact the accessibility of services for people with disabilities (Prynn & Kuper, 2019). Gender and disability are interlinked. Global burden of disease data from 2021 shows that women have a higher prevalence of disability in the age groups of 15 to 59 years and over 60 years (WHO, 2022a). Previous studies reported that disability and gender can exacerbate discrimination and stigmatisation faced by women and girls (Allen *et al.,* 2022). This also impacts women and girls with disabilities accessing different types of health services, as families may discourage involvement in community-based public health interventions (Gailitis *et al.,* 2019). The intersection between gender and disability was first reported by Boylan (1991) who stated that women with disabilities have inferior status compared to men with disabilities due to them being a woman and because they are disabled. A study by Dhungana (2006) found that in Nepal women with disabilities have the lowest social level and face discrimination and stigmatisation from society, while men with disabilities are not subject to this same treatment. The double discrimination faced by women impacts their ability to access healthcare, employment and education. For older people with disabilities, they are more likely to have elevated health service use due to additional impairments or health conditions (WHO, 2015b). As with women and girls with disabilities, older people with disabilities are also more likely to encounter discrimination and face barriers accessing health services (WHO, 2022a).

Stigma and marginalisation has been widely reported to be a barrier to healthcare services for people with disabilities (DSPD, 2016; Barbareschi *et al.,* 2021; Hashemi *et al.,* 2022). The stigma and marginalisation faced by of people with disabilities impacts many aspects of their lives, including access to education and employment and can prevent inclusion within communities (WHO, 2022a). In LMICs, the stigma of disability is often attributed to a lack of understanding and knowledge about the root causes of disability (Rohwerder, 2018a). Education of individuals and community level education plays an important role in health and the utilisation of healthcare services, studies report that education increases utilisation of services (Ensor & Cooper, 2004; Andersen *et al.,* 2013). Inequalities in access to education exist and people with disabilities often do not receive the same education as people without disabilities (WHO, 2011). Shamrock *et al.* (2016) state that women with physical disabilities in Southeast Asia experience difficulties in gaining opportunities for education advancement as well as having limited social support when seeking opportunities. Thus, this can further lead to the double discrimination of women with disabilities by preventing independence and employment opportunities.

Research on access to healthcare for people with disabilities in rural South Africa found education to be a major barrier to utilisation (Vergunst *et al.,* 2017). Previous research has found that education levels are linked with health literacy, with poor health literacy negatively impacting health through unhealthy health behaviours and poor vaccination rates (Raghupathi & Raghupathi, 2020). A lack of awareness about the health and rehabilitative services available to people with disabilities has also been reported as a significant barrier to utilisation (Baart & Taaka, 2017; Bernhardt *et al.,* 2020). Research conducted by Ormsby *et al.* (2012) alongside people with disabilities in Cambodia found that there were large differences in knowledge of how best to treat cataracts between people with and without disabilities. This suggests people with disabilities were not receiving the same health information as people without. This finding has also been supported by Gudlavalleti *et al.* (2014) who reported a knowledge gap between people with disabilities and people without disabilities in information about where to go for treatment. Knowledge about health services and social assistance programmes available allows people with disabilities to better navigate the health system and increase their satisfaction with care services received (WHO, 2011).

Increasing knowledge of caregivers to people with disabilities is also crucial, for example teaching caregivers about healthy behaviours and the availability of services (Baart & Taaka, 2017). For families providing support to children with cerebral palsy in LMICs, they frequently do not have access to information and support to help with caregiving. A study by Zuurmond *et al.* (2018) in Ghana found that community-based training programmes for caregivers improved their knowledge and confidence of caring for their child with cerebral palsy. Additionally, for people with physical disabilities who depend on family members or caregivers to travel with them to medical appointments or to seek treatment for conditions, this may leave them vulnerable to missing appointments or delaying treatment due to their family or caregiver being unable to assist them in attending healthcare facilities (Grills *et al.,* 2017). Cordier *et al.* (2014) suggested that seeking healthcare for people with disabilities may reduce the time available to take part in income-generating activities, therefore, can discourage timely utilisation. Further, family control over healthcare spending can dictate when medical treatment is sought, hence limited personal autonomy for people with disabilities could prevent utilising necessary services (Osamor & Grady, 2018; Prynn & Kuper, 2019). In sum, this section has examined the demand-side barriers to both health and physical rehabilitation services, in the next section, the supply-side barriers to are investigated.

2.3.2 Supply-side barriers

2.3.2.1 Health system barriers

On the supply-side, barriers to the health system include funding and finances, quality of healthcare, and the physical inaccessibility of services. In many LMICs, government expenditure on healthcare is lower compared to HICs (Asante *et al.,* 2020). With LMICs spending an average of US$ 110 per capita in 2015, whereas HICs averaged US$ 5551 per capita (HFCN, 2019). Cambodia is no exception, with low government public expenditure and resource allocations in health focusing on the antenatal and maternal services and prevention and treatment of CDs (WHO*,* 2015c). Limited funding available for curative and rehabilitation services in LMICs means that often public health services face challenges in delivering high-quality care (Antunes *et al.,* 2018). Furthermore, in LMICs, the private health sector may also provide suboptimal clinic practice (WHO, OECD & WB, 2018). Receiving poor quality healthcare can have a serious impact on an individual. Kruk *et al.* (2018) reported that in LMICs a lack of access to high quality healthcare causes extra mortality. Previous studies have found that quality of healthcare services prevents people with and without disabilities from accessing healthcare services in LMICs (Ozawa & Walker, 2011; Dean *et al.,* 2017; Zuurmond *et al.,* 2019). Additionally, Dassah *et al.* (2018a) reported that because of the perceived poor quality of care, participants preferred to seek services from local drug vendors, who typically have limited formal training, but they have previously perceived receiving high quality healthcare when using these services.

The use of cheaper, poor-quality healthcare may indicate that there are financial barriers to accessing healthcare. Evidence denotes that in LMICs, the most marginalised populations often do not benefit from public health care spending, with the rich benefiting more (Peters *et al.,* 2008; Cotlear *et al.,* 2015). A lack of health financing programmes to support access to health and physical rehabilitation services for people with disabilities may sustain inequities in health (Kabia *et al.,* 2018). Moreover, health financing programmes need to specifically recognise other non-financial barriers to the health system for people with disabilities to ensure efficacy (Kabia *et al.,* 2018). So, to achieve equity in health for people with disabilities, inclusive health financing is needed (WHO, 2022a). This means the needs and rights of the poorest and most marginalised populations are considered at all stages of development of health financing programmes.

The accessibility of health facilities is a major barrier to healthcare seeking for people with disabilities. People with disabilities have often been ignored in the design and construction of buildings, meaning that they are unsuitable for their needs (Nguyen *et al.,* 2019). Inaccessible buildings and structures create disabling environments for people with disabilities which can make mobility difficult (Palmer *et al.,* 2018). This issue has been reported in Dassah *et al.* (2018b), who found that access to health centres was difficult for people with physical disabilities and those requiring mobility aids because of the design and location of the building. Stairs and the absence of ramps at public facilities were significant physical barriers for participants in the study. For pregnant women with disabilities, many had to rely on partners or family members for support when attending health services because of the physical inaccessibility. Inaccessible toilets also pose a challenge for people with disabilities, with family members relied on to access toilet facilities (Nguyen *et al.,* 2019).

2.3.2.2 Availability of services

Availability in access to healthcare refers to the opportunity to access care when needed. Hence, assessing the availability includes waiting times at health facilities and the availability of treatments, medications and equipment available (Peters *et al.,* 2008). In a qualitive study by Dassah *et al.* (2018a) people with physical disabilities in rural Ghana stated that because of drug shortages, they sometimes had to travel longer distances to other health centres. Expensive or unavailable medications from health facilities means that pharmacies are significant source of medical care in LMICs, yet medications bought from shops are often incomplete doses or potential counterfeit (Peters *et al.,* 2008). In public health facilities in Cambodia, challenges in delivering healthcare remain in relation to waiting times, with many people discouraged from using public facilities and choosing private facilities instead (Ozawa & Walker, 2011). This same study also found that limited opening hours pushed people to seek healthcare from non-medical providers as these services are more readily available (Ozawa & Walker, 2011). Research conducted in rural Ghana found long waiting times caused ‘chaos’ in health centres, leading to those with disabilities being ignored (Dassah *et al.,* 2018a). Healthcare facilities may also lack appropriate equipment to effectively assess and treat patients, for example, adjustable beds and weighing scales (Palmer *et al.,* 2018; Nguyen *et al.,* 2019). Inappropriate equipment could mean that people with disabilities are not being properly assessed or treated when using health facilities or have to suffer pain or embarrassment (WHO, 2011).

LMICs frequently have underdeveloped rehabilitation services, and specialist services providing prosthetics and orthotics often have long waiting lists or are unavailable to many (Grills *et al.,* 2017). In Cambodia, these services are provided through NGOs in conjunction with the government. A reliance on NGOs can create issues in the delivery of providing services. Fluctuations in donor funding can cause services to be inconsistent and unable to sustain usual activities (Khieng & Dahles, 2015). The World Report on Assistive Technology (2022) found that lack of availability was a major barrier to accessing assistive products. Rohwerder (2018b) state that the AT industry is concentrated in HICs, with largely small-scale producers and providers available in LMICs. This impacts the availability of services in LMICs as they are often unable to meet the demands of those requiring assistive products. Therefore, limited availability of services acts as a barrier for people with disabilities because they may be unable to access physical rehabilitation services at all. In turn, this can impact the ability for the SDGs to be achieved equitably. For instance, access to AT can enable school attendance and reduce inequities in the completion of primary school, which supports Goal 4 and Targets 4.1 and 4.5 (Tebbutt *et al.,* 2016).

2.3.2.3 Health workforce barriers

Health professionals play an important role within the health system through treating and caring for patients (Meade *et al.,* 2015). Previous experiences of health professionals with negative attitudes can prevent people with disabilities utilising healthcare services (Baart & Taaka, 2017). A study by Dassah *et al.* (2018a) in Ghana, found that although some participants did record positive experiences at health centres with staff, the majority reported experiencing negative attitudes. One participant recalled being scolded for not bringing a caregiver and being refused help to climb on and off hospital beds. The insensitivity of staff towards people with disabilities as well as their needs can lead to poor quality care received and can prevent future seeking of healthcare services when needed (Baart & Taaka, 2017; Nguyen *et al.,* 2019). This was found in a study by Marella *et al.* (2019) in Indonesia, where negative attitudes of healthcare workers against people with disabilities deterred future utilisation of health services. Therefore, healthcare professionals have a significant impact upon utilisation of health services by people with disabilities.

Communication between patients and healthcare providers can also be challenging for certain sensory impairments, such as hearing or seeing. This can exclude people with disabilities from health promotion or prevention activities which are often not provided in accessible formats such as Braille or Easy Read (WHO, 2022a). Further, health professionals who can only communicate via speech and spoken language to people with hearing impairments can prevent the transfer of health information successfully to the patient (Baart & Taaka, 2017). A literature review conducted by Kuenburg *et al.* (2016) found that major issues reported by many Deaf participants related to communication barriers to accessing healthcare services. Consequently, health facilities may not be able to affectively disseminate health information to people with disabilities. This can impact both access to services and the overall health of people with disabilities in LMICs as they may receive limited information about where to access healthcare and about healthy behaviours.

Many health systems also have chronic staff shortages as well as being poorly trained and insufficiently paid (WHO, 2000). Staff shortages impact public and private health institutions in Cambodia (DPHI, 2016). The lack of qualified healthcare professionals is particularly worse in rural areas, compared to urban areas (WHO, 2015c). In addition to healthcare jobs with the in public sector, public health professionals frequently work in the private sector to supplement low wages which further pulls people away from work in public health facilities (Kelsall & Heng, 2016). This is also the case for rehabilitation workers in LMICs, i.e., physiotherapists, occupations therapist, prosthetists and orthotists where a lack of trained professionals impacts the ability to provide services (Gupta *et al.,* 2011).

Overall, this section has highlighted the considerable number of barriers people with disabilities face in access to healthcare and physical rehabilitation services both at the demand-level and the supply level. These barriers can make it difficult for people with disabilities to access the health system in LMICs, so removing and reducing barriers is vital for the achievement of global initiatives such as the SDGs. The failings of health systems can lead to many preventable deaths, often with the poorest and most disadvantaged of society impacted the most (WHO, 2000). Subsequently, the next section includes a description and discussion of the different models of healthcare access and considers how the adoption of different definitions can impact how research is conducted.

2.4 Conceptual frameworks of healthcare access

This section provides a description of the definition of access to healthcare suggested by several authors, and the various mechanisms that frame it. The conceptual frameworks used in this thesis are also described, as well as the justification for their use within this research.

2.4.1 Defining access to health services

Access to healthcare is considered a human right, as stated by the Universal Declaration of Human Rights of the United Nations (1948) (UN, N.Da). Defining access, like disability, is multifaceted and complex, with access being defined in several different ways. The definition of access that is used affects how the conceptual frameworks are operationalised into testable models, as the data needed for the operationalisation varies between definitions (Gulzar, 1999). In academic literature, access has been found to be related to the characteristics of delivery systems such as the structure and organisation of health facilities or population characteristics such as household income or health literacy (Aday & Andersen, 1974). Therefore, Aday and Andersen (1974) have conceptualised access to healthcare in terms of utilisation rates and user satisfaction of services using different dimensions to separate enabling, predisposing and need factors. Hence, higher utilisation of services is related to greater access to healthcare services.

Following the work by Aday & Andersen (1974), Penchansky and Thomas (1981) formulated access in terms of the fit between the characteristics of healthcare users and of providers and health services available. Hence, access is a general concept which can be separated into different dimensions that summarise access into specific areas, for example: Availability, Accessibility, Accommodation, Affordability and Acceptability (Penchansky & Thomas, 1981). Conversely, access was described by Mooney (1983) as a product of supply factors, such as location of services and availability of resources and demand factors, such as health literacy and the extent of the illness or disease. More recently, Peters *et al.* (2008) define access as actual use of health services considering characteristics of both users and providers of health services, using the following four dimensions: geographic accessibility, availability, financial accessibility and acceptability. The many definitions of access provided suggest that access is an elusive concept. Creating conceptual frameworks to model access to healthcare services allows for the different definitions to be tested empirically.

The measurement of access to healthcare services can therefore be ascertained using different methods and data. Some of the most recognised approaches are to measure healthcare access in terms of *potential* and *realised* access (Joseph & Phillips, 1984). *Potential* access is defined as the presence of resources which enable healthcare usage, for example healthcare workers and the availability of facilities (Andersen, 1995) and is reflected in the characteristics of the health system, as well as the population in the surrounding area (Andersen *et al.,* 1983). Potential access is measured in terms of potential users and demand of healthcare services (Langford & Higgs, 2006). Many different techniques exist in measuring *potential* access, the most popular methods include measuring distance and travel times from healthcare facilities and healthcare professionals per population (Langford & Higgs, 2006). Measuring *potential* access is often used to identify where additional healthcare facilities are needed (Langford & Higgs, 2006).

On the other hand, *realised* access is defined as the utilisation of services (Gulzar, 1999), hence, *realised* access relates to actual usage of services within the health system (Andersen, 1995). Within this, equitable access can be measured through dominant predictors of utilisation (Andersen, 1995). Satisfaction with services and utilisation are considered indicators of *realised* access (Andersen *et al.,* 1983). *Realised* access is measured using utilisation data, which can be gained from different sources such as administrative and survey data, to ascertain the characteristics of those utilising the health system (Langford & Higgs, 2006). Utilisation of services can include a range of different services, for example use of primary, secondary and tertiary healthcare services (Andersen *et al.,* 2013). Use of services are then impacted by barriers and facilitators at micro, meso and macro levels which influence individual health service use. The differences between *potential* and *realised* access are important to consider when researching access to healthcare services. *Potential* access does not necessarily mean actual utilisation, as usage is dependent on certain barriers and facilitators (Khan, 1992). If barriers do not exceed facilitators, then a degree of *realised* access can be said to be achieved (Khan, 1992). In this thesis, utilisation of services will be used to investigate the barriers to health and physical rehabilitation services in Cambodia, and hence *realised* access is investigated.

Measuring *realised* and *potential* access individually can create significant issues when defining access in terms of user and system characteristics. As argued by Aday and Andersen (1974), using these approaches alone to describe access does not explain whether people actually use services when they want and need to (Gulzar, 1999). Lastly, studies measuring both *realised* and *potential* access often make assumptions about people’s behaviour, for example that they will utilise the healthcare facility closest to their residence and that there will be no cross-boundary flows (Langford & Higgs, 2006). Whether access to healthcare is measured in terms of *realised* or *potential* access depends on the research questions posed. The following section will discuss the two conceptual frameworks used in this thesis and how physical disability fits within them.

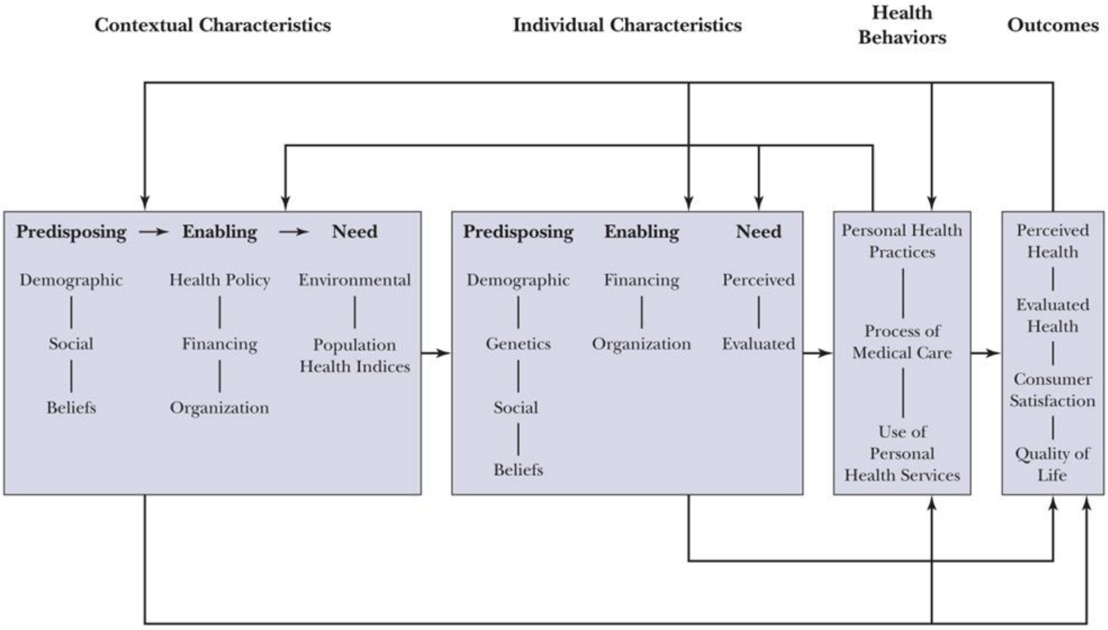
2.4.2 Andersen, Davidson and Baumeister (2013) model of access to health services

An early model of access to healthcare was the behavioural model which attempted to incorporate different determinants of health service usage (Babitsch *et al.,* 2012). This model of health services use was developed by Andersen in 1968 to help understand family health service usage and measure equitable access to health care (Andersen, 1995). The initial model suggested that utilisation is a combination of health services usage being predisposed by a person’s tendency to use services, factors which enable and prevent usage and the need for healthcare (Andersen, 2008). Since then, the model has been adapted several times by Andersen and a number of different collaborators to introduce different components into the model (Gelberg *et al.,* 2000). By the 1970s, phase two of the model was emerging and developed alongside Lu Ann Aday and other collaborators at the University of Chicago (Aday & Andersen, 1974). Phase two incorporated an explicit health systems component, as well as acknowledging the importance of health policy, the resources and organisation of the health system (Aday & Andersen, 1974). Consumer satisfaction was also explicitly added to the model. Despite the addition, the model was criticised for not considering the potential cultural and contextual factors that can impact health service use (Andersen, 1995).

Phase three of the model followed in the 1980s and 1990s, which saw the inclusion of extra personal health behaviours such as diet and exercise (Andersen, 2008). Effective and efficient access was also recognised through consumer satisfaction, as well as recognising that health status perceived by individuals and evaluated by health professionals are important aspects of satisfaction (Andersen, 1995; Andersen, 2008). Further to this, the external environment was also considered a determinant of health service usage of individuals (Andersen, 1995). By the late 1990s, phase four of the framework began to emerge which displayed the dynamic nature of the usage of health services by including various feedback loops to display how outcomes can impact predisposing, enabling and need factors (Andersen, 1995; Andersen, 2008). Phase four highlights multiple factors of healthcare utilisation, and consequently, factors of health status which allow for better understanding of health behaviour and informing health policy (Andersen, 1995; Andersen, 2008).

The most recent phase of the model, phase five, began in the early 2000s (Andersen *et al.,* 2013). Shown in Figure 2.2, phase five builds on the introduction of feedback loops and multi-directional relationships between the different components which were introduced in the fourth phase of the behavioural model. Within this phase, Andersen, Davidson and Baumeister (2013) define access as actual utilisation of services, or *realised* access, and the barriers or facilitators to use. Moreover, access to healthcare is also defined by a person’s ability to seek the right medical care at the right time. Further, greater focus has been emphasised on the contextual determinants which impact health service usage, as well as individual determinants, building on earlier critiques of the model (Andersen *et al.,* 2013). Contextual factors are defined as organisation-related factors, as well as characteristics of the community which can be at the predisposing, enabling and need level, for example attitudes towards people with disabilities and policies in place enabling healthcare seeking (Andersen *et al.,* 2013).

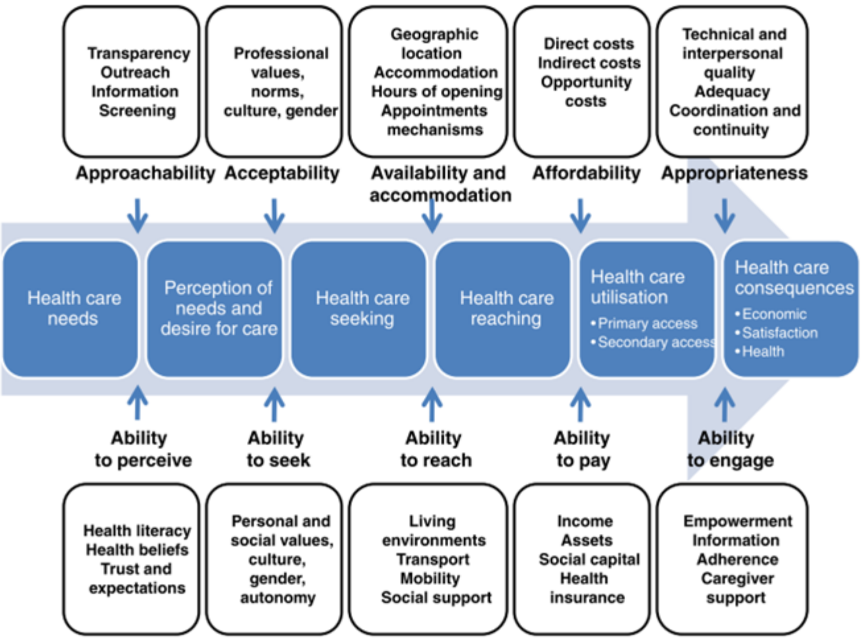
Figure 2.2. Andersen, Davidson and Baumeister (2013) model of access to health services (Andersen *et al.,* 2013. pg. 35)



2.4.3 Levesque, Harris & Russell (2013) model of patient-centred access to healthcare

The second access model used in this thesis was proposed by Levesque, Harris & Russell (2013) who use a realised access approach to define access as '*the opportunity to reach and obtain appropriate health care services in situations of perceived need for care'* (Levesque *et al.,* 2013, pg. 4). Access is conceptualised using five dimensions of accessibility and five abilities of persons, which correspond and interact with one another. As shown in Figure 2.3 the five dimensions are: 1) Approachability; 2) Acceptability; 3) Availability and Accommodation; 4) Affordability; 5) Appropriateness. The dimensions focus on the supply or organisation side of healthcare access, for example, the direct costs of healthcare are included in the affordability dimension. The five abilities of persons conceptualised are 1) Ability to perceive; 2) Ability to seek; 3) Ability to reach; 4) Ability to pay; 5) Ability to engage. These abilities are at the individual or community level, such as living environments and transport in the ability to reach dimension. The framework encompasses supply and demand side societal, economic, geographic and structural barriers to healthcare access. A key component of the framework is the notion that access should be patient-centred, meaning it should encompass the different stages of care-seeking an individual must go through before receiving medical care (Levesque *et al.,* 2013). Hence, as shown in Figure 2.3, the model flows in the direction of the large arrow in the middle of the framework and moves through each stage of a person's identification of needing to use services to the healthcare consequences such as satisfaction with services used. In the model, each stage of the care seeking process, corresponds to the dimensions, abilities and barriers that are crucial at that stage. For example, barriers relating to availability and accommodation and ability to reach such as transport, mobility and geographic location impact healthcare reaching.

Figure 2.3. Levesque, Harris & Russell (2013) model of patient-centred access to healthcare (Levesque *et al.,* 2013. pg. 5)



2.4.4 Criticisms and selection of the models

In this section, the reasons for using both the Andersen, Davidson and Baumeister (2013) and Levesque, Harris and Russell (2013) models are discussed, alongside some criticism of the models. Both the conceptual frameworks selected for inclusion in this research have not been designed to model the access to healthcare for people with disabilities, rather they recognise the impact of need factors and individual health. Previous research has shown the strongest determinants of health service utilisation are need factors (Fernández-Olano *et al.,* 2006; McDonald & Conde, 2010; Wandera *et al*., 2015). It is known that people with disabilities tend to have higher health care needs than people without disabilities (Kuper & Heydt, 2019). Therefore, need factors may be more important when investigating access to health services for people with disabilities. The conceptual frameworks also have been created for health service use. Access to rehabilitation and assistive products may present different challenges that are not included in the conceptual frameworks, such as political prioritisation. Although it is hypothesised that both models are suitable for both conceptualising health service use and use of physical rehabilitation services for assistive products.

Nonetheless, there are some key differences to note in the availability of services between provisions of physical rehabilitation and healthcare services. For example, the mix (or lack) of assistive product providers, and outreach and education programmes available to increase awareness of services may be relevant. In comparison to physical rehabilitation services, outreach programmes and knowledge about the delivery of assistive products is different. Both models do somewhat address this in the models of health service use, for example Andersen, Davidson and Baumeister (2013) recognises this through the enabling contextual characteristics which includes health system structure.

Additionally, the Andersen (1968) behavioural model, and future iterations of the model were first developed in the context of the USA, which has different mechanisms and policies regarding healthcare access (Chappell and Penning, 1996). This means its application to LMIC contexts may be limited. However, the model has been updated over time to provide a more universal understanding of utilisation of health services and has been used by several authors researching in LMIC contexts (Zhang *et al.,* 2019; Tolera *et al.,* 2020; Mekonnen *et al.,* 2021). The model proposed by Levesque, Harris & Russell (2013) has also been applied to research of health service utilisation in LMICs for people with and without disabilities despite not being specifically designed for this context (Pryn & Kuper, 2019; Casebolt, 2020; Asa *et al.,* 2021; Matin *et al.,* 2021; Mesiäislehto *et al.,* 2021; Hashemi *et al.,* 2022)

To ensure the models selected for the empirical chapters are the most suitable, some other models of access to health services were explored for inclusion in this thesis. Meade *et al.'s* (2015) model of healthcare disparities and disability draws upon previous models of access, healthcare disparities and disability in order to create a new conceptual framework. Another model that was considered was Peters *et al.'s* (2008) conceptual framework for assessing access to health services which proposes a model of healthcare access for LMICs with a focus on poverty and vulnerable groups. Whilst these models have specific disability or LMICs focus, they were not used to conceptualise access to health and rehabilitation services in this research because the other models were found to address the research questions posed in this study in a more appropriate way. This is because the 2013 models by Andersen, Davidson and Baumeister and Levesque, Harris and Russell have been used extensively in research, including in LMICs. In both models, the characteristics of access to health services are comprehensive, and include an array of demand and supply-side factors. The model by Peters *et al.* (2008) was deemed as less comprehensive and the model proposed by Meade *et al.* (2015) has limited application in existing research.

Andersen, Davidson and Baumeister (2013) behavioural model has been used as the conceptual framework for the research in Chapter 4 and 5 in this thesis. Both chapters use quantitative data to analyse the utilisation of health and rehabilitation services as a proxy for access in Cambodia. The Andersen, Davidson and Baumeister (2013) model focuses on access to health facilities;

however, it is still appropriate when investigating access to rehabilitative care services due to the broad supply and demand characteristics included at both the individual and contextual level. Furthermore, it also can apply to people with physical disabilities as it recognises the contextual characteristics, which includes policy that can assist or impede utilisation through health financing or discrimination (Andersen *et al.,* 2013). For Chapter 6, the conceptual framework by Levesque, Harris and Russell (2013) has been used instead of the Andersen, Davidson and Baumeister (2013) model. This model applies a patient-centred access framework to understand *realised* access to services. This is important when exploring healthcare pathways as the framework can help to understand the barriers to P&O services at each stage of the health seeking process. Both of these models have been selected for use in this thesis because they are the most suitable for the research questions addressed in their particular chapter. For instance, the Levesque, Harris and Russell (2013) model has been used extensively in qualitative research because of the patient-centredness of the model, with the pathways to health service use experienced being important in the model. This is different to the Andersen, Davidson and Baumeister (2013) model which seeks to conceptualisation access in a more structured manner.

2.5 Summary

This literature review has described health equity and UHC for people with disabilities in LMICs and provided a discussion of the many barriers that people with disabilities face to health and rehabilitation services. These barriers can cause health inequities to form between people with and without disabilities which can hinder the achievement of UHC (WHO, 2022a). The WHO 2022 report on health equity for people with disabilities denotes that more research is needed on health systems and disability to produce evidence to support the removal of health inequities. This means that there is a need for high-quality research on people with disabilities and healthcare access in Cambodia, and LMICs to achieve this goal. This thesis will focus on investigating the demand-side barriers for people with disabilities accessing health and rehabilitation services, although throughout the empirical papers the findings will reflect on the impact of supply-side barriers. Following this chapter, an explanation of the Cambodian context is provided in Chapter 3.

Chapter 3 Cambodia and its Health System

3.1 Introduction

This chapter provides information about Cambodia to help situate the context of this thesis. The first part includes a description of the demographics of Cambodia and some geographic information (Section 3.2). This also includes a short section detailing the impact of the Khmer Rouge (Section 3.2.1). Following this, the current health system of Cambodia will be described in Section 3.3 including the organisation and structure and the financing structures which support healthcare delivery in Section 3.4. Lastly, the Health Equity Fund (HEF) scheme, which aims to support vulnerable people, such as those with disabilities, in Cambodia seek healthcare is described in Section 3.4.1.

3.2 Country profile

Cambodia is situated in Southeast Asia and shares land borders with Thailand, Vietnam and Laos People's Democratic Republic (Figure 3.1). The most recent Cambodian General Population Census, completed in 2019, revealed a total population size of just over 15.5 million, with over 9 million living in rural areas (NIS, 2020). Cambodia has a youthful population, with 29.4% of the population aged under 15 years and only 8.9% aged 60 years and older (NIS, 2020). This is comparatively low to countries in Europe and East Asia. Additionally, the population sex ratio in Cambodia is skewed, with 94.9 men to 100 women (lower than what is found in other countries; Hesketh & Xing, 2006), with only a small difference between urban and rural areas (NIS, 2020). Population sex ratios are impacted by three factors; sex ratio at birth, migration and mortality rate differences (Hesketh & Xing, 2006). Cambodia's turbulent past of conflict and civil war can partly explain the imbalance between men and women due to the greater active involvement of men in conflict (de Walque, 2006). Employment migration has also played a role in the difference between the sex ratios; however, labour migration of women is having an increasing impact in Cambodia (Tunon & Rim, 2013). In 2019, 87.7% of the population were literate, however, there are differences between men and women, with the former having higher rates of literacy in both urban and rural areas (NIS, 2020).

Geographically, Cambodia consists of 24 provinces and one municipality (Phnom Penh) (Figure 3.1). Provinces are further separated into districts, communes and villages. The population of Cambodia is concentrated in the areas surrounding Phnom Penh, the southern coastal regions and the Tonle Sap Lake, shown in blue in Figure 3.1, which lies within the Mekong river basin

(Tsujimoto *et al.,* 2018). The north and eastern areas of Cambodia are more remote and sparsely populated, with travel in this region often proving difficult due to the geographical remoteness (Walter & Sen, 2018). Much of the land in western Cambodia is flat terrain (Tsujimoto *et al.,* 2018). The landscape of Cambodia has been severely affected by years of conflict and civil war. Explosive remnants of war such as landmines were planted in large quantities across numerous provinces, with those along the border with Thailand being most heavily affected (Roberts, 2011).

Figure 3.1. Provincial level map of Cambodia (NIS, 2019/20. pg. viii.)

In the early 2000s, it was estimated that nearly half of the population of Cambodia was impoverished (ADB, 2012). The poverty rate has since steadily decreased, and according to the World Bank, between 2009 and 2019 the poverty rate in Cambodia dropped from 33.8% to 17.8% (Karamba *et al.,* 2022). This reduction was largely due to sustained peace, capitalising on the demographic dividend and open and free trade policies to encourage investment. However, the COVID-19 pandemic exposed Cambodia's economic vulnerabilities and in 2020 the economy contracted by 3.1% causing many households to experience a decline in household income (Karamba *et al.,* 2022). It is estimated that 460,000 Cambodians fell below the poverty line, equating to an increase in the poverty rate of 2.8% (Karamba *et al.,* 2022).

3.2.1 Recent history of Cambodia: The Khmer Rouge and the aftermath

After gaining independence from France in 1953, Cambodia was ruled as a constitutional monarchy under King Norodom Sihanouk (Chandler, 2018). During the US-Vietnam war in the 1960s and early 1970s, Cambodia was heavily affected as Vietnamese soldiers used Cambodian land as a supply route which led to Cambodia becoming a target for heavy bombing by the US (Roberts, 2011). The overflow of the US-Vietnam war caused greater insecurity within Cambodia, leading to civil conflict (Grundy *et al.,* 2016). King Sihanouk ruled until 1970 when he was removed from power and replaced with a pro-American government (Chandler, 2018). During the early 1970s, a communist insurgency grew with the rise of the Khmer Rouge and leaders such as Pol Pot (Grundy *et al.,* 2016). At the beginning of 1975, the Khmer Rouge launched an offensive in Phnom Penh on the government of Cambodia, leading to an eventual surrender in April 1975 (Grundy *et al.,* 2016).

The Khmer Rouge controlled Cambodia from 1975 to 1979, during which millions of lives were lost due to starvation, poor living and working conditions and mass executions (Grundy *et al.,* 2009). Educated citizens such as healthcare workers were specifically targeted by the Khmer Rouge, resulting in the health system being almost completely dismantled (Dunleavy, 2009). During this period, most of the population had to rely on traditional healers and medicine, with access to modern medicines reserved for leaders of the Khmer Rouge (Grundy *et al.,* 2009). The lack of healthcare available, in conjunction with poor living and work standards negatively impacted the health of the Cambodian population. There is very limited data on the health of the population before, during, and directly after the Khmer Rouge, therefore, the true impact of the Khmer Rouge on health in Cambodia is unknown. After the regime was overthrown in 1979, a new health system was rebuilt on socialist foundations such as centralised health planning and financial management (Grundy *et al.,* 2009). Health clinics were built across communes in Cambodia and immunization programmes were initiated with the help of international assistance from organisations such as the WHO during the 1980s (Grundy *et al.,* 2009). During this time, civil war ensued in many districts across Cambodia, continuing until the 1990s when Paris Peace Accords were signed (Grundy *et al.,* 2009; Palmer *et al.,* 2018;). In the next section, an overview of the health system is provided, including how healthcare is financed and a description of the social assistance fund, the HEF.

3.3 The health system

Health system structure and financing in Cambodia has gone through several changes since the 1990s. Reforms to the public health sector have aimed to strengthen and improve the health system, to ensure the essential health needs of the population were being met (DPHI, 2016; Soors *et al.,* 2016). Since the 1990s, significant improvements in health outcomes have been seen, with considerable reductions in maternal and infant mortality rates, as well as wider population coverage of child immunisations (Grundy *et al.,* 2009; Asante *et al.,* 2019). Despite this, Cambodia still lags behind neighbouring countries in health outcomes with many poor and vulnerable households, particularly in rural areas, having limited access to quality healthcare services (Asante *et al.,* 2019). Major constraints of the health system at the supply-side level include the capacity of the health workforce, the fragmentation of delivery and management systems, limited supply of equipment and medicines, and inequity in access to healthcare for marginalised groups (Grundy *et al.,* 2009).

The organisational level reforms that took place included the restructuring of the Ministry of Health (MOH) and services, transforming the distribution of resources and budgets and retraining staff (MOH, 2016). Decentralisation played an important role in the restructuring, which resulted in Operational Districts (ODs) being given significant control over healthcare budgets and the delivery of services (WHO, 2015c; Grundy *et al.,* 2016). This means that the quality of services provided at public facilities can vary substantially due to differences in operations between ODs. Since the reforms began in the 1990s, Cambodia has attempted several different models of health sector contracting which entailed contracting local health services out to NGOs and private facilities, with providers agreeing to operate within certain predefined outputs, such as physical rehabilitation centres (OECD, 2009; Vong *et al.,* 2018).

Since 2002, the MOH has created four Health Strategic Plans (HSP) which contain objectives and aims for improving and strengthening the health system (DPHI, 2016). The most recent is the Health Strategic Plan 2021-2030 (HSP4)[4]. Within these documents, the government of Cambodia has committed to implementing UHC and adopting the SDG goal of health for all. Throughout the third HSP (2016-2020), there is little mention of people with disabilities, suggesting the potential for them to be overlooked within the health system. Failing to include people with disabilities and access to physical rehabilitation and assistive products in the HSPs could potentially prevent gains in health and delay the transition of achieving the government's goal of achieving health for all.

The collection of basic data at health facilities began in the 1990s with the aid of the WHO and other IOs (Liverani *et al.,* 2018). In recent years, reconstruction has taken place within the health sector to develop a national information system (Liverani *et al.,* 2018). The UNCRPD signatories have an obligation to collect health information data on people with disabilities, yet many LMICs, such as Cambodia, are unable to adequately fulfil this commitment (McPherson *et al.,* 2017). The MOH is attempting to address these issues and has recognised the importance of using national information systems, which can provide evidence to support policy making and identify gaps in the health sector (MOH, 2008). At health facilities patient data is frequently still collected using

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[4] The fourth HSP is currently unavailable for those outside the government or key international organisations of Cambodia.

paper registries, particularly at commune level facilities (Liverani *et al.,* 2018). Consequently, fragmented services and inconsistent care make it challenging to meet the health care needs of people with disabilities (Durham *et al.,* 2016). Inadequate health information systems also impact the ability for referrals to other health services and can have a major impact on the continuum of care for people with disabilities (McPherson *et al.,* 2017). Thus, this demonstrates the importance of developing effective information systems within health system reform.

3.3.1 Who delivers healthcare in Cambodia?

The administration of the public health sector is still largely centralised with MOH officials at the provincial and district level (WHO, 2015c). The current health system in Cambodia has a pluralistic structure, with public health services operating within a decentralised district health system model in conjunction with a large but fragmented private healthcare sector (Meessen *et al.,* 2011; WHO, 2015c; Strachen *et al.,* 2023). The private healthcare sector in Cambodia provides predominately curative outpatient care, whereas the public healthcare sector is the leading provider of preventative healthcare, including vaccinations and antenatal services (Kleinitz *et al.,* 2012; WHO, 2015c). Primary healthcare needs in the public sector are usually fulfilled at health centres which have large population catchment areas and are predominately staffed with nurses and midwives only (Grundy *et al.,* 2009). Within the public system, there are Provincial Health Departments containing 103 ODs (WHO, 2015c; Digital Library, N.D). ODs usually have at least one referral hospital covering the whole OD population, plus a number of health centres to cover a population of approximately 10,000 to 20,000 people (WHO, 2015c). In remote areas, health posts provide more basic healthcare services to smaller populations of around 3,000 people (WHO, 2015c). Overall, there were 1,250 public health centres, 94 district referral hospitals, 25 provincial referral hospitals, and nine national hospitals in 2021 (Koy *et al.,* 2023). Health facilities tend to be concentrated in urban areas, whereas a large percentage of the population live in rural areas where infrastructure such as roads and transport networks can be poor (Palmer *et al.,* 2018).

The most recent statistics available about the number of private-for-profit healthcare providers in Cambodia were reported in the third Health Strategic Plan 2016-2022. In 2015, there were 8,488 formal private providers with 244 clinics, 47 polyclinics and 11 hospitals, excluding pharmacies (DPHI, 2016). This suggests that there are a large number of private healthcare providers supplying healthcare to the population. However, over the last eight years since the data was collected, it is likely that the number of private health facilities will have changed. The COVID-19 pandemic exposed the vulnerability of private healthcare providers in LMICs. Williams *et al.* (2021) reported that private providers experienced crises in financial and liquidity, service provisions and state-provider relations. This means that to fully understand the number of private providers in Cambodia, more recent data is needed which covers the COVID-19 pandemic.

Despite the substantial role the private health sector plays, there are also limited mechanisms in place to assess the quality of healthcare provided at private facilities (Pheakdey *et al.,* 2020). The lack of regulation of the private sector also enables unqualified healthcare workers to deliver healthcare services (WHO, 2015c). Privately operated pharmacies play a significant role in the health system, as pharmaceuticals are reasonably accessible to the public in Cambodia through large networks of private pharmacies as well as informal drug markets and sellers (WHO, 2015c). For many, private pharmacies are often the first choice of healthcare provider sought (Palmer *et al.,* 2018). However, issues of unregulated and counterfeit medications are present within pharmacies and drug markets as enforcement is difficult (WHO, 2015c). Traditional medicine is also still important culturally and historically for many Cambodians, particularly in remote and rural areas (Yi *et al.,* 2017). Traditional medicine in Cambodia is primarily provided by *Kru Khmer*, mediums known as *Kru Chol Ruup,* and Buddhist monks (Peltzer *et al.,* 2016). In 2010, the government of Cambodia enacted the policy on Traditional Medicine of the Kingdom of Cambodia which details the regulations surrounding practices (WHO, 2019a). This signifies the importance that traditional medicines and practices still have in Cambodia.

Healthcare services are also provided by an estimated 180 IOs and NGOs working in Cambodia (DPHI, 2016). Outsourcing healthcare, also known as contracting, enables NGOs to be awarded contracts for providing certain healthcare in Cambodia to fill the gaps in medical care unable to be provide by the public health system (OECD, 2009). The work of NGOs is often focused on increasing community health knowledge and health promotion (DPHI, 2016). In Cambodia, NGOs also play an important role in the delivery of physical rehabilitation services and the provision of assistive products. In the following section, an overview of physical rehabilitation services is provided.

3.3.2 Physical rehabilitation centres

The delivery of physical rehabilitation services in Cambodia is a joint effort between the MOH, Ministry of Social Affairs, Veterans and Youth Rehabilitation (MOSVY), IOs and NGOs. Physical rehabilitation services offered include physical therapy and provisions of assistive products such as prosthetics and orthotics (MOH-MOSVY, 2018). Until recently, rehabilitation was solely under the remit of the MOSVY, through the People with Disabilities Foundations (PWDF), in collaboration with IOs and NGOs. However, in line with the WHO recommendations that rehabilitation should be integrated within health systems (WHO, 2017a), the remit of physical rehabilitation services is shifting to the MOH (S. Kheng, personal communication, November 2022). In total, there are eleven physical rehabilitation centres in Cambodia, established initially by IOs and NGOs (MOH-MOSVY, 2018). The responsibility for running the physical rehabilitation centres has shifted, with the PWDF operating five centres, while the other centres are run by ICRC, Exceed and Humanity & Inclusion (HI) (Ramstrand *et al.,* 2021). In Cambodia, rehabilitation services are also provided at the Spinal Cord Injury Centre (SCIC) in Battambang. This centre is operated by the PWDF, who took over control from HI in 2009. Over the years, the SCIC has struggled with management and administration challenges and currently only has a capacity of 24 beds, which is unable to meet the needs of the Cambodian population (MOH-MOSVY , 2018). In addition to clinic-based delivery, rehabilitation services in Cambodia are also provided through Community Based Rehabilitation (CBR) activities (MOH-MOSVY, 2018). CBR programmes are run by both NGOs and Disabled Persons Organisations.

The MOH have previously provided limited rehabilitation services, typically in the form of physical therapy with more specialised services being available at large national hospitals such as the National Paediatric Hospital and Calmette Hospital (MOH-MOSVY, 2018). This is unable to meet the needs of people with physical impairments, particularly for those that need comprehensive in-patient rehabilitation. In the third HSP (2016-2020), rehabilitation services were not included in the minimum package of activities that all health services in Cambodia should provide. Rather, rehabilitation was included as part of the complementary package of activities (DPHI, 2016). The rehabilitation strategic plan for Cambodia 2018-2023 states that the minimum package of activities will be updated to include physical rehabilitation. The aim of this is to ensure that physical rehabilitation services are prioritised within the health sector and are recognised as an important part of healthcare. There are also some private hospitals in Cambodia which can provide physical rehabilitation services alongside a number of organisations that will provide paid-for assistive products.

3.4 Financing of the health system

The previous section of this chapter described the structure of the health system in Cambodia. The complexity of the health system structure also means that the financing of the health system comes from multiple different sources. In 2019, the WHO produced a report on the national health accounts of Cambodia from 2012 to 2016 which detailed information about health expenditure. This report revealed that government healthcare expenditure on health has increased by 35% from US$199.3 million in 2012 to US$268.6 million in 2016 (WHO, 2019b). The MOH (2014) reported that in 2012, Cambodia spent 7.2% of its GDP on health expenditure (WHO, 2015c). Data taken from the World Bank reported that in 2016, current health expenditure equated to 6.1% of GDP (Karamba *et al.*, 2022). This figure is comparable to Vietnam, but higher than other Southeast Asian countries, such as Thailand and Lao People's Democratic Republic (WHO, 2019b). Moreover, it is unclear whether this expenditure includes funding for physical rehabilitation services and assistive products. In total, US$1207 million was spent on health expenditure in 2016 from all sources for example, government, donor, OOP payments, private health insurance and social health insurance (WHO, 2019b). In Cambodia, OOP payments make up the largest percentage of current health expenditure, with an estimated 60% of health expenditure coming from OOP costs in 2016 (WHO, 2019b). The most recent data available taken from the World Bank reported OOP expenditure has since increased, making up an estimated 64.4% of current health expenditure (Karamba *et al.*, 2022). In the National Social Protection Policy (NSPP) Framework 2016-2025, the government recognises the need for increasing financial protection coverage to protect vulnerable groups from high health expenditure.

Funding from external donors contributes a significant amount of revenue to the health system in Cambodia which is pooled with government revenue to be allocated to health projects (WHO, 2015c). This funding provides significant financing for the health system in Cambodia, as well as provide numerous vertical programmes targeting specific health initiatives such as HIV/AIDs (Asante *et al.,* 2019). The 2019 WHO report on health expenditure in Cambodia found that in 2016, 16.6% of financing for current health expenditure comes from donor sources. The amount of donor funding received is expected to reduce over time due to Cambodia being upgraded from a low-income country to a low-middle income country (WHO, 2019b). During this period of transition, it is important for Cambodia to strengthen domestic financing to ensure continued functioning of health services (WHO, 2019b). Furthermore, private insurance and public social health insurance provide a small amount of revenue to the health system, equating to a combined income of US$2 million in 2012 (MOH, 2014). In 2016, their contribution had increased to US$7.5 million from private health insurance and US$2.3 million from social health insurance (WHO, 2019b).

The author was unable to find any substantial information about the financing of rehabilitation services in Cambodia. It is known that there is limited availability of physical rehabilitation and assistive products provided at public healthcare services and a limited scope for the MOH to fund provisions currently (MOH-MOSVY, 2018). NGOs and IOs provided funding for this gap in service provisions (Harte *et al.,* 2019), however; there is limited information about the financing structure of the major organisations involved in the delivery of services. Physical rehabilitation centres have been impacted by the withdrawal of donor funding; this has led to the reduction in centres from 16 in 2002 to 11 in 2017 (RCG, 2017). To address the reduced amount of funding from donors and development partners, new ways of fundings physical rehabilitation centres needs to be explored.

Research into the impact of cost recovery charges for service users, where they pay for a percentage of the product costs, at a physical rehabilitation centre operated by Exceed found that more clients were eligible for free services than expected (Harte *et al.,* 2019). This same study also found that there was a larger demand than expected for service users opting to pay for higher-tech assistive products. This suggests a demand for both modern high-tech devices and assistive products that can be provided free of charge.

For public health services, health budgets are allocated annually by the MOH and in 2014, around 30% of the budget was allocated to provinces and the remaining was maintained at central MOH level (Asante *et al.,* 2019). Provisions for public health services, such as funds for staff, equipment and medicines are provided by the MOH. A study by Koy *et al.* (2023) reported that 93.9% of health centre funding comes from the government, whilst 6.1% comes from direct patient fees. Of these direct user fees, 2.0% comes from HEF and 0.3% from the National Social Security Fund (NSSF) (Koy *et al.,* 2023). The NSSF is a social security scheme, part of Cambodia NSPP framework, whereby people pay into to receive protection against income security caused by issues such as disability, injury, old age and maternity (RGC, 2017). The NSPP framework also supports social assistance programmes which provide support to vulnerable groups, for example Health Equity Funds (HEFs). HEFs first were introduced in the early 2000s as small-scale projects operated by NGOs. Over time, HEFs were scaled up and are an important component of the NSPP framework (Chhun *et al.,* 2015). The following section of this chapter will describe the introduction of HEFs in more detail, provide an explanation of how households are deemed eligible to use them, and also describe the impact for people with disabilities.

3.4.1 Health Equity Funds

As previously stated, HEFs were first introduced in the early 2000s and were managed at district level by NGOs (Chhun *et al.,* 2015). By May 2015, nation-wide coverage was achieved with over 1,200 public health facilities accepting HEFs, providing coverage to three million poor Cambodians (Nagpal *et al.,* 2019). HEFs provide a full range of healthcare services at public healthcare facilities, with all services being provided at no costs to HEF eligible households at all levels of the health system (MOH, 2018). Although some health services are excluded from HEF coverage, including selected treatment options for cancer, organ transplants and certain medications not listed by the MOH as essential (MOH, 2018). Additionally, HEFs provide non-medical benefits to recipients such as the reimbursement of transport costs, coverage of food expenditure and funeral support (MOH, 2018). As HEF eligible households do not pay any OOP payments for receiving healthcare, public facilities are reimbursed directly by the government (Van de Poel *et al.,* 2014). To date, a number of studies have shown that HEFs have been successful in reducing OOP payments for poor households (Noirhomme *et al.,* 2007; Flores *et al.,* 2013; Annear *et al.,* 2019).

To determine eligibility for HEFs, households are identified as poor through the National Identification of Poor Households Program (IDPoor) (Asante *et al.,* 2019). IDPoor aims to accurately identify poor and at-risk households through measures such as means testing and household characteristics (Kolesar *et al.,* 2019; DIPH, 2023). Collecting data on at-risk households was introduced in 2022 to better understand the number of households that are at risk of poverty in Cambodia (DIPH, 2023). Initially IDPoor was concentrated in rural areas, however since 2016, it was expanded to include urban areas (Kolesar *et al.,* 2019). Before 2020, IDPoor data was collected on a rolling basis where collection would take place in around eight to nine provinces per year; however, since COVID-19 this has changed (DIPH, 2023). IDPoor now collects data on poor households continuously to monitor changing household situations. To establish eligibility households are interviewed about a range of topics such as income, debt, education, assets, health and disability (GIZ, 2022). An overall score is then calculated based off the responses from the interview which can then be used to place households into four categories: poor Level 1 (very poor), poor Level 2 (poor), at-risk and non-poor (GIZ, 2022). Households identified as eligible for HEFs are then provided with an equity card which can be used at public health facilities (Kelsall & Heng, 2016).

Previously, when IDPoor data was collected in rounds, any poor households missed during the initial data collection could be identified through post-identification (Post ID) (Jacobs *et al.,* 2018). This allowed interviews to be conducted at health facilities to determine the poverty status of households. If households were deemed as poor, they were given a Priority Access card, which enabled them to receive free or subsidised public healthcare and access to non-medical benefits such as transport costs and food allowances (MOH, 2018b). Several limitations of this method have been identified, for example, the vulnerability of the Post ID process to manipulation as interviews took place at the health facility where household characteristics could not be verified (GIZ, 2022). Furthermore, public health facilities were unable to claim reimbursement when providing assistances to households that have possession of a Priority Access card which discouraged these cards being provided (GIZ, 2022). The change in IDPoor from intermittent data collection from provinces every three years means that the Post ID system is no longer needed as it allows for poor households to be identified continuously. This is beneficial for at-risk households and for households that are impacted by illness, injury or impairment as they will no longer need to wait until data collection commences again in their province. Any changes in household status can mean they are eligible for an IDPoor assessment interview.

This chapter has provided some contextual information about Cambodia and outlined the key components of the Cambodian health system and how it is financed. For people with disabilities, the health system has some supports in place to ensure that they are able to seek healthcare when needed. The introduction of the HEFs has been shown to have some impact on access to healthcare for poor households, however, there is limited research into how people with disabilities have been impacted by their introduction. Furthermore, there is limited information about HEFs and provisions of rehabilitation and assistive products. As there are limited government funded provisions of services, this impacts financial protections provided by HEFs in increasing access to these services. The following chapters of this thesis are stand-alone empirical papers which form this paper-based thesis and investigate the barriers to accessing health and physical rehabilitation services for people with physical impairments in Cambodia.

Chapter 4 Paper 1: Access to healthcare for people with physical disabilities in Cambodia: how does healthcare provider utilisation compare for people with and without physical disabilities?

4.1 Background

Previous research has shown that people with disabilities in Low- and Middle-Income Countries (LMICs) do not have the same access to healthcare, including curative, preventive and health promotion compared to people without disabilities (WHO, 2011; Bright & Kuper, 2018; Kuper & Heydt, 2019; Vergunst *et al.,* 2019). In this study disability has been defined using the International Classification of Functioning, Disability and Health Framework (ICF). The World Health Organisation (WHO) created the ICF to provide a standard framework for health and health-related conditions (WHO, 2002). Within the ICF, disability is understood as an umbrella term for impairments, limitations and participation restrictions, whilst impairments relate specifically to the issues with the body and body functions (WHO, 2002). The most recent report published by the WHO on health inequities for people with disabilities estimates that globally over one billion people have some form of disability, equating to around 16% of the population (WHO, 2022a). Healthcare services are not distributed equitably, with people in LMICs having poorer access to healthcare services as well as healthcare sought being poorer in quality than for people in High Income Countries (HICs) (Tegegne *et al.,* 2018).

It is known that, globally, people with disabilities frequently report poorer general health, are more likely to be poorer, and are, on average, older compared to people without disabilities (Banks *et al.,* 2017; Hashemi *et al.,* 2022). People with disabilities may also develop comorbidities or secondary health conditions which can create a further need for healthcare (Kuper & Heydt, 2019). In addition, people with disabilities are frequently excluded from employment, education, and participation in society increasing the risk of poverty (Saran *et al.,* 2020). Moreover, poverty can also increase the risk of becoming disabled, therefore, poverty and disability can be described as a reinforcing cycle (Groce *et al.,* 2011). Having a disability may also exacerbate barriers to healthcare, for example, people with hearing or vision impairments may be impeded by a limited number of healthcare workers who can effectively communicate and understand their needs (Kuper & Heydt, 2019). These factors may lead to people with disabilities delaying accessing healthcare or accessing healthcare from lower quality providers which may worsen health outcomes. This study aims to contribute towards the literature on disability and access to healthcare services by examining predictors of health service use and the types of healthcare sought for people with disabilities in Cambodia.

4.1.1 Inequity in health systems for people with disabilities

Equity in health for people with disabilities can be defined as the removal of unjust differences in health outcomes, that cannot be explained by underlying differences in health conditions (WHO, 2022a). Within the United Convention on the Rights of Persons with Disabilities (UNCRPD) equitable access to quality healthcare has been enshrined (Kleinitz *et al.,* 2012; Mannan *et al.,* 2012). Article 25 and 26 of the UNCRPD state that people with disabilities must have access to appropriate healthcare. Thus, as Cambodia is a signatory, a lack of equal access to services is a clear infringement upon a person's human rights (Bright & Kuper, 2018). Furthermore, recent global initiatives such as the Sustainable Development Goals (SDGs) 2030 recognise the importance of promoting health and well-being for all, including for people with disabilities (Kuper & Heydt, 2019). This is echoed in goal three, which aims to provide quality healthcare for the world's most vulnerable populations by 2030 (UN, 2018). In recognition of the failure of the previous Millennium Development Goals to specifically acknowledge the needs of marginalised groups such as people with disabilities, the SDGs have been created to promote a stronger focus on vulnerable groups, including people with disabilities (Banks *et al.,* 2017). Despite the global commitment to increasing access to health services and 16% of the world's population having a disability, accessing healthcare services is often challenging for many people with disabilities (Kuper & Heydt, 2019).

The extent to which people with physical disabilities in LMICs face barriers to seeking healthcare varies across different individual, household and system level characteristics. These characteristics influence the type of healthcare sought and the quality of healthcare received. For some households, certain barriers such as the cost of treatment can prevent or delay the seeking of care when in need. The type of healthcare sought is also important, as certain healthcare providers may offer lower quality or poor care compared to others. Across LMICs, health systems are typically made up of a mixture of public health facilities, formal private providers and informal private providers (i.e., traditional medicine and drug sellers) (Bloom *et al.,* 2014; McPake & Hanson, 2016). Hence, this highlights the need for equity in healthcare for marginalised and vulnerable groups to ensure that people with disabilities can access timely and quality healthcare services irrespective of contextual and individual characteristics. To ensure the healthcare needs of people with disabilities are met, research is needed to investigate the barriers to accessing healthcare at different healthcare providers to enable an understanding of how access can be improved. Firstly, to understand access to care, definitions of access and the conceptual framework utilised in this study are described.

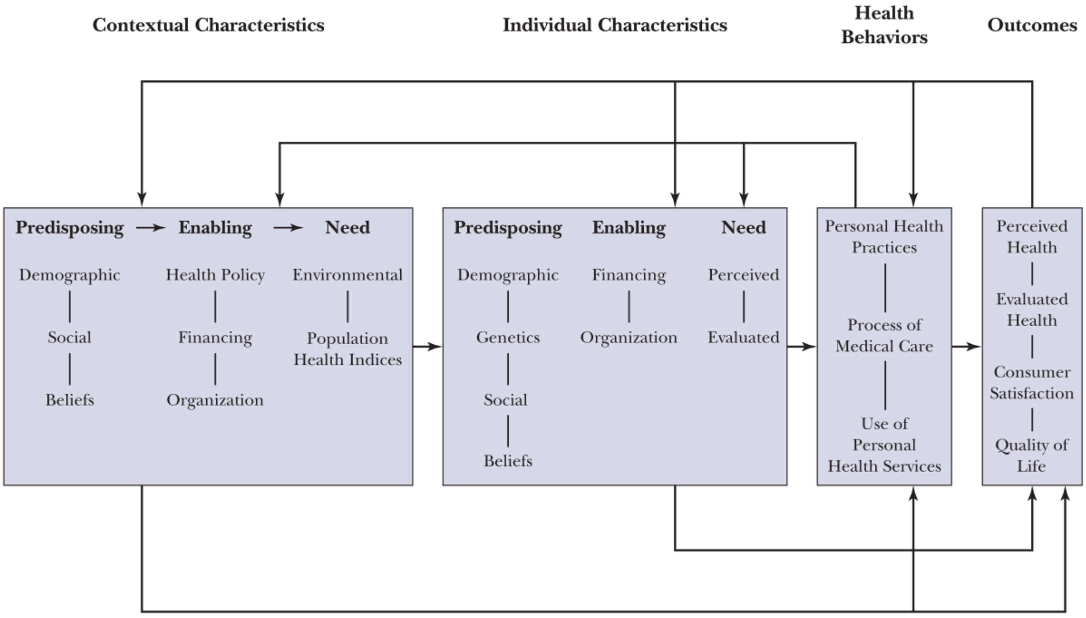
4.1.2 Conceptual framework

In healthcare research, the definition of access used will often depend on the type of research conducted. In this study, treatment seeking after illness or injury is used as a proxy measure for access to healthcare. This is known as *realised* access, which is defined as the utilisation of healthcare services, whereas *potential* access relates to the resources available which enable healthcare usage, for example, the number of doctors and the availability of facilities in relation to certain areas or populations (Andersen, 1995). This measures access in terms of potential users and the demand for healthcare services, rather than actual utilisation (Langford & Higgs, 2006). Overall, *realised* access is less challenging to measure and is more frequently used in analysis of access to healthcare (Levesque *et al.,* 2013).

This paper uses the conceptual framework created by Andersen, Davidson and Baumeister (2013) (Figure 4.1). This framework incorporates both contextual and individual determinants of access to healthcare. Using this framework, contextual factors are those such as the characteristics of local communities, factors related to healthcare providers and governmental support structures (Andersen *et al.,* 2013). Contextual factors are at the aggregate level, ranging from household units to the national healthcare system as a whole (Andersen *et al.,* 2013). For people with disabilities, contextual factors also include national disability policy and discrimination faced within health services. Individual level characteristics are individual levels factors that can impact health service use such as age, gender, income, education and health status. As shown in Figure 4.1, both contextual and individual characteristics are separated into (a) predisposing (existing conditions that can influence use of healthcare services); (b) enabling (conditions that can impede or facilitate healthcare service use); and (c) need (conditions that can be recognised as needing medical treatment by both healthcare providers and individuals) (Andersen, 1995).

Predisposing factors include the following characteristics: demographic, social, family and individual beliefs i.e., cultural norms, and communities and wider areas, such as the population structure. Cultural norms can play a significant role in access to healthcare for people with disabilities, as stigma and marginalisation can be an important barrier to healthcare use (Hashemi *et al.,* 2022). Individual predisposing characteristics including age, gender, religious beliefs and genetic predisposition to certain illness (Figure 4.1). Contextual enabling characteristics are related to health policy, financing and organisations. At the aggregate level these include community income and wealth, the supply of healthcare services and personnel and outreach programmes. Individual level enabling characteristics include availability of insurance and ability to pay for services, the availability of transport and travel time to healthcare services. Lastly, need characteristics include health-related measures (Figure 4.1). At the contextual level they are environmental characteristics such as the quality of water and air and population-level health. Individual need level characteristics relate to the perceived health of individuals and their self-reported functional status and their evaluated need from a healthcare professional based on objective health measures. The arrows in the conceptual framework in Figure 4.1 denote how health behaviours and health outcomes can be impacted by contextual and individual characteristics. The contextual characteristics work through the individual characteristics but can also directly impact health behaviours and health outcomes (Andersen *et al,* 2013). For example, for a woman with a visual impairment, contextual characteristics such as the availability of health information in accessible formats can directly impact their health behaviours, such as whether and where they use the health service, and their satisfaction of the service used.

Figure 4.1. Andersen, Davidson and Baumeister (2013) model of access to health services (Andersen *et al.,* 2013. pg. 35)



In the next section, the barriers to healthcare access for people with disabilities will be explored using demand and supply side characteristics. Demand side barriers to healthcare exist at the individual, household or community level, whereas supply barriers exist within the organisation and structure of the health sector (Ensor & Cooper, 2004). In this study, the influence of individual and household characteristics on healthcare seeking for people with disabilities are the main focus, so the literature review will be based around these characteristics. Some of the key contextual characteristics noted in the conceptual framework will also be discussed.

4.1.3 Barriers to the health system for people with disabilities

The availability of healthcare services can restrict when and where healthcare is sought for people with physical disabilities. In LMICs, specialist services such as physical rehabilitation centres, opticians or audiologists are limited. For example, in Kenya and Malawi, the main providers of low-cost hearing care services are NGOs as these services are unavailable at public health facilities (Kuper & Heydt, 2019). This means that services may be inaccessible for a large proportion of the population that do not live near an NGO services or where private health services are expensive. Healthcare services are often located within urban areas, with fewer healthcare services available in rural areas. This is the case in Cambodia; however, a large percentage of the population live in rural areas (Palmer *et al.,* 2019). Informal providers (IPs), such as informal drug markets and drug sellers are more likely to provide allopathic (i.e., conventional or western medicine) healthcare in LMICs, particularly in rural areas where there are fewer health facilities (WHO, 2015c; Gryseels *et al.,* 2019). However, the quality of medicines and advice received from IPs can be questionable, with counterfeit medicines, improper dosing and mixing of medications being common (Bloom *et al.,* 2014).

The health system in LMICs face challenges in meeting the needs and preferences of service users, particularly for people with disabilities. This can make service users reluctant to use healthcare services if they are perceived as poor quality or ineffective. Communication barriers mean that people with disabilities may miss important health information. A study by Chintende *et al.* (2017) found information available about HIV and AIDS in Zambia was not accessible for people with visual impairments due to the format of information delivery. As a result, people with visual impairments did not have access to the same information as people without visual impairments. Furthermore, cultural beliefs and attitudinal barriers are reported to impact healthcare seeking for people with disabilities due to the presence and experiences of discrimination and stigma from others (Kuper & Heydt, 2019; Hashemi *et al.,* 2022). This stigma can come from within families to prevent healthcare seeking. For example, Zuurmond *et al.* (2019) found that in Cameroon participants reported that family members of people with disabilities are unwilling to spend money on healthcare resulting in delays or prevention of healthcare seeking. Additionally, research in Kenya by Kabia *et al.* (2018) found women with physical disabilities experienced mistreatment from healthcare workers which made them less willing to seek healthcare services. The impact of public healthcare workers' rude and unfriendly attitudes has been shown by Ozawa and Walker (2011) to drive more people towards using private health facilities in Cambodia.

Enabling factors can facilitate access to healthcare services for people with disabilities in LMICs. Geographical accessibility and proximity to healthcare services are important predictors of healthcare utilisation (Dassah *et al.,* 2018b). Research shows that the location of healthcare services in relation to a person's home can impact the likelihood of seeking healthcare when in need, with utilisation decreasing with increasing distance and travel time to nearest healthcare facility (Blanford *et al.,* 2012). Liverani *et al.* (2017) found that for rural villagers in Kampot, Cambodia, the travel time to the nearest health facility was reportedly '*too far*', meaning that village health workers with limited training were more relied upon. Difficult landscapes and topographies, such as mountainous and rainforest regions can be problematic for populations seeking healthcare, especially in rural areas and for people with physical disabilities (WHO, 2017b). On top of this, poor road conditions can further impede the ability of accessing care (Idei & Kato, 2019).

People with physical disabilities can also be prevented from accessing healthcare because of the inaccessibility of the built-up environment, for example, the lack of pavements and uneven ground. This can be particularly hazardous in urban areas where roads are often busy and congested (WHO, 2011). Cost of transportation to and from medical facilities can be a considerable expense for people seeking healthcare, which may ultimately reduce demand (Ensor & Cooper, 2004). The impact of the cost of transport and its deterrent to accessing healthcare services were found by Tsegay *et al.* (2015). There is frequently a lack of transport systems available, including hospital transport such as ambulances and public and private transport options available to people with disabilities (Grut *et al.,* 2012; Vergunst *et al.,* 2017; King *et al.,* 2018).

Financial barriers to accessing healthcare can impact healthcare service use for people with disabilities. Healthcare needs are often greater for people with disabilities compared to those without, as they may need greater levels of prevention, diagnoses and treatment services (WHO, 2011; Kuper & Heydt, 2019). Moreover, a reinforcing cycle between poverty and disability could be detrimental to the health of household members as poverty and health are intrinsically linked; poverty can lead to poor health, and poor health sustains poverty (Peters *et al.,* 2008; Banks *et al.,* 2017). Many LMICs rely on user fees for financing health systems and providing public healthcare, however, it is widely recognised that this prevents the utilisation of healthcare services, with poorer and more vulnerable populations being more impacted than more well-off (Korachais *et al.,* 2019). In turn, for some households this can mean choosing to not use healthcare services when needed or opting to self-medicate instead (Korachais *et al.,* 2019). The choice of where to get care is also impacted by financial barriers, with research from Uganda showing that households in the poorest quintiles more frequently use public health facilities, as opposed to private facilities, compared to the richest quintiles (Pariyo *et al.,* 2009). In response, some LMICs have completely removed user fees for public healthcare, removed user fees for certain types of healthcare, such as maternal healthcare and immunisations or enacted pro-poor health financing policies (Robert & Ridde, 2013; Plouffee *et al.,* 2020).

In addition to the costs of using healthcare services, the direct costs of medicines and other assistive and medical products can create additional barriers for people with disabilities which can result in worse health outcomes (Palmer *et al.,* 2018; Kuper & Heydt, 2019). Research from Ghana found that people with disabilities who were unable to afford specific medications often went periods of time without, exacerbating existing impairments (Dassah *et al.,* 2018a). The costs associated with using formal providers of healthcare have also been found to increase the use of informal healthcare providers. A study by Suy *et al.* (2019) found that in Cambodia people chose to use IPs for healthcare because they allowed partial or delayed payments for medicines and sold medicines in smaller quantities. To date, there is limited research on the use of IPs by people with disabilities in LMICs. The existing research that does exist tends to focus on the use of traditional healers for mental health conditions, intellectual and behavioural disabilities (Burns & Tomita, 2015; Kpobi & Swartz, 2018; Bitta *et al.,* 2019; Mwaka *et al.,* 2023).

Different individual characteristics have been found to impact patterns of healthcare use for people with disabilities. Individual factors such as gender and education can create different experiences for people with disabilities in healthcare seeking behaviour (Prynn & Kuper, 2019). The 2011 World Report on Disability found that women are more likely to report having moderate or severe disabilities. Evidence suggests that there are differences in treatment seeking between men and women, with the direction of the difference varying between context and countries. Marital status is provided as a personal factor in the access to healthcare for people with disabilities in seeking healthcare. Research by Gartrell *et al.* (2017) has highlighted that for women with disabilities in Cambodia being married plays an important role in their understanding of sexual and reproductive health services, as single women with disabilities are excluded from conversations about sexual and reproductive health. Furthermore, differences were found in type of healthcare provider used between younger and older people with physical disabilities in Bangladesh, with older people with physical disabilities being more likely than younger people with physical disabilities to use formal healthcare providers (Talukdar *et al.,* 2018). The individual factors age and sex represent differing likelihoods of needing care at different stages of life, for example, healthcare utilisation may increase for women around childbearing age or the elderly (Andersen *et al.,* 2013).

Education of individuals plays an important role in health and the utilisation of healthcare services. Studies have found evidence to suggest education increases utilisation of services (Ensor & Cooper, 2004). Inequalities in access to education exist, which means that people with disabilities often do not receive the same education as people without disabilities (WHO, 2011). Research on accessing healthcare for people with disabilities in rural South Africa found education to be a major barrier to utilisation (Vergunst *et al.,* 2017). Poor quality of care and lack of knowledge about some disabilities also prevents treatment-seeking for people with disabilities (Kleinitz *et al.,* 2012). A lack of awareness about the healthcare services available to people with disabilities has also been reported as a significant barrier to utilisation (Baart & Taaka, 2017).

In sum, this section has described some of the key barriers to healthcare for people with physical disabilities. The following section provides a brief overview of Cambodia and its health system to provide contextual information to aid understanding of the current situation for people with disabilities in Cambodia and accessing healthcare.

4.1.4 The Cambodian Health System

Cambodia is situated within Southeast Asia, sharing borders with Thailand, Vietnam and Laos. Rapid economic growth has occurred in the last 30 years which has helped increase standards of living and see the poverty rate fall from 33.8% in 2009 to 17.8% in 2019 (Karamba *et al.,* 2022). Prior to this period of economic growth, Cambodia endured many years of conflict which significantly impacted citizens and decimated public services. In 1975, the Khmer Rouge took power in Cambodia which led to the deaths of an estimated two million people (Rutherford & Saleh, 2019). Educated and working professionals were specifically targeted by the Khmer Rouge, with services such as healthcare being destroyed and dismantled. Consequently, most of the population had to rely on IPs for healthcare (Heng & Key, 1995). After the overthrow of the Khmer Rouge in 1979, the health system in Cambodia needed to be completely rebuilt. The rebuilding of the health system was aided through the help of various NGOs and international aid to provide health services to the general population. Public health clinics were built in districts which employed a nurse and midwife to provide basic healthcare services to the population (Grundy *et al.,* 2009). The public health system has faced several constraints, some of which continue to impact today, such as a lack of resources such as medicines and equipment and inadequately trained staff (Gryseels *et al.,* 2019). Resource constraints have meant that the public health system is unable to provide a high-quality care to citizens, with primary healthcare needs being the predominant focus.

The Ministry of Health (MOH) oversees all areas regarding health and healthcare in Cambodia, with input from the People With Disabilities Foundation (PWDF), a department of the Ministry of Social Affairs, Veterans and Youth Rehabilitation (MOSVY) (DPHI, 2016). Healthcare needs are met by both the public and private sector, with the latter becoming more prominent in the delivery of healthcare since the 1990s (WHO, 2015a). NGOs also play an important role in the delivery of healthcare , particularly for more specialised care, such as provision of assistive technologies and rehabilitation (DPHI, 2016). The funding of the health system relies heavily on OOPs, in 2012, it was estimated that 60% of revenue was from OOPs (Asante *et al.,* 2019). For some households, the impact of OOPs can cause significant financial hardships and catastrophic health expenditure (WHO, 2015c). The private health sector in Cambodia is made up of licensed and unlicensed providers, with an estimated 5500 licensed providers, situated largely in urban areas (Ros *et al.,* 2018). However, the number of unlicensed private healthcare providers is unknown (Ros *et al.,* 2018).

IPs are widely used in Cambodia in the place of formally trained healthcare professionals such as doctors and pharmacists (Suy *et al.,* 2018). Traditional medicine in Cambodia is predominately based within the private healthcare sector, with very limited involvement in the public sector (Ros *et al.,* 2018). These traditional methods of healthcare describe a wide variety of providers, including, Buddhist monks and mediums known as '*kru chol ruup*', traditional healers, often termed '*Kru Khmers*' and traditional birth attendants (WHO, 2015c; Peltzer *et al.,* 2016). Traditional healthcare is typically provided from the home or religious institutions and is not formally integrated into allopathic medicine (WHO, 2015c). The Cambodian MOH estimates of 40% to 50% of the population utilise traditional medicine (Ros *et al.,* 2018). In this study, the term IPs will be used to refer to both informal drug markets and sellers and traditional medicine providers.

To ensure low-income families can access care and are not financial constrained, the Cambodian government first introduced Health Equity Funds (HEFs) to provide free or subsidised care to the poorest and most vulnerable in society (Ir *et al.,* 2019). Households eligible for HEFs are identified via the national Identification of Poor Households Program (IDPoor) by the Ministry of Planning (Asante *et al.,* 2019). Households which are then classed as poor are provided with an IDPoor card which can be used in public healthcare facilities (Kelsall & Heng, 2016). Overall, the health system in Cambodia has seen marked improvements since the early 2000s and access to formal healthcare has increased for the general population. Despite this, research is needed to collect evidence about inequities in healthcare access between population groups such as people with and without disabilities in Cambodia.

4.1.5 Research questions

The overarching aim of this study is to investigate the factors which are associated with a person's first interaction with healthcare services, after reporting an illness or injury within the four-week period prior to the 2019 Cambodian Socioeconomic Survey (CSES). Use of different healthcare providers for people with physical disabilities, including moving, seeing, hearing and speaking impairments, will be examined for differences compared to people without physical disabilities. To understand how people with physical disabilities in Cambodia interact with the health system and the barriers they face, this study will investigate access to health and the utilisation of different healthcare providers for first healthcare visit after illness or injury. Consequently, the research questions posed are:

1. What individual and contextual factors are associated with healthcare utilisation after illness or injury in a period of 30 days preceding a survey in Cambodia for people with and without physical disabilities?
2. Where are people with physical disabilities seeking healthcare for the first time after illness or injury, and does this differ to people without disabilities in Cambodia?

This introductory section has emphasised the significant barriers to the health system for people with disabilities in LMICs. Investigating these barriers enables a greater understanding of the patterns of healthcare seeking behaviours. In turn, this understanding could be used to support policy and health initiatives which aim to improve the accessibility of healthcare for people with physical disabilities in Cambodia. Overall, to answer the research questions posed, the conceptual framework will be operationalised to provide a framework of factors which impact healthcare seeking behaviours of people with physical disabilities. Individual and contextual level characteristics which have been identified in the literature review that are available in the dataset will be tested in the data analysis. A discussion of the results and their links to the literature will follow the results section. Lastly, in the final section of the paper, the limitations of this study will be discussed, as well as potential policy implications and scope for future research.

4.2 Methodology

The subsequent section provides a detailed description of the methodology used in this chapter. Ethical approval (submission ID: 53514.A1) has been provided for this research by the University of

Southampton Ethics and Research Governance Online (ERGO II) before undertaking any data analysis.

4.2.1 Data

The data derived for this study comes from the 2019 CSES which is a nationally representative population level survey collecting a wide range of information about households (Flores *et al.,* 2013; NIS, 2019/20). There have been twelve rounds of the CSES conducted since 1993, and since 2007 data has been collected annually (NIS, 2019/20). Every five years, a larger sample is collected, in 2004, 2009, 2014 and 2019, which contains around 12,000 households, apart from the 2019 wave which contained just over 10,000 households. The data for the 2019 round was published in February 2021. Non-response has been reported by the NIS to be low, with the official 2019/2020 governmental report states that out of the total 10,080 households sampled, only five households did not respond to the survey invitation (NIS, 2019/20). The CSES is a suitable choice of data for this study because it has specific questions on disability and healthcare utilisation, as well as having a large sample size and being nationally representative. The survey also over-samples households from rural areas to ensure a better understanding of living standards for people living in these areas.

Four different questionnaires are used in the data collection: a village questionnaire, a household questionnaire, household listing, and a diary to capture household expenditure and consumption of own-production and for household income and receipts (NIS, 2019/20). The household questionnaire collects information about the individual members of the household and is answered by the head of the household. The modules included are housing and living conditions, economic activities, household production and incomes, household consumption, health and treatment seeking after recent illness or injury, disability, vulnerability to food shortages and victimisation, as well as household structure and demographic information. Health and healthcare utilisation are measured by respondents answering questions on whether they have been ill or injured in the 30 days preceding the survey. If respondents stated that they or a member of their household had been ill or injured, further questions were asked about the type of illness, whether they sought treatment or advice, the type of healthcare provider sought, any hospitalisations and health expenditure. In this study, the response variable for the first stage of the analysis will be whether an individual sought treatment after illness or injury in the 30 days preceding the survey. The second stage of the analysis uses the response variable, first healthcare provider sought after illness or injury.

Disability is measured by questions relating to functional limitations. These questions aim to capture information about whether respondents have any difficulties with seeing, hearing, speaking and moving and the severity of these difficulties. The disability questions used in the CSES are similar to the Washington Group (WG) short set of six questions, but some key differences exist between them. The WG questions are a standardised set of disability questions, evolved from the ICF, and are based on the notion of functional limitations that are used in national surveys such as Demographic and Health Surveys (Palmer & Harley, 2012). A difference is the CSES includes psychological and learning difficulties as part of the functional limitations included, whereas the WG short set does not. Further, the WG also include the usage of assistive devices such as glasses and hearing aids within the short set of six questions, whereas the CSES does not. More information is provided about how disability and the response variables are coded for the analysis is included in Section 4.3.2.

To obtain the data, an online account was created with the National Institute of Statistics (NIS) microdata catalogue. Once the account was created, an online form was completed and details such as user details, organisation affiliation and reasons for requesting and plans for the data were reported. After completion of the form an employee from the NIS made contact to provide an invoice for payment, which cost US$300 to purchase. Once payment had been made, the data was sent securely online and then downloaded onto the University of Southampton's secure network.

4.2.1.1 Sampling technique

Data collection for the 2019 round of the CSES took place from July 2019 to June 2020 with certain residences being excluded from the sampling frame including institutional households such as military barracks, prisons, long term hospitals, monasteries, as well as diplomatic and UN households (NIS, 2019/20). The CSES 2019/2020 report published by the NIS does not state whether data collection was affected by COVID-19. The sampling frame for the 2019 CSES was taken from the register of villages and enumeration areas (EAs) that were also used for the 2019 Population Census of Cambodia (NIS, 2019/20). The CSES utilises a three-stage stratified sampling technique to ensure a representative sample. The first stage involved the identification of villages, known as Primary Sampling Units (PSUs), from each stratum of the sampling frame. For the second stage, EAs were mapped onto the selected PSUs and then one EA was randomly sampled from each PSU. For some urban stratum, due to the size of the villages, they were split into more than one PSU with an EA. Essentially, this means that some larger villages have more than one EA (NIS, 2019/20). Lastly, for the third stage of sampling, households were mapped within the EAs, with 10 households being selected from each EA through a systematic sampling approach (NIS, 2019/20).

4.2.2 Variables of interest

The following section describes the response variables for the analysis, and the explanatory variables.

4.2.2.1 Response variables

The response variable utilised in the first analysis was treatment seeking after illness or injury in the last 30 days at the time of the survey. This was a binary variable coded as 0 = no treatment sought after illness or injury and 1 = treatment sought after illness or injury. This variable enabled those who sought treatment after illness or injury to be identified. For the second analysis, the multicategory response variable first type of healthcare provider sought has been used. This has been recoded as 0 = public healthcare, 1 = private hospital or clinic, 2 = private pharmacy, visit with trained health worker, overseas medical care and other private and 3 = IPs which included informal drug seller or market, Buddhist monks and *Kru Khmer* magicians. A list of the full categories included in each category are shown in Appendix A, Table A.1. Only the first incidence of healthcare seeking is relevant for this analysis due to this paper focusing on where healthcare is first sought. Access to healthcare is complex and the treatment pathways that people take is not always linear, and someone may move between utilising public, private and informal healthcare services. Hence, the first incidence of healthcare has been used as this research is investigate where people with and without physical disabilities go at the start of the healthcare seeking process.

In total, 289 respondents stated they did not seek treatment or advice for their illness or injury, but they provided a response to the first healthcare provider sought question. This is due to people stating they sought healthcare for other reasons, including maternal health services and health checks. Some individuals had responses to the first provider question, despite saying they had not sought treatment for illness or injury in the last 30 days and they had not sought healthcare for other reasons. As this paper only focuses on people who had been ill or injured in the 30 days preceding the survey, only those who had sought treatment or advice because of illness or injury are included in the second stage of the hurdle model and those seeking healthcare for other reasons were not included. Overall, 4,921 people had been ill or injured in the last 30 days preceding the survey. However, for some respondents there was no data recorded about the first healthcare provider sought, so these were removed from the analysis. Thus, the final sample size used in the first analysis is 4,783 (Table 4.1), with 357 or 7.3% not seeking treatment or advice and 4,426 or 89.9% seeking some form of treatment or advice. This means that the second analysis included 4,426 respondents.

Table 4.1. Total sample size for the Hurdle Model

Variables	**N**	**%**
Illness or injury in the last 30 days		
Disease	4811	15.6
Injury	110	0.4
None	24046	84.0
Total	**28967**	**100.0**
Did you seek treatment at least once?		
No	357	7.3
Yes	4426	89.9
Missing	138	2.8
Total	**4921**	**100.0**
Type of healthcare provider sought		
Public	899	20.3
Private hospital or clinic	1782	40.3
Private pharmacy or other private	1443	32.6
IP	302	6.8
Total	**4426**	**100.0**

In the CSES, disability is recorded using questions based on the notion of functional limitations which can cause difficulties in conducting daily activities, such as difficulties in moving, hearing or seeing. In the questionnaires, for each household member, up to three disabilities were recorded, as well as their corresponding severity. In this chapter, people with physical disabilities, including sensory, are the group of interest. Therefore, disability was identified if an individual had at least one seeing, hearing, speaking or moving impairment. To assess the severity of disability, respondents reported the severity of the difficulties experienced, by stating whether their difficulty is 1 = mild, 2 = moderate or 3 = severe. Due to the similarity of the questions in the CSES to the WG short set of six questions, the recommendations proposed by the WG on how to approach analysis of the questions are applied. It is recommended that mild disabilities are not included with moderate or severe disabilities and should not be classified as having a disability (Palmer & Harley, 2012). This approach has been applied by Palmer *et al.* (2018) who researched disability and standard of living using the 2014 CSES and used the data to construct a disability indicator containing only moderate and severe disabilities. In this paper, physical disability has been coded into a binary variable with 0 = none or mild physical disability and 1 = moderate or severe physical disability (MSPD).

4.2.2.2 Explanatory variables

This section provides a description of the categorical explanatory variable names and codes tested in the regression analysis (Table 4.2). A full table of counts and weighted percentages for all the variables can be found in Appendix A, Table A.2. As shown in Table 4.2, age has been included as a categorical variable. Only those over 18 years have been included in the analysis due to child healthcare seeking being decided by parents and guardians. Due to only a small number of respondents being divorced or separated, marital status was recoded into three categories. Ethnicity was also recoded due to only a small number of individuals of non-Khmer ethnicities (Table 4.2). Several variables are included in the CSES to measure education and literacy. The variables that were included were whether the individual has ever attended school, ability to read, and ability to write (Table 4.2). In the dataset, data pertaining to individual highest completed education level was collected, although has not been used because it had a large percentage of missing data. The reason for the missing data is believed to be due to the household head answering the highest education qualification on behalf of all household members, so was unable to provide an answer to this question for some household members. The variable employment status was created from the question asking about respondents' main activity in the last 12 months (Table 4.2). The categories unemployed and student and retired, dependent, rent or income receiver or other have been merged because of small sample sizes.

To measure household poverty, a variable has been created which categorises households as either poor or non-poor by using household consumption and expenditure data collected. The method of calculating poor households has been taken from Xu (2005). Total monthly expenditure per capita has been calculated using household food consumption, non-food consumption and spending on housing, fuel, electricity, and water. To create a binary variable which categorises respondents into poor and non-poor households, subsistence spending was calculated by generating a monthly food consumption as a share of total monthly household consumption, using household size to equivalise the variable. Following Xu's (2005) recommendations[5], the weighted average food consumption as a share of total household consumption at the 45th and 55th percentile was generated to create a national poverty line. Subsistence expenditure was then calculated using the poverty line and equivalised household size. Lastly, to generate a variable of the percentage of poor and non-poor households, a new variable was created to categorise household with subsistence expenditure less than total monthly expenditure as poor, and those with higher expenditure as non-poor (Xu, 2005). Overall, 15.6% of households in the sample are classified as poor, this is lower than the 2019 estimates of poverty which estimate that the poverty rate in Cambodia is 17.8% (Karamba *et al.,*

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[5] Xu (2005) recommends not including alcohol and tobacco consumption in the calculations. However, in the CSES 2019/20 report, they report using both in their calculations, therefore, alcohol and tobacco consumption have been used in the composition of household expenditure.

2022). Differences between the figure calculated in this research and others are likely due to data sources and different methodology. However, the percentage of poor households estimated here is similar and is a reasonable estimate.

The variable household debt has been recoded to remove one household with missing data for this question, this is reflected in Appendix A, Table A.1. The survey collects information on whether households possess HEF cards making them eligible for free or subsidised public healthcare, these are known as IDPoor cards or Priority Access Cards. Prior to the reform of the IDPoor programme process in 2021, Priority Access Cards were given to poor households identified via the post-identification; this means that they were missed during the IDPoor round for their area (Kaba *et al.,* 2018). So, a single variable has been created combining those who own either an IDPoor card or a Priority Access Card. The variable household size has included in the analysis as a continuous variable. To examine for differences between households with female and male heads of household, a binary variable was created (Table 4.2). The variable Urban/Rural measures whether a household is situated in a rural or urban area. In the dataset, the variable ecozone of residence which separates the province of residence into five categorical geographic areas has also been tested. Lastly, four binary variables of household ownership of different modes of transport have been included in the analysis (Table 4.2).

Table 4.2. Categorical variable names and codes

Variable name	**Codes**
Gender	0 = Men 1 = Women
Age groups	0 = 18 to 39 years 1 = 40 to 59 years 2 = 60 years and over
Marital status	0 = Married or cohabiting 1 = Divorced, separated or widowed 2 = Never married or cohabited
Ethnicity	0 = Khmer 1 = Non-Khmer
Has the individual ever attended school?	0 = No 1 = Yes
Ability to read	0 = No 1 = Yes
Ability to write	0 = No 1 = Yes
Main activity in the last 12 months	0 = Employed 1 = Unemployed or student 2 = Homemaker 3 = Retired, dependent, rent income receiver or other
Poverty	0 = Non-poor household 1 = Poor household
Household debt	0 = No 1 = Yes
Access to HEF card	0 = No 1 = Yes
Female headed household	0 = No 1 = Yes
Urban/rural	0 = Rural 1 = Urban
Ecozone of residence	0 = Phnom Penh 1 = Plains 2 = Tonle Sap 3 = Coastal 4 = Mountains
Household ownership of bicycle	0 = No 1 = Yes
Household ownership of motorcycle	0 = No 1 = Yes
Household ownership of car	0 = No 1 = Yes
Household ownership of jeep or van	0 = No 1 = Yes

4.2.1 Methods

To assess whether there were any associations between treatment seeking at different healthcare providers after illness or injury and MSPD, crosstabulations were performed on the individual and household level variables. Chi-square tests were also used to test whether the differences were significant. This analysis provides information into which variables may be significant in the regression models and to show trends in the data. In the regression models, gender, age, school attendance, poverty status and female head of household were all included as control variables. For the analysis, person weights have been applied. The weights used were created from the person weights that were provided with the dataset by standardising the person weights. The weight was then used in the preliminary analysis for crosstabulations and multilevel binary and multinomial logistic regression. In the crosstabulations, the unweighted counts and weighted percentages are reported. The following section describes the method used including the hurdle model equations. The data preparation and analysis has been performed in Stata version 16.0.

4.2.1.1 Hurdle model

The methodology in this paper adopts a hurdle model design to examine the probability of healthcare seeking and the probability of seeking treatment or advice from different healthcare providers. Hurdle models comprise two-stage process and have commonly been used to model healthcare utilisation data (Rose *et al.,* 2006). The first part of the model, a binary model, determines probability of an event happening. Then, conditional on a positive outcome in the binary model, or passing the zero hurdle, the second part then models subsequent events. The second stage of a hurdle model typically utilises count models, such as a truncated-at-zero count model (Rose *et al.,* 2006). However, in this analysis, the second stage comprises multilevel multinomial models to investigate the type of healthcare provider sought.

The first part of a hurdle model can be expressed as:

$$P[y = 0] = f_1(0) = p$$

Where $f_1(0)$ is the probability of crossing the hurdle. The conditional probability that the outcome, treatment seeking, is represented by $\Pr(Y = 1|x) = \pi(x)$, where π is the probability of seeking treatment, compared to not seeking treatment (1- π) (Hosmer *et al.,* 1991). The logit of the 2-level multilevel binary regression model is therefore denoted by the following equation:

$$log\left(\frac{\pi_{ij}}{1-\pi_{ij}}\right) = \beta_0 + \beta_1 x_{ij} + \beta_2 x_{ij} \dots + \beta_k x_{ij} + u_j$$

Where β_0 is the intercept, which represents the log-odds that y is equal to one when x is equal to zero and β_1 represent the covariates in the model, with x_{ij} denoting an individual-level explanatory variable (Goldstein, 1995). For this analysis, no level two explanatory variables have been included. The group or level two random effect in this model, represented by u_j, is the household PSU. PSU was used instead of the household level because there was very limited variation within households whether and where healthcare was sought The u_js are independent with mean zero and variances equal to τ_0^2. Therefore, the inclusion of the level-2 random effect means that the variance is adjusted for x (Snijders & Bosker, 2012)**.** The results of the binary regression models are expressed in the form of odds ratios, these are calculated by exponentiating the log-odds, for example exp (β_0).

To aid the interpretation and presentation of the results, the response probabilities have also been calculated for the multilevel binary model. The following equation denotes the probability for i in group j:

$$\pi_{ij} = \frac{exp(\beta_0 + \beta_1 x_{ij} + u_j)}{1 + exp(\beta_0 + \beta_1 x_{ij} + u_j)}$$

To investigate differences in healthcare seeking in Cambodia after illness or injury for the second part of the hurdle model, a multilevel multinomial regression has been utilised. Multinomial models are the most appropriate because the data has multiple categories yet is unordered. The goal of multinomial regression is to estimate the probability of seeking healthcare at different healthcare providers, compared to public healthcare facilities, as well as estimating the odds of which healthcare provider is sought as a function of the covariations which are expressed in odds ratios. The equation for a multilevel multinomial logit model is:

$$log\left(\frac{\pi_{kij}}{\pi_{1ij}}\right) = \beta_{0k} + \beta_1 x_{ij} + \beta_2 x_{ij} \dots + \beta_k x_{ij} + u_{kj}, \qquad k = 2, \dots, C$$

As with the previously described multilevel binary model, β_{0k} represents the intercept, and β_{1k} the covariates, however for a separate category k and the 1st response categories. u_{kj} is the level 2 random effect with the reference category one for response category k. It is further assumed that the random effects $C - 1$ follow a normal distribution with mean zero. The results of the multinomial regressions have been presented in the form of relative risk ratios (RRR), as with the odds ratios for the binary model, RRRs can be calculated by exponentiating the log-odds. In addition, predicted probabilities of response k for an individual i in cluster j have been calculated for the multilevel multinomial model containing the interactions between disability and other explanatory variables. The equation for this is as follows:

$$\hat{\pi}_{kij} = \frac{exp(\hat{\beta}_{0k} + \hat{\beta}_{1k}x_{ij} + \hat{u}_{kj})}{1 + \sum_{l=2}^{C} exp\left(\hat{\beta}_{0k} + \hat{\beta}_{1k}x_{ij} + \hat{u}_{kj}\right)}, \qquad k = 2, \dots, C$$

where $\hat{\beta}_{0k} + \hat{\beta}_{1k}x_{ij} + \hat{u}_{kj}$ are sample estimates of $\beta_{0k} + \beta_{1k}x_{ij} + u_{kj}$.

To build on the regression models, a forward selection approach was adopted when adding more predictors to the models. Other predictors were added into the regression models one by one and were subsequently tested for significant in the model using Wald Tests and Likelihood Ratio Tests. Variables which remained in the model were found to be significant at the 5% level (P=<0.05). To assess for a relationship between physical and sensory disability and the explanatory variables, several interaction terms with tested for significance in the binary logistic and multinomial regression models, chosen based on the relationships seen in the existing literature.

4.3 Results

This section of the paper will describe the results of the exploratory analysis (Section 4.3.1) and the results of the hurdle models, multilevel logistic models (Section 4.3.2) and the multilevel multinomial models (Section 4.3.3).

4.3.1 Exploratory analysis

For the exploratory analysis, crosstabulations and Chi-square tests were performed to assess the differences between and within the explanatory variables and the response variables. In this section, the results of the exploratory analysis for health provider type and disability are reported in Table 4.3. The results of the crosstabulation and chi-square test for whether respondents sought healthcare is provided in Appendix A, Table A.3.

Overall, an estimated 13.6% of the sample reported at least one MSPD, with only a small percentage difference in treatment or advice seeking between people with and without MSPD. In total, 92.5% of people without a MSPD sought treatment or advice and 90.0% of those with a MSPD sought treatment or advice (Appendix A, Table A.3). Whilst a difference of 2.5% was found, the Chi-square test showed that this difference was not significant. A significant association was found between disability and treatment type sought after illness or injury (p=<0.001). Table 4.3 shows that a higher percentage of people with MSPD use a public healthcare facility compared to people without MSPD (27.3% vs. 20.0%). Additionally, people with MSPD have a lower percentage of utilisation of private pharmacy or other private facilities compared to those without MSPD (25.8% vs. 32.6%) (Table 4.3). For private hospitals and clinics and IPs, only a small difference was found.

Gender, marital status and being from a female headed household were not found to be significantly associated to where treatment or advice was sought (Table 4.3). Ability to read, ability to write and whether the respondent has ever attended school were found to be significantly associated to where treatment or advice was sought (p=0.006, p=<0.001 & p=<0.001) (Table 4.3). Households that are poor have a greater percentage of accessing public providers and IPs compared to non-poor households, this was also found to be significant (p=<0.001) (Table 4.3). Furthermore, 10.0% of respondents who were unemployed used IPs for treatment or advice, compared to only 2.7% for homemakers (Table 4.3). Household possession of a HEF card was found to be significantly associated to the type of healthcare provider used, with public health facilities being the most common provider type (p=<0.001). Households without a HEF card have a greater percentage of private hospital or clinic use (26.6% vs. 42.5%) compared to households with a HEF card (Table 4.3). Household debt was also significantly associated to where health services were sought, with those with household debt have higher use of private hospitals and clinics and private pharmacies and other private (Table 4.3). Those residing in Phnom Penh had significantly greater usage of public healthcare and private hospital and clinic usage compared to the other categories at 26.2% and 50.5% (Table 4.3). Meanwhile, this category has the lowest percentage use of private pharmacy and other private and traditional provider use at 23.0% and 0.3%. However, for IPs utilisation, only one person from Phnom Penh used this type of provider, therefore, it was decided that ecozone would not be used in the logistic and multinomial models. For households with ownership of a motorcycle and for household ownership of car, they both have the highest percentage of using private hospitals and clinics compared to those without a motorcycle or car (42.0% vs 34.2% and 52.6% vs 39.5%) (Table 4.3). Households without a motorcycle or car also have a higher percentage use of public healthcare and informal healthcare providers (Table 4.3).

Table 4.3. Crosstabulation between healthcare provider type and explanatory variables

	Public		Private hospital or clinic		Private pharmacy or other		Informal Providers		
Variables	**N**	**%**	**N**	**%**	**N**	**%**	**N**	**%**	**Total %**
Physical disability-(0.001)[6]**									

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[6] p-value relates to the chi-square tests

None or mild physical disability	733	20.0	1541	40.6	1285	32.6	262	6.8	100
Moderate or severe physical disability	166	27.3	241	40.4	158	25.8	40	6.5	100
Age groups - (0.368)									
18 – 39	225	18.8	527	43.1	396	30.9	91	7.2	100
40 – 59	351	22.1	671	39.6	567	31.3	119	7.0	100
60+	323	21.4	584	40.0	480	32.8	92	6.2	100
Sex – (0.879)									
Male	320	20.7	636	41.1	508	31.9	103	6.4	100
Female	579	21.1	1146	40.3	935	31.6	199	7.0	100
Marital status – (0.466)									
Married/cohabiting	608	20.1	1295	41.2	1026	31.8	217	7.0	100
Divorced/separated/widowed	219	22.8	360	38.6	326	32.6	63	6.1	100
Never married/cohabited	72	23.7	127	40.8	91	28.7	22	6.7	100
Female head of household (0.252)									
No	690	20.3	1412	40.7	1132	31.8	242	7.1	100
Yes	209	23.1	370	40.0	311	31.3	60	5.5	100
Ever attended school- (0.006)**									
No	281	24.4	435	36.3	401	32.8	77	6.5	100
Yes	618	19.6	1347	42.2	1042	31.3	225	6.9	100
Ability to read a short sentence in any language – (<0.001)**									
No	323	24.3	494	35.8	466	33.3	92	6.6	100
Yes	576	19.4	1288	42.7	977	31.0	210	6.8	100
Ability to write a short sentence in any language – (0.001)**									
No	334	24.2	521	36.2	481	33.1	94	6.5	100
Yes	565	19.4	1261	42.7	962	31.1	208	6.9	100
Poor household status – (<0.001)**									
Non poor	804	20.7	1664	41.7	1306	31.6	247	6.1	100
Poor	95	23.4	118	29.2	137	33.3	55	14.1	100
Main activity in the last 12 months – (<0.001)**									
Employed	649	19.5	1388	41.0	1129	32.0	252	7.4	100
Unemployed/student	28	23.7	45	39.3	29	27.0	10	10.0	100
Homemaker	85	27.0	121	34.6	124	35.8	12	2.7	100
Retired/dependent/other	137	25.1	228	41.8	161	28.3	28	4.8	100
Possess IDpoor or priority access card – (<0.001)**									
No	701	18.8	1641	42.5	1267	31.8	266	6.9	100
Yes	198	36.4	141	26.6	176	31.4	36	5.6	100
Household debt – (0.017*)									
No	591	22.8	1075	40.1	824	30.1	186	6.9	100
Yes	307	18.0	706	41.3	618	34.2	116	6.5	100

Urban/Rural – (0.018*)									
Urban	309	21.4	632	44.2	482	29.4	74	5.0	100
Rural	590	20.7	1150	38.7	961	32.9	228	7.7	100
Ecozone of residence – (<0.001)**									
Phnom Penh	63	26.2	131	50.5	58	23.0	1	0.0	100
Plains	308	20.0	541	35.0	580	36.4	130	8.6	100
Tonle Sap	245	18.4	591	44.5	408	30.1	93	7.0	100
Coastal	65	17.8	174	47.7	108	26.9	25	7.6	100
Plateau/mountains	218	27.1	345	39.0	289	29.2	53	4.7	100
Household bicycle ownership – (0.518)									
No	446	21.5	847	41.0	677	31.5	133	6.0	100
Yes	453	20.5	935	40.3	766	31.9	169	7.4	100
Household motorbike ownership – (<0.001)**									
No	204	26.5	279	34.2	252	31.2	68	8.1	100
Yes	695	19.7	1503	42.0	1191	31.8	234	6.5	100
Household car ownership – (<0.001)**									
No	847	21.6	1586	39.5	1315	31.7	293	7.2	100
Yes	52	13.9	196	52.6	128	31.7	9	1.8	100
Total	**899**		**1782**		**1443**		**302**		**4426**

**p-value significant at 5% level, **p-value significant at 1% level*

4.3.2 Hurdle Model: Stage 1

The first stage of the hurdle model includes a multilevel binary logistic model which models the probability of seeking treatment or advice after illness or injury in Cambodia. The results of the multilevel logistic models can be found in Appendix A, Table A.4, where model one is an empty model containing only the constant, model two includes MSPD and other explanatory variables that were found to be significant at the 5% level and the control variables, age, sex, female headed household, school attendance, poor household status and urban or rural residence. Model three includes the same variables as model two with the addition of two interaction terms, one between gender and MSPD and the other between poor household status and MSPD. In model two, the results show that the odds of people with MSPD seeking treatment or advice after illness or injury are 1.22 times greater than people without MSPD, this equates to a 22% increase in treatment seeking (Appendix A, Table A.4). Significant differences were also found for poverty and main activity in the last 12 months. No significant differences were found for the control variables age, sex, female headed households school attendance and urban or rural residence. Additionally, no significant differences were found for the variables ethnicity, marital status, ability to read or write, household debt, HEF card and household ownership of a bicycle, motorcycle or car.

In model three, two interaction terms were included. The odds for the control variables remained similar and non-significant between model two and three (Appendix A, Table A.5). As with model two, the variable main activity in the previous 12 months was significant (p=0.009). The interaction term between MSPD and poor household status shows that people with MSPD from a poor households have significantly lower odds of seeking treatment or advice after illness or injury (0.33 < 1.00) compared to non-poor household. This relationship is displayed in Figure 4.2, displaying the predicted probabilities for MSPD, poor household status and the interaction term. Overall, people with MSPD from poor households have a lower probability of seeking treatment or advice after illness or injury compared to people with MSPD from non-poor households at 0.87 and 0.95 respectively (Appendix A, Table A.5). The latter group has the highest probability of seeking treatment or advice, which is higher than both those without MSPD from non-poor and poor households. Another interaction between gender and MSPD was also included in model three, this showed that women with MSPD are less likely to seek treatment or advice compared to men with MSPD (Appendix A, Table A.5). Figure 4.3 displays the probabilities calculated for this interaction. Following the modelling of the probability of seeking healthcare, for those that did seek healthcare after illness or injury, the data was then modelled further to assess for differences in the type of healthcare provider sought using multilevel multinomial models. The results of these are presented in the following section.

Figure 4.2. Predicted probabilities of seeking health services for MSPD and poverty

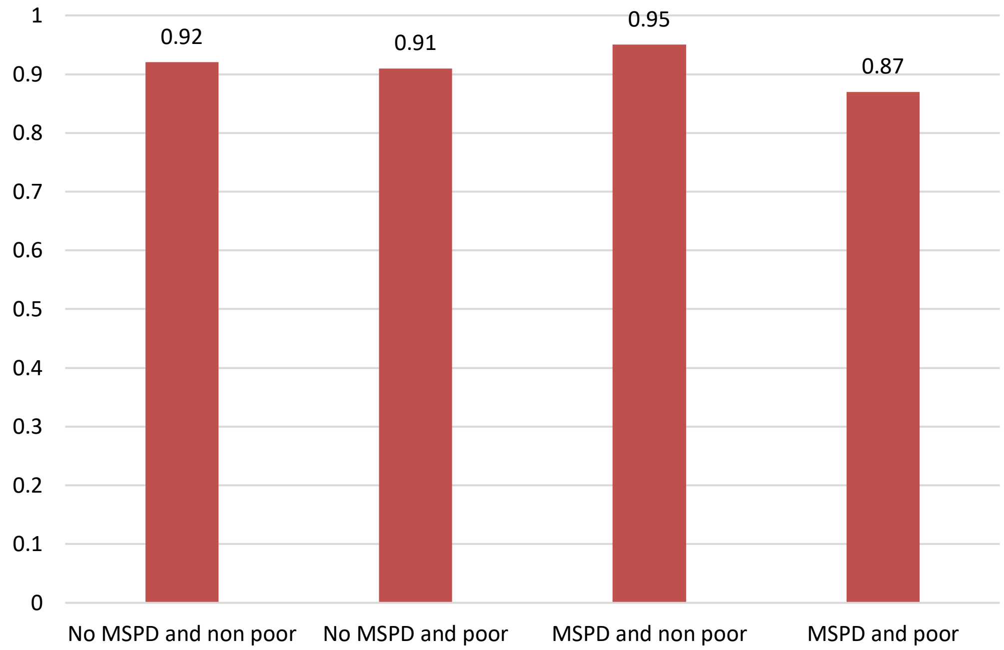
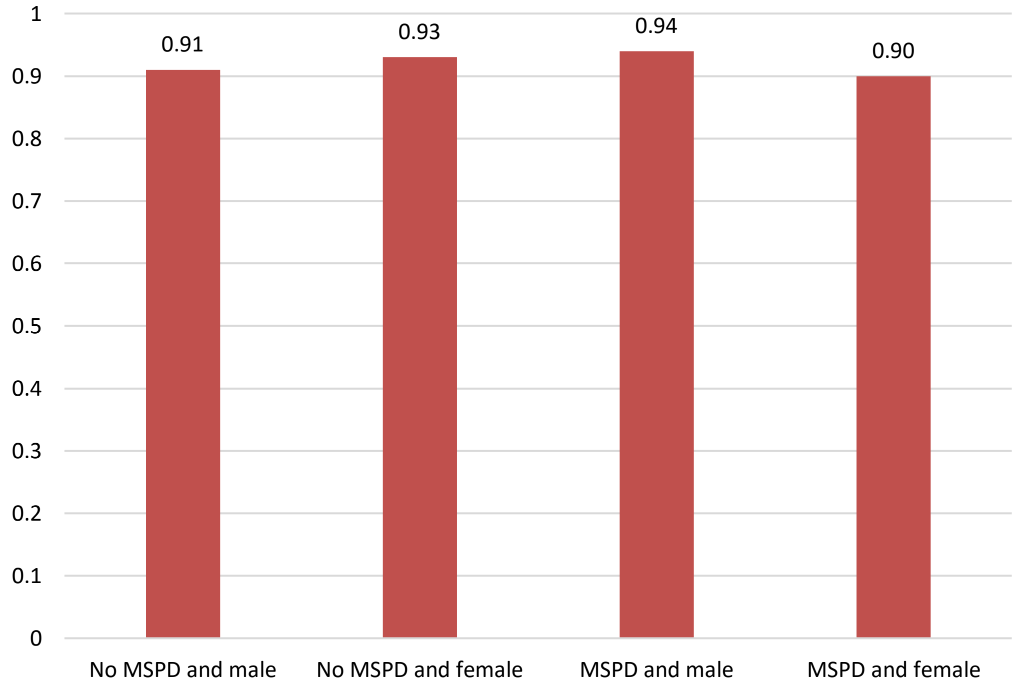


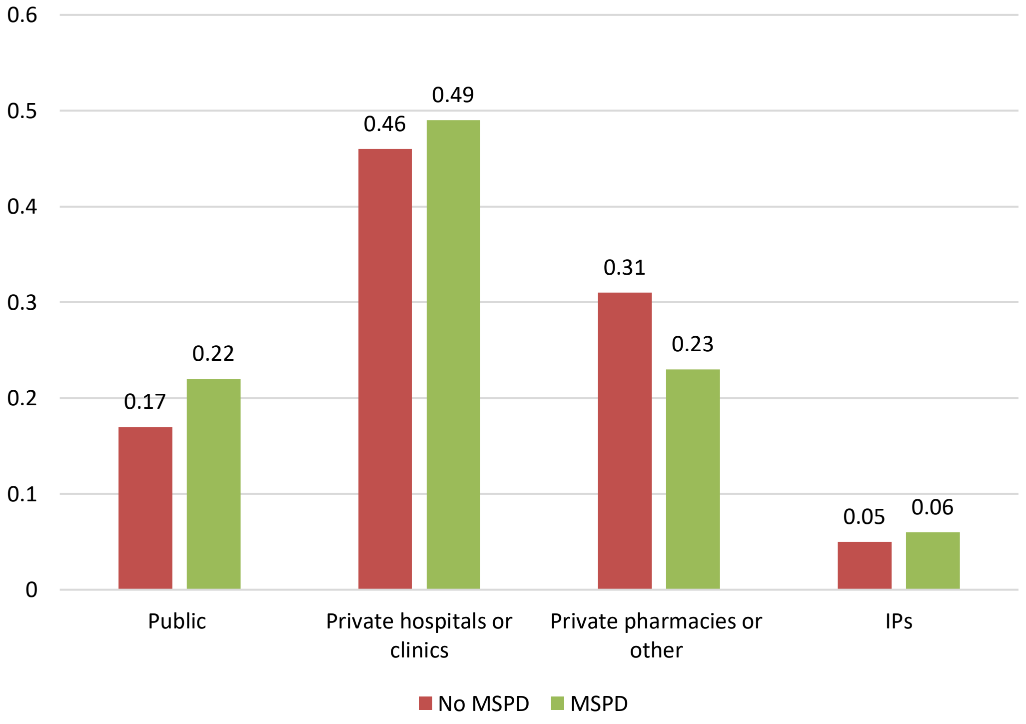
Figure 4.3. Predicted probabilities of seeking health services for MSPD and gender



4.3.3 Hurdle Model: Stage 2

The second part of the hurdle model investigates the first type of healthcare provider sought after illness or injury. Therefore, respondents that did not report seeking health services were removed from the analysis. The variables ethnicity, marital status, ability to write and ability to read, and the household ownership of bicycle or motorcycle were also tested in the multinomial models and were found to not be significant so were not included in the final model. The same control variables: age, sex, female headed household, school attendance, poor household status and urban or rural residence were included. The results of multinomial model four, the multinomial model without interactions and the predicted probabilities are displayed in Appendix A, Table A6. MSPD was found to be significantly associated with the first type of healthcare provider sought for illness or injury. Here, is it shown that people with MSPD have a greater probability of utilising public healthcare providers and private hospitals and clinics compared to those without MSPD (Figure 4.4). With 49% of people with MSPD seeking treatment or advice from private hospitals and clinics, compared to 46% of people without MSPD. For private pharmacies and other private providers, those without MSPD have a greater probability of use at 31% compared to 23% (Figure 4.4). Only a small difference in probability was found between the two groups in utilisation of IPs, with respondents with MSPD having a marginally higher probability at 6% compared to 5% for people without MSPD.

Figure 4.4. Predicted probabilities for the type of healthcare provider sought and physical disability



The final model expands upon model four, the previous model, by including interaction terms between MSPD and gender, poor household status and HEF card ownership (Table 4.4). The predicted probabilities have also been calculated and the full table of results are shown in Appendix A, Table A.7 and Table A.8.

Figure 4.5 displays the predicted probabilities between MSPD and gender which shows some interesting differences in first type of healthcare provider sought. Women with MSPD have the highest probability of using private hospitals and clinics compared to women without MSPD and to men with and without MSPD (0.54 > 0.47, 0.47 & 0.44). For these groups, the largest difference in probability was observed between private pharmacy and other private providers where 31% of men without MSPD used this type of provider, whereas for men with MSPD only 19% used this type. The difference between women with and without MPSD, shows a similar trend, however not as large (0.30 vs 0.22). Women and men with MSPD have a higher probability of using public healthcare providers than those without MSPD. Although, men with MSPD have a higher probability than men with MSPD (0.29 vs 0.19). Overall, use of IPs is lowest, with similar probabilities of use, although 8% of men with MSPD used this type of provider.

An interaction term between MSPD and poor household stats was also found to be significant. The graph of the predicted probabilities displays some large differences in use of the different types of healthcare provider (Figure 4.6). As shown in Figure 4.6, a small difference was found in the probability of utilising public healthcare providers for treatment or advice for those with MSPD for both non-poor and poor households (0.29 & 0.33). Rather, the largest differences in probability are between those with and without MSPD in determining the likelihood of utilising public providers after illness or injury, those without MSPD from either non-poor or poor households have a much lower probability of using this type of healthcare provider (0.17 & 0.13). The same pattern is followed for private pharmacies and other private providers, with those without MSPD being more likely to use this type of provider for both poor and non-poor households (0.34 & 0.31) compared to those with MSPD (0.19 & 0.23). For private hospitals and private clinics, respondents with MSPD from poor households had the lowest probability of using this type of provider at 29% of people using this type of provider first for treatment or advice. Unlike the use of public providers and private pharmacies and other providers, respondents without MSPD from poor households had a lower probability of using private hospitals and clinics compared to respondents with MSPD from non-poor households (0.40<0.44). The use of IPs was also found to differ between the different groups, respondents with MSPD from poor households had the highest probability of using this provider at 0.15, which is closely followed by respondents without MSPD from poor households at

0.13. Respondents without MSPD from non-poor households had the lowest probability of using IPs, with only 5% probability of respondents using this type of provider after illness or injury.

Figure 4.5. Predicted probabilities for the first type of healthcare provider sought with an interaction between MSPD and gender

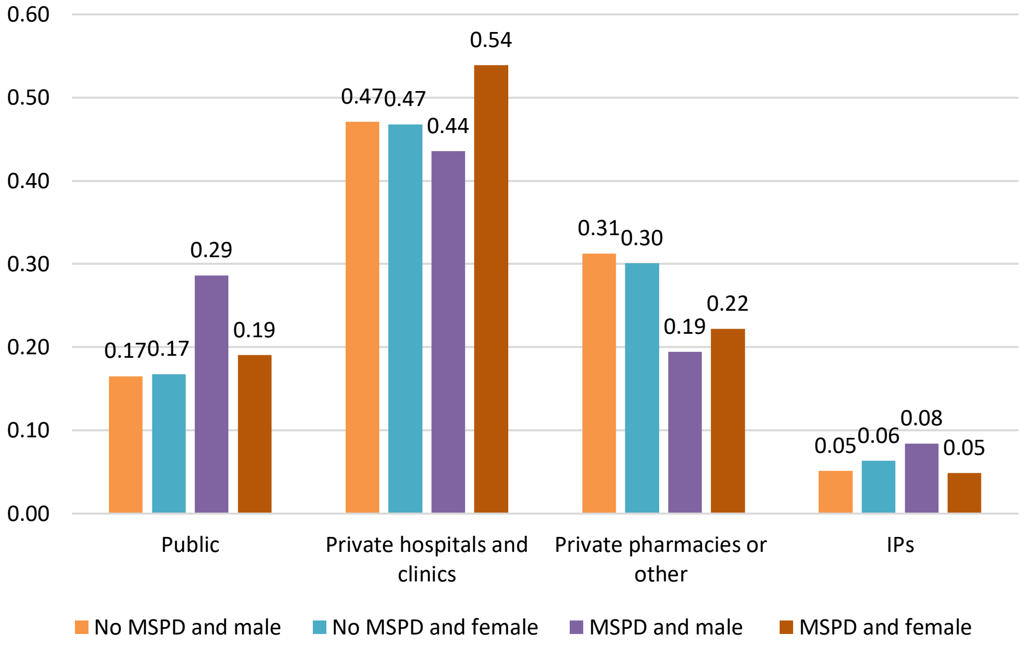
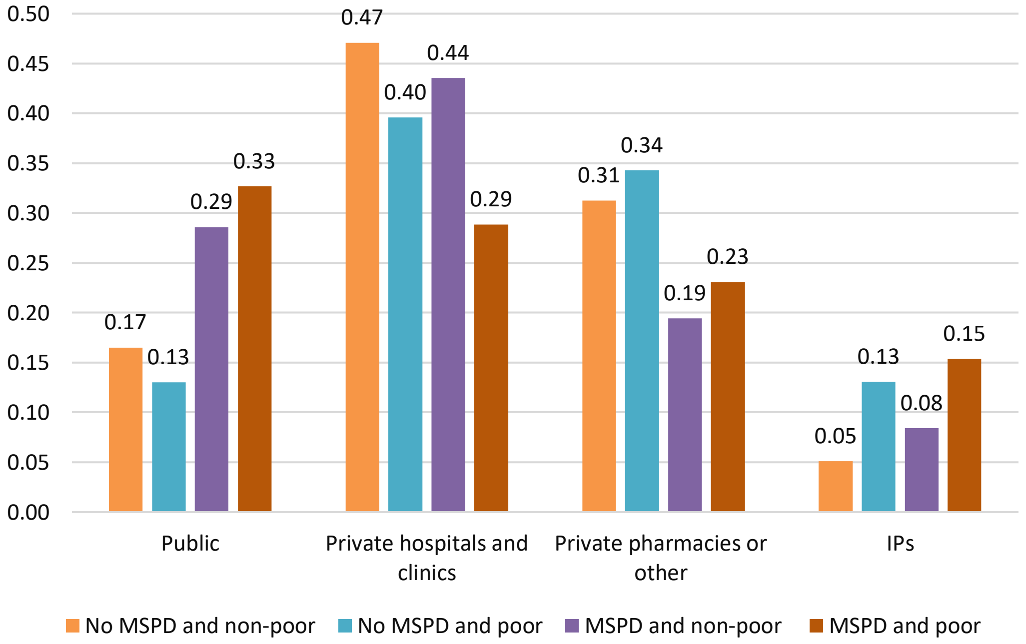


Figure 4.6. Predicted probabilities for the first type of healthcare provider sought with an interaction between MSPD and poor household status



Household HEF card ownership and physical disability were found to be significantly related in model five. As shown in Figure 4.7, households with a HEF card have a greater probability of utilising healthcare from public providers compared to households without, with respondents with a MSPD and HEF card having a probability of 0.44. For respondents without a MSPD and without a HEF card, have only a 17% probability of using public healthcare providers after illness or injury, compared to 44% for those with a MSPD and HEF card. In turn, households without a HEF card and without MSPD had the highest probability of utilising private hospitals or clinics for treatment or advice at 0.47, with respondents with MSPD and no HEF card having a slightly lower probability at 0.44. Interestingly, for those without MSPD from households with and without a HEF card, a similar probability of use of private pharmacies or other private providers for treatment or advice was found (0.31 & 0.29). Furthermore, for those with MSPD from households with and without a HEF card, they also have a similar probability (0.21 & 0.19). Lastly, respondents with MSPD without a HEF card have an 8% probability of using IPs, whereas respondents with a HEF card and MSPD only have a 5% probability of using this type. For respondents without a MSPD and a HEF card, the probability of using IPs was only 0.03. Overall, the results of stage one and stage two of the hurdle model indicate some important differences in healthcare seeking for people with and without physical disabilities in Cambodia. The next section will discuss the results in more detail using evidence from previous research. Following this, the limitations of the study will be discussed.

Figure 4.7. Predicted probabilities for the first type of healthcare provider sought with an interaction between MSPD and household HEF card ownership

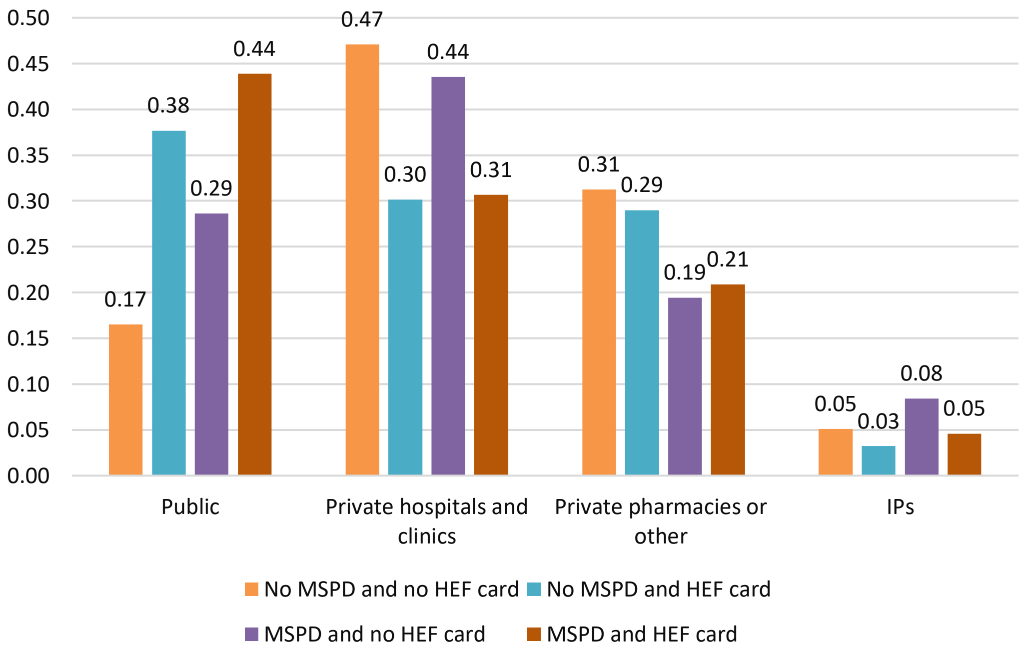


Table 4.4. Hurdle Model Stage 2: Final Model

	Final Model					
	Private hospital or clinic vs. Public		Private pharmacy or private other vs. Public		IPs vs. Public	
Covariates	RRR (SE)	P	RRR (SE)	P	RRR (SE)	P
Cons	2.85 (0.22)	<0.001**	1.90 (0.22)	0.003**	0.30 (0.35)	0.001**
Physical disability						
None or mild	1		1		1	
Moderate or severe	0.53 (0.25)	0.009**	0.37 (0.24)	<0.001**	0.96 (0.36)	0.918
Age groups						
18-39	1		1		1	
40-59	0.81 (0.14)	0.130	0.87 (0.14)	0.330	0.85 (0.20)	0.419
60+	1.01 (0.16)	0.968	1.25 (0.16)	0.159	1.05 (0.25)	0.829
Gender						
Male	1		1		1	
Female	1.00 (0.12)	0.996	0.95 (0.12)	0.698	1.28 (0.17)	0.151
Female Headed Household						
No	1		1		1	
Yes	1.10 (0.15)	0.519	1.04 (0.15)	0.765	0.76 (0.22)	0.227
Ever attended school?						
No	1		1		1	
Yes	1.14 (0.12)	0.258	1.00 (0.12)	0.987	1.23 (0.20)	0.297
Employment status						
Employed	1		1		1	
Unemployed/student	0.68 (0.31)	0.221	0.66 (0.36)	0.242	1.12 (0.43)	0.783
Homemaker	0.56 (0.20)	0.005**	0.75 (0.21)	0.161	0.26 (0.38)	<0.001**
Retired, dependent, other	0.77 (0.18)	0.155	0.70 (0.19)	0.053	0.52 (0.30)	0.027*
Poor						
Non-poor	1		1		1	
Poor	1.11 (0.22)	0.640	1.37 (0.23)	0.172	3.24 (0.30)	<0.001**

Health equity fund card						
No	1		1		1	
Yes	0.28 (0.18)	<0.001**	0.41 (0.17)	<0.001**	0.29 (0.29)	<0.001**
Household debt						
No	1		1		1	
Yes	1.34 (0.12)	0.014*	1.52 (0.12)	0.001**	1.28 (0.18)	0.161
Household car ownership						
No	1		1		1	
Yes	1.81 (0.23)	0.009**	1.55 (0.24)	0.072	0.42 (0.44)	0.050*
Residence						
Urban	1		1		1	
Rural	1.00 (0.12)	0.976	1.23 (0.14)	0.128	1.43 (0.0.23)	0.121
Disability*Sex						
Moderate or severe*Female	1.97 (0.29)	0.020*	1.83 (0.29)	0.035*	0.77 (0.44)	0.546
Disability*Poor						
Moderate or severe*Poor	0.52 (0.41)	0.114	0.76 (0.47)	0.553	0.51 (0.61)	0.268
Disability*hefcard						
Moderate or severe*Yes	1.68 (0.41)	0.205	1.68 (0.41)	0.202	1.25 (0.60)	0.713
Variance(std.error)	1.03 (0.16)					

**p-value significant at 5% level, **p-value significant at 1% level*

4.4 Discussion

The results reported in Section 4.3 indicate that there are distinct differences in healthcare seeking behaviour for people with MSPD in Cambodia. To answer the research questions posed, the first step of the hurdle model modelled whether people sought care and assessed differences between people with and without MSPD. The second step then modelled the different types of healthcare provider to understand where people with MSPD seek healthcare compared to people without MSPD. Overall, the results show that seeking advice or treatment after illness or injury is high, with an average of 92.3% seeking care, although differences were found between population groups in who seeks care and where. In the coming paragraphs, the results of the analysis will be elaborated on and discussed in detail in relation to wider literature and the conceptual framework.

4.4.1 Treatment or advice seeking after illness or injury

In this study, the binary logistic regression models found that people with MSPD had marginally greater odds of seeking treatment or advice compared to people without MSPD, although this difference was not significant. However, the slight increase in care corresponds to results found in a WHO (2017c) study using the Cambodian Demographic and Health Survey (CDHS) 2014 data. Here, it was found that people with severe disabilities are significantly more likely to seek treatment or advice after illness or injury compared to those with moderate, mild or no disabilities. The presence of complex health conditions and comorbidities increases the need for accessing healthcare services. Research from India by Gudlavalleti *et al.* (2014) shows that people with disabilities visit hospitals more frequently than people without disabilities. The same study also found people with disabilities in India reported significantly higher percentage of diabetes and depression, as well as significantly higher rates of medicine use indicating a potentially higher need for healthcare. Additionally, Moodley & Ross (2015) found that in South Africa, people with disabilities also reported a significantly higher prevalence of conditions such as tuberculosis, diabetes, stroke and asthma. Consequently, this reiterates the need and requirements of people with disabilities to have equal access to a range of diagnostic, curative, health promotion and prevention services in LMICs as codified in human rights laws such as the UNCRPD. At the basic level of receiving any care, it appears that in Cambodia, there is little difference between people with and without MSPD in access to healthcare.

The Andersen, Davidson and Baumeister (2013) framework identifies that a perceived and evaluated need to use health services influences health care seeking behaviours. Furthermore, individual predisposing factors such as genetics and susceptibility to certain health conditions can also influence health service use. The presence of disability may influence future health service use. Research has previously show that need is significant and is often one of the most important factors in determining health service use (Fernández-Olano *et al.,* 2006; McDonald & Conde, 2010; Wandera *et al*., 2015). Unfortunately, the data used in this study had no variables pertaining to the severity of the illness or injury that led to seeking treatment or advice. This could also help to explain the use of certain healthcare providers as someone with a more severe illness or injury would be more likely to see hospitals or clinics, compared to pharmacies or IPs.

In the analysis, although there were no differences in disability status in health service use, other variables were related to access and disability. Poor household status, a proxy measure for poverty, was found to be significant predictor of healthcare access in this study. Poor households have significantly lower use of healthcare services after illness or injury compared to non-poor households. A significant interaction term was also found between MSPD and poor household status, where poor households with a person with MSPD had the lowest probability of accessing healthcare services for treatment or advice after illness or injury. Recent research by Dassah *et al.* (2018a) found that the financial constraints of seeking healthcare for people with disabilities in Ghana was a major barrier, despite Ghana having a national health insurance scheme. This suggests that poverty is a significant factor in access to healthcare.

In LMICs, healthcare expenditures are often paid as OOP payments and for people with disabilities and chronic health conditions frequent use of healthcare services can cause severe economic hardship (Brinda *et al.,* 2014; Sultana *et al.,* 2017). Brinda *et al.* (2014) found that in Tanzania, higher catastrophic expenditure for households that have a low socioeconomic status and an individual with functional disabilities significantly increases OOP payments in health expenditure (Brinda *et al.,* 2014). In Cambodia, research by Dalal *et al.* (2017) found that poorer households faced a greater economic burden when seeking healthcare compared to households that are better-off. The healthcare system in Cambodia is heavily reliant on OOPs. Therefore, for poor households, the high costs of healthcare spending acts as significant barriers to access healthcare services. Andersen, Davidson and Baumeister (2013) framework identifies household and individual income and access to healthcare insurance as factors that can influence decisions to seek healthcare services for illness or injury. Social assistance programmes, such as HEFs introduced in Cambodia, can improve access to healthcare services by subsidising or providing services free of charge at public healthcare facilities for household identified as poor (Kwon & Keo, 2019). Household ownership of a HEF card and access to healthcare services for treatment or advice were not found to be significant. No differences were found between households with and without a HEF in healthcare seeking, although utilisation of healthcare services was found to be lower for those with ownership of a HEF card. Andersen, Davidson and Baumeister (2013) framework, recognise health financing as an enabling contextual factor to healthcare access and impacts a person’s decision to utilise healthcare services. The framework also explains that contextual factors are impacted by other contextual and individual characteristics which can impact health service use. This may explain why the presence of health financing mechanisms are not found to be significant and that there are other factors that are influencing healthcare seeking decisions (Andersen *et al.,* 2013).

Employment status in the last 12 months was found to be significantly associated to seeking healthcare after illness or injury in Cambodia, with those who are retired, a dependent or have other employment status having lower odds of seeking healthcare compared to those who are employed. It could be hypothesised that those who are employed may have access to more disposable income and are less reliant on other people assisting them to healthcare services. Previous research has found that people with disabilities are more reliant on family members when needing to seek healthcare, for example transport to and from health services, assisting at health facilities and providing funds (Opoku *et al.,* 2017; Harrison *et al.,* 2020; WHO, 2022a).

4.4.2 Type of healthcare provider sought after illness or injury

For the different healthcare providers, there are differences in the quality of care provided. These differences in where people access healthcare, can indicate whether certain population groups are using formal or informal providers more frequently than others. The results from the multinomial models found that people with MSPD disabilities were more likely to use public healthcare providers and private hospitals and clinics, compared to people without MSPD. This echoes Moodley & Ross (2015) who also found that people with disabilities in South Africa sought healthcare in public hospital and clinics in significantly higher numbers, while people without disabilities consulted with private doctors significantly more. Public healthcare in Cambodia is generally lower cost than private healthcare services, hence, if frequent healthcare utilisation is needed a person may be more likely to use public providers. A study by the WHO (2017b) using Cambodian Demographic & Health Survey (CDHS) data reported higher health expenditures for people with disabilities at public health services compared to people without disabilities, with the latter group having higher expenditure at private healthcare providers. Several factors have been found to discourage people from seeking healthcare from public providers, these are, health professional and medicine shortages, distance to facilities and transportation, long waiting times and mistrust (WHO, 2015a).

Participants from a study in Cambodia conducted by Ozawa & Walker (2011) stated that public healthcare providers had no equipment, had long waiting times and they complained that doctors did not visit the patients. The same study also found that formal private healthcare providers were generally viewed as having '*good medicine'* and '*treat carefully'*. Consequently, formal private healthcare facilities were often first choice. This finding is supported by Korachais *et al.* (2019) who found poor households continued to use private healthcare services in Cambodia, despite entitlement to pro-poor financing policies enabling them to free or subsidised public healthcare. The private sector in Cambodia, including IPs, is loosely regulated and evidence suggests that poor quality medicines and unnecessary care have been found to be prescribed (Meessen *et al.,* 2011). This indicates that using private healthcare services in Cambodia may not always mean accessing better quality healthcare. The government requires all pharmacies to be registered, although currently it does not have the resources to ensure that all pharmacies are operating in line with regulations, such as hiring qualified pharmacists (Gryseels *et al.,* 2019). This lack of regulation allows IPs to operate without adhering to the law. This can put users of IPs at risk due to improper dosing or counterfeit medications.

In the second multinomial model, an interaction term between physical disability and poor household status was found to be significant. The results found that people with MSPD from poor households have the highest probability of utilising IPs, compared to those from non-poor households. Furthermore, this same group also had the lowest probability of using private hospitals and clinics after illness or injury. This implies that poor household status plays a significant role in the decision to seek treatment or advice from different healthcare providers after illness or injury. IPs such as informal drug sellers and markets and traditional and religious healers play an important role in the delivery of healthcare in many LMICs. Traditional medicine is frequently viewed as an important source of healthcare as findings from Cameroon show that poor patients willing to travel distances to seek traditional medicine and pay more for medicine even if more expensive than biomedicine (Labhardt *et al.,* 2010). Additionally, in India, IPs are often the first choice of healthcare provider in rural areas where medically trained doctors are less accessible (Gautham *et al.,* 2021). Other authors also state that informal drug vendors frequently are the first point of contact with the health system in LMICs for many (Shah *et al.,* 2011; Nguyen *et al.,* 2019). In Cambodia, research by Peltzer & Pengpid (2018) found traditional healthcare providers are often used alongside allopathic medicine. Currently, there is limited research on the use of IPs by people with physical and sensory disabilities in LMICs, although there is some research on the role of traditional healers. This indicates a strong need for more evidence on how people with disabilities interact with IPs and whether they are used as a main healthcare provider. Andersen, Davidson and Baumeister's (2013) framework identifies the importance of income and availability of funds in decisions of when and where to seek healthcare services. However, this is also impacted by contextual factors, such as pro-poor health financing schemes that can help low-income households access healthcare services.

This study found households ownership of a HEF card to be significantly associated to the first type of healthcare service sought after illness and injury, and a significant interaction between HEF card ownership and MSPD. The results found that public providers were more likely to be utilised by households with a HEF card, compared to those without. This is an encouraging finding, which highlights that those with HEF cards are utilising them in public health facilities. However, the previous version of the IDPoor programme, was unable to monitor for households that fell below the poverty line during the rounds of data collection rounds, therefore, not everyone who would qualify as poor had access to free or subsidised public healthcare. The most recent version of the IDPoor programme aims to better identify households at risk of poverty, this includes entitling households with disability, chronic illness or high healthcare expenditure to an interview to assess their eligibility for access to HEFs (GIZ, 2022). The idea behind this process of guaranteeing households that have someone with a disability is to ensure access to assistance in times of need.

In model five, it was found that those with MSPD and HEF cards had the highest utilisation of public providers, with households without MSPD and a HEF card having the second highest probability. This suggests that the presence of MSPD is associated with an increased use of public healthcare for households with a HEF card. The results also show that MSPD without a HEF card have the second highest probability of utilising private hospitals or clinics, behind respondents with no MSPD or no HEF card. While the analysis cannot say whether the HEF cards were used to seek treatment or advice at the time, it provides encouragement that households with a HEF card are using them at public facilities where they would have been entitled to free or subsidised care. For people with physical disabilities, access to HEFs may only improve access to public health service for preventative and curative healthcare, for example health checks or acute illnesses. An increasing number of studies are investigating the impact the extra costs associated with disability. Reviews of the available literature by Banks *et al.* (2017) and Mitra *et al.* (2017) find evidence to suggests that people with disabilities incur extra costs associated to their disability, such as for assistive products and for higher medical expenses, although there are variations according to different factors. Both reviews highlight the need for more robust quantitative data to explore the extra costs associated with disability in more detail. Therefore, for other specialised health services, HEFs may not remove the financial barriers to healthcare seeking, due to needing to use private healthcare services for specialist treatments or care. Furthermore, HEFs in Cambodia are operated and managed by ODs rather than the MOH, this means that access to public healthcare through using HEFs can vary depending on OD. To fully understand the impact of HEFs on access to healthcare services from people with disabilities more in-depth research would be needed.

Rural and urban locality was not found to be significantly associated to healthcare seeking or choice of treatment provider. Therefore, in this study, rural and urban populations were not found to have different healthcare seeking behaviours after illness or injury. Other research has found rural or urban locality to be a significant predictor of healthcare utilisation for promotive, preventative and curative healthcare (Harris *et al.,* 2011; Blanford *et al.,* 2012; WHO, 2017b). In this study, rural and urban locality was used to look at variations in location on treatment seeking behaviour. However, this variable may be masking any variations between and within provinces, ODs and communes. For example, Nilsen (2017) found considerable spatial inequities between operational districts in births at health facilities in Cambodia. Understanding differences in access at smaller spatial areas may be important for realising geographic differences in access for people with disabilities.

Phnom Penh hosts many healthcare facilities, with both public and private providers available (Gryseels *et al.,* 2019), hence this may explain why the probability of using public and private hospitals or clinics is the highest urban areas. The results found no significant differences in access to healthcare for treatment or advice for household ownership of a bicycle or motorbike. However, a significant association was found for household car ownership, with access to a car increasing the probability of using private hospitals and clinics over public healthcare compared to households without a car. In this study wealth was controlled by poor household status, implying car ownership in addition to being from a poor-household increases the likelihood of using private hospitals and clinics. No significant interactions were found between MSPD and household ownership of a car. For people with disabilities in LMICs, transport availability poses a significant barrier to accessing healthcare services with several studies finding access and availability of transport and the costs of using public and private transport prevent people with disabilities seeking healthcare from different healthcare providers (Magnusson & Ahlström, 2012; Vergunst *et al.,* 2017; Munthali *et al.,* 2019; WHO, 2022a).

Household debt was not found to be significantly associated to whether healthcare treatment or advice is sought after illness or injury, but it was found to be significantly associated to the type of healthcare provider sought. Ir *et al.* (2019) highlighted nearly 30% of households in Cambodia have had to borrow to pay for healthcare, with loans taking an average of 8 months to pay off. Therefore, households which are already in debt before seeking healthcare treatment or advice could be more vulnerable to distress financing to cover the costs of healthcare or catastrophic health expenditure. This may explain why households with debt have a higher probability of utilising private pharmacies or other private providers, which tend to be less formal and lower in cost. Household debt was not found to interact with disability, meaning that having a disabled household member does not affect the relationship between household debt and the type of healthcare provider sought.

Gender was not found to be significantly associated to differences in healthcare provider sought for men and women. However, the presence of an interaction term between disability and gender makes gender significant in model five. In a study of access to healthcare for people with disabilities in Malawi, it was found that men are more likely than women to delay healthcare seeking due to inefficient healthcare delivery and inadequate care (Harrison *et al.,* 2020). This means that men with disabilities appear to have a greater delay in healthcare seeking, compared to women. Hence, delays in healthcare seeking may also dictate where healthcare is sought. Furthermore, evidence from Khun & Manderson (2007) found that for women with children suspected of having Dengue fever, they pragmatically shifted the type of healthcare provider sought in response to the child's illness. Research from Kenya found that women with disabilities preferred to utilise public health facilities as public healthcare professionals frequently allowed them to jump the long queues (Kabia *et al.,* 2018). In comparison, the results from the multinomial analysis showed that men with moderate or severe disabilities have more variation in the type of healthcare provider used, whereas women have less variation in where they obtain healthcare.

This findings from the second stage from the analysis indicate that disability impacts where healthcare is sought in Cambodia. With the presence of disability being related to high probability of using formal private healthcare providers such as hospitals and clinics. However, when disability is interacted with other poverty, gender and access to HEFs, the probability of use of certain types of healthcare provider changes for people with and without MSPD. This suggests that use of certain healthcare provider does change for different population groups, and that certain groups have lower use of formal healthcare providers, i.e., people with MSPD from poor households.

4.4.3 Implications for policy

This study found that poverty impacts access to health services for people with MSPD in Cambodia. Cambodian Disability Law dictates that people with disabilities who are poor are entitled to social assistance to enable healthcare seeking (WHO, 2017b). The results of this study indicate that poor people with MSPD have the lowest probability of care seeking and the highest probability of seeking IPs. This suggests that a lack of health equity for poor people with disabilities in Cambodia. Research by Mont & Nguyen (2011) found that people with disabilities in Vietnam were more likely to be pushed below the poverty line because of the costs associated with disability. Therefore, more social protection is needed for people with disabilities in Cambodia. The government in Cambodia should aim to extend HEFs to encompass all people with disabilities to ensure SDG three can be achieved by 2030. This research agrees with other studies that show the public health sector in Cambodia is used less frequently compared to the private health sector (Ozawa & Walker, 2011; Dalal *et al.,* 2017; Jacobs *et al.,* 2018; Korachais *et al.,* 2019).

Improving access to health financing assistance could help to increase the use of formal providers and could facilitate health care access away from IPs (WHO, 2017b). This could be facilitated by Public-Private Partnerships (PPPs) to help fill the gaps in service provisions by the public health sector in Cambodia. These partnerships between the government and private providers have the potential to reduce the pressure on the public health system (Fanelli *et al.,* 2020). Improving the quality of healthcare services received should also be a target for the Cambodian government. Within the public health system, progress indicators and quality monitoring, including patient satisfaction, can be used to incentivise providing quality care (Pheakdey *et al.,* 2020). Furthermore, efforts should also aim to improve the regulation of IPs, and work to prevent the sale of counterfeit medications and incomplete doses. To ensure that people with MSPD in Cambodia have suitable and adequate access to healthcare services when needed, more focus should be placed on how public services can be improved to deliver adequate, yet affordable care, to people with disabilities. The mechanisms to identify households that are currently in or at risk of poverty that also are impacted by disability also need to be strengthened. Currently, households with disabilities are identified through ownership of a Disability Card, yet registration has been slow and those interviewing people with disabilities are reported to have poor knowledge of disability (Sokny, 2023). To improve identification of eligible households, those collecting the information require more in-depth training about disability to ensure people with less common impairments or health conditions are understood.

4.5 Limitations

This study has a number of limitations which will now be addressed. The first limitation relates to the measurement of disability used in the survey. Whilst the disability questions in the survey are not the WG questions, they are based upon functional limitations and have some of the same limitations. Both the WG short set of six questions and the CSES questions may not capture people who experience limitations or restrictions in more complex activities (Palmer & Harley, 2012). For the CSES questions this may exclude people that have difficulties in other areas such as pain and fatigue. The functional limitation questions were also answered on behalf of all households' residents by the head of households, this means that disability may be underreported. Specifically, for this study, only physical disabilities such as mobility, hearing, visual and speaking impairments have been used. This means that people with other disabilities such as psychological and learning impairments have been excluded. In addition, the different types of physical impairments have been grouped together. Differences in healthcare access may exist for different impairments, for example between visual and mobility impairments, therefore, the aggregating of the data means these differences have been lost. However, relatively small sample sizes of the different types of physical impairments means that to conduct this analysis, disability needed to be grouped.

The data also does not include any information about the severity of illness or injury which is significant indicator of the need for accessing health services. Furthermore, this study has used self-reported utilisation data to measure access to health services. Whilst several studies have used utilisation data to investigate access to different health services for people with disabilities (E.g., Trani *et al.,* 2011b; Gudlavalleti *et al.,* 2014; WHO, 2017b; Talukdar *et al.* 2018; Mac-Seing *et al.,* 2022), there are some limitations of using utilisation data to measure access. Self-reported healthcare utilisation is subject to recall bias, and respondents may incorrectly state or omit information about where and whether they sought healthcare. There are issues with utilisation data in measuring access to health services, including the presence of survey bias and the need for large scale surveys at regular intervals to measure how health services are being used (Allin *et al.,* 2007; McGrail & Humphreys, 2009). This study also has no information on other measures of health service accessibility, for example proximity to services and service availability. Respondents in the CSES do not report perceived quality of care received, therefore, this study assumes that informal healthcare services are poorer in quality than more formal providers.

Some categories of the variables used in the analysis have small sample sizes, for example for IPs in Phnom Penh where only one person utilised this provider and only ten people overall from the unemployed or student category. Small sample sizes can hinder the extrapolation of findings (Faber & Fonseca, 2014) and can over-estimate association, creating false-positives or under-estimating association causing a lack of statistical significance (Hackshaw, 2008). All of these can undermine the validity of a study. Cross-sectional studies have weaknesses compared to other research techniques such as randomised controlled trials and longitudinal studies. A key difference between them is the inability for cross-sectional studies to establish causation as confounding variables cannot be eliminated, rather the results are inferred to the population (Asiamah *et al.,* 2021). Confounding variables are extraneous variables which are correlated to both the response and explanatory variables and can affect the relationships found within the study (Pourhoseingholi *et al.,* 2012). The impact of confounding variables can be reduced via statistical techniques such as randomisation, restriction, matching and stratification.

4.6 Conclusion

This study has shown that there are differences in health service use for people with and without MSPD in Cambodia. Disability was not found to significantly impact whether health services were sought after illness or injury. However, a significant interaction term between poor household status and disability were found to be associated. This supports the notion that poverty and disability are interlinked. More research is needed to unpack how poverty and disability influence health service use and how the barriers for poor people with disabilities can be removed. The removal of these barriers will help to increase equity in access to health services for people with disabilities. Furthermore, this study also examined where people with MSPD first use healthcare after illness or injury. The results highlight that public healthcare services are more frequently used by people with MSPD compared to people without MSPD. To fully understand why this is the case, further research should investigate the reasons for this. The interaction terms between disability and gender, poor household status and HEF card ownership further denote differences in health service use. Therefore, future research should endeavour to assess inequity in health for women and men with disabilities in LMICs.

Access to a HEF card was not found to increase healthcare seeking for people with MSPD and was not found to increase healthcare seeking at public healthcare facilities for people with MSPD. However, HEF cards may have reduced the financial burden for those who chose to access healthcare from public providers. To further understand the impact of the HEF scheme, more research is needed to understand the impact of HEF cards for both people with and without disabilities. Whilst the present study has its limitations, this paper offers important insights into the healthcare seeking behaviours of people with MSPD in Cambodia. It shows how survey data can be used to study utilisation of healthcare services. Future research could further build on this work by linking other data, such as the census data, to allow for more spatial analysis to be performed. This could also include location of health services and estimated travel times which would allow for the study on potential access to be examined.

Chapter 5 Paper 2: Utilising administrative data to investigate inequities in access to orthotic services: an analysis of service user data from three physical rehabilitation centres in Cambodia.

5.1 Background

It is estimated that over one billion people worldwide would benefit from access to Assistive Technologies (AT) to aid mobility and limb function, as well as to improve other functional difficulties such as hearing or seeing (ATscale, 2020; WHO-UNICEF, 2022). AT is an umbrella term for the systems and support services, for example physical rehabilitation services, which relate to the delivery of assistive products. In this respect, assistive products, such as orthoses, wheelchairs, hearing aids and digital apps can help with mobility and movement, self-care and communication which, in turn, support a person's independence and participation in society and maintain or enable individual functioning (WHO, 2018). However, provisions of assistive products are often overlooked as an intrinsic part of the health system. The unmet need for assistive products in both Low- and Middle-Income Countries (LMICs) and High-Income Countries (HICs) is seldom reported, with the WHO-United Nations Children's Fund estimating that globally 2.5 billion people that would benefit from using one or more assistive products, including orthotic, prosthetics and other products such as eyeglasses and hearing aids (WHO-UNICEF, 2022). Furthermore, ATscale (2020) estimated that only 10% of people have access to the assistive products they could benefit from. This paper focuses on access to and use of orthoses as this is an understudied area in LMICs, with the majority of Prosthetic and Orthotic (P&O) services research focusing on prosthetics.

Orthotics are devices that are applied externally to the body to aid functioning and the structure of the neuro-muscular and skeletal systems (ATscale, 2020). Orthoses can be applied to different parts of the body, including the lower body, the spine, neck and head. Orthoses of the lower limbs make up a large proportion of all orthoses prescribed. For example, in the US, 26% of prescribed orthoses are for the lower limbs (Fox & Lovegreen, 2017). Examples of lower limb orthoses are Foot Orthoses (FOs), Ankle-Foot Orthoses (AFOs) and Knee-Ankle-Foot Orthoses (KAFOs). Using orthoses can be beneficial in providing support to limbs, better alignment, and helping with loss of motion and restricting painful motion (Elattar *et al.,* 2018). Orthotic devices are usually provided as part of P&O

services, where a mixture of assistive products can be prescribed, including prosthetics, wheelchairs and mobility aids.

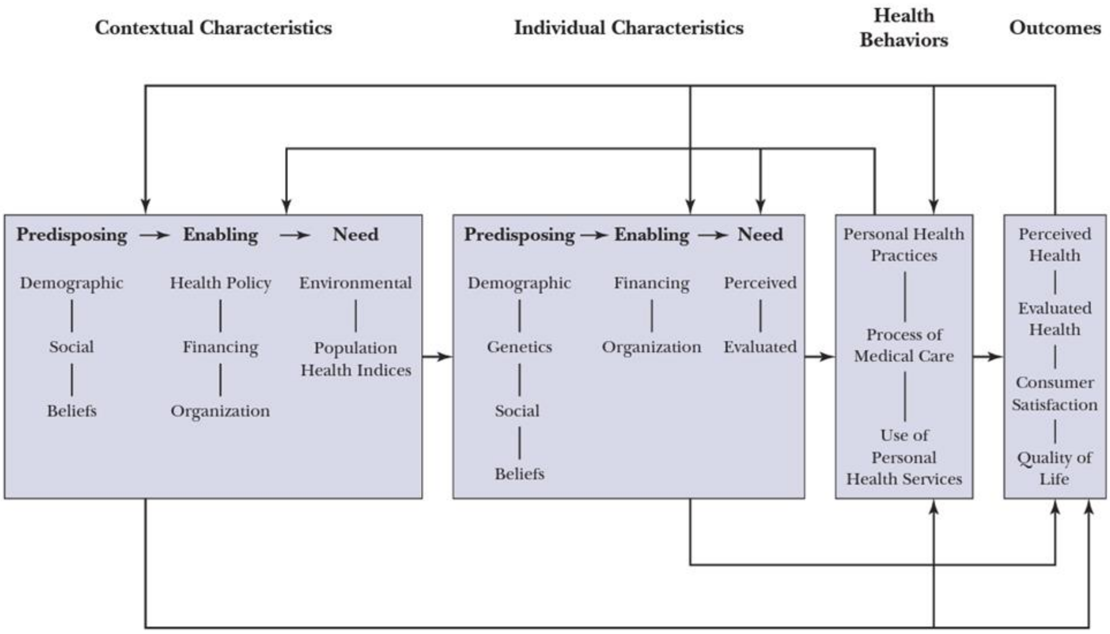
Although this paper focuses on orthotics, there is a lack of research on many aspects regarding assistive products. The existing research largely focuses on the advancement of technology, such as developing new devices, particularly in HIC contexts, yet less attention is given to planning and researching sustainable assistive products and rehabilitative care services in LMICs (Harkins *et al.,* 2013). Research is needed to ensure that assistive products are suitable for the environment in which a person lives, meaning they can be maintained by services in LMICs (Dickinson *et al.,* 2019). For example, they should provide proper fit and alignment for the individual and also be sustainable to provide at an affordable price (Jensen & Sexton, 2010). A lack of consideration for the local context means that services may be unsustainable, which could have a lasting impact on the accessibility and may lead to the abandonment of assistive products (Borg *et al.,* 2011). Understanding inequities in access can help identify and target certain groups who may have limited potential and realised access to rehabilitative care. This introductory section describes evidence from existing literature on access to P&O services and major causes of impairments in LMICs alongside a description of the conceptual framework used, the research questions and justification for why this study is important.

5.1.1 Conceptual framework

In this study, the most recent phase of the model of health service use proposed by Andersen, Davidson and Baumeister (2013) based on a behavioural model of healthcare utilisation has been used (Figure 5.1). The framework was originally developed based on data from the USA relating to access to medical care for different population groups, whereas in this research, the framework has been applied to orthotics users at three physical rehabilitation clinics. The framework highlights the importance of different factors, based on contextual (environmental) and individual level characteristics, which influence utilisation of care. Contextual characteristics include aggregate level factors such as community, regional or country level demographic characteristics, health policy and financing and population health indices. At the individual level, demographic and socio-economic factors, such as age, sex and income, as well as beliefs, such as the perceived need for healthcare, are related to access. These characteristics are separated into predisposing, need and enabling factors, which can either impede or enable utilisation of care (Figure 5.1). Predisposing characteristics are existing characteristics which can influence health service use. Enabling characteristics facilitate access to a health service by providing support mechanisms which can facilitate use of services.

For example, predisposing contextual characteristics may include the demographic and social composition of a person's local community or environment. At the individual level, predisposing factors could include the demographic and social attributes of the individual. Enabling contextual characteristics may the availability of government or Non-Governmental Organisation (NGO) assistance programmes and health policy. This is particularly important in the context of P&O services in Cambodia due to a lack of official social insurance funding schemes and a reliance on NGOs to provide AT. Lastly, contextual need factors are driven by environmental factors and population health. Individual need characteristics include both perceived and evaluated need for P&O services, both of which impact utilisation of services. Health behaviours and outcomes are also included in the framework. Individual health behaviours impact the frequency and need for healthcare services, and outcomes after seeking P&O services can enable or impede access to healthcare services in the future.

Figure 5.1. Andersen, Davidson and Baumeister (2013) model of access to health services (Andersen *et al.,* 2013. pg. 35)



To apply this framework, Andersen, Davidson and Baumeister (2013) define access in terms of *potential* and *realised* access to healthcare. Andersen (1995) defines *potential* access as the presence of resources which enable healthcare utilisation, such as the number of orthotists, physiotherapists or physical rehabilitation centres. In comparison, *realised* access is defined as the actual use of services (Andersen, 1995). The conceptual framework measures *potential* access through enabling contextual and individual characteristics and realised access through use of personal health services. In this respect, attending the P&O clinics to receive a new or replacement orthoses can be recognised as *realised* access. Thus, this study examines *realised* access for people accessing orthotics services from an NGO providing P&O services, drawing on utilisation data from adminsitrative patient records.

5.1.2 Inequities in access to assistive products for people with disabilities

Access to assistive products for people with disabilities is stated as a human right in the United Nations Convention of the Rights of People with Disabilities (UNCRPD), as access to assistive products can enable functioning and improve well-being and quality of life for users (Borg *et al.,* 2011). Improving access to assistive products plays a significant role in global health commitments, such as the Sustainable Development Goals (SDGs) (ATscale, 2020). For example, to ensure inclusive and equitable access to education, assistive products play an important role in facilitating access and empowering educational attainment (Tebbutt *et al.,* 2016). Strengthening and extending rehabilitation and AT were also listed as an objective in the WHO Global Disability Action Plan 2014-2021 (WHO, 2014). In addition, the WHO created the Global Cooperation on Assistive Technology (GATE) initiative in 2014 as it recognises the need for providing high-quality assistive products globally (Layton *et al.,* 2018). This initiative created a global priority research agenda through consultations and consensus to work towards achieving the aim of improving access to assistive products. In sum, there are strong calls for increasing availability and access to physical rehabilitation and assistive products globally, therefore more research is needed to understand how this can be done effectively.

The global unmet need for assistive products is high and the number of people that would benefit is projected to increase to 3.5 billion by 2050 due to ageing populations and the rise of Non-Communicable Diseases (NCDs) (WHO-UNICEF, 2022). The WHO estimates that the need for orthoses is high and there is a lack of visibility about the need compared to assistive products such as prostheses (Harkins *et al.,* 2013). Inequities in provisions of assistive products exist in LMICs for many reasons, with one of the most significant causes of inequities is the lack of rehabilitative services that provide assistive products. The main drivers for this are the lack of awareness of the need and low political prioritisation, a weak enabling environment, meaning that the environment is unable to support and facilitate the development and maintenance of rehabilitative services, discrimination and stigma, a lack of investment and demand and supply-side market barriers (ATscale, 2020).

To date, there is limited research on the use and access to P&O services in LMICs, with existing research including countries such as Cambodia, Sierra Leone, Malawi, Haiti and Nepal. Physical rehabilitation services that provide assistive products are often scarce in LMICs as these provisions are rarely provided within primary and secondary healthcare facilities. This is the case in Cambodia as there are only 11 physical rehabilitation centres which deliver and repair assistive products such as prosthetics, orthotics, wheelchairs and mobility aids. One study from Cambodia conducted by Ramstrand *et al.* (2021) interviewed both prosthetic and orthotic users and found that most of the participants waited several years to get their first device because they had difficulties locating services and did not know about the services available to them. Furthermore, in Cambodia, P&O services are not distributed across the country evenly and not every province has a rehabilitation centre. For the populations within these provinces, accessing P&O services may be costly and time consuming. Elsewhere, the physical and geographical inaccessibility of healthcare services in Cambodia has been noted as a significant barrier to healthcare seeking for people with disabilities (Jacobs *et al.,* 2011; Grills *et al.,* 2017).

In Sierra Leone, Andregård & Magnusson (2017) found that access to services is impeded by transport barriers such as inaccessibility and cost. A further study conducted in Cambodia which interviewed prosthesis users found that a lack of suitable transport options act as an additional barrier to seeking P&O services (Donovan-Hall *et al.,* unpublished). This same study also found several other financial barriers to accessing P&O services in Cambodia including the loss of income when attending P&O services. This financial impact was often extended to the family, due to a family member assisting in traveling to and from the clinic, meaning they need to take time away from work. A study by Magnusson (2019) found that P&O professionals were hesitant to make a device for clients that lived far from the P&O clinic because they previously have experienced clients living far away not returning for delivery and fitting, which wastes valuable resources.

An individual's personal characteristics also lead to inequities in accessing P&O services for people with impairments. Gender may play a role in inequities in access to rehabilitation. Research by Barth *et al.* (2020) found that women were less likely to use rehabilitation services compared to men, for both conflict and non-conflict related reasons (i.e., traffic accidents or disease). The same study also found that younger individuals were more likely to be using rehabilitation services, with fewer service users in older age groups. Results from a study on access to assistive products for children in the USA found that unmet needs for assistive products were higher in older children, African Americans, those with low socioeconomic status and children with more severe conditions (Benedict & Baumgardner, 2009). As children grow, they require assistive products to be adjusted or replaced completely. This could mean a greater need for seeking services from P&O clinics for younger ages.

In a study by Eide & Øderud (2009) in Malawi, Namibia, Zimbabwe and Zambia from 2003 to 2006, which surveyed households to investigate the living conditions of people with disabilities, they found that in all four countries, 53% to 100% of respondents developed their impairment at birth or before their 21st birthday. However, an increase in prevalence of NCDs and life expectancy in all four countries was also found, which may suggest that the age of onset of impairments would be different if the survey was conducted today. Age-related disabilities can also mean that more people could benefit from assistive products such as orthoses, mobility aids and wheelchairs as age increases. People acquiring disabilities at later stages in life may have different barriers to care seeking compared and rehabilitation needs compared to younger populations.

To date, there is limited published research on the impact that certain health conditions can have on access to rehabilitative services and whether there are differences in care seeking behaviour based on the condition. Investigating which health conditions are the main causes of a need for rehabilitation and whether certain health conditions have better or worse access to services than others can help to inform an understanding of where more attention is needed (Barth *et al.,* 2020). For example, individuals with poliomyelitis or post-polio syndrome have different healthcare needs compared to those with para or quadriplegia. The impairment an individual has also dictates which (if any) orthosis could be used to support mobility. For individuals with scoliosis, different types of back braces are common orthoses to help treat and manage the condition (Janicki & Alman, 2007). In comparison, for those with sequalae of polio, AFOs and KAFOs are orthotic devices that are frequently prescribed depending on the extent of a person’s condition (Lovegreen *et al.,* 2019).

Ramstrand *et al.* (2021) noted that in Cambodia, impairments caused from landmine explosions had the shortest amount of time to getting their first device compared to individuals with other causes of impairment. They suggested that this may be due to better care pathways for landmine related injuries in the country in comparison to other reasons for orthosis. This is likely due to widespread campaigns to increase knowledge and for the removal of landmines and other explosive ordnance. Hence, individuals with certain impairments may receive inadequate and incomplete care compared to people with other impairments. A study by Smythe *et al.* (2017) estimated that in South East Asia the clubfoot birth prevalence is estimated to be 1.21 per 1000 live births. This is lower than the region of the Americas and India which have prevalence of 1.74 and 2.03 per 1000 but higher than the region of Africa and West Pacific at 1.11 and 0.94 per 1000. In Cambodia, treating clubfoot has received national attention through programmes supported by NGOs and IOs, such as the Global Club Foot Initiative and miracle feet. The existence of these programmes can increase awareness of conditions and lead to more proactive treatment for the condition.

Physical rehabilitation services require different specialisations and trained personnel to provide a more comprehensive range of assistive products. Some assistive products need to be provided by qualified healthcare professionals such as physiotherapists, Prosthetists and Orthotists (POs), whereas others assistive products such as canes and crutches can be provided by other trained personnel such as community workers (WHO-UNICEF, 2022). In low resource settings, having a suitable number of specialist staff is challenging due to lack of adequately trained rehabilitation workers (WHO, 2017a). A study by Chatukuta *et al.* (2022) on rehabilitative care for people with road traffic injuries in Namibia found that due to a shortage of rehabilitation professionals and extensive administrative duties of those trained, auxiliary staff without any formal rehabilitation qualifications were conducting treatments on patients. Consequently, this impacts the quality of physical rehabilitation care received. A lack of prioritisation and awareness by governments in was also reported to be a barrier to delivering high-quality P&O services by rehabilitation professionals in Tanzania, Malawi, Sierra Leone and Pakistan (Magnusson, 2019).

Stigma and marginalisation from health professionals have previously been shown to impact health service use in Kenya and Pakistan, with participants reporting negative attitudes and poor treatment by healthcare workers towards people with disabilities (Ahmad, 2013; Kabia *et al.,* 2018). This mistreatment can then prevent access to other types of services such as rehabilitation as people with disabilities may mistrust those working within the rehabilitation sector. Disability is often stigmatised due to unfavourable views of disability in the dominant religious and cultural beliefs (Gartrell *et al.,* 2020). In Cambodia, disability has historically been viewed as karmic punishment for the wrongdoing of parents or ancestors, therefore, children or adults with disabilities may be hidden and kept inside the home to prevent exclusion of the family (Gartrell *et al.,* 2020). Hence, the stigma and marginalisation faced by people with disabilities in Cambodia may prevent the seeking of rehabilitative healthcare or delay the timely seeking of care. Furthermore, in some cultures, the negative perception of disability also means that people with disabilities are excluded by their families and denied access to education, employment and healthcare, particularly for women (Dhungana, 2006). This can prevent their access to physical rehabilitation services as outreach services may not be able to reach them.

5.1.3 Need for and provisions of assistive products in Cambodia

In Cambodia, the reasons for use of orthotics have changed over time. Trauma, from conflict, remains a major cause of impairment in Cambodia due to years of war and civil unrest from the 1970s until the early 1990s. From 1979 to 2021, 45,144 people were left injured due to landmines, cluster munitions and other explosive remnants of war (Dickinson *et al.,* 2022). As with many LMICs, incidence of road traffic accidents has also increased in Cambodia, leading to an increase in amputations and impairments (Kitamura *et al.,* 2020). Another major cause of impairment in Cambodia is polio. The disease was officially reported to have been eradicated from the country late 1990s. However, the effects of polio can still be found across Cambodia with individuals living with physical impairments caused by the virus and post-polio syndrome (Powell *et al.,* 2002). Post-polio syndrome can cause significant permanent mobility issues which may lead to people using assistive products assistive products (Nielsen *et al.,* 2003).

Congenital conditions and other conditions that can be acquired at early development such as Cerebral Palsy are also found to be significant causes of physical impairments, and those with these conditions may utilise orthoses, mobility aids or wheelchairs to support mobility. As Cambodia continues to develop, the prevalence of NCDs, some of which can lead to physical impairments, has increased since the early 2000s. The prevalence of Type 2 diabetes has also grown, which if left unmanaged, elevates the risk with further complications such as infection, foot ulcers and amputation (Dickinson *et al.,* 2022). Hypertension, which can lead to strokes and other cardiovascular conditions, is also prevalent in Cambodia, with an estimated 11.2% of the population having high blood pressure (Jacobs *et al.,* 2017).

Additionally, assistive products can also provide support to those with age-related disabilities to maintain independent living and mobility, for example mobility aids and wheelchairs. In LMICs, the age distribution of populations is changing to reflect those more like HICs (Sudharsanan & Bloom, 2018), and this shift in the age profile to higher ages means that age-related disability may continue to increase. This suggests provisions are needed to ensure older populations also can access assistive products to the same extent as disabled populations under 65 years of age (Marasinghe *et al.,* 2015). In Cambodia, P&O services currently lie within physical rehabilitation centres operated by the Ministry of Social Affairs, Veterans and Youth Rehabilitation (MOSVY), however, it was announced in November 2022 that services will move to the remit of the Ministry of Health (MOH). Physical rehabilitation services are provided by the Persons with Disabilities Foundation (PWDF) established within the MOSVY (MOH-MOSVY, 2018). Since the mid-2000s, there has been a push to handover NGO funded and operated physical rehabilitation centres to the Cambodian government. Currently, there are 11 rehabilitation centres across Cambodia with six currently receiving support from organisations such as Exceed, ICRC and Humanity and Inclusion, while the other five are financed by the PWDF (Ramstrand *et al.,* 2021). The PWDF also operate three repair workshops and an orthopaedic component factory (MOH-MOSVY, 2018). There are significant challenges facing the operation of physical rehabilitative care services including a lack of funding and insufficient workforce to meet demands.

In sum, there is a strong need for affordable and accessible P&O services in Cambodia due to increasing prevalence of NCDs and road traffic injuries, as well as the continued risk of communicable diseases that could lead to physical impairments and the residual risk from mines and other unexploded ordinance. This study specifically examines access to P&O services by investigating utilisation of services for orthoses. Investing in evidence and data on AT is a recommendation endorsed in the WHO-UNICEF report (2022) to support delivery of services and policy-making decisions. The lack of data means the situation for orthosis users is largely unknown. Using administrative data to examine the situation provides vital information can be used by providers, the government and the wider orthotic community to improve access.

5.1.4 Research Questions

Much of the existing published research on P&O services in LMICs focuses on prosthetics and prosthesis users. This study provides important insights into P&O service use in Cambodia for orthosis users, an area that has limited academic research in most countries. Understanding patterns of utilisation is also vital for service providers as it informs them about who is using their services, and whether there are differences in use between certain groups. This study also aims to assess how administrative data can be used to investigate utilisation of P&O services for assistive products. This paper employs data from service users of three Cambodian P&O clinics in Phnom Penh, Kampong Chhnang and Sihanoukville, operated by Exceed. The use of the administrative data from three P&O centres for research purposes has the potential to uncover a breadth of information about access to services for orthotics, including understanding the dynamics of orthotic device usage. This will add important evidence to the narrative of access to P&O services in Cambodia. It will also highlight dimensions of access that could be applicable to other settings and countries.

Three research questions have been developed for this study; the first two relate to investigating service use for orthotic users:

1. What are the demographic characteristics of people who use orthotic services at three P&O clinics in Cambodia?
2. Are there differences in the frequency of service use for orthotic device replacements from three P&O clinics in Cambodia?

The third research question of this study assesses how administrative data can be used to understand service use in a low resource setting:

3. How can administrative data be used to provide information about P&O service use for orthosis users in a low resource setting?

To answer the research questions, the study used descriptive statistics such as crosstabulations and survival analysis, using extended Cox proportional hazard models for multiple event data. These have been performed to assess for differences in frequency of orthotic replacements and the gaps between orthotic replacements. This was used as a proxy measure for measuring utilisation of services by clients. Next this paper will provide a detailed discussion of the methodology (Section 5.2). The results are then explained, see Section 5.3, followed by a discussion about how they are situated within the context of the wider literature (Section 5.4) and some limitations of the study (Section 5.5).

5.2 Methodology

This section of the paper describes the methods used to investigate the three research questions. Firstly, the data source and the variables used will be discussed, followed by an explanation and justification of the statistical methodology used.

5.2.1 Data

Administrative data in healthcare, in the form of digital patient records, is routinely collected through information gathered from service users when utilising a service (Mbizvo *et al.,* 2020). Data on rehabilitation is limited in most countries so administrative data can be used to gain a greater understanding of access to services and to investigate an individual's pattern of P&O service use. The data for this study was taken from a standardised digital patient management system five (PMS5), established by ICRC and used in 60 countries. This enables the production of standardised clinical data, across different settings. Exceed are an international NGO working in Cambodia since 1989 and operate three P&O clinics in Cambodia in Phnom Penh, Kampong Chhnang and Sihanoukville. Assistive products are currently provided free of charge by Exceed, with support also being provided for travel and accommodation costs to help further reduce some of the financial barriers of accessing rehabilitative care in Cambodia. The client digital records used contain personal information such as age, gender and residential address, as well as medical information such as the cause of impairment, medical diagnosis and the type of orthoses provided. Each line of data describes a single visit to an Exceed clinic and is recorded as either an assessment, delivery or repair, linked using a unique client ID.

Assessments are the first type of appointment that an individual has at the clinic, and it assesses their health conditions before the potential assistive product options are discussed with the service user. For orthoses clients, after an assessment deems an orthosis to be a suitable option, a delivery of an orthotic device would take place after serial casting[7] of the affected body part to make the device, and fitting to ensure that the device fits the client. When an orthosis is replaced, this is also recorded as a delivery in the data. Appointments labelled repairs are returns to the clinic to have a device repaired. This means that clients are likely to have multiple events of the same and different consultation type.

The data was extracted by Exceed from the PMS5 digital record into Excel file format from all three P&O clinics in Phnom Penh, Kampong Chhnang and Sihanoukville. To ensure anonymity of services users, their name, day and month of birth, address and telephone number were removed from the dataset by the clinicians before being shared with the researcher. Overall, 25 separate files were received containing information on orthotics, wheelchairs and mobility aids for each of the three clinics. The wheelchair dataset only included repairs and deliveries and the mobility aid dataset only included deliveries. The data was then merged in Stata version 16.0. Pooling the data from the three clinics allowed for a larger sample size to help capture the characteristics of P&O services users across Cambodia.

Due to the way the data is recorded, clients often had duplicate appointments of the same type on the same day. For example, a client had two deliveries recorded on the 23/08/2015. One of these duplicate appointments was removed from the data analysis, as this study focuses on the time between deliveries of orthoses. Furthermore, clients who have not attended one of the three Exceed clinics since January 2013 were also removed from the survival analysis, as recommended by Exceed. Therefore, clients that have not used the service since January 2013[8] have been labelled as inactive and active clients are those that have had at least one appointment since January 2013. This means that some active clients have been using the service for many years and first attended before 2013, while other active clients first started using the service after 2013. Furthermore, the data was also censored at 31/12/2019 because of the unknown impact of COVID-19 on P&O service use.

As part of the survival analysis, two separate models have been generated, one for those younger than 18, and another for those over 18. The main justification for this is that adults and children have different physical rehabilitation service use. Firstly, different types of diagnoses and orthotic

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[7] Serial casting involves taking a cast of the affected body part using Plaster of Paris techniques.
[8] As recommended by staff at Exceed.

devices are more frequently or only used with children. Secondly, as children grow, they typically need their assistive products to be replaced more frequently than adults. This means that for the survival analysis, some of the variables have been categorised differently to account for different sample sizes between those over and under the age of 18.

5.2.2 Variables of interest

The following section provides an overview of the variables used in the analysis. The selection of variables was driven by data availability, given the limited range of data in the PMS5 system. Some of the variables were also coded differently in the survival analysis, compared to in the descriptive analysis. This is reflected in Table 5.1 which contains information about the different variables and how they are coded. For the descriptive data analysis, the variable ‘consultation type,’ was created and contains information about the type of appointment attended at the clinic, 1 = assessments, 2 = deliveries and 3 = repairs, and to enable the isolation of deliveries for the survival analysis.

Table 5.1. Categorical variable names and codes

Variable Name	Codes
Sex	1=Female 2=Male
Clinic	1=Phnom Penh 2=Kampong Chhnang 3=Sihanoukville
Diagnosis	1=Infection/other disease 2=Trauma/injury 3=Other congenital 4=Cerebral Palsy 5=Clubfoot 6=Paralysis 7=Dislocation/fracture 8=Sequalae of Polio 9=Scoliosis/curved spine 10=Short leg 11=Stroke 12=Other 13=Missing
Diagnosis under 18s	1=Cerebral Palsy 2=Clubfoot/short leg/other congenital 3=Infection/other/sequalae of Polio 4=Trauma/paralysis/fracture/dislocation 5=Scoliosis/curved spine 6=Other/missing
Diagnosis over 18s	1=Sequalae of Polio 2=Trauma/paralysis/fracture/dislocation 3=Clubfoot/short leg/scoliosis 4=Other/missing

Type of orthotic device	1=AFO 2=FO 3=KAFO 4=Shoe Raise 5=SFAB 6=Lower Limb 7=Upper Limb 8=Spinal 9=Other
Type of orthotic device for under 18s	1=AFO/FO 2=KAFO 3=Shoe Raise/other 4=SFAB 5=Spinal
Type of orthotic device for over 18s	1=AFO/FO 2=KAFO 3=Shoe Raise 4=Spinal/other
Previously received wheelchair or mobility aid	1=Never received wheelchair or mobility aids from Exceed 2=Yes, received wheelchair or mobility aids from Exceed
Previously used exceed for repairs	1=Never used Exceed services for repairs 2=Yes, used Exceed services for repairs

The unique client ID variable identifies which clinic a person attends; however, a separate clinic variable was created from this information (Table 5.1)[9]. Another key variable in the dataset is orthotic device type, this variable has been recoded due to small sample sizes of some orthoses (Table 5.1). The variable pertaining the gender of a client remained unchanged. Overall, there were over 50 recorded causes of impairment and 94 different diagnoses. However, some of these were the same cause or diagnoses recorded more than once due to different spelling and the use of capital letters, for example ‘CONGENITAL’ and ‘congenital’ were listed as different causes. The cause of impairment variable has a fair amount of missing data; out of 3460 rows of data, 546 have missing data for this variable which equates to 15.8%. Therefore, the diagnosis variable has been used in the analysis. This variable has been recoded in three different ways, an overall variable, diagnosis for under 18s and diagnosis for over 18s.

The recoded orthotic type has seven categories which are: Ankle-Foot-Orthoses (AFO), Foot-Orthoses (FO), Knee-Ankle-Foot-Orthoses (KAFO), shoe raise (SR), Steenbeek Foot Abduction Brace (SFAB), spinal and other orthoses. Two additional orthotic device type variables were also created

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[9] Users of Exceed services use the same clinic throughout their treatment, so there is no changing between clinics

for under and over 18s (Table 5.1). Throughout a client's use of P&O services, they may receive different orthosis types or use more than one type of orthotic, for example a person may originally be prescribed a AFO following an initial assessment, however clients may change to an FO. For the purpose of the survival analysis, people with deliveries of different orthosis types were removed so that only those with a consistent orthosis throughout their time receiving care are included. This was because of assumptions of the survival analysis needed to be satisfied. A full list of the categories that make up the reason for orthosis use (diagnosis) and orthosis types can be found in Appendix B, Table B1 and Table B2.

Clients at Exceed can also be provided with a wheelchair or mobility aid depending on their condition or rehabilitation needs. A binary explanatory variable was created to indicate whether clients who also have been prescribed a mobility aid or wheelchair more frequently replace their orthotic device. A binary variable indicating the number of repairs a client has previously had at Exceed was also created to provide insight into how frequently they interact with Exceed's services. Therefore, using the consultation type variable, the number of repairs a client has attended the clinic for has been made into a binary categorical variable with the categories 'no repairs' and 'previously had repairs. The coding of both these variables is displayed in Table 5.1.

The dataset also includes information pertaining to the age of the clients who have used Exceed's services. Using the year of birth variable, age-related variables were created including age at the end of 2019, age at the time of appointment and age at first consultation. Client age at the end of 2019 informs us how old the client is at the end of the dataset; this provides information about the age demographics of those currently classified as active users of the service. The client's age at the time of appointment and client's age at first consultation allow for the study of client ages when actually interacting with the services. For the survival models, age has been added as a continuous variable. Age at time of appointment is a time-varying covariate which means that because the variable changes value, the hazard of the risk also changes (Cleves *et al.,* 2010). This is accounted for in the dataset as each client has a single row per delivery of new orthotic device which allows for variations in age at the time of appointment. The variable age at first consultation has missing data for four individuals due to their first consultation being recorded as before their year of birth suggesting an error has been made in the recording of either the year of birth or date of consultation. Therefore, these individuals were removed from the analysis.

Some additional variables were also present in the dataset, for example occupation, province and commune of residence and side of the body impacted by their impairment, although these could not be included in the data analysis. Occupation and province of residence were not included for two reasons. The first reason was because clients' responses for these questions were recorded on their first visit to Exceed services and was then not updated on future visits. This means that for some, this data was 10 to 20 years old, for example, for adult users who first used the service as a child, their occupation was listed as 'child'. The second reason, which also is why side of the body was not included, was because these variables had a significant amount of missing data.

5.2.3 Methods

The purpose of this research is to provide an exemplar study to investigate patterns of P&O service use for orthosis users, drawing on a novel application of survival analysis using administrative data. To answer the first research question, bivariate analysis and crosstabulations were performed to investigate differences between groups of orthoses users. For research question two, further data analysis has been conducted by calculating the time between replacement of orthotic devices using survival analysis. Cox proportional hazard models were used to examine differences between groups in the number of days between deliveries of replacement of orthoses. The number of days was used as the analysis time for the survival analysis, which models the probability of needing a replacement of an orthotic device within a given time period. Only clients with more than one delivery of an orthosis have been used in the survival models meaning clients with only one delivery have been removed. There are several reasons for their removal, for example: the status of the most recent orthoses delivered to a client is unknown, and this study seeks to explore the time between orthosis device replacements and differences between population groups.

The Cox proportional hazards model is a form of multiple regression that allows for differences between groups in survival times to be estimated (Bewick *et al.,* 2004). Consequently, these methods are suitable for this analysis as both allow for the instantaneous risk of orthoses being replaced to be compared for different groups. The standard Cox model can only model time to the first event, due to the assumption of independence, and neglects all subsequent events (Amorim & Cai, 2015). For multiple event data as seen here, the Cox model needs to be extended to model recurrent events. Within multiple failure event data (i.e., an individual has multiple 'failures,' defined as a replacement orthotic device), the replacement of orthoses is correlated within subjects which then violates the assumption of independence of failure times. This means that multiple failures should be accounted for when performing a Cox proportional hazards model.

In order to account for these multiple failures, this research study utilises an extended model proposed by Prentice, Williams and Peterson (PWP) (1981) which stratifies the model in order based on prior events (Ozga *et al.,* 2018). The PWP Gap-Time (PWP GT) model resets the time index to zero after each recurrent event which allows the baseline hazards to vary (Amorim & Cai, 2015). The first stratum contains all the events that first took place in which all clients are at risk, and the second stratum contains all the events that occurred second and continues for all subsequent events (Ozga *et al.,* 2018). Only those who had an event at the previous stratum can be at risk for successive events. As the number of strata increase, event-specific estimates can become unreliable due to the risk set becoming too small, this means that the number of recurrent events may need to be restricted (Amorim & Cai, 2015). In this study, the number of recurrent events was restricted to a maximum of fifteen orthosis replacements per individual, as events become more infrequent after this number of replacements. Overall, the equation for the hazard is modelled as:

$$\lambda_{ij}(t) = \lambda_{0j}\left(t - t_j\right)\exp\left(\beta_j X_{ij}\right),$$

$$i = 1, \dots, n, j = 1, \dots, k_i, k_i \leq k$$

Where $\lambda_{ij}(t)$ refers to the common baseline hazard and $\lambda_{0j}(t - t_i)$ is the baseline hazard of individual i for each recurrent event $j = 1, \dots, k_i$ (Ozga *et al.,* 2018). This means that separate hazard functions can be modelled with their own baseline hazard and are allowed to vary from event to event (Ezell *et al.,* 2003). $\exp\left(\beta_j X_{ij}\right)$ refers to the hazard ratio which expresses the effect of the covariates in the model. The hazards for each covariate are proportional, this means they are assumed to be constant overtime (Ozga *et al.,* 2018). To test whether the model satisfies the proportional hazards assumption, a key component for Cox proportional hazards models, the models were tested using the postestimation commands in Stata. A model violates the proportional hazards assumption if the variables and overall test are significant (p=<0.050). To satisfy the proportional hazards assumption, stratification and recoding variables into smaller or wider categorical groups was used. However, for the model of clients over the age of 18, Sihanoukville clinic is significant (Appendix B, Table B.3). This implies that the hazard is not proportional meaning that the relative hazard does not remain constant over time (Kuitunen *et al.,* 2021), however, this was the best result possible. Ethical permission for this research was granted by an ethics committee in Cambodia (230&311NECHR) and ERGO II at the University of Southampton (ID 63066).

5.3 Results

The results of this study are presented in two sections. Part one presents the results of the descriptive analysis which answers research question one, to examine current and previous trends in Exceed service users for orthotic devices (Section 5.3.1). Part two provides the results of the survival analysis, where the gap time between orthotic device replacements has been used to understand the difference in frequency of use for service users and whether certain clients are using the service more often than others (Section 5.3.2). For this part of the analysis, clients with multiple deliveries of orthoses have been used.

5.3.1 Part 1: Descriptive Analysis

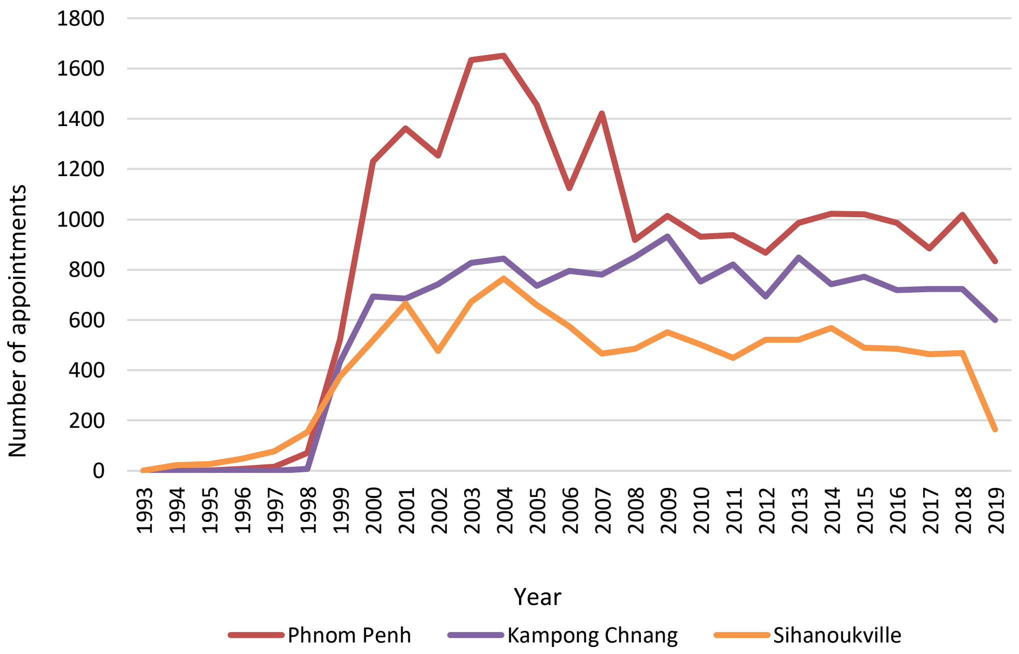
After data cleaning and removing duplicate appointments of the same type on the same date, there have been just over 50,000 orthotic appointments for all clients, including those clients who were no longer deemed as active (Table 5.2). For active clients only, there have been over 25,000 appointments since the start of the dataset in the mid-1990s. These appointments are broken down into assessments, orthotic deliveries (i.e., a new device), and repairs to devices. This equates to 12,000 individuals in total (active and not active clients), and 4,000 active clients (Table 5.2Table 5.2. Total number of appointments for all clients).

Table 5.2. Total number of appointments for all clients

	All clients incl. not active		**Active clients only**	
Appointment type	**N**	**%**	**N**	**%**
Assessment	19948	39.9	9070	35.5
Delivery	17651	35.3	8731	34.2
Repair	12461	24.9	7725	30.3
Total	**50060**	**100.0**	**25526**	**100.0**
Total number of clients	**12332**		**4278**	

Figure 5.2 shows the change over time in appointments for all clients at Exceed’s P&O clinics. Overall, Phnom Penh has provided the largest number of appointments, reaching a peak of over 1,600 appointments per year in 2003 and 2004. Since 2005, Phnom Penh has experienced a decline the number of appointments delivered (Figure 5.2). Kampong Chhnang deliver fewer appointments compared to Phnom Penh, however, the number of appointments delivered every year has been more consistent (Figure 5.2). For Sihanoukville, the number of appointments has been slowly decreasing since 2004, with 2019 only seeing a total of 165 appointments.

Figure 5.2. Total number of appointments per year for all clients by clinic.



To investigate who is using Exceed services, crosstabulations were performed between gender and several different variables for active orthotic clients (Table 5.3). In Phnom Penh 48.1% of users were female, whereas in Sihanoukville only 41.3% were female ($p<0.01$). Furthermore, a majority of individuals who have been diagnosed with infection/other disease or scoliosis/curved spine are females across the clinics (Table 5.3). For all other diagnoses, there were a higher percentage of males. The largest differences between males and females were seen for paralysis (68.4% vs 31.7%), trauma/injury (64.2% vs 35.8%) and clubfoot (61.1% vs 38.9% respectively) (Table 5.3). No significant differences were found between the percentage of males and females previously having been given a wheelchair or mobility aid and previous use of services for repairs (Table 5.3).

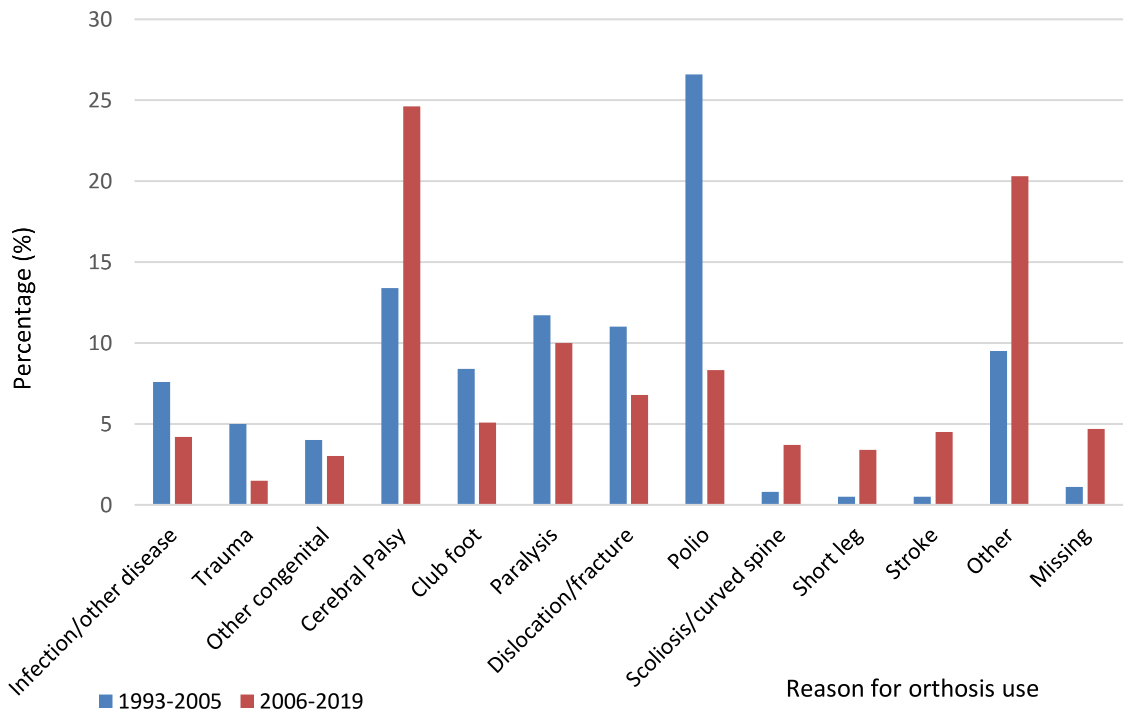
To examine further the reasons for use of orthosis for clients, Figure 5.3 shows how diagnoses of clients has changed over time. For all clients, including those who are now inactive, who first used the service between 1993 and 2005, Polio was the most common diagnosis (26.6%), followed by cerebral palsy (13.4%) and paralysis (11.7%). In comparison to clients that first used the service between 2006 and 2019, there has been a shift in the most common diagnoses. The most common diagnosis for service users between 2006 and 2019 were cerebral palsy (24.6%), followed by other diagnoses (20.3%) and paralysis (10.0%). The diagnosis of 'other' consists of a number of diagnoses that have small sample sizes and do not fit within any of the more common diagnoses. This includes malnutrition, bowleg, pain and contractures. It also includes diagnoses that were listed as unknown or other in the actual data.

Table 5.3. Categorical variables by gender for active clients

Active clients only	**Female**		**Male**		**Total**	
Variable	**N**	**%**	**N**	**%**	**N**	**%**
Clinic (χ^2 p=0.001**)						
Phnom Penh	934	48.1	1006	51.9	1940	100.0
Kampong Chhnang	641	44.0	815	56.0	1456	100.0
Sihanoukville	364	41.3	518	58.7	882	100.0
Diagnosis (p<0.001**)						
Infection/other disease	100	50.8	97	49.2	197	100.0
Trauma/injury	24	35.8	43	64.2	67	100.0
Other congenital	50	47.2	56	52.8	106	100.0
Cerebral Palsy	536	46.8	609	53.2	1145	100.0
Club foot	95	38.9	149	61.1	244	100.0
Paralysis	113	31.7	244	68.4	357	100.0
Dislocation/fracture	127	48.5	135	51.5	262	100.0
Polio	226	43.4	295	56.6	521	100.0
Scoliosis/curved spine	122	78.2	34	21.8	156	100.0
Short leg	81	45.5	97	54.5	178	100.0
Stroke	98	40.0	147	60.0	245	100.0
Other	317	46.8	360	53.2	677	100.0
Missing	50	40.7	73	59.4	123	100.0
Wheelchair or Mobility aid (p=0.237)						
No	1291	46.0	1517	54.0	2808	100.0
Yes	648	44.1	822	55.9	1470	100.0
Repair (p=0.671)						
No	1233	45.1	1502	54.9	2735	100.0
Yes	706	45.8	837	54.2	1543	100.0
Total	**1939**	**45.3**	**2339**	**54.7**	**4278**	**100.0**

***p-value significant at 1% level*

Figure 5.3. Change in reason for use of orthosis over time for all clients



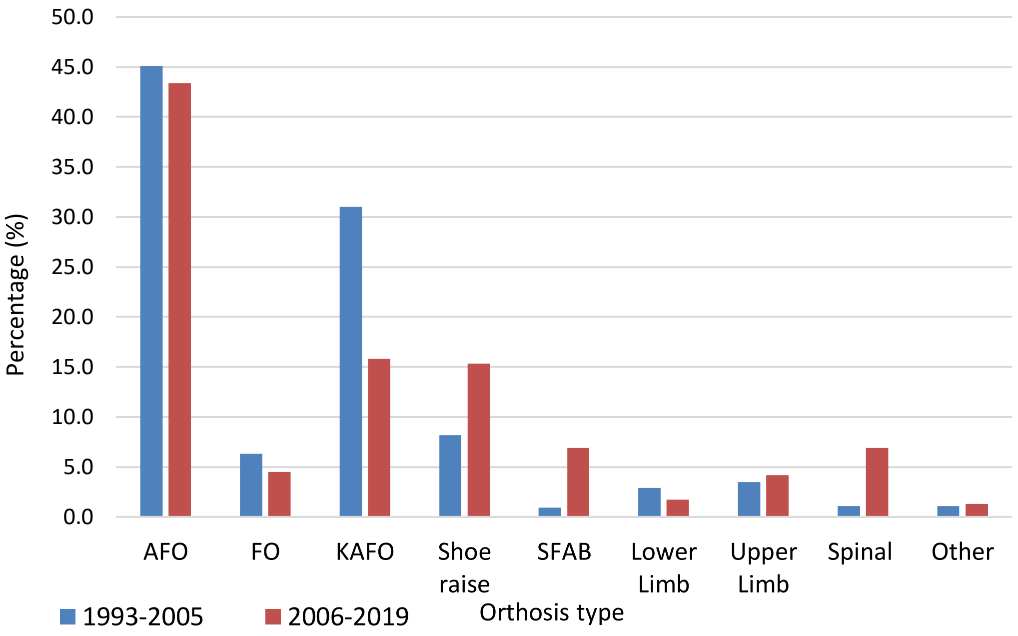
A crosstabulation between orthotic type and gender for active clients was also performed and the results can be found in Table 5.4. Females have lower percentage of AFOs compared to males (36.4% vs 44.2%), although for KAFOs and FOs, there is only a difference of 1% between males and females (Table 5.4). The largest differences can be found between shoe raises and spinal orthoses where females have a higher percentage of delivery of these orthotic types compared to males (Table 5.4). The higher percentage of spinal orthosis in females is likely to correspond to the higher percentage of scoliosis/curved spine diagnoses in females (Table 5.3). Figure 5.4 displays the change in the distribution of orthotic type from 1993 to 2005 and 2006 and 2019. Over time, the percentage of AFOs and FOs delivered to clients has remained relatively stable with only a small reduction in 2006 to 2019. One of the major differences is the reduction in KAFOs; in 1993 to 2005 over 30% of devices delivered were KAFOs, while in 2006 to 2019 only 16% were KAFOs. In between the years 2006 to 2019, the percentage of shoe raises, SFAB and spinal orthosis have also increased compared to 1993 to 2005. The change in orthotic type may be due to change in diagnoses over time.

Table 5.4. Orthotic type and gender for active clients

Active clients	**Female**		**Male**		**Total**	
Orthotic type (p=0.001)**	**N**	**%**	**N**	**%**	**N**	**%**
AFO	1503	36.4	2027	44.2	3530	40.5
FO	171	4.1	154	3.4	325	3.7
KAFO	1118	27.1	1288	28.1	2406	27.6
Shoe Raise	716	17.3	554	12.1	1270	14.6
SFAB	129	3.1	198	4.3	327	3.8
Lower Limb	53	1.4	69	1.5	122	1.4
Upper Limb	140	3.4	137	3.0	277	3.2
Spinal	265	6.4	129	2.8	394	4.5
Other	34	0.8	28	0.6	62	0.7
Total	**4129**	**100.0**	**4584**	**100.0**	**8713**	**100.0**

***p-value significant at 1% level*

Figure 5.4. Change over time in orthosis types for all clients



5.3.2 Part 2: Survival Analysis

Part two of the descriptive analysis includes a specific subset of the dataset. These clients were either under the age of 18 years when they first used the service and were still under the age of 18 at the end of 2019 or service users that were over the age of 18 when they first used the service. This was because of the distinct differences in patterns of use over time for children and adults. Although age 18 is a crude delineation as the main factor affecting patterns of use is growth, it is the only available indicator within the clinic data. Furthermore, clients also all had a single orthotic type. This means during an individual's time using Exceed services they have only received one type of orthotic device such as an AFO, and not received a combination of devices, for example an AFO and then switching to a FO. The purpose of this was to ensure that the assumptions of the Cox proportional hazards models were not violated, as it requires the hazard to remain constant over time. Additionally, only clients that have had more than one orthotic delivery are included. As noted above, this is because the survival analysis examines the time between orthotic device replacements and doing this is not possible when a client has only received one device.

Figure 5.5 and Figure 5.6 show the survival estimates for all replacements for clients under and over 18. Figure 5.5 shows that for clients under 18, around 90% have replaced their orthosis after 1,000 days. This is lower than Figure 5.6 where around 90% of over 18s have had their orthosis replaced within 2,000 days. Although, the Kaplan-Meier plots they are unable to take into account multiple events and the nesting of the data. Appendix B, Table B4 provides the survival estimates for both under and over 18s for first to second and second to third replacement only.

Figure 5.5. Kaplan-Meier survival estimates for under 18s

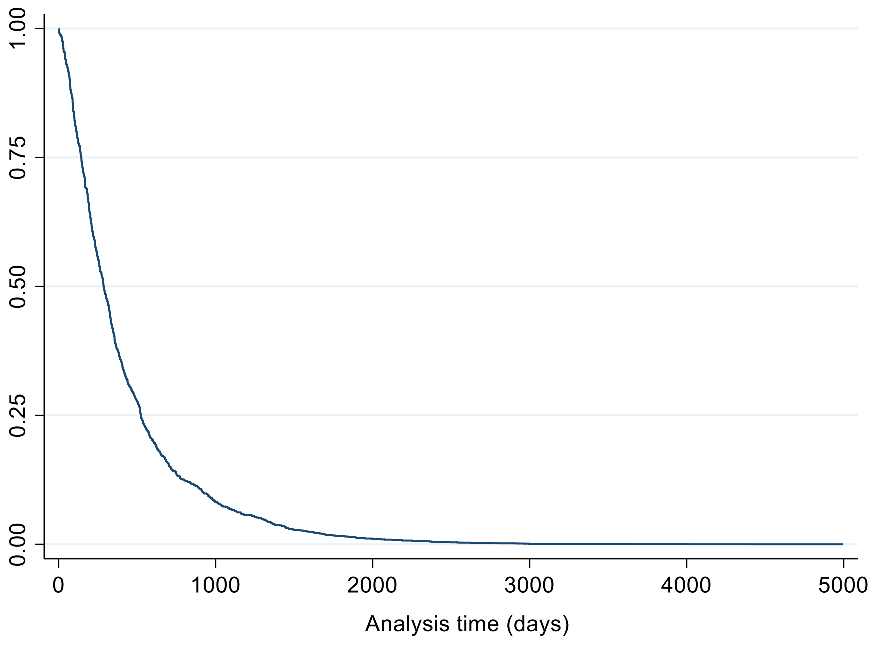
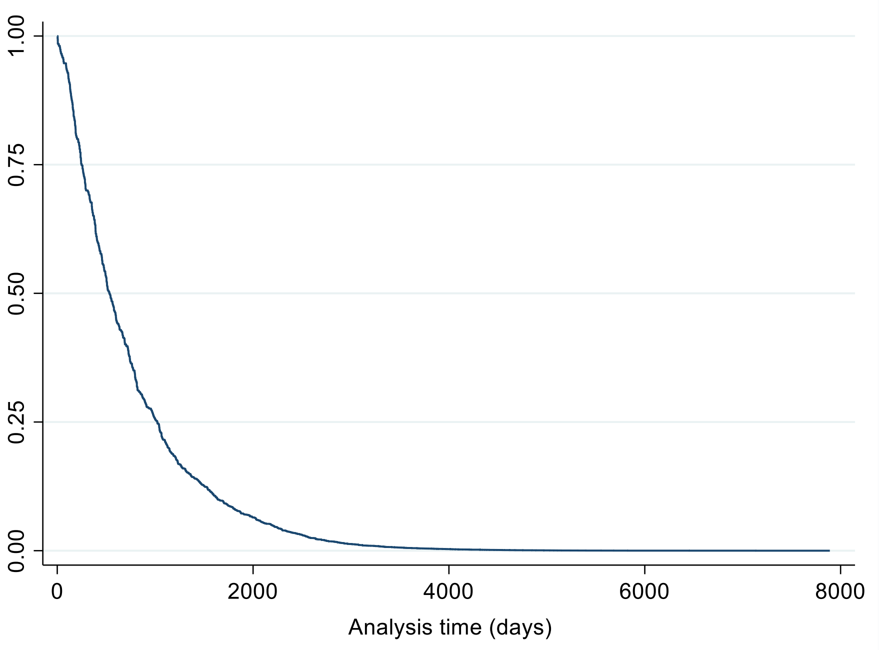


Figure 5.6. Kaplan-Meier survival estimates for over 18s



To investigate differences in the time between replacements, Table 5.5 and Table 5.6 displays differences in the mean number of days between orthotic device replacements for clients for under and over 18s. This descriptive analysis does not account for any nesting found in the data, for example the dependence of a future appointment on previous appointments as summary statistics accounting for this have not been developed. Orthotics delivered to girls under the age of 18 had a median number of days to replacement of 314 days, whereas for boys this was only 265 days (Table 5.5). This suggests that boys under 18 have their devices replaced quicker than girls. The opposite is the case of over 18s with 50% of orthotics delivered to women being replaced by 475 days (Table 5.6). The median number of days for replacements for orthotics given to men over 18 was found to be 594 days (Table 5.6). Differences were also found between clinics in the replacement of orthotic devices with Sihanoukville having the smallest median number of days to replacement for under 18s (Table 5.5). Orthotics from Phnom Penh and Kampong Chhnang had a similar median number of days to replacement. For over 18s, orthotic device from Phnom Penh have a median replacement of 616 days, or around 1.75 years, which is much higher than for orthotics from Kampong Chhnang and Sihanoukville at 469 and 479 days (Table 5.6). In Kampong Chhnang, 75% of orthotics are replaced within 800 days, which is just over two years.

Table 5.5. Median number of days until orthotic replacement for under 18s

Under 18s (N=415)	**N**	**25th percentile (95% CIs)**	**Median (95% CIs)**	**75th percentile (95% CIs)**
Female	202	167 (139, 194)	314 (270, 352)	574 (517, 677)
Male	213	116 (91, 150)	265 (215, 307)	484 (407, 534)
Phnom Penh	208	159 (116, 206)	331 (293, 363)	560 (515, 643)
Kampong Chhnang	100	169 (123, 194)	291 (241, 356)	548 (439, 685)
Sihanoukville	107	106 (80, 136)	210 (167, 253)	402 (325, 503)
Cerebral Palsy	217	208 (167, 236)	368 (330, 420)	679 (580, 773)
Clubfoot/short leg/other congenital	54	71 (45, 98)	151 (103, 189)	293 (203, 358)
Infection/other disease/polio	37	139 (68, 203)	285 (193, 332)	450 (332, 623)
Trauma/paralysis/fracture/dislocation	18	101 (30, 153)	251 (101, 331)	524 (278, 824)
Scoliosis/curved spine	31	202 (97, 270)	346 (208, 461)	515 (424, 617)
Other/missing	58	114 (89, 143)	188 (143, 247)	385 (264, 488)
AFO/FO	238	189 (145, 211)	332 (289, 368)	595 (537, 677)
KAFO	73	197 (153, 264)	339 (302, 419)	672 (505, 750)
SR/other	25	98 (20, 131)	162 (101, 312)	439 (278, 510)
SFAB	36	56 (41, 75)	91 (71, 140)	181 (136, 210)
Spinal	43	148 (89, 214)	294 (206, 415)	488 (415, 579)
No other assistive product	259	123 (101, 147)	259 (215, 293)	461 (407, 518)
Yes, other assistive product	156	156 (137, 219)	347 (288, 390)	656 (554, 714)
No repairs sought	127	104 (83, 145)	278 (196, 338)	557 (481, 656)
Yes, repairs sought	288	165 (136, 188)	293 (260, 327)	517 (463, 566)

Table 5.6. Median number of days until orthotic replacement for over 18s

Over 18s (N=261)	**N**	**25th percentile (95% CIs)**	**Median (95% CIs)**	**75th percentile (95% CIs)**
Female	113	233 (180, 313)	475 (393, 579)	882 (765, 1021)
Male	148	270 (202, 355)	594 (502, 723)	1126 (1006, 1300)
Phnom Penh	117	258 (182, 398)	616 (505, 741)	1209 (1041, 1456)
Kampong Chhnang	114	241 (180, 286)	469 (388, 568)	910 (790, 1051)
Sihanoukville	30	288 (114, 393)	479 (360, 669)	800 (629, 985)
Polio	101	390 (238, 479)	723 (565, 813)	1309 (1065, 1581)
Trauma/paralysis/fracture/dislocation	84	224 (145, 270)	441 (332, 565)	902 (742, 1065)
Clubfoot/ short leg/scoliosis	35	189 (158, 264)	353 (244, 454)	608 (434, 749)
Other/missing	41	355 (118, 460)	638 (404, 875)	1232 (910, 1532)
AFO/FO	88	322 (182, 406)	683 (491, 847)	1323 (1063, 1581)
KAFO	75	390 (238, 508)	728 (565, 822)	1269 (1040, 1620)
SR/spinal/other	98	188 (158, 242)	388 (283, 461)	742 (603, 837)
No other assistive product	200	264 (202, 355)	571 (491, 667)	1097 (970, 1215)
Yes, other assistive product	61	224 (137, 288)	455 (331, 579)	811 (683, 985)
No repairs sought	98	223 (160, 283)	475 (388, 609)	1021 (813, 1133)
Yes, repairs sought	163	277 (224, 353)	553 (491, 664)	1023 (875, 1126)

Variations of days between orthotic device replacement were also found for different causes of impairment. For under 18s, orthotics owned by clients with other reasons or missing information for this variable only had a median of 188 days between replacements, with 75% of devices being replaced by 385 days (Table 5.5). The highest median number of days between replacements was cerebral palsy with 50% of orthotics being replaced in just over a year (368 days) (Table 5.5). When looking at the differences in days between replacements for over 18s, orthotics owned by clients with reasons for use such as trauma, paralysis, fracture or dislocation or clubfoot, short leg or scoliosis 75% of orthoses were replaced in less than three years (902 and 608 days respectively) (Table 5.6). Table 5.5 shows that for SFAB, 75% of these orthoses are replaced within 181 days. This number is much lower than other orthotic types for under 18s. For over 18s, KAFOs have the largest median number of days between replacements at 728, which is just under two years (Table 5.6). Shoe raises on the other hand have fewer days between replacements, although this difference is not unsurprising because the orthotic devices are very different, and shoes raises more likely to require replacements more often.

Whether or not a client has previously been given another assistive product such as a wheelchair or mobility aid shows a relationship with the number of days between replacements of orthotics. For those with no other assistive products over the age of 18, the median number of days between replacements was 571 days, whereas those with other assistive products the median number of days was lower, at 455 days (Table 5.6). For under 18s, the opposite was found to be case for other assistive products. Overall, 50% of orthotic devices are replaced within 259 days for those without additional assistive products, while for those with additional assistive products, 50% of orthotics are replaced at 347 days, just less than one year (Table 5.5). Previous use of Exceed services for repairs can indicate how active a person is at using services and their orthotic device. For clients under 18, orthotic devices owned by clients who have never used repairs services from Exceed, 75% were found to have replacements after 557 days (Table 5.5). This is slightly longer than orthotic device replacements for those that have previously received a repair where 75% of devices are replaced within 517 days (Table 5.5). Lastly, when looking at over 18s, orthotics owned by clients that have never used Exceed services for repairs have fewer days to replacement than for those that have, with 50% of devices replaced within 1.5 year (475 days) and 75% replaced within three years (1021 days) (Table 5.6).

5.3.3 PWP G-T Models

5.3.3.1 Service users under the age of 18

The first survival model studies the time between orthotic device replacements for clients who are currently under 18 years at the end of 2019. Overall, boys under the age of 18 have an increase in the risk of replacement of devices compared to girls (Hazard Ratio (HR): 1.26 (95%, CI 1.09, 1.46) vs 1.00) (Table 5.7). This means, holding all other variables constant, boys have a 26% increase in the likelihood of having their device replaced within a defined time period (p=0.002). In comparison, between the different clinics, for those under 18 years, no significant difference in the time between replacements was found for Kampong Chhnang and Sihanoukville, compared to Phnom Penh. The risk of having an orthotic device replaced at any time point for service users from Kampong Chhnang were 0.95 (95% CI, 0.77, 1.16) lower than those in Phnom Penh. In contrast, for service users in Sihanoukville, the risk at any time point was 1.08 (95% CI, 0.88, 1.32) greater than service users from Phnom Penh (Table 5.7).

Diagnosis was found to be a significant predictor of orthotic device replacements for clients under 18. When comparing to the reference category, cerebral palsy, all other diagnosis were found to have a hazard ratio greater than one. Overall, for all other types of diagnoses there was an increased risk of orthosis replacement, ranging from 37% for clients with clubfoot and other congenital conditions (HR 1.37; 95% CI, 1.02, 1.85) to 68% for clients with other or missing diagnoses (HR 1.68; 95% CI, 1.24, 2.27) compared to service users with cerebral palsy (Table 5.7). The type of orthotic device given was also found to be significantly associated with the risk of replacement. The risk of have an orthotic device replaced for service users under the age of 18 with an SFAB and SR/other were 4.43 (95% CI, 2.88, 6.80) greater compared to those with an AFO or FO (Table 5.7).

Two different variables have been used for age: age at the time of appointment, which is a time varying covariate, and age at first consultation at Exceed. Both variables have been included as continuous variables. A one-year increase at age of appointment, lowers the risk of orthotic device replacement by 0.92 (95% CI, 0.85, 0.99) for service users under the age of 18 years. This means that an increase in the age of a client significantly increases the time between orthotic device replacement (p=0.023). Client age at first appointment was also found to be significantly associated to orthotic device replacement (p=0.032). A one-year increase in age increases the hazard of device replacement by 1.08 (95% CI, 1.01, 1.16), which suggests that for under 18s service users who are older at the time of their first consultation will have more orthotic deliveries within a defined period of time.

Service users under the age of 18 who have previously received a wheelchair or mobility aid from Exceed were not found to have significantly more orthotic device replacement compared to those who have not previously had a wheelchair or mobility aid (p=0.938) (Table 5.7). Lastly, the number of repairs variable measures whether service users have also used Exceed services for repairing orthotic devices during the length of their service use. Service users under 18 who have had repairs to an orthotic device have a greater risk of orthotic device replacement compared to those that have never had a repair with a hazard ratio of 1.12 (95%, CI, 0.93, 1.36). However, this was not found to be significant (p=0.233) (Table 5.7). The results highlight some key differences between service users that first used the service when they were under 18 and were still under 18 at the end of 2019. The next section reports the results of the survival analysis for service users that first used the service when they were over 18 years of age.

Table 5.7. PWP G-T model for clients under 18 years

Under 18s

Variables	HR	SE	P-value	95% CIs
Sex				
Female	1			
Male	1.26	0.10	0.002**	1.09, 1.46
Clinic				
PP	1			
KC	0.95	0.10	0.597	0.77, 1.16
KS	1.08	0.11	0.460	0.88, 1.32
Diagnosis under 18s				
Cerebral Palsy	1			
Clubfoot/short leg/other congenital	1.37	0.21	0.036*	1.02, 1.85
Infection/other disease/polio	1.43	0.20	0.011*	1.08, 1.89
Trauma/paralysis/fracture/dislocation	1.51	0.29	0.034*	1.03, 2.22
Scoliosis/curved spine	1.55	0.60	0.264	0.72, 3.33
Other/missing	1.68	0.26	0.001**	1.24, 2.27
Type of device				
AFO/FO	1			
KAFO	0.99	0.10	0.915	0.82, 1.20
SR/other	1.35	0.26	0.126	0.92, 1.97
SFAB	4.43	0.97	<0.001**	2.88, 6.80
Spinal	0.94	0.35	0.866	0.45, 1.96
Age at appointment	0.92	0.04	0.023*	0.85, 0.99
Age at first appointment	1.08	0.04	0.028*	1.01, 1.16
Previously received wheelchair or mobility aid				
No	1			
Yes	1.01	0.09	0.938	0.84, 1.21
Previously used exceed for repair services				
No repairs	1			
Sought repairs previously	1.12	0.11	0.233	0.93, 1.36

**p-value significant at 5% level, **p-value significant at 1% level*

5.3.3.2 Service users over the age of 18 years old

The survival analysis has also performed on service users over the age of 18 at the end of 2019 and that were over the age of 18 when they first used the Exceed services.

Overall, men over 18 years had significantly lower risk of orthotic device replacement than women (Table 5.8). The risk of replacement was found to be 19% lower for men compared to women (HR 0.81; 95% CI, 0.70, 0.93). This suggests that women are having their orthotic device replaced more frequently than men. No significant differences in hazard ratios were found for the clinic used which means that users of the Phnom Penh, Kampong Chhnang and Sihanoukville clinics have similar levels of orthotic device replacements. Similarly, no significant differences were also found in replacements by the type of diagnoses. Service users over the age of 18 that have been diagnosed with clubfoot, short leg or scoliosis have a 36% increase in the risk of orthosis replacement compared to the reference category, polio (HR 1.36; 95% CI, 0.97, 1.91) although this was not significant (Table 5.8).

The type of orthotic device used was found to be significantly associated to the risk of device replacement. For those over the age of 18 years, no service users have been given an SFAB: this is because this device is designed specifically for children to help treat clubfoot. In comparison to the reference category, AFO and FO, service users with a KAFO have significantly lower risk of replacements with a hazard ratio of 0.72 (95% CI, 0.55, 0.95, p=0.018), which means that clients with a KAFO have fewer replacements compared to those with an AFO (Table 5.8). Service users who use SRs, spinal or orthoses were found to have significantly more orthotic device replacements compared to those with AFOs and FOs with a hazard ratio of 1.64 (95% CI, 1.25, 2.14, p=<0.001) (Table 5.8) This means that service users with SRs have a 64% increase in the risk of orthotic device replacement compared to AFO and FO users over a defined time period.

As with the under 18s model, the same age variables have been used in the model investigating differences for those aged over 18 years. A one-year increase in age at the time of delivery significantly reduces the risk of orthotic device replacement by 11% (HR 0.89, 95% CI, 0.84, 0.94, p=<0.001) (Table 5.8). Furthermore, for client age at first appointment, an increase age actually has the opposite impact to age at delivery. A one-year increase in age at first appointment significantly increases the risk of orthotic device replacements by 12% (HR 1.12, 95% CI, 1.06, 1.19, p=<0.001) (Table 5.8). This suggests that service users who have their first appointment at a later age actually have more frequent replacements. Service users that were over the age of 18 and have previously received a wheelchair or mobility aid from Exceed were found to be significantly more likely to have orthotic device replacements compared to those who have not previously had a wheelchair or mobility aid (p=0.001) (Table 5.8). In comparison to service users that have never previously been prescribed a mobility aid or wheelchair, service users that have been prescribed them have an increase in the risk of replacement by 31% (HR 1.31, 95% CI, 1.11, 1.54) (Table 5.8). Finally, for service users over the age of 18 that have also used Exceed services for repairing orthotic devices, risk of replacement is 1.29 greater compared to the reference category of services users who have never used the service for repairs (95% CI, 1.03, 1.63). This was found to be significant (p=0.028) (Table 5.8). This suggests that people who use the service for repairs, also have devices replaced more frequently.

Table 5.8. PWP G-T model for clients over 18 years

Over 18s

Variables	**HR**	**SE**	**P-value**	**95% CIs**
Sex				
Female	1			
Male	0.81	0.06	0.003**	0.70, 0.93
Clinic				
PP	1			
KC	0.94	0.09	0.506	0.77, 1.14
KS	0.98	0.14	0.905	0.74, 1.30
Diagnosis over 18				
Polio	1			
Trauma/paralysis/fracture/dislocation	0.99	0.15	0.943	0.74, 1.33
Clubfoot, short leg, scoliosis	1.36	0.24	0.076	0.97, 1.91
Other/missing	0.97	0.16	0.870	0.71, 1.34
Type of device				
AFO/FO	1			
KAFO	0.72	0.10	0.018*	0.55, 0.94
SR/spinal/other	1.64	0.23	<0.001**	1.25, 2.14
Age at appointment	0.89	0.03	<0.001**	0.84, 0.94
Age at first appointment	1.12	0.03	<0.001**	1.06, 1.19
Previously received wheelchair or mobility aid				
No	1			
Yes	1.31	0.11	0.001**	1.11, 1.54
Previously used exceed for repair services				
No repairs	1			
Repairs sought	1.29	0.15	0.028*	1.03, 1.63

**p-value significant at 5% level, **p-value significant at 1% level*

5.4 Discussion

The findings provide important insights into the use of P&O services for orthotic devices in Cambodia and can provide a baseline to compare results from other countries to as well. To answer the research questions posed, descriptive statistics have been performed to assess the characteristics of service users and temporal changes over time. Survival analysis has been used to answer the second research question, which aimed to assess for differences in the utilisation of services for replacement of orthoses in Cambodia. A third research question was included which aimed to explore how administrative can be used to inform about service users in a low resource setting. This section will explore the different findings for each of the research questions in the context of existing literature.

5.4.1 Characteristics of orthosis users

The first research question of this study aimed to understand the characteristics of service users and whether there have been changes over time in their characteristics. This section relates to the Andersen, Davidson and Baumeister (2013) as it links to both individual predisposing and need factors that can impact service use. For instance, the type of orthotic device used could indicate whether a person is likely to need more appointments at a P&O clinic. Overall, since the beginning of the Exceed client database in the 1990s until the end of 2019, over 12,000 clients had at least one consultation, including nearly 4,300 active clients, which is more than the 7,177 prosthetics users and 2,820 active clients from the same three Exceed clinics during the same time frame (Dickinson *et al.,* 2022). Despite the lack of research regarding orthotic users compared to prosthetic users, this study found that at Exceed clinics there are more orthotic users. This indicates that both prosthetics and orthotics should be paid equal attention in research and service design, implementation and delivery. The need for more research and evidence on AT is recognised in the WHO-UNICEF (2022) report which includes two recommendations related to investing in data and evidence-based policy and in research and innovation. This study also found that the total number of appointments at the P&O clinics has declined since the mid-2000s, with all three clinics seeing larger declines from 2018 to 2019. The cause for this sharp decline is unknown, although in Phnom Penh, Exceed trialled cost recovery from 2019 until 2021, where clients were asked for pay for a portion of the device depending on their income pay for a portion (Harte *et al.,* 2019). Introducing user fees for the service may explain why there was a larger decline from 2018 to 2019 compared to other years.

The present study found that for active users, a higher number were under the age of 18 than over the age of 18. This is different compared to prosthetic device users from Exceed clinics, where in 2019, the majority of clients were over the age of 18 (Dickinson *et al.,* 2022). This echoes findings from a study by Magnusson *et al.* (2014) where it was found that orthotics clients were more likely to be younger than prosthetics users. In total, men and boys were found to comprise just over half of active orthotic users at Exceed clinics. In comparison to prosthetics users from the same three clinics, the balance between men and boys and women and girls is more equal. Dickinson *et al.* (2022) found that only 13.7% of active prosthetic clients from Exceed were women or girls. Furthermore, in a study of rehabilitation service users from fourteen conflict affected countries, male dominance in service use for amputations was found (Barth *et al.,* 2020). In study of P&O users in Sierra Leone, Magnusson *et al.* (2014) found that women were more likely to be orthosis users compared to men, and that for prosthetics users a higher percentage of these were male. This highlights that there is an important distinction between use of services for prosthetics and orthotics between men and women and that data should be disaggregated by sex to understand the full picture of service use. In the Andersen, Davidson and Baumeister (2013) model of health service use, gender and age are both indicated as predisposing demographic characteristics that can impact health service use.

The results from this study found that the most common reasons for orthosis used were sequalae of polio and cerebral palsy. However, the descriptive analysis showed how the diagnoses profile has changed over time, with sequalae of polio becoming less common. Cambodia was declared to be free of indigenous wild poliovirus (WPV) in 1997 (GPEI, N.D), consequently, those with a diagnosis of sequalae of polio are likely to have been living with the condition for a while. In total, eleven under 18s have been recorded as diagnosed with polio in the data, with the earliest birth year being 2002 and the latest being 2015. The cause of this could be due to misdiagnosis, but also from vaccine-derived poliovirus (VDPV) which is a mutation of poliovirus contained within the oral polio vaccine (OPV) (WHO, 2022d). Furthermore, individuals that previously had polio can develop disabling symptoms due to post-polio syndrome later in life, which impacts an estimated 25% to 40% of polio survivors (Groce *et al.,* 2014). This highlights that polio still impacts people today, despite eradication of wild polio virus. This suggests that rehabilitation is still very much needed due to polio, as well as the increased prevalence of other diagnoses. In a study by Magnusson & Ahlström (2017), violence and polio were found to be the most common causes of impairments in Sierra Leone, and in Malawi, the common causes were traffic accidents, non-healing wounds, and fractures. The results also found an increase in the predominance of cerebral palsy. This is likely due to improvements in healthcare, meaning more children with congenital conditions or those that contract severe infections survive beyond infancy (Harkins *et al.,* 2013).

The descriptive analysis found significant associations between reasons for orthosis use and gender. It was found that women and girls have a higher percentage of diagnosis of idiopathic scoliosis or curved spine. This is consistent with global epidemiology of adolescent idiopathic scoliosis where research shows that females are more likely to develop scoliosis than males, with the ratio increasing with age (Konieczny *et al.,* 2013). The descriptive statistics also indicate that at Exceed clinics, a higher percentage of men and boys have been diagnosed with clubfoot than women and girls. Research has also provided evidence to support the notion that there is a gender difference in prevalence of clubfoot with a ratio of 1:2 (F:M) (Gibbons & Gray, 2013), confirming the Exceed differentials.

Exceed provide a number of orthotic devices to service users, with the most popular device being AFOs. The majority of the spinal orthoses provided by Exceed attended the Phnom Penh clinic. This is because, at Exceed, Spinal Orthotic Management is only performed in Phnom Penh where there is a qualified category one PO. In addition, service users with spinal orthosis prescription are required to be assessed by an orthopaedic doctor or surgeon, which are only available in Phnom Penh. Using the Andersen, Davidson and Baumeister (2013) model of health service use, the cause of impairment or health conditions which has led to use of an orthosis and the type of orthosis used can be identified as both a predisposing characteristic and a perceived and evaluated need impact of physical rehabilitation service use. The type of orthosis device delivered by Exceed also impact health behaviours and outcomes, this will be explored further in the following section.

5.4.2 Frequency in service utilisation and the barriers to use

The second research question aimed to investigate the frequency of service use for orthotics users. This involved using survival analysis to model the time to orthotic replacement from their previous delivery. In the analysis, two different measures of age were included, these were age at date of the delivery and age at first appointment at the Exceed clinics. For all clients, both under and over 18 years, age at the time of orthotic device delivery was found to be significant, with the number of days between orthotic device replacements becoming larger as age increases. For example, for those under 18, a child aged two years would have more days between replacements as they continue to age. This echoes previous research which found that for children with cerebral palsy in Bangladesh, Nepal and Indonesia, as their age increased, use of rehabilitative services declined meaning they had fewer appointments (Al Imam *et al.,* 2021). For children with cerebral palsy and congenital conditions, early rehabilitation is vital for developmental outcomes and improving limb function (Smythe *et al.,* 2022). Effective early interventions could mean needing to use services less as one gets older.

The same result was also found with over 18s, with an increase in age associated with fewer orthotic device replacements. This could be due to school or work commitments that make it more challenging to attend Exceed services due to the clinics typically only opening during the weekdays from 8am to 4pm which could interfere with the ability to access services. In a qualitative study with adult prosthetic users by Donovan-Hall *et al.* (unpublished), participants reported costs of transportation and loss of daily income due to not being able to work when accessing services as significant barrier to use. A decrease in orthosis replacements in older adults could also be due to long-term orthotic device use or worsening of impairments over time causing pain and muscle loss. Conditions such as post-polio syndrome can cause progressive muscle weakness, generalised fatigue and muscle and joint pain (Bickerstaffe *et al.,* 2015). This can cause declines in physical mobility, creating orthosis uses and more need for assistive products such as wheelchairs. To date, there appears to be limited studies on the long-term impact of using orthotic devices in LMICs. This implies a paucity of research about the impact of using orthoses and whether there are any challenges to long term use, such as increased pain and overuse of the working limb.

Interestingly, age at first appointment was also found to be significant in both models with less time between replacements being associated with an older age at first appointment. For instance, a service user aged ten at the time of their first appointment is expected to have less time between replacements compared to a user aged one when they had their first appointment. This is unexpected as those at younger ages would in theory need their devices replaced more than adults due to significant growth and higher activity levels during that period (Harkins *et al.,* 2013). It also appears to contradict the finding that as age increases, the number of days between replacements also increases. The fact that for both survival models, both age variables are significant suggests that age plays a significant role in utilisation of P&O services in Cambodia, with different age groups using services more than others. In the Andersen, Davidson and Baumeister (2013) model of health service use, outcomes are linked to health services, including consumer satisfaction with care and services received and quality of life. Orthoses and other assistive products have been found to improve access to employment, education and social participation, which in turn can improve quality of life (Eide & Øderud, 2009; Magnusson & Ahlström 2017; Ramstrand *et al.,* 2021). However, problems of pain during use of an orthosis device can impact consumer satisfaction with the device, which could then lead to orthoses being abandoned (Sugawara *et al.,* 2018). The impact of outcomes such as consumer satisfaction and quality of life can then impede or enable future physical rehabilitation service use.

The results of the survival analysis indicate slight differences between users from Phnom Penh, Kampong Chhnang and Sihanoukville for children and adults, although they were not found to be significant when controlling for other factors. Clients under 18 using the Sihanoukville clinic have less time between replacements, compared to Phnom Penh, whereas, for over 18s this was not found to be the case. For both over and under 18s, Kampong Chhnang had less time between replacements compared to Phnom Penh. Phnom Penh is highly urbanised, whereas Kampong Chhnang is more rural, with residents from this province relying more on agriculture and farming as their main employment compared to Phnom Penh. Kleinitz *et al.* (2012) state that in Cambodia during planting and harvesting seasons for people living in rural areas delays to healthcare seeking were more common due to the costs of themselves or carers missing work. Therefore, for services located in more rural settings, patterns of client utilisation may change throughout the year.

The coverage of assistive products in LMICs is frequently limited to urban or semi-urban areas, often with a limited range of assistive products offered (WHO-UNICEF, 2022). The differences between the clinics, while small, may also highlight that even though the same NGO is providing P&O services, variations are found between the clinics. The cause of the variation is unknown, however some potential causes for the difference are the different practices of the orthotists and P&O technicians to replace devices earlier in Sihanoukville than in Phnom Penh and Kampong Chhnang, as well as different client profiles. Staff practices, the lack of staff and poor management of health services have been identified as significant barriers to accessing healthcare services in Cambodia as well as communication barriers caused by ineffective communication from staff to service user can also impede access to using services (Jacobs *et al.,* 2011; Baart & Taaka, 2017). Hence, the difference between staff members at each of the three clinics may provide one explanation for differences in replacements of orthoses. The impact of health service management and workforce is also noted in Andersen, Davidson and Baumeister (2013) model which state that they are contextual predisposing and enabling factors to health service utilisation.

Gender was found to be significantly associated to the replacement of orthotics for both child and adult service users. Boys under the age of 18 were significantly more likely to have orthotic devices replaced compared to girls. In contrast, for those over 18, men were significantly less likely to have a device replaced compared to women over the age of 18 years. The results highlight differences in P&O service use for males and females which is also impacted by age. The WHO-UNICEF (2022) report on AT states that in many countries women tend to have less access to assistive products because assistive products, the services and the health professionals operating them are not gender friendly. In other studies, gender has been found to impact access to assistive products and P&O services. For instance, in a study by Allen *et al.* (2022) in Sierra Leone on access to prosthetic services, women reported facing childcare barriers and having less access to transportation compared to men. In contrast, this research found women have their orthotics replaced significantly more often than men, which suggests that in this case, women do not necessarily have lower access than men. P&O services should be available and accessible to those who need it, and AT providers should continue to work to improve access to services for men and boys and women and girls, and also the systems that enable P&O service use, such as free services, providing travel or transport support, and community outreach. Furthermore, ensuring that female POs and rehabilitation workers are fully trained is important to ensure gender equity in service use, as not all patients will feel comfortable being seen by a member of the other sex (Magnusson, 2019). An implication of this finding for the future is that analysis of service use should routinely be done by gender. This study has found differences in gender for those under and over the age of 18 which suggests that for future work, analysis should be disaggregated by both age and gender.

It was hypothesised in this study that people with certain reasons for orthosis use utilise P&O services differently. In the data, significant differences were found for clients under the age of 18, however no significant differences were found for those aged over 18. Those under the age of 18 with cerebral palsy had the most time between replacements compared to other reasons for orthosis use. This suggests that children with cerebral palsy do not have their devices replaced as frequently as other children. For children with cerebral palsy, the majority reach their gross motor potential before their fifth birthday and for severe cerebral palsy potential may be reached even earlier (Karim *et al.,* 2021). Therefore, early intervention is key for rehabilitation to have the most long-term impact (Smythe *et al.,* 2022). Having effective interventions as a child can improve outcomes as an adult and improve quality of life, including requiring less or no rehabilitation as an adult. For Exceed's service delivery, this suggests that access to more frequent physical rehabilitation for this particular group could lead to more favourable outcomes in terms of gross motor potential. This could include increasing access through community-based rehabilitation and follow-up appointments.

For adults, compared to clients' with sequalae of Polio, no difference in orthotic device replacements was found for client's over 18 years with trauma, paralysis, fractures or dislocations as their reasons for orthosis use. Barth *et al.* (2021) found in their comparative observational study of traumatic amputations that delays to rehabilitation were shorter for different causes of amputation, with non-traumatic amputations having a shorter delay between amputation and rehabilitation use compared to those with a traumatic cause of amputation. Understanding whether different causes of impairment have different levels of access to care is vital for improving access to rehabilitation services. Interventions may be needed to improve access and awareness or knowledge of rehabilitative services.

Furthermore, for under 18s, the hazard ratio was lower for clients with spinal orthoses compared to AFOs or FOs, although this was not significant. This adds an extra barrier to access P&O service for those outside Phnom Penh municipality, as they have to bypass closer physical rehabilitation centres to see a specialist in a different province. The type of orthotic device worn was shown to impact frequency of utilising P&O services in Cambodia. For service users under 18 years, children that have had an SFAB or a shoe raise, or 'other' orthotics, were significantly more likely to get these replaced, compared to AFOs and FOs. This is unsurprising because SFABs are typically given to children as part of the Ponseti method to treat club foot and it is recommended that children are followed up monthly at first, with follow up increasingly further apart until age four (Mang'oli *et al.,* 2014). This means that SFABs are expected to be replaced more frequently for the best outcomes. For those who utilising shoe raises, this orthotic device is smaller and are worn either as an insole inside the shoe or on the bottom of the sole, hence, are not made of lots of component parts. In many countries, there is inadequate provision of assistive products, including spare and component parts for orthotics (WHO-UNICEF, 2022). Therefore, replacing a shoe raise can be cheaper and less time-consuming than other devices such as AFOs, KAFOs and spinal orthoses.

For service users over the age of 18, clients who use shoe raises are significantly more likely to have these replaced than AFOS or FOs. As with those under 18 this is due to the ease of replacement of this type of orthotic device. The analysis also found that for adults with KAFOs that these are replaced significantly less than those with AFOs and FOs. KAFOs are larger orthotic devices with encompasses the foot, ankle and knee of the user. The process of making a KAFO involves limb casting for the device to be handmade by an orthotist or PO technician. This type of device can take several weeks to make and may require multiple trips to the clinics for fitting. This may cause people to delay getting a device replaced or using it for longer than expected or self-repairing. Therefore, due to the time it can take to make the device, this may explain why for those over 18 years KAFO users have more time between orthotic replacements. This indicates the need for long-lasting and well-made assistive products, as the time it takes to make an orthotic can negatively impact users. The Andersen, Davidson and Baumeister (2013) model states that process of medical care impacts health behaviours to accessing services. Assistive product providers should put systems in place to ensure waiting times are acceptable, source high-quality components that have longevity and also provide orthosis users with care instructions to ensure devices are well maintained. Follow-up services are an important aspect of P&O services as check-ups and regular maintenance can increase the longevity of a device, therefore, it important that funding is allocated to follow-up services and community-based rehabilitation programmes to facilitate access (Magnusson & Ahlström, 2017).

Exceed also provide mobility aids such as crutches and walkers or wheelchairs to help with mobility. In the database, several clients have been provided with both an orthosis and another assistive product. Previous research shows that prosthetic and orthotic users choose to use crutches or wheelchairs alongside their orthotic device, with orthotic users using their crutches more than prosthetics users (Magnusson *et al.,* 2014). Clients aged 18 and over have significantly less time between replacements when they have been previously given a wheelchair or mobility aid. For those under 18, no significant differences were found although having a wheelchair or mobility aid was associated with a lower likelihood of orthotic replacement. Using or having access to an additional assistive product may indicate a more severe physical impairment, which in turn may mean that a client relies on their device for walking and standing more than someone with a less severe physical impairment.

Other contact with Exceed, for services such as repairs of orthotics, was also found to be a significant predictor of orthotic device replacement for those aged 18 or over. Clients that have used Exceed services for at least one orthotic device repair at any time are more likely to have a replacement compared to those that have never used the service for repairs. For those aged under 18, any repairs sought was not found to be a significant predictor of orthotic replacements. This may be due to the orthotic device given to younger age groups being less likely to be repaired. Moreover, clients that have orthotic devices repaired more frequently may be different to those who do not. For example, they may live in closer proximity to the services or are able to take time out of work more frequently, so their access is not impeded. Therefore, they are more likely to interact with the services for repairs and replacements due to relying more on the device. Data about proximity to the service was not available in the dataset, meaning it cannot be known for certain why this difference has been found. Future research could be done to investigate access to P&O services which includes further information into occupation, severity of medical condition and need for services more closely.

5.4.3 Use of administrative data

The findings from this analysis using routinely collected data highlight the demographic and clinical characteristics of orthosis users from three P&O clinics, as well as differences in service use for replacement orthoses over time. There are many potential benefits of analysing administrative data for service users, healthcare providers and policy makers as the data can highlight where resources can be targeted to improve services and accessibility. In the absence of other types of data, administrative data can be used to provide real world evidence on how P&O services are utilised (Miller & Wurdeman, 2021). In this study, the results were found to be consistent with other studies, for example, the demographic differences in prevalence of clubfoot and idiopathic scoliosis and gender (Gibbons & Gray, 2013; Konieczny *et al.,* 2013). This provides a certain degree of confidence in the results found. Other findings were less anticipated though, for example women having less time between orthosis replacement than men.

Whilst a number of significant results were found, using administrative data to investigate P&O service use has challenges. The PMS5 database had a limited number of variables that were able to be used in the analysis due to large amounts of missing and inconsistent data between the three Exceed clinics, despite using the same standardised database. For example, occupation data was collected from the clients when they first attended the clinic, however, this data was never updated throughout their time using the services. This means that those who first came to the clinic as a child, their occupation is still listed as ‘child’, despite now being an adult. Information pertaining to the side of the body impacted was also missing in the Kampong Chhnang dataset, so was not used the analysis. The accuracy of the Exceed data depends on how it is reported and entered into the PMS5 database by employees and is affected by any differences in reporting practices (Dickinson *et al.,* 2022). To improve the recording of patient data, providers of assistive products, such as Exceed, should provide training and sufficient guidelines to those entering the data to ensure consistency within and between services. Having consistency makes analysing the data more efficient to conduct and more accurate, which in turn could lead to more frequent analysis to investigate changes in service provision over time. This information could then be shared with government bodies, IOs and other key rehabilitation actors to support policy decision-making. The WHO-UNICEF report (2022) states that all countries should invest in collecting and analysing data to develop evidence-based policy.

Administrative data can help to understand national AT situations by providing context and knowledge about who is using services. This should be done in conjunction with other data to understand need and gaps in service provision. In 2018, the rapid Assistive Technology Assessment (rATA) questionnaire was first drafted to collect self-reported data on AT (WHO-UNICEF, 2022). Data collected from 35 countries was subsequently collected and completed in 2021 using the rATA survey. This was the first large-scale representative survey of its kind to collect data on access to AT and assistive products. Two Southeast Asian countries were involved in the data collection, these were Myanmar and Indonesia. Currently, there is no published research using the rATA survey in Cambodia, so, in the absence of survey data, administrative data can be used to fill this gap. Administrative data can also have specific benefits over survey data. Survey data is often collected cross-sectionally, making it challenging to investigate device use over time due to the data being gathered at a single time point (Miller & Wurdeman, 2021). Longitudinal population level surveys which follow the same individual over time are expensive and often not possible in low resource settings. Therefore, patient data can provide unique insights into the utilisation of rehabilitation services and how use may change over time in a low resource setting. Overall, this study has demonstrated that administrative data can be used to explore trends in use and service users of P&O clinics in a low resource setting. The application of survival analysis also demonstrates that the analysis performed can move beyond descriptive statistics to help to explain differences in service use of orthosis users. The results can then be used by service providers to target interventions or outreach programmes to certain population groups. In addition, the results suggest a greater need for consistency in client data recording, to ensure uniformity between the three clinics to enable valuable comparisons to be drawn. This could be done through the training of rehabilitation workers in the storing and managing data, and the importance of understanding who is using services.

5.5 Limitations

This study has used a novel approach to examine differences in P&O services utilisation from administrative data. As noted in the previous section, the administrative data has its disadvantages, such as missing data and a limited number of variables. Hence, population-based data, from surveys for example, do have specific benefits over using administrative data to study demand for services. The data taken from this study may not be generalisable to Cambodia as a whole, because the data only includes service users of Exceed services and is not necessarily representative of the wider population (Timofte *et al.,* 2018). In this study, no information is available about those who are not using P&O services for orthoses, as the data does not correspond to prevalence, rather utilisation of physical rehabilitation for orthotics (Barth *et al.,* 2021). This means that this study cannot explain why some people are not accessing P&O services for orthotic devices. It is important to know why people are not accessing services as they may face greater barriers to access compared to those who are active service users. Another limitation is the inability to know why people are no longer using the services or why they no longer appear in the data. There are many potential reasons such as death, no longer needing or wanting to use the service or using another provider of assistive products or moving away from the area.

There are also some methodological limitations of this study, in addition to the limitations of using administrative data. In survival analysis, analysis time is important and identifying the correct entry times and censoring of the data can be challenging (Rabe-Heskth & Skrondal, 2012). This study has individuals entering and leaving the dataset at different time points. This makes the dataset complex, which can leave it vulnerable to misspecification. To take into account the complexity of the data, an extended Cox proportional hazard model was used, the PWP-GT model. There is a specific limitation for this model in that for later events, estimates can become unstable due to risk sets becoming small (Amorim & Cai, 2015). This means that the data needs to be truncated, so only those with less than fifteen events were included. The data analysis was also restricted by the study data and the proportional hazards assumptions required by the survival analysis. This led to a relatively small sample size used in the survival models compared to the full sample used in the descriptive analysis. For instance, for those aged over 18 years, only seven orthotics given to clients were either a spinal or other type of device. Furthermore, separating age into smaller groups would also be beneficial for understanding differences in service use, however the sample size was not large enough to do this.

5.6 Conclusion

The purpose of this study was to investigate the utilisation of P&O services for orthotic devices using data from three P&O clinics in Cambodia. It adds to the growing amount of research that uses administrative data in LMICs to assess use of and access to rehabilitation services. The results of both the descriptive statistics and survival analysis show important differences in the utilisation of Exceed’s services for orthotics and that service users are not a homogenous group. The patterns of service use for children and adults was shown to be different and therefore, interventions to enable access should be addressed and designed according to the target age group. Examining administrative data is an important tool for understanding more about the utilisation of services by helping to identify who is using the services, and potentially whether there are groups that are underrepresented in the data. This highlights the importance of collecting quality administrative data and ensuring that those collecting the data understand and recognise the importance of this data being accurate. In addition, collecting and updating data from service users’ socio-demographic information such as occupation and education will help to further understand service users and where interventions can be better targeted. Future research could also investigate the impact that COVID-19 has had on healthcare seeking behaviour for orthotic services. For example, a comparison could be done between appointments pre-2020 and after 2020 during the COVID-19 outbreak in 2020 and 2021.

Chapter 6 Paper 3: Understanding the pathways to physical rehabilitation and assistive products and the barriers and facilitators faced to access services in Cambodia

6.1 Background

Globally, people with disabilities can benefit from access to Assistive Technologies (AT) and physical rehabilitation activities to aid and support mobility, independence, self-care and communication (WHO, 2022a). AT is an umbrella term for the systems and services which relate to the delivery of assistive products, including physiotherapy, such as prosthetics, orthotics, wheelchairs and crutches to help with mobility, as well as other types of assistive products such as hearing aids, communication aids and eye glasses (WHO-UNICEF, 2022). The United Nations Convention of the Rights of People with Disabilities (UNCRPD) states that access to rehabilitative care for people with disabilities is a human right, meaning provisions should be accessible for all. Furthermore, the Sustainable Development Goals (SDGs) are a list of seventeen goals which aim to end poverty, reduce inequality and encourage economic growth globally. The third SDG promotes health and wellbeing for all, particularly vulnerable groups like those with disabilities. Target 3.8 specifically aims to attain Universal Health Coverage (UHC) of basic medical services, affordable medications, and immunisations for everyone (WHO, 2020). The WHO defines UHC as "*all people and communities can use the promotive, preventive, curative, rehabilitative and palliative health services they need without fear of financial hardship*" (WHO, 2020a, p. 6). This includes access to services that promote health, such as informational campaigns, immunisation programmes, physical therapy, and AT. However, in the third SDG, access to assistive products is not specifically recognised as important mechanism in promoting health for all. Yet, access to assistive products can enable independence, the ability to achieve an education, access to employment opportunities and social participation, all of which can enhance the achievement of further SDGs (Tebbutt *et al.,* 2016).

Despite this, assistive products and physical rehabilitation services are unavailable to many people due to the lack of services and development of rehabilitation within health systems in Low- and Middle-Income Countries (LMICs). Additionally, if services are available, they are inaccessible to many because of barriers such as the costs of using services, lack of transport and distance to facilities. Therefore, these challenges make it difficult for people to get the services they want or need (Borg *et al.,* 2011). These challenges are important to explore, as early interventions for rehabilitation can mitigate the risk of further and ongoing complications for individuals, communities and the health system (Mills *et al.,* 2018). Prosthetic and Orthotics (P&Os) are an important component of physical rehabilitation services and play a vital role in delivering assistive products within health systems. P&O services typically provide prosthetics and orthotics, as well as other mobility aids such as wheelchairs and crutches. As part of P&O services, physiotherapy sessions may also be offered if the service has trained physiotherapists, although this is not always the case in LMICs as the supply of human-resources for rehabilitation is limited (Gupta *et al.,* 2011). This means that trained rehabilitation professionals often have to provide comprehensive services in different aspects of rehabilitation, even when training is lacking (Mulindwa *et al.,* 2023). Currently, there is limited research to estimate the unmet need for orthoses and other assistive products such as wheelchairs in LMICs, with the majority focusing on the unmet need for prosthetics. Overall, the unmet need for assistive products in LMICs is high, with the WHO estimating in 2011 that approximately 100 million people worldwide require access to P&O products such as prosthetics and orthotics, although it is not clear whether this figure also includes other assistive products such as mobility aids (WHO, 2011).

Orthotics are assistive products that are applied externally to the body to assist the structure and functioning of neuro-muscular and skeletal systems (ATscale, 2020). The main purpose of wearing an orthotic is to control the position and movement of the body. These devices can be used on various parts of the body, for example ankles, legs, back and arms. Two common types of orthoses are Ankle-Foot Orthoses (AFOs) and Knee-Ankle-Foot Orthoses (KAFOs) which are custom braces worn on the lower body. Wheelchairs are commonly used by individuals with a range of conditions for example, people with physical disabilities, people with chronic conditions, the elderly and people with short-term conditions such as broken limbs (WHO-UNICEF, 2022). Several types of wheelchairs exist, however manual wheelchairs are typically provided in LMICs and are often imported or donated via Non-Governmental Organisations (NGOs) from high-resource settings (Rispin & Wee, 2015). The wheelchairs provided may be inappropriate for local environments, for example in the context of seasonal flooding and uneven or challenging terrains (McSweeney & Gowran, 2019). Additionally, wheelchair prescription is multifaceted, and many factors need to be considered when prescribing wheelchairs. This can pose challenges, particularly regarding poor education and training of personnel in wheelchair prescription. The negative consequences can impact the wheelchair user’s physical health, safety, vocational and economic status and quality of life (McSweeney & Gowran, 2019). There is often an overlap between orthosis and wheelchair users, particularly for those with lower limb conditions. Orthoses users may choose to use a wheelchair when not using their orthotic device to enable mobility, or orthoses users that are no longer able to wear an orthosis due to ageing or worsening of their condition may opt to permanently use a wheelchair. Hence this research study, explores orthosis and wheelchair users lived experiences in seeking physical rehabilitation at P&O clinics.

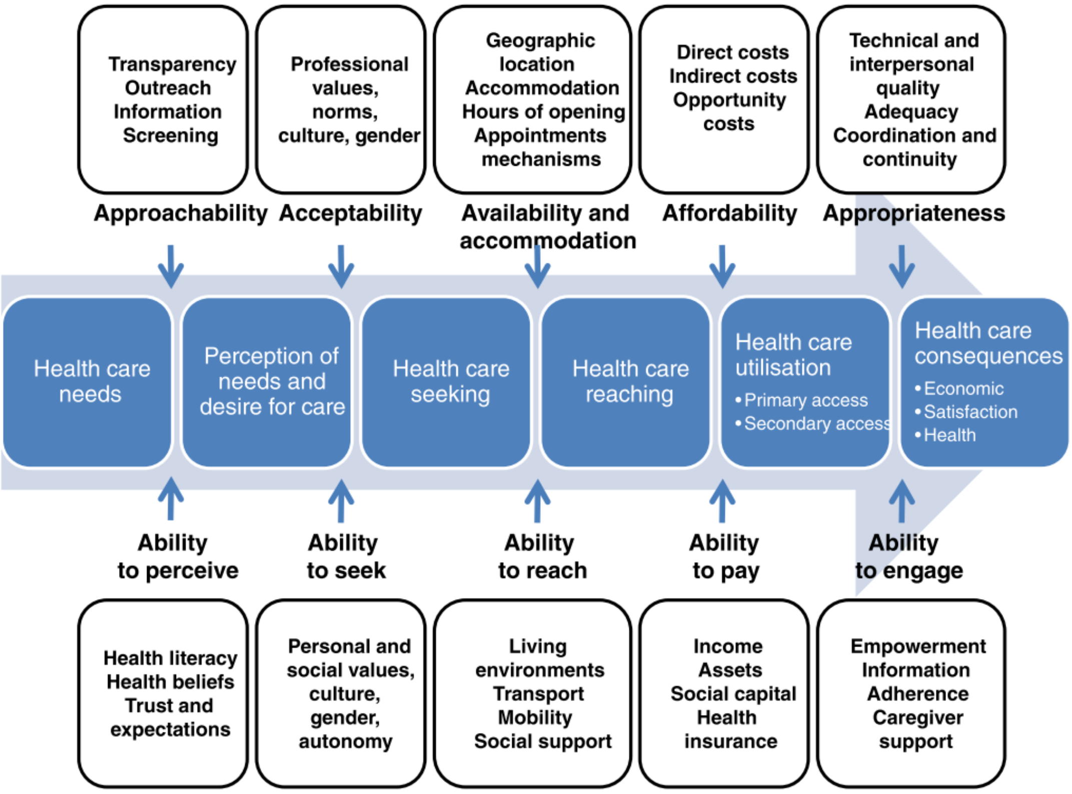
Poor awareness and referral systems for physical rehabilitation in LMICs causes the absence of effective care continuums. This means that individuals often have extensive delays before accessing P&O services and receiving an assistive product (ATscale, 2020; WHO-UNICEF, 2022). The care continuum can be described as how patients are followed by healthcare providers through different stages of care, for example, health promotion, preventive, curative, and after-care such as rehabilitation services (Heine & Hanekom, 2023). The care continuum should be a coordinated effort by different providers to deliver better outcomes for patients. Within the context of rehabilitation, rehabilitative care needs to be integrated into healthcare and should begin within the hospital setting (Wissel *et al.,* 2013). There is little research into the continuum of care in rehabilitation in low-resource settings, including how people find out and learn about services available. Existing research in these areas typically concentrates on adherence to rehabilitation and illness detection, rather than linking care services across a continuum (Heine & Hanekom, 2023). There are certain conditions, for example strokes, that require an integrated and comprehensive continuum of care to ensure that survivors and their families are supported (Wissel *et al.,* 2013). In LMICs, physical rehabilitation users may find that services are fragmented with weak links between the health and rehabilitation sectors preventing effective continuums of care (WHO, 2017a). This means people often wait for long periods of time before accessing physical rehabilitation services. In this respect, rehabilitative care pathways are the processes negotiated by potential service users to gain access to P&O services.

Existing research relating to P&O tends to focus on the products and their design and focuses on developing highly engineered devices to improve functional outcomes. However, in many LMICs, delivering high-spec assistive products on a wide scale is not sustainable or feasible because the rehabilitation systems and structures are not in place. In comparison to research about prosthetic users, there is less research which focuses solely on the experiences of orthotic and wheelchair users. Many studies opt to explore both P&O or just prosthetic users' access to P&O services in LMICs. Consequently, there is a paucity of research about orthotic and wheelchair users' experiences. Therefore, this paper seeks to fill this gap in the literature by exploring the barriers to accessing P&O services for orthosis and wheelchairs users and the rehabilitative care pathways followed by services users. To do this, a qualitative design has been adopted and semi-structured in-depth interviews were used to collect data to gain insights into the lived experiences of rehabilitative care and the pathways undertaken to access P&O services in Cambodia.

6.1.1 Conceptual framework

There are many ways that access can be conceptualised. In this paper, the conceptual framework proposed by Levesque, Harris & Russell (2013) has been used to describe access to rehabilitation. This framework utilises a patient-centred structure, as shown by the central boxes and arrow in Figure 6.1. This arrow follows the path a person takes to identifying healthcare needs to obtaining healthcare services and the potential supply and demand side factors that may impact access (Levesque *et al.,* 2013). Within the framework, five dimensions of accessibility have been included, these are: Approachability; Acceptability; Availability and accommodation; Affordability; and Appropriateness. Additionally, the abilities of individuals are included as five corresponding dimensions, these are: Ability to perceive; Ability to seek; Ability to reach; Ability to pay; and Ability to engage (Levesque *et al.,* 2013). The five dimensions of access correspond to the stage of healthcare utilisation an individual is at, for example, when an individual identifies their healthcare needs, approachability and ability of an individual to perceive is associated with this stage. This includes supply and demand side factors such as transparency of services and individual health literacy and beliefs. This conceptual framework conceptualises access to healthcare in general. However, the framework remains valid for access to rehabilitation, such as P&O services, as the demand and supply side factors that can impact are similar. The WHO (2017a) positions rehabilitation within health systems, therefore, utilisation of rehabilitation is part of healthcare seeking.

Figure 6.1. Levesque, Harris & Russell (2013) model of patient-centred access to healthcare (Levesque *et al.,* 2013. pg. 5)



6.1.2 Barriers and facilitators to P&O services

Globally, there are many barriers which impede access to physical rehabilitation services. Conversely, access can be enabled through various facilitators to improve access to physical rehabilitation services. Facilitators are vital for reducing or removing the demand and supply side barriers that exist. The following paragraphs will examine the different barriers to P&O services and physical rehabilitation in LMICs using the Levesque, Harris & Russell (2013) framework. Physical rehabilitation services, as offered at P&O clinics, are an important component of the health system for people with disabilities. Despite their importance, the provision of P&O services and assistive products are inadequate in LMICs where there is a high unmet need for physical rehabilitation services and assistive products (WHO-UNICEF, 2022). There is often low priority given to provisions of assistive products in low resource settings, with governments focusing on primary health care coverage and basic packages of care (ATscale, 2020). This means that there is often limited support for rehabilitation services provided by the government for people with disabilities, with NGOs and International Organisations (IOs) helping to fill the service provision gap. Access to physical rehabilitation is important across the continuum of care (Mills *et al.,* 2018), however; information about assistive products is insufficient. Limited awareness about P&O services can impact the livelihoods of people with physical disabilities and cause a delay in receiving physical rehabilitation (WHO-UNICEF, 2022). In turn, this impacts an individual's ability to attend school, participate within the community and earn a living.

Previous research indicates that there is a gender imbalance in access to P&O services, with studies finding that a higher percentage of men use physical rehabilitation services for prosthetics in Cambodia and other LMICs compared to women (Barth *et al.,* 2020; Barth *et al.,* 2021; Dickinson *et al.,* 2022). Although these studies are not able to measure prevalence and need for prosthetics devices. This may explain some of the difference in use of physical rehabilitation services for prosthetics. Research by Magnusson (2019) has found that there is more even balance in use of P&O services for orthotic devices. Gender and disability have been found to be linked, with research reporting stigmatisation faced by women and girls in Sierra Leone is made worse by their gender and disability (Allen *et al.,* 2022).

The affordability and ability of users to pay for services plays a significant role in the access to rehabilitation and P&O services in LMICs. The cost of available services has been identified as barrier to using rehabilitation for stroke rehabilitation (Bernhardt *et al.,* 2020). Rehabilitation services that are available often have certain cost-covering fees; in a qualitative study in Sierra Leone by Allen *et al.* (2022) participants reported being unable to use services because of the fees. Having a regular income can reduce the financial burden of accessing physical rehabilitation, however work-related barriers and the loss of income from utilising services can be damaging to access. Physical rehabilitation services that have opening hours during the workday only, means that an individual may have to take time away from work to use the services, potentially leading to a loss of income. Additionally, this can also impact family members or caregivers that may have to assist them in travelling to and from the services (Grills *et al.,* 2017). For those with low incomes, this can be detrimental to individual and household finances. This can lead to delays in accessing services until enough resources have been accrued to offset the loss of income. Previous research also indicates that people with disabilities are often more at risk of poverty than their non-disabled counterparts (Mitra, 2018; Banks *et al.,* 2021). Disability and poverty have a cyclical relationship, where disability can lead to poverty through an inability to work or have an education and poverty can lead to disability through poor living conditions, lack of access to healthcare and malnutrition (Groce *et al.,* 2011). In LMICs, people with disabilities are often unable to access employment due to stigma and marginalization. Previous research including P&O service users has found differences in employment status (Grills *et al.,* 2017; Magnusson & Ahlström, 2017; Allen *et al.,* 2022).

A lack of transport options can prevent people from accessing physical rehabilitation services. Transport can be expensive and physically inaccessible, particularly for people in rural areas. Vergunst *et al.* (2015) found that for wheelchair users in rural South Africa, accessing healthcare services was made more challenging due to the costs of transport and the lack of accessibility of privately owned minibus taxis in addition to a lack of public transport options. Facilitating use of rehabilitation services, such as improving transport systems and ambulatory services, particularly from rural areas can help to reduce these transport barriers. Furthermore, a limited availability of services means that participants often must travel long distances to access physical rehabilitation services. For example, in Namibia there is limited capacity for healthcare workers to deliver rehabilitation services in rural areas. As a result, Chatukuta *et al.* (2022) found differences in access to physical rehabilitation services for participants living in Windhoek, the capital city, and rural areas.

The availability of assistive products and their components also presents a major barrier for the health system to adequately supply devices to the population. In LMICs, health systems may frequently struggle to provide for people with disabilities in the procurement of medicines and medical supplies and assistive medical equipment to maintain adequate levels of service provision (WHO, 2022a). Allen *et al.* (2022) found that while public hospitals in Sierra Leone charge for crutches and were regularly able to provide them, the National Rehabilitation Centre, ran by the government, which provides crutches free of charge often experiences stock shortages. The lack of available assistive products provided free of charge perpetuates the financial barriers to accessing provisions of assistive products. This can then impact the lives of individuals who may benefit from access to an assistive product. Inconsistencies in service provision and lack of component parts to make high-quality assistive products can lead to the abandonment of assistive products and for service users to not return. Abandonment of assistive products can happen for several reasons including pain and discomfort when using the device, improper training on use and maintenance, lack of access to P&O services for repairs and simply people preferring not to use an assistive product (Federici *et al.,* 2016; Sugawara *et al.,* 2018).

At the macro level, various factors exist which impact the approachability and delivery of physical rehabilitation services, including limited funding and investment, a lack of political prioritisation, poor awareness of the need for ATs and market barriers (ATscale, 2020). Additionally, P&O workforces are chronically understaffed due to lack of trained professionals in the sector (Metcalf *et al.,* 2023). These supply challenges make the delivery of services difficult, which, in turn, impact the ability of individuals to access P&O services. There is also a lack of coordination between the health system and providers of rehabilitation due to the lack of integration of physical rehabilitation services into the health system in LMICs. This can lead to people being inappropriately discharged from hospitals when rehabilitation could be beneficial after events such as a stroke or road traffic accidents (WHO, 2017a). Access to specialised rehabilitation units within hospitals was found to improve physical functioning and increased receipt of assistive products (WHO, 2017a). In LMICs, physical rehabilitation centres which provide assistive products have been traditionally provided by NGOs and IOs. This causes challenges in establishing standardised referral systems as physical rehabilitation services may have little contact with hospitals and health centres. Having standardised referral pathways to rehabilitation between different levels of the health system is essential for maintaining a continuum of care for people that require prolonged care (WHO, 2017a). A key component of ensuring that rehabilitation services are integrated into the health system is to promote understanding of rehabilitation amongst the entire healthcare workforce to increase knowledge of services available and appropriate referrals (WHO, 2017a). This involves increasing coordination between the different health, education and social-welfare ministries, organisations or providers of physical rehabilitation and assistive technologies and local governments (WHO-UNICEF, 2022).

Information about physical rehabilitation services should be provided within local communities in local languages, accessible formats and at health centres where healthcare workers can direct individuals and their support networks to services (WHO-UNICEF, 2022). In LMICs, social networks are an important channel for information sharing in health where formal support is less available (Berkman *et al.,* 2000). Research by Perkins *et al.* (2015) highlights that people depend on social relationships in resource limited environments for support. This support can help to increase awareness of services, and also may enable access to service through assistance physically attended services. In addition, to be able to access suitable and sustainable options for rehabilitation, a person needs to understand their health and rehabilitation options to allow for informed decision-making. However, this is not always possible for example, for people with limited education, illiteracy or communication challenges (Baart & Taaka, 2017).

Access to physical rehabilitation, such as P&O services can be facilitated using Community Based Rehabilitation (CBR). CBR was first introduced by the WHO in the 1970s to address the lack of rehabilitation services available (Hartley *et al.,* 2009). It is an inclusive community development strategy that aims to use local resources to provide rehabilitation services from within communities in an equitable and sustainable way (Miles, 1996). The implementation of CBR programmes and activities are intended to be performed by people with disabilities themselves and their families and local communities alongside different health, educational, social, vocational and other services operated by governmental organisations and NGOs (Iemmi *et al.,* 2015). CBR often provides community-based initiatives that support and enable access to assistive products such as orthotics and wheelchairs. This is demonstrated by NGOs in Cambodia, such as Exceed, who use CBR strategies, such as community health workers conducting outreach, knowledge sharing, mobile repair services and wheelchair clinics to provide access to and information about services (Exceed Worldwide, 2022a). CBR activities can be important in improving access to hard-to-reach areas to increase knowledge of services available. This study is interested in exploring user's experiences of CBR activities as a potential facilitator of access to P&O services in Cambodia.

The barriers and facilitators described in this section have provided an overview of access to physical rehabilitation, with a focus on P&O services in LMICs and more specifically Cambodia. The individual barriers include the costs of using services, lack of and costs of transport, employment and caring responsibilities and health and rehabilitation service literacy have all been shown impact access. In contrast, social support networks, CBR and community outreach activities are a facilitator of access to P&O services. The remaining parts of this literature describe the demographics of disability and the provisions of physical rehabilitation and P&O services in Cambodia.

6.1.3 P&O services in Cambodia

The health system in Cambodia was severely affected by the Khmer Rouge's ascension to power in the 1970s. During their period of control from 1975 to 1979, an estimated two million Cambodians, in particularly educated citizens, died because of the regime (Dunleavy *et al.,* 2009; Grundy *et al.,* 2016). Due to the conflict, a large amount of unexploded ordnance such as mines and explosive remnants of war remain scattered throughout the landscape in Cambodia. From 1979 to 2021, over 45,000 people have been injured by landmines and other explosive remnants of war, although the since the early 2000s the number of people injured per year has decreased (CMAA, 2021). Poliomyelitis, hereafter polio, was still prevalent until the mid-1990s which means that many people with sequalae of polio are alive today. Furthermore, post-polio syndrome can develop later in life in people that contracted polio many years ago (Groce *et al.,* 2014). Other conditions which can lead to the use of P&O services for orthotics and wheelchairs are NCDs include Diabetes and Hypertension which are increasing in prevalence in Cambodia (Jacobs *et al.,* 2017; Dickinson *et al.,* 2022). The number of traffic accidents in Cambodia has also been increasing since the year 2000, with young people being the most likely to be in a road traffic collision (Kitamura *et al.,* 2018). Other conditions such as clubfoot and cerebral palsy are also prevalent as a cause of P&O service use, as demonstrated in Chapter 5 of this research.

Government provided physical rehabilitation centres, such as those providing P&O services, were under the remit of the Ministry of Social Affairs, Veterans and Youth Rehabilitation (MOSVY), rather than the Ministry of Health (MOH). At present, the responsibility of physical rehabilitation centres in Cambodia has moved to the MOH. The Persons with Disabilities Foundation (PWDF), established by the MOSVY, provides physical rehabilitation services in collaboration with four IOs and NGOs. In total, there are 11 physical rehabilitation centres where people can access P&O services. Exceed operate three of these physical rehabilitation centres in Phnom Penh, Kampong Chhnang and Sihanoukville. Exceed provide prostheses, orthoses, wheelchairs, mobility aids and physical therapy free of charge. They also operate a modern service clinic where individuals can purchase higher specification assistive products. In turn, this pay for service helps to fund the free of charge services. Community-based rehabilitation (CBR) activities and community workers are used by Exceed in service delivery. The community workers identify people with disabilities in local communities that require support and may benefit from P&O services and can refer them to Exceed centres (Exceed website, 2022a). The support offered does not just include physical treatments and access to assistive products, but also access to education and training and assistance to start a small business (Exceed website, 2022a).

6.1.4 Research Questions

This introductory section has summarised existing research on the barriers and facilitators to physical rehabilitation centres in LMICs. The aim of this paper is to understand how people who use orthotics and wheelchairs find out about, access and interact with physical rehabilitation services, and the barriers and facilitators they face. This research is important as it helps to uncover the mechanisms which support or impede access for users of orthotics and wheelchairs in Cambodia. Existing literature which focuses on both orthotics and wheelchair users in LMICs is sparse, therefore, this paper contributes much needed evidence to explore access to P&O services. To meet the aims of this paper, three research questions have been posed:

1. How are the pathways to health and rehabilitative care experienced and negotiated by people with physical disabilities in Cambodia?
2. How does access to assistive devices such as orthoses and wheelchairs impact the everyday lives of people with disabilities in Cambodia?

3. What are the facilitators and barriers for people with physical disabilities to accessing P&O services and healthcare services in Cambodia?

To answer these research questions a qualitative approach has been used to understand experiences of access to assistive products in Cambodia. This study found several themes in the data. These were: 1) Background context of impairment; 2) Experiences and impacts of access to P&O services; 3) Barriers to P&O services and 4) Facilitators to P&O services. Access to orthotics and wheelchairs were enablers of participants independence, ability to work and have an education and social inclusion. However, participants described experiencing various barriers to accessing services, including the costs and lack of availability of transport, employment, work, and family related barriers. The community health workers from Exceed were also identified as important facilitators of access to services. The following sections provide a description of the methodology and findings from the interviews and a discussion about the findings in the context of wider literature.

6.2 Methods

6.2.1 Design

This paper utilises a qualitative approach to explore participants' experiences in accessing and using P&O services for orthoses and wheelchair users. The data gathering technique selected for this study was semi-structured in-depth interviews. This involved conducting interviews with participants using a translator and the help of an interview guide. Using a semi-structured interview guide ensures the data collected reflects the research questions, but also allowing for flexibility in the interviews. The purpose of the interviews was to explore P&O service users' experiences of rehabilitative care pathways and the barriers to services. To do this, questions were asked about the healthcare seeking regarding their condition, first and most recent experiences of P&O service use for orthotic devices and wheelchairs and the impact of the assistive devices they received on their livelihoods. The interviews took place from May to June 2022 in Phnom Penh and Kandal province, Cambodia. Ethical approval for this study was granted from the University of Southampton Ethics and Research Governance Online (ERGO:68254.A1) and the National Ethics Committee for Health Research in Cambodia (NECHR:088).

6.2.2 Participants

This study aimed to recruit a maximum of 20 orthosis and wheelchair users that are currently or have previously used rehabilitation services from the Exceed. Exceed are an organisation which support people with disabilities in Southeast Asia and Sri Lanka by providing free P&O services. In total, Exceed have three centres located in Phnom Penh, Kampong Chhnang and Sihanoukville. For this study, participants were recruited from the Phnom Penh P&O centre only, but they may previously have used other P&O services from other providers in Cambodia. The decision to only include clients from the Phnom Penh clinic was due to the distance between the three clinics leading to limited time and resources to cover each of the clinics. This limits the scope of the study, as participants attending the Phnom Penh clinic may potentially have different experiences compared to services users of Kampong Chhnang and Sihanoukville.

The eligibility criteria to take part in the study was any individual between the age of 18 and 65 and a current or past user of an orthosis or wheelchair obtained from Exceed and other physical rehabilitation centres in Cambodia. Under 18s were excluded from this study, along with individuals with intellectual or other types of disability as these services users are likely to have differing needs and experiences compared to adults with physical impairments. Participants were recruited largely through a convenience sampling approach, for example, when a client attended the clinic for either a prearranged appointment or a walk-in visit. Those identified within the clinic as eligible were asked whether they would like to take part in the interview.

Community visits were also used to identify potential participants, where participants meeting the criteria were asked whether they were happy to take part. In total, three pre-planned community events were attended by the researcher. These community visits involved outreach activities to conduct a disability survey of villages and communes in the wider Phnom Penh area and surrounding Kandal province. The commune or village chief was contacted beforehand and asked to organise a meeting place for all people with disabilities in that local area. On the day of the visit, people with disabilities and their families would attend the event and Exceed community workers would record some basic information about them. Those attending the event would also be given information about Exceed services if they were unaware or had not previously used physical rehabilitation services and appointments were made for them to attend the Phnom Penh clinic in person for an assessment if they wanted.

The community visits also entailed home visits to those identified by other community members as having a person with a disability but were not in attendance at the event. One of the community visits consisted of a repair workshop, where in the same way as the other community visits, the village or commune chief was provided with the details of the repair workshop at a central location in the village or commune which people were able to drop in and attend for repairs to their assistive product. In total, five participants were recruited through the community visits. In addition, the final three participants were recruited via the community workers telephoning the participant in advance to ask whether they would like to take part and arranging an interview date and time. This was done because only two men were interviewed using a convenience sampling approach, and for the purpose of this research the experiences of both men and women were wanted.

Participants were provided with a Participant Information Sheet (PIS) with all the information pertaining to the purpose and format of the interviews, as well as how their data will be stored and who will have access to it. The PIS and consent forms were translated into Khmer by an employee of Exceed. For participants unable to read or with limited reading capacity, the PIS and consent form was read and explained to them by the translator. All participants signed the consent form before taking part the in study. After careful consideration and conversations with Exceed and colleagues who previously conducted fieldwork in Cambodia, it was decided to compensate participants for their time. The amount of 12,000 Khmer Riel was given to participants (equivalent to around GBP£2.40 in 2022), as well as a pen with the University of Southampton logo. The English version of the PIS and consent form can be found in Appendix C.1 and C.2.

6.2.3 Data collection

The interviews were performed with the help of a translator, a lecturer from the Department of Prosthetics and Orthotics (DPO) at the National Institute of Social Affairs. The questions were asked by the interviewer in English and then translated into Khmer by the translated for the participants. The participant’s response was then translated back into English by the translator. The interviews took place either at the Exceed P&O clinic in Phnom Penh or during community visits in the wider Phnom Penh and Kandal Province. The interviews that took place at the P&O clinic took place in a private room, either the assessment room or the DPO library, with only the interviewer, participant and translator present. During the community visits, four of the interviews were conducted at the home of the participant in a private area away from family members and the other community workers. One of the interviews was conducted at the community meeting area away from other people attending the community visits in a quiet location. The interviews were recorded using an audio device.

An emergent design approach was adopted in conducting the interviews. This meant that questions and interview techniques were continually adapted. After a few interviews, it became apparent that participants were finding it difficult to talk about their experiences of barriers to P&O services. The questions were then adjusted at the recommendation of a Cambodian colleague to better ensure understanding of the question by participants. Despite this, challenges remained, therefore, the possibility of interview facilitation methods was explored. In the end, eight flash cards were created in both Khmer and English with different barriers to accessing P&O services. The list of barriers was chosen based off previous literature, previous interviews and discussions with supervisors. This technique was more successful in facilitating conversations about participants' experiences of barriers to rehabilitative services, as it allowed them to share their experiences and explain whether these barriers prevented them from utilising services, or why they were not impacted by these barriers and allow them to offer other barriers that they faced. Some of examples of the interview facilitation cards can be found in Appendix C.3, as well as the semi-structured interview guide in Appendix C.4.

6.2.4 Analysis technique

The approach chosen for this research was thematic analysis because it allows for themes to be identified to provide a nuanced account of participants experiences. Other potential qualitative methods such as content analysis and grounded theory were considered but not found to be the most appropriate method to answer the proposed research questions. Grounded theory aims to construct theory from data which can allow for the creation of conceptual frameworks (Charmaz, 2006), which is not the aim or purpose of this study. Content analysis adopts a categorisation approach and involves systematically coding textual information to determine trends and patterns in words (Vaismoradi *et al.,* 2013). Thematic analysis is a common method to analyse qualitative data as it is an accessible and flexible approach to conduct qualitative research (Braun & Clarke, 2012). Further advantages of using this approach include the ability to analyse substantial amounts of data and a flexible choice of theoretical or epistemological framework (Kiger & Varpio, 2020). This method allows themes to be identified and organised with the aim of understanding the collective meanings and experiences when talking about certain topics (Braun & Clark, 2012), for example, talking to participants about the barriers they have faced in finding P&O services and making sense of commonalities between them.

To uncover the meanings and experiences of participants, deductive codes were developed from the outset, but inductive codes were allowed to emerge through an iterative process. This means that further codes were developed throughout the process of data analysis. This approach is explained in Fereday & Muir-Cochrane (2006), whereby, they describe how deductive and inductive codes can be used together to analyse qualitative data. The advantage of using an iterative framework when conducting thematic analysis is that it is not stuck to a rigid set of codes, and further meanings can be attributed to the data. The thematic analysis was performed within an interpretivist paradigm; so, participants own interpretation of social reality and their subjective experiences of using P&O

services are important. Firstly, to set up the thematic analysis, the interviews were transcribed by the researcher, by transcribing the English sections of the interviews, and making notes on the Khmer language sections, for example the tone of the participants voice, any long pauses, or displays of emotion such as crying. In the transcription, all spoken words and sounds were documents including hesitations, and long pauses. Any interruptions or background noises were also noted. Any questions arising from the interview or the content, the translator was contacted to assist and provide clarifications.

To ensure methodological rigour, the six steps for thematic analysis proposed by Braun & Clarke (2006) have been used to carry out the thematic analysis. The first step was to read the transcripts thoroughly several times before undertaking the analysis so to be fully familiarised with the data. Second, the codes from the codebook were applied to data and additional coding was performed and included a mixture of descriptive and interpretative codes. The third step then included searching for emerging themes by analysing, combing through and comparing the codes generated. Fourth, the themes and relevant sub-themes were thoroughly reviewed using an interpretivist lens and modified accordingly, for example combined or removed. The fifth step of the process then involved defining and naming themes. These final themes were checked to ensure they were brief but adequately descriptive. The ultimate step of the process involved interpreting the data within the context of the study, but also wider literature. The analysis was performed by the researcher, with the aid of NVivo version 16.1 to assist with data organisation.

6.2.5 Reflexivity

An important part of the research process is reflexivity and acknowledging the role of the researcher in the whole research process, from development to data analysis and discussion of the findings as prior assumptions, influences and pre-understandings can impact the research process and outcomes (Creswell & Poth, 2018). In addition, the researcher’s socio-demographic and cultural characteristics such as ethnicity, nationality, sexuality, class and gender influence the research process (Pillow, 2003). Therefore, researchers need to “position” themselves and write about their biases and experiences when conducting a qualitative study (Creswell & Poth, 2018). The main researcher is from the UK with a background in global health research with, at the time, limited previous experience of conducting qualitative research. This informed the project’s development in terms of the methods selected for the research. Previous research experience of the researcher has been more involved with quantitative research about barriers to healthcare services and physical rehabilitation in Cambodia, meaning this qualitative research was approached with pre-conceived notions of what barriers may exist. In addition, the researcher also does not identify as being disabled. The context of the study is important for qualitative studies, and despite spending some time in Cambodia and studying the cultural context of the health system, the researchers understanding of the context is limited due to being unable to speak the language and not having spent considerable amount of time living there. Relying on a translator to carry out the researcher could also have impacted that findings from this study. The translator, though sticking to the semi-structured interview questions, may have asked the questions in a slightly different way, or when additional questions were asked outside of the interview guide, these may have also been translated by the translator to have a different meaning.

6.3 Findings

Table 6.1 displays an overview of the participants. In total, 17 participants were interviewed for the study, of whom twelve were women and five were men ranging in age from 18 to 65 years, with a mean age of 35.2 years. Overall, the average interview length was 43 minutes, and the maximum interview length was 62 minutes, and the minimum interview length was 19 minutes. The most common type of assistive product used was KAFO, used by a total of nine participants. The table also includes information about participants occupation and highest education level; however, education was unknown for some participants due to the participant not sharing this information.

Table 6.1. Participant information

Pseudonym	Gender	Age	AT	Reason for device use	Location of interview	Occupation	Highest education level
Bopha	F	40	KAFO	Polio	Clinic	Factory worker	Unknown
Sambath	M	31	AFO	Polio	Clinic	Information Technology worker	University
Chaya	F	55	KAFO	Polio	Clinic	Housewife	Grade 4
Chhean	F	30	KAFO	Polio	Clinic	Hair Salon owner	Grade 6
Daevy	F	33	AFO	Polio	Clinic	Stay at home mother	University
Leap	F	35	AFO	Polio	Community	Salon owner and food seller	Grade 7
Sothy	F	38	KAFO	Polio	Clinic	Unemployed	None
Samnang	F	18	AFO	Cerebral Palsy	Clinic	Student	Grade 6
Sophal	F	51	KAFO	Polio	Community	Business owner	None
Chamroeun	F	20	AFO	Cerebral Palsy	Community	Unemployed	Grade 10
Rotha	F	18	KAFO	Polio	Clinic	Student	Grade 10
Choun	F	18	KAFO	Club Feet	Clinic	Student	Grade 8
Chea	F	28	Wheelchair	Undiagnosed spinal condition	Community	Business owner	Grade 2
Narin	M	65	Wheelchair	Stroke	Community	Unemployed	Unknown
Chanthou	M	51	Wheelchair	Polio	Community	Security Guard	Grade 7
Savy	M	35	KAFO	Polio	Community	Business Owner	University

Viseth	M	32	KAFO	Polio	Community	Business Owner	Grade 12

6.3.1 Theme 1: Background Context of Impairment

6.3.1.1 Medical conditions

The most stated cause of impairment for participants was fever, attributable to polio although it was not always formally diagnosed. All but one participant were either born with their impairment or were young children when their impairment developed, so they were often unable to go into much detail about the development of their medical condition and were relaying the information given to them by their parents or grandparents. Several participants also reported scepticism from their parents about the cause of their impairment. Many participant's parents or the participant themselves believe that their impairment was caused by the injection they had received as treatment at a healthcare facility. The translator stated that these injections were likely antibiotics or medicine to reduce fevers. This scepticism was also highlighted by one participant who stated that their mother did not believe or understand how a fever could impact their child's ability to walk.

"she also added that uh like that time before she got (illness) she also able to walk right, why, her mum unbelieve that why is after, she got uh fever for a night, why is she able to stand and walk right now" – Samnang (F, 18)

Due to the participant's age at the time of healthcare, decisions were made solely by their parents. As a result, participants did not know much about the treatment they had received. Two participants who were in their 40s and 50s at the time of the interview spoke about a lack of treatment options for them when they were younger due to the insecurity and civil unrest in the country. Some participants reported never seeking healthcare when they first became ill, even though they were experiencing paralysis or limb weakness. Khmer traditional treatments were also used exclusively or in combination with modern medicine.

"at that time only Khmer traditional treatment only, not brought her to the hospital or the other treatments… after few days and quite a few days still the mother didn't bring to the hospital" – Bopha (F, 40).

Healthcare was often sought from different providers with parents often using multiple types of healthcare to treat their medical condition. One participant attributed this to her mother not trusting what the healthcare providers were saying, but still was brought to different healthcare providers to find a treatment.

"when her mum like is not trust on that healthcare but she still bring her daughter to the other hospital to check up why this problem happen to her… she went all the places." – Sophal (F, 51)

The experiences of healthcare seeking at the time of illness varied, despite most participants having similar or the same cause of mobility impairment, i.e., polio. Some service users reported utilising treatment more than others. Participants gave several reasons for their parents not seeking medical care, such as lack of available healthcare services, parents being too busy with work and a lack of money to pay for treatment. Some reported that their parents sold assets or land to help fund medical expenditure.

6.3.1.2 Experiences of treatments

Lengthy delays from when participants first developed their impairment in receiving further medical treatment, including surgery or physiotherapy (PT) from a hospital or P&O service were common. These prolonged delays negatively impacted many people's conditions and impacted their mobility, meaning they had to undergo invasive surgery. Surgery, to release muscles and tendons in the lower limbs, was experienced by several participants, with many having to spend several months in hospital before they could receive an orthosis or wheelchair, and often using crutches or walkers in the meantime. No participants reported any ill effects of receiving surgery. Not all the recommended treatments were obtained though, for example some participants reported not being brought to the hospital to receive PT treatment by parents. A lack of treatment can make conditions worse and impact a person's day-to-day functioning further down the line. One participant explained that her mother refused the recommended surgery due to not believing it was necessary. This highlights the importance of trust in healthcare seeking; trusting the opinions of the healthcare provider or a lack of trust can play a key role in the management of health conditions. The reason for the lack of trust was not explored in depth in this study, but these findings indicate its role in parental healthcare seeking behaviours.

"But the doctor in Kantha Bopha hospital they mention that the most important thing is her trunk, her spine… they also decided to do the operation on her spine, but her mum didn't agree" – Chea (F, 28)

6.3.2 Theme 2: Experiences and impacts of access to P&O services

6.3.2.1 Initial P&O visits

The experiences of participants' first visit to a P&O clinic varied across participants. The first experience would usually involve an assessment and potentially PT treatments and casting for an orthotic device or assessment for wheelchair. For some participants, the first experience of getting fitted for a device was accompanied with pain, particularly for those that were children when they got their first device. The three male orthoses users interviewed did not report the same struggles getting used to the device, with one mentioning they found it only difficult for the first week, but they were able to adapt quickly. The experience of pain was described more by women that got their first orthosis as a child. The device was reported to be heavy when wearing for the first time, both AFOs and KAFOs can be bulky and heavy, especially for children. Fear was also something that participants experienced and caused participants when they were children to be emotional and scared of wearing their device. One participant stated that she was scared because she did not know what the orthosis was and thought they were going to put metal inside her leg.

"that time she was 8 years old, and then uh because that time she's scary to use the KAFO because she thought they might take uh metal to put inside the leg…that's why she's scary about using an orthosis" – Rotha (F, 18)

Many participants stated that they wanted to persevere with the device because they wanted to feel comfortable using it as they believed that it would benefit them eventually. Adapting to the device was quicker for some participants, with them stating it only took a few weeks and they felt comfortable, although for some participants this took longer. Furthermore, one participant spoke about how the device first gave her blisters which were very painful, but she adapted by wearing multiple socks to prevent it from happening.

"she said that for the first device it was like heavy…and difficult to take a step, and step her weight to walk, so that's why [stutter] she doesn't want to use much. But (name) community worker try to encourage a lot and so now she's familiar with the device and she's able to use for the whole day" – Sophal (F, 51)

Participants demonstrated a desire to use assistive products through their perseverance despite the initial negative experiences with pain. This tenacity enabled participants to continue until they became accustomed to their assistive product. However, not all participants were able to get used to their device at first, which led to the first orthosis being abandoned, and waiting several years to try again. The willingness to try again also links to the belief that having an assistive device is a positive aid.

"she said that after she throw that device, the first device away… she said she afraid to be shy so that's why she try… try to… to get the second device and try to walk with with that device that place the knee in flexion" – Bopha (F, 40)

6.3.2.2 Impact of P&O service use

According to many participants, the assistive products impacted their lives in different ways. This positive impact of orthotics and wheelchairs were frequently reported by participants as it enabled their independence, mobility and inclusion; without these assistive products they would not have the same quality of life. Participants stated that having access to an assistive product makes them feel happy and more confident. Having an assistive product also improved how others treated participants. Participants reported that they were able to make friends more easily because of their orthotic device. Being able to do housework and exercise independence was important to participants.

"*…with an orthosis is better because both hand are free and she is able to walk faster and able to do the housework, like more confident and, how you say, more faster" – Sothy (F, 38)*

Orthotic devices were typically used for most of the day, with participants only removing them to wash or when going to bed. For participants using wheelchairs, these were less used when at home as they were not needed to move around the house. In contrast, wheelchair users always used their assistive product outside the home. One participant noted that they prefer not to take their orthotic device off unless they must because of the time it takes to don and doff it. This indicates a reliance on both orthotics and wheelchairs for mobility and moving around.

"she said sometime she take but uh she she take it off, but she said when take it off when she put it on, it take more time to put it on so that's why she didn't take it off." – Choun (F, 18)

Despite this, participants often delay attending P&O services for repairs or replacement assistive product due to several barriers faced (explored below), so they opt to make do with a broken or ill-fitting orthotic or wheelchair or repair their device themselves. One participant had actually been using the same orthosis for 11 years, which is much longer than the anticipated two to three years and had made several at-home repairs to the device. Furthermore, not all participants use or wear their device regularly or at all. This was attributed to several reasons, including not feeling confident and scared to use their assistive product, and not feeling like they need it due to being unemployed or their condition not being severe enough. For one participant from the community, they believe that they are stronger and more confident in walking when not using an orthotic device after stopping using their orthosis and was not interested in obtaining a new device. Another participant, from the clinic, also noted that wearing their orthotic device made their leg feel weaker and look smaller although they continued to use their orthotic device because it helped with their leg length discrepancy.

"… for her nowadays she just only stay home and sleep and walk around the house and not to do hard work so she said it is ok for her. Also she said that now when stopping using the device she feel herself also more more stronger and more confident because she said that when she was small she fall off or fall down right? But now is ok for her, she not… fall often" – Chamroeun (F, 20)

6.3.2.3 Limits of P&O services

Despite the positive impacts of the P&O services and assistive products, the opportunities afforded by using an assistive product did not ameliorate all issues. A handful of participants had some complaints about their orthosis or wheelchair. For example, using assistive products on uneven ground or when the ground is flooded makes moving more challenging and increases the risk of falling over. One participant also noted that wheelchair frames rust too easily. Additionally, orthoses were reported as being hot and sweaty, with the plastic of the orthosis expanding in the heat causing the device to become too loose and ill-fitting. Despite this, most participants did not have many criticisms or any suggestions for improvement of the services. This poses the question of whether participants are completely happy and content with the services, or whether they felt unable to criticise the services, or there are wider cultural and societal factors impacting expressing criticisms of services. More than half of the interviews were conducted at the Phnom Penh clinic which may have impacted their willingness to criticise the service. Participants who were interviewed within communities also did not frequently criticise the services, although this may be due to being part of the Exceed community visits.

More generally, despite P&O service use and access to assistive products, the impact of impairments on the day-to-day life of participants varied, with some impairments having a limited impact, ranging to more severe impact. The main issues reported by participants was mobility, with many commenting that without wearing an orthotic device or using a wheelchair, they are unable to walk without assistance or would need to crawl on the floor to move around. This also impacts their ability to carry out housework, such as cooking, cleaning, carrying water and practicing self-care. This limits their independence and having to rely on others for help or strengthens their reliance on an assistive device. The variation between clients also depended on the severity of their conditions, for example, those with worse mobility also struggled more with housework and self-care. Two female participants noted that their impairment or their assistive products impacts their ability to attend community or family events, such as wedding or ceremonies at the temple. One participant felt too shy to join in and explained how it made her friend angry at her for not attending, however, despite this she still did not feel comfortable attending. Furthermore, wearing an orthotic device impacts the ability to sit on the floor, as customary when attending a temple which would involve don and doffing their orthotic device.

"Even though like the other people ask her to join the ceremony or something, she's unable to go and sit down, right because, she need to wear the orthosis and she need to take off an orthosis." Sothy (F, 38)

Therefore, having an assistive product can enable participants to perform daily living activities. However, using an assistive device still impacts participants' willingness to take part in social and community events due to their feelings about themselves, and social norms and expectations. The interviews revealed that many participants had a negative self-perception or thoughts about themselves. This included feeling like a burden by interrupting the lives of their family for their assistance or feeling useless; this was particularly felt by the participant who acquired their impairment later in life. He compared himself to how he used to be, and that now he views himself as a 'useless' person because he's not able to do the same anymore, despite the people around him supporting him.

"yeah so the people around pity on him, it's just only him, he feel himself like before he can do everything and he worked hard, but now he cannot do anything so that's why he feel like he's a useless person" – Narin (M, 65)

Furthermore, three participants also reported having suicidal ideation due to how they feel about themselves and the negative treatment they face from other people. Participants also reported that people often did not treat them well or were mean to them due to their impairment, including name calling and staring. This negative treatment faced was mostly from strangers or people that do not know the participant well. One participant noted that people look at him like he is not 'normal'. This suggests that lack of exposure and contact with people with physical disability may perpetuate the stigma and marginalisation. Therefore, more awareness and education of people with physical disabilities is needed.

"but for her, especially, she said especially her relative like the old people, say something that mmm she is disabled … she hardly to go out and hardly to do something like that and then uh the other also like, when the way she walk they follow her, they… they do follow her and tease on her" – Samnang (F, 18)

Not all participants reported facing these challenges or feeling discriminated against. For some participants, having an orthotic device improved their ability to make friends and socialise with others. Some participants felt they were not disabled because they are able to 'do as other people'.

"she doesn't feel anyone discriminate or criticise on her disability or impairment…they (family) try to say that she's ok, she's able to, she has impairment but able to get married she has a family and she's able to work as the other normal people and compared to the other normal people because they have no job, they don't do anything, for she's her comparing to the normal people, she's better than the normal people." – Leap (F, 38)

These participants highlight that because they can work, be independent and contribute to their families and communities their impairment has an insignificant impact on their lives. The concept of 'normal' was described by several participants, because they are able blend in with 'normal' people, they have not experienced discrimination or ill treatment from others. This may also be due to the visibility of their disabilities, if they are able to hide or reduce the appearance of their disability, they may not face same level of discrimination. Additionally, some participant also stated that the treatment of people with disabilities had improved since they were a child. Participants attributed this to better education about disabled people in Cambodia and a shift towards a greater understanding about them. Some of those interviewed also expressed the need for more information sharing about in Cambodia to prevent the discrimination of people with disabilities through schools, TV and other types of media.

6.3.3 Theme 3: Barriers

6.3.3.1 Barriers to P&O services

The barriers to accessing P&O services reported by participants were numerous and included financial barriers, availability of transport distance, work and employment, lack of support networks, and caring responsibilities. The barriers were also not consistently experienced by all participants, as differences in barriers were reported between men and women, by employment status and education levels. The costs and availability of transport were noted by most participants as one of the key barriers to utilising P&O services for both clinic and community-based participant interviews, with one participant noting that many people with disabilities in Cambodia do not have access to disposable income. The main barriers stated by two men using KAFOs were the cost and time of travelling to Exceed clinics for repairing or replacement their orthotic device.

"this is the biggest barrier…we need to pay for the services and either we need to pay for the travel costs so is the big problem" – Savy (M, 35)

For one wheelchair user, they noted that transport was not barrier for them, but recognised that the significance of transport as barrier for people with disabilities in Cambodia. This participant had built their own modified motorcycle which allowed them to travel independently. The ability to modify their own transport enabled them to move around Phnom Penh more freely and removed transport as a barrier for them. Furthermore, women also noted the significance of transport barriers with travel expenditure preventing access to P&O services, particularly travelling alone to the clinic and having to pay for transport upfront. The reduction in support to help with transport expenditure given by Exceed to service users due to funding constraints, from a reduction in donor funding which became more apparent in the 2010s, impacted participants service use as it delayed service seeking. As Sothy mentions, this support had reduced by over half, so it no longer covers the total cost of the journey. This has a significant impact on the ability to attend the P&O clinic because participants must pay more upfront costs and impacts those living outside of Phnom Penh the most.

"So uh she said that before, previously… for both way from home to centre and back from centre to home is about 50,000 riel, so they gave 50,000 riel…but now…they gave her only 24,000 only" – Sothy (F, 38)

Exceed temporarily introduce cost-recovery to help cover the costs of making orthotic device to also help manage growing funding challenges in 2019. This was also reported as barrier. Some participants, particularly those in the community were not aware that cost recovery was no longer happening, as it ended in 2021. Work related barriers were also commonly reported by many participants. However, the type of occupation impacted how the barrier presented. Two participants who are employed by a company reported they did not feel comfortable requesting time off to use services. For Bopha, a factory worker, her employers were not happy to give her the time off to use services, despite her orthosis enabling her mobility and ability to work at the factory. Another barrier that participants frequently reported was loss of income from taking time away from work. One participant noted that she did not feel like she had the time because of work commitments. She expanded this point by stating that she was worried about the impact on her profit and potentially losing customers. This can have significant impact on household finances, and often disproportionately impact those that work in the informal sector.

"so when, you know like uh when they open the salon, so when they close for uh one day maybe the customer come to find her. So is maybe… impact the profit right." – Chhean (F, 30)

Barriers relating to caring responsibilities were reported solely by female participants. This included caring responsibilities for children and needing to find babysitters or family members that can take care of their child. Furthermore, caring responsibilities for older or sick parents also impacted access to P&O services as tasks need to be completed before leaving the home or alternative care arrangements needs to be made. The following participant stated they need to fulfil caring responsibilities before being able to leave the home.

"the main problem is her mother right now, her mother got accident so she need to cook, she need to prepare everything for her before she can go to, and she need to make everything at home before she's release herself from home" – Chea (F, 28)

COVID-19 was also reported as a barrier to utilising services for one participant, this was due to wanting to wait longer. Additionally, another participant cited both COVID-19 and pregnancy as barriers to use, despite her orthotic device not fitting well even before pregnancy. During the first wave of the pandemic, Exceed clinics were only open for repairs with no new devices being made. Therefore, for participants that needed a new device instead of just a repair had to delay using services.

6.3.3.2 Limited health knowledge

Poor health literacy and knowledge about services has been identified as a specific hinderance to P&O service use. Many participants are unsure about their diagnoses and the treatment they have previously received for their condition. Without participants knowing about the cause of their impairment it makes advocating for themselves challenging. They may be unable to seek out rehabilitation services if they do not understand their condition. Furthermore, this is particularly true in the case of finding out about the existence of suitable services, with several participants unaware about the services and provisions available to them. This led to them not starting using an assistive product until several years after first developing their impairment as a young child. One participant who did not find out about the P&O services available to them until they were in their late 20s noted that healthcare professionals will provide the information about the services available to amputees, but do not provide the same information to those who may benefit from orthotics or wheelchairs.

"so he said that err for people who lost their leg, right? so when they got treatment at the hospital so the doctor or nurse they know physiotherapy they know, they will share that in-information to the patient or the client and so they know about the service here. but for him, he said, as a Polio patient, yeah? so how can the other people explain to him that he have the service and going to provide free of charge and going to make an orthosis. So he says its different for those who lost limb" – Sambath (M, 31)

One participant also noted that after they spent time in hospital after having a stroke, they were not provided any information about rehabilitative services or where they can get wheelchairs from free of charge. This led to this the children of this participant sourcing their own assistive products, from a private seller which were poor in quality. A lack of awareness about where assistive products can be provided free of charge was therefore a barrier to accessing services.

"so after he got stroke, after a year so in 2017, his children or his kid bought one wheelchair for him but it was not strong and after that it was broken. And then he just request this wheelchair in in from Exceed in this year only." – Narin (M, 65)

6.3.4 Theme 4: Facilitators

6.3.4.1 Importance of community workers

As part of Exceed's services, they have a team of community workers that play an important role in outreach, and the delivery of services to those that live outside of Phnom Penh city. Many service users found out about Exceed P&O services through disability surveys conducted by community workers that attended villages in the wider Phnom Penh province and Kandal province. These surveys, conducted by Exceed, are facilitated by the chief of the village or commune who will provide the information about local residents that have a disability, or they will ask those with disabilities to gather in at a local pagoda or community meeting space so Exceed can share information. Exceed also distribute information to hospitals within Phnom Penh about the services that they offer. Participants also stated that when they were younger, the community workers organised transport that took them from their village to an Exceed clinic.

The community visits also include repair workshops and delivery of wheelchairs and crutches to service users. These are vital services for those that are not able to travel to Phnom Penh to attend the clinic in person often. It was noted that community visits have decreased over the years, and two participants mentioned that there should be more of them. Participants were very keen on community workers doing more at home visits as they enable service use, particularly for those that face many barriers to using services. Having these mobile repair workshops facilitates access to P&O services because it reduces the cost and transport barriers that participants contend with. The repair workshops and wheelchair delivery provide vital access to assistive products for service users in rural areas and for those with more severe mobility impairments, therefore can increase access for a wide range of people.

"so she said that erm it easy if the staff come to do the wheelchair repair at home because she said she mentioned that previously it ok because everything depend on mother right, and father, but now her mother after got accident she not really well and her father also getting old so that is really hard for her." – Chea (F, 28)

Participants also reported that the community workers and rehabilitation professionals working at Exceed had excellent communication with service users. The survey for collecting information from communities on disability was remarked by one participant as effective communication method to inform people about the services available. The community workers also provide important encouragement to service users. This encouragement enabled participants to continue using their device. One participant noted, friendly 'teasing' from the community workers was used to encourage wearing their device.

"then they also teasing to her when she's not wearing the device when she is growing up, she might feel shy when she goes out to see the other people…she said that she also want them to encourage the patient"– Bopha (F, 40)

Overall, the community workers provide a vital service to clients of Exceed. This ranges from home visits and repairing devices, to provide encouragement and support. This service is particularly important for those that live in Kandal Province where it can take several hours to travel to the clinic themselves. For these clients, having a mobile service enables access to P&O services and getting support with their assistive product.

6.3.4.2 Social support networks

Social support networks were found to be important facilitators of access for participants in multiple different ways. These networks enable P&O service use through providing transportation to and from services, providing money, encouraging service use and sharing information about services. This encouragement was due to the perceived benefit of the assistive products of the participants family and knowing they would be unable to earn money or be independent without it. Women participants spoke about how their family assists in taking them to the clinics by providing money or transporting them there, whereas male participants stated that their families pushed or forced them to go. Hence, the experiences of family support are different between men and women.

"he said this is not the barrier because his family is supporting him. He said that when his [stutter] orthosis broken, they always push him or force him to go" – Viseth (M, 32)

"she also said that the people at her family, when she go to centre they afraid that's she going to be like, because when she's travelling going to take 2 or 3 transportation. So so they said that its better to brought her, to bring her to the centre, if not she might be confusing the way, they so worry about her so" – Sophal (F, 51)

Participants were aided in getting to the clinics by the people in their communities, with neighbours offering to take them to and from the centre. Social networks were also important for participants finding out about services in the first place. Participants explained that they learnt about P&O services through other people they knew, some of whom were also service users themselves. However, this information was not always factually correct, as one participant explained they were told that a wheelchair provider in Kandal province could make orthotic devices, however the translator revealed this place only provides wheelchairs. This indicates the importance of ensuring that information about services is available in accessible formats to prevent miscommunication or wrong information being shared. Furthermore, one participant expressed a desire for wanting to share information about P&O services to other disabled people, however, they felt it was inappropriate for them to do so. This is due to cultural norms and lack of openness to talk about disability, makes people uncomfortable about sharing experiences with others.

"even though he he saw one lady also her leg the way she is walking is like bending the leg or something like that but he could not ask and he could talk or anything because he said that err that lady patient, so also he scary to talk with err that patient might be shy or something like that to talk with him so that's why he scary to talk and explain how the service here." Sambath, (M, 31)

Another participant also explained they that share information and the advantages of have a device with other disabled people in their community, but the other people with disabilities do not want to come to the service. The secrecy of disability within Cambodia means that for those that want to share information they may find it challenging to do so. Furthermore, there are also issues of not knowing whether a person is choosing not to using P&O services because they do not want to, rather than because they face barriers to accessing services.

6.3.4.3 Exceed enabling use

Participants generally spoke well about Exceed services and did not have many changes they would make to services, apart from issues such as providing more socks to wear with an orthosis. Good communication between the workers at Exceed clinics and service users was frequently mentioned by participants. Ensuring that service users feel comfortable when using the service can help facilitate use as negative experiences may prevent them from returning.

"he said that for the staff, staff … and everything, always good and welcome and either they also explaining when the wheelchairs or wheel and when it's time to come they appoint him to get the wheelchair so they explain clearly" – Chanthou (M, 51)

The lack of transport provisions and the costs of services were previously stated as barriers to using P&O services for participants. Exceed help towards transport costs, food and accommodation in addition to providing devices free of charge. One participant noted the importance of providing services that are free of charge to facilitate service use as not all Exceed clients can afford to pay. Therefore, by providing services free of charge, Exceed can ensure that all those who need to use the services can.

"so for him he said that it can be uh it can be good like example if uh for the services that providing for the client must be free but for the cost of the transportation, he said that some client are able to afford with that, so it's ok, but the main problem is services must be free" – Savy (M, 35)

When Exceed temporarily introduced costs for using P&O services for service users, they only paid a percentage of their income, so higher earning service users paid more for their device. However, despite the costs being proportional to income, this still was found to a be barrier. This highlights how important providing services free of charge are to facilitating P&O service use. One participant stated that she could not use the service because it was too expensive during time of cost-recovery, and now that it is no longer happening, she would go to Exceed to make a new device. The interviews highlighted that providing services free of charge is vital for enabling access to P&O services and to provide ongoing care.

6.3.4.4 Individual agency

The agency of participants relates to their capacity to make their own choices and decide for themselves where P&O services are sought. This acts as a facilitator because people were searching for services and wanted to know other places where they could receive assistive products. Participants demonstrated agency by changing between services or using multiple P&O providers.

This agency was expressed in several ways, for example, searching for a P&O service provider closer to their home or place of work to make it easy to access services. Furthermore, participants also wanted to try different providers to compare and contrast services in order to find the best service provider for them. Even when P&O services are limited, participants wanted to explore other providers because they were interested in what they have to offer, for example, one participant noted they wanted to attend Exceed services because she knew other people attending the services and wanted to try for herself.

"she said that actually she also heard VI in Kien Khleang right, but when she come to study in (name) school so that teacher said that ok because we have here so they just bring…But for her she feel interested, maybe her friend, so she feel interested that the teacher told her that Exceed also making the device, so that's why she came to Exceed." Rotha (F, 18)

This suggests that people with physical disabilities in Cambodia will travel further away and not near to their homes to get certain treatments in an attempt to improve their condition. This indicates that quality of services and individual preferences are important, and participants are willing to travel further afield to use them.

6.4 Discussion

The aim of this study was to explore the rehabilitation care pathways and how people who use orthosis and wheelchairs experience and negotiate them in Cambodia. This study also aimed to further understand the impact of assistive products on the everyday lives of orthosis and wheelchair users. The barriers and facilitators were explored, with participants reporting both barriers and facilitators to accessing P&O services for orthotics or wheelchairs. This section will explore the different findings for each of the research questions in the context of existing literature.

6.4.1 Pathways to health and physical rehabilitation services

In this research, participants reported different reasons for use of orthoses or wheelchairs, for instance, polio, cerebral palsy, clubfoot and stroke. It was identified that participants had differing pathways to health services and physical rehabilitation, with participants who reported they contracted polio as a child having long delays to receiving physical rehabilitation. In 1997, indigenous wild poliovirus (WPV) was reported to be eradicated in Cambodia (GPEI, N.D), however the impact of the virus remains with many people still alive today living with sequalae of polio or post-polio syndrome. Post-polio syndrome develops in 25% to 40% of polio survivors later in life in which disabling symptoms are developed (Groce *et al.,* 2014). Therefore, P&O services still provide services to many survivors of polio and those with post-polio syndrome.

As mentioned, sequalae of polio was the most frequent cause of impairment for participants, with clubfoot, cerebral palsy and stroke also being reported. For participants with sequalae of polio, they were often unsure about their exact diagnosis, and some believed that their impairments were caused by the treatment they received at the health centre or hospital at the time. This echoes findings by Andregård & Magnusson (2017) who found that many participants with sequalae of polio believed it was caused by the vaccine injection, which is possible with the oral vaccine (WHO, 2022d). Multiple sources of healthcare were also used in response to illness, ranging from different types of formal providers and traditional medicine. An ethnographic study by Khun & Manderson (2007) found that women caregivers for children with suspected dengue fever in Cambodia pragmatically shifted between different healthcare providers in response to the child's illness. This study found that participants reported seeking healthcare from different providers in response to a lack of improvement in their condition. Although this was not the case for all participants as some never received medical treatments during their initial illness that caused their physical impairment. The lack of healthcare seeking was attributed, by participants, to a lack of funds, a lack of availability of services and parents being busy with work.

In this study, participants understandings of their conditions were often disjointed, with many having a limited understanding of diagnoses they have received. Within society, understandings of disability and disease varies and intersects with people's experiences, beliefs and knowledge (Andregård & Magnusson, 2017). For people who are illiterate or have limited education, knowledge about disability and disease is built through verbal information and personal experiences (Lupton, 2012). This makes their understanding of disability susceptible to existing norms and beliefs about disability, which can perpetuate negative stereotypes and understandings (Andregård & Magnusson, 2017). Participants stated that they wanted more education about disability available through TV and media, accessible to everyone, not just those with disabilities. The UNCRPD recognises that governments should adopt measures to raise awareness throughout society about people with disabilities to combat harmful stereotypes and inform about the capabilities of people with disabilities (UN, N.Db). Therefore, governments should work to increase awareness to further implement the UNCRPD.

Participants reported having long delays in receiving their first assistive product, largely because they were unaware of the services available to them or because services were unavailable at that time, for example before the 1990s. For NCDs, such as stroke, early access to rehabilitation is vital for maximum recovery, however in LMICs the number of people able to access rehabilitation is low due to poor access, sporadic and low-skilled nature of the rehabilitation available (Bernhardt *et al.,* 2020). In LMICs, pathways to assistive technologies can be challenging to negotiate in part due to inadequate referral systems and a disconnect between the health system and rehabilitation providers (WHO-UNICEF, 2022). Referrals are still frequently not routine in LMICs, with hospitals directly discharging patients home without discussion or recommendations for rehabilitation (Morris *et al.,* 2021). In addition, physical rehabilitation services are frequently provided by NGOs who may have limited contact with the wider health system.

To increase access, in some LMICS, initiatives have been put in place to improve referral systems. More specifically, Namibia established a tax levy funds such as the Motor Vehicle Accident Fund (MVAF) which provides support such as medical costs, rehabilitation, carer allowances and lump sum payments for survivors of road traffic injuries (Chatukuta *et al.,* 2022). The study by Chatukuta *et al.* (2022) found that the MVAF was reported by healthcare workers to have improved awareness and access to physical rehabilitation for road injury survivors. However, initiatives such as the MVAF will have limited impact in improving access to physical rehabilitation for people with other causes of impairment, such as stroke. Furthermore, the initiative struggles with funding, staff, supply shortages and lack of physical rehabilitation centres available to access care (Chatukuta *et al.,* 2022). For Cambodia, a MVAF could help to strengthen the pathways to physical rehabilitation for certain causes of impairment, such as road traffic injuries, a leading cause of impairment currently (Kitamura *et al.,* 2018). This could help to fund physical rehabilitation centres and their integration within provincial and national hospitals. In Cambodia, there are only 11 public physical rehabilitation centres that can provide and repair assistive products across the country. The lack of available centres was commonly noted by participants as a barrier to utilising P&O services. Rehabilitation services, such as P&O clinics, are a vital component of the health system and are relevant along the continuum of care (WHO, 2017a). Access to rehabilitation for people with impairments ensures the maintenance of functioning during the post-acute and long-term phases of care (WHO, 2017a).

6.4.2 Impact of physical impairments and assistive products

The findings highlight that physical impairments can significantly impact the day to day lives and experiences of individuals in Cambodia. These experiences are unique to individuals and vary for different characteristics such as age, gender, and severity of impairment. In this study, participants reported their highest education level, which varied widely, with a few participants have no or very little education and some participants having completed secondary and university level education. In a study by Trani *et al.* (2018), it was found that people with impairments were less likely to have attended school, compared to people without impairments. Access to AT is vital for increasing access to health, education and employment in LMICs, as well as facilitating independent living and inclusion within communities (WHO-UNICEF, 2022). Without adequate provisions of orthotics and wheelchairs, people with physical impairments will continue to face challenges in accessing education. However, access to assistive products does not completely remove barriers to health services, education and employment for people with disabilities (Tebbutt *et al.,* 2016). In the presence of inaccessible transport systems and a lack of social assistance users of assistive products bear the brunt of the costs and loss of income associated with accessing P&O services in LMICs (WHO-UNICEF, 2022).

In many LMICs, including Cambodia, people with disabilities experience discrimination and stigmatisation because of their impairments (DSPD, 2016; Barbareschi *et al.,* 2021). The reasons for this are often due to misconceptions about the causes of disability and lack of understanding, which are often rooted in traditional or religious cultural perceptions (Rohwerder, 2018a; Barbareschi *et al.,* 2021). For example, in Cambodia, people with disabilities may be viewed as having bad karma and are disabled as punishment for their, or a family members bad behaviour in their current or previous lives (Nuth *et al.,* 2018). The impact of these negative attitudes towards disability means that people with disabilities experience stigmatisation and discrimination. This discrimination can have a significant impact on the livelihoods of people with disabilities in LMICs, and prevent equal access to employment, education, healthcare and social participation compared to people without disabilities (UN, 2018).

Different types of disability also have different levels of stigma attached, as well as other characteristics such as severity and socio-economic status (Rohwerder, 2018a). Discrimination was not reported by all participants in the study as they were able to do as '*normal*' people and described their ability to work and have a family as being the same as others. Thus, they described being able to adapt with their impairment and did not report facing activity and participation limitations. This adheres to the ICF understanding of disability, where impairments are not the sole cause of disability, rather it is the interaction between impairments and health conditions with activity and participation prescriptions (WHO, 2002). It was argued by Grech *et al.* (2012) that, in LMICs, concepts of independence and self-reliance are different to those found in western countries, with access to social capital facilitating closer connections, promoting acceptance and integration in society. Participants reported that when their assistive product was in use and visible, they did not experience any or experienced less discrimination when using their assistive product. Barbareschi *et al.* (2021) found that in Kenya, assistive products were viewed as a sign of privilege, as the user has access to resources such as finances and knowledge to obtain their device. They linked this finding to the notion that poverty stigma is often worse than disability stigma in LMICs. Therefore, because participants had access to assistive products, they are viewed as having access to resources and are less likely to face poverty stigma. This may explain why participants reported experiencing people treating them better. For example, participants reported that people were friendlier to them, and they were able to make friends after receiving an orthotic device.

The findings from this study also demonstrate the importance of assistive products in enabling independence and the ability to take part in every-day activities such as housework and self-care, while also increasing their ability to work and access education. So, without their assistive product they would not be able to live their lives in the same way they currently are. Andregård & Magnusson (2017) found that for participants with sequalae of polio and amputations, their assistive devices were highly important and helped to preserve and increase their dignity. Furthermore, Ramstrand *et al.* (2021) reported that prosthetic and orthotic users from Cambodia stated their prosthetics improved their day-to-day functioning, particularly with the ability to walk and walk without having to use mobility aids such as crutches. This suggests the importance that assistive products can have on livelihoods of people with disabilities. However, the impact of devices may be limited, particularly if the wider social and political environment is restrictive and stigmatising (Trafford *et al.,* 2021). If people with disabilities face significant barriers to education or employment because of their disability, access to assistive devices has limited capacity to improve inclusion without a focus on increasing participation and social inclusion (Trafford *et al.,* 2021). Furthermore, in this study, not all participants chose to wear their orthotic device daily, or even at all. This demonstrates that some people choose not to use an assistive product or engage with physical rehabilitation services. The capability approach recognises the needs of people with disabilities, and that assistive products can merely help to improve functional capabilities rather than 'fixing' impairments (WHO, 2011). The idea of capabilities is also reflected in the ICF. However, provisions of assistive products in LMICs are poor and lack availability of different types of designs (WHO-UNICEF, 2022). Therefore, those choosing not to use an assistive product may be a product on lack suitable devices available for their environment.

6.4.3 Barriers and facilitators to accessing P&O services for orthosis and wheelchair users

It is known that there are numerous barriers to accessing P&O services for assistive products in LMICs. A study by Andregård & Magnusson (2017) found people using orthotics in Sierra Leone reported more difficulties with mobility and fewer possibilities to access P&O services compared to people who use prosthetics. This study provides evidence which confirms the presence of some of these barriers for people with orthotics and wheelchairs in Cambodia. A significant barrier reported by many participants was the cost and availability of transport to obtain P&O services. Other research has also found transportation related barriers to significantly impact the utilisation of physical rehabilitation and health services in LMICs (Van Rooy *et al.,* 2014; Grills *et al.,* 2017; Magnusson *et al.,* 2020). Previous research has also highlighted that women find it more challenging to access transportation because of competing with others to get transport (Allen *et al.,* 2022). This echoes the findings from this study as women reported relying more on assistance from family members to attend the P&O clinic compared to men. For users of Exceed services, the amount of funding available for transportation has reduced over time, with service users being provided with less financial support than in previous years. This was noted by participants as a barrier to accessing P&O services, and they requested more support for covering transport costs. However, the reduction of funding sources for NGOs and lack of government support means that increasing the provision of support is not always possible.

Participants in this study also reported other cost related barriers to using services, such as employment and loss of income barriers and the costs of services themselves. In a qualitative study on barriers to rehabilitation for people with lower limb amputations in Sierra Leone, several participants reported being unemployed and being unable to pay for services without the assistance of family members (Allen *et al.,* 2022). Assistive products in LMICs are not always provided free of charge, however; in Cambodia Exceed currently do provide assistive products without charge. Fundings constraints faced by NGOs and the PWDF in Cambodia creates increasing challenges to service provisions. In attempt to address the issues of funding constraints, Exceed have adapted their model of service delivery by establishing a social enterprise model approach (Harte *et al.,* 2019). As part of this approach, a modern service clinic (MSC) was opened in December 2018 (Exceed Worldwide, 2022b). The MSC provides appropriate but imported assistive products for service users that want to pay for a higher level of service. The profits generated from the MSC are then used to provide free of charge services, transport and accommodation support for service users (Harte *et al.,* 2019).

In many LMICs, physical rehabilitation services have limited funding from governments. Hence, adopting sustainable strategies are important to ensure that the services are able to continue to provide assistive products free of charge or at a subsidised cost. There is limited evidence about the role of social enterprises in the delivery of health and rehabilitative services in LMICs. However, some previous studies have found that social enterprises and social business models to be viable models of health and rehabilitation service delivery in low resource settings (Caccamo *et al.,* 2014;

Lokman & Chahine, 2021; Al Imam *et al.,* 2022). Furthermore, to ensure that provisions of assistive products are sustainable and affordable, establishing mechanisms to use locally sourced materials and regionally produced assistive products can ensure that assistive products can be made in low resourced settings at a low cost (WHO-UNICEF, 2022). Thus, the low costs of producing assistive products can keep the costs of devices lower for service users.

Another barrier that was reported by participants was caring or family responsibilities that prevent attending P&O services. A study by Allen *et al.* (2022) highlighted women experienced reduced access to rehabilitation than men in Sierra Leone because of having to find childcare to use services. In this study, women also reported that due to needing to find childcare or care for family members they were not able to use P&O service whenever needed. The responsibility of caring activities frequently lie on the shoulders of women and the impact of these caring responsibilities and household duties for women with disabilities has been found in previous research. The impact of gender-specific barriers have also been shown in other LMICs. Dawkins *et al.* (2021) found in a systematic review of access to healthcare that gender roles and norms played a significant role in the ability of women to seek healthcare, particularly in patriarchal societies. A study from Pakistan by Habib *et al.* (2017) revealed that a woman’s ability to seek care undermined by the demands of household chores and inability to leave the household.

In addition, a study by Neyhouser *et al.* (2018) found that women with visual impairments face several barriers accessing to eye care due to patriarchal attitudes and gender stereotypes in Cambodia. Women were found to have less agency in their own healthcare seeking for eye care and had to negotiate with their families to organise childcare or household duties. Less access to household resources further acted as a barrier to healthcare seeking for eye care. Gender-specific barriers have also been highlighted by Yi *et al.* (2022) who found that for women in Cambodia work and family commitments prevented them from accessing Tuberculosis services and information, whereas for men, ignorance about their own health and downplaying their illness were significant barriers to accessing services. Therefore, strong cultural norms and divisions of labour in patriarchal societies can lead to women not having the same access to services compared to men. Currently, there is little research on the gender aspect of access to P&O services and assistive products in LMICs. More research should be conducted to investigate gender differences in utilising rehabilitation services as many of the barriers to healthcare which impact women are also likely to impact their ability to seek rehabilitation.

The COVID-19 pandemic was reported by participants to have impacted their ability to access P&O services. During this time, Exceed was only offering repair services and was not making new assistive devices for service users. Therefore, if their assistive product was damaged, this could significantly impact their day to day lives if the device was unusable. Bettger *et al.* (2020) explained the many ways in which rehabilitation services were affected by the COVID-19 pandemic, this included: shorter length of inpatient stays, fewer non-urgent appointments, suspension of home-based rehabilitation, redeployment of rehabilitation workers to other healthcare settings and high numbers of COVID cases amongst healthcare workers. The use of community-based provision models such as telerehabilitation, mobile clinics and community-based programmes were found to be effective in providing health and rehabilitation during the pandemic (WHO-UNICEF, 2022).

The facilitators to P&O services found in this study were social support networks, community health workers and Exceed enabling use and participant agency. Social support networks were found to be an important source of information about P&O services in Cambodia and for assistance in attending the clinics. This was found by Ormsby *et al.* (2012) who reported that social support networks were vital for knowledge of eye care services and encouraging the use of eye services in Cambodia. Previous research also shows that having family members play a greater role in rehabilitation activities can help to optimise outcomes for people with disabilities as families can assist with and have more knowledge about rehabilitation practices (Dawkins *et al.,* 2021; Morris *et al.,* 2021). Consequently, strong social support networks and family involvement in physical rehabilitation play a vital role in improving outcomes. Through participants social networks, it enabled information to be shared about the availability of different services in Cambodia. This allowed participants to use their own agency to decide where to use services, rather than continuing to use the services that they have previously used. Agency is important because it allows people to make choices unconstrained by barriers such as poverty and a lack of access to services (Graham *et al.,* 2013). In many societies, networks of social relationships and agency are interlinked, with individual capabilities determined by individual agency and by social interactions and support systems (Dubois & Trani, 2009). Nevertheless, individual agency can be diminished when there is little choice. For example, for some users of assistive products, there are limited places where P&O services can be accessed and a limited availability in the type of assistive product received (WHO-UNICEF, 2022). Therefore, access to P&O services can be facilitated by social support networks and through individual agency, however, the influence of these as facilitators can be diminished by external factors.

Community health workers employed by Exceed and the outreach activities performed were described as important facilitators of P&O service use by participants. The community health workers have several responsibilities such as outreach activities and sharing information about the services to local communities, disability advocacy, encouragement, and support. They also facilitate home visits and inform local communities about repair workshops with trained POs and PO technicians. Community-based health workers can also be trained to provide services under the supervision of trained providers, where appropriate, to increase access to physical rehabilitation (Morris *et al.,* 2021). Using community-based approaches can facilitate more inclusive, realistic and sustainable initiatives by ensuring that the development of rehabilitation can reach at the community-level (WHO, 2010b). This is due to CBR being implemented by a range of stakeholders, including disabled people, their families and communities, local government and NGOs (Pollard & Sakellariou, 2008).

Research by Ahmed *et al.* (2022) found that community health workers are equitable for many different populations group and could improve access to health services and health advice, although there was limited evidence available for people with disabilities. A study by Trani *et al.* (2022) did find evidence to support that for people with disabilities, CBR activities can help to provide services in conflict areas. This previous research suggests that CBR programmes can benefit people with disabilities in LMICs. However, many argue that there is not enough high-quality, empirical evidence into the effectiveness and the evaluation of CBR programmes, making it challenging for evidence-based practices to be adopted (Hartley *et al.,* 2009; Iemmi *et al.,* 2015; Saran *et al.,* 2020). The introduction of CBR programmes also pose many challenges that can impact their appropriateness, sustainability and effectiveness. Firstly, CBR cannot completely replace the need for clinic-based physical rehabilitation as some services are required to be performed in clinic settings. For orthotic devices, service users must attend one of Exceed's clinics in person, as limb castings and device fitting are challenging to perform in community settings. In contrast, for wheelchairs, those identified by correctly trained community workers as potentially benefiting from a wheelchair can be prescribed without attending the clinic in person.

Secondly, community health workers need to be adequately trained and fairly compensated for their work, this also helps to support their credentials to be working on the programmes. Thirdly, there is frequently limited involvement of people with disabilities in planning and design of CBR programmes, and they are largely just the recipient of services (Hartley *et al.,* 2009). It is important for people with disabilities to be actively involved to improve sustainability of programme. CBR programmes should aim to foster empowerment for people with disabilities, ensuring that they are able to assume decision making roles (Pollard & Sakellariou, 2008). Lastly, a lack of inclusion of local communities and people with disabilities can also not consider the cultural context (Pollard & Sakellariou, 2008). Programmes that have limited awareness of cultural notions of disability and attitudes towards people with impairments can also lead to negative attitudes and practices being perpetuated (Turmasani *et al.,* 2002). The community workers at Exceed are Khmer, with some also having a disability. Participants mentioned that encouragement from the community workers was important in their use of P&O services and made them want to continue accessing services, despite encountering challenges with their device. This suggests the outreach activities performed by Exceed are a vital component of their service delivery and in reducing barriers to physical rehabilitation in Cambodia. To ensure the longevity and sustainability of CBR programmes in LMICs, the WHO stated that effective leadership, community ownership, the use of local resources, cultural sensitivity, capacity building activities, financial support, political support and building partnerships are needed to be successful (WHO, 2010b).

6.4.4 Implications for policy

In Cambodia, there have been changes over the years in those providing P&O services and how these services are provided. Participants described receiving P&O services from Exceed, as well as other providers such as ICRC, Humanity and Inclusion (HI) and Veterans International (VI). The services previously provided by VI are now provided by the PWDF as operations have been handed over to the Cambodian Government. However, the shift of operations from an NGO to local government can pose challenges for service delivery. In a study in Sierra Leone by Jerwanska *et al.* (2022), participants stated that the shift from NGO to governmental control made the existing provisions available worse in quality. This was attributed to a lack of recognition of the importance of rehabilitation centres by hospital management. Local governments and relevant stakeholders need prioritise and understand the importance of providing physical rehabilitation services before any transition starts. Physical rehabilitation and provisions of assistive products are often not viewed a health priority; however, it is important for achieving the SDGs and UHC (WHO-UNICEF, 2022). The WHO guidance recommends that rehabilitation should be under the remit of the health system and integrated at primary, secondary and tertiary levels of the health system with the ministry of health being the most appropriate agency for governance in most cases (WHO, 2017a). At the end of 2022, it was reported that control and management of physical rehabilitation centres is moving to under the remit of the MOH, from the MOSVY. This provides several challenges and opportunities in the provisions of P&O services in Cambodia.

The WHO recommends that rehabilitation service should be integrated at different levels of the health system (WHO, 2017a). This allows for better coordination of rehabilitation activities and healthcare which can optimise health outcomes (WHO, 2011). Better links between rehabilitation providers and the health system can be made, generating greater awareness of services available and provisions of assistive technologies in Cambodia. Yet in many LMICs public healthcare frequently faces resource and funding constraints, so without adequate funding, the MOH may struggle to maintain effective provisions of physical rehabilitation. Furthermore, the move of physical rehabilitation from the MOSVY to the MOH presents challenges relating to the medicalisation of disability. Under the ICF, disability is not defined solely because of medical conditions and impairments of the body, rather it also includes functional limitations and participation activities as causing disability (WHO, 2002). Therefore, this may cause interventions to be medically focused and put too much emphasis on treating health conditions and impairments and ignore interventions in other areas such as increasing access to education and employment opportunities and reducing discrimination faced by people with disabilities.

6.5 Limitations

There are several limitations of this study. The participants in the study are limited to those who have previously used or are currently using Exceed services. The study cannot inform about people who have never used services or allude to why people are choosing not to use assistive products. Consequently, those who face the fewest barriers, are more likely to be interviewed than those with the greatest. This study also only included people with mobility impairments, people with other types or additional impairments such as mental, intellectual and sensory, may face different or even greater barriers to accessing services. Another limitation of the study is that only service users of Exceed services in Phnom Penh took part in the research. The findings are limited to services users that live in Phnom Penh or the surrounding Kandal province. As such, users of Exceed services in Kampong Chhnang or Sihanoukville, or users of services elsewhere in Cambodia may have different experiences. Moreover, more rural or Indigenous populations are likely to have different experiences of access to physical rehabilitation in Cambodia, for example the rural provinces of Rattan Kiri and Mondul Kiri do not have a physical rehabilitation centre, with the nearest being in the province of Kratie. Access in these areas is further impeded by lack of transport available and environmental factors such as challenging terrain (Morris *et al.,* 2021).

In research where the researcher is dependent on translator, language barriers in collecting and analysing the data can occur (Vergunst *et al.,* 2015). There were occasions where the translator was unable to fully convey the participants meanings in English during the interviews, so in-depth explanations of participants experiences may have been lost. This also impacted the transcription stages where there was confusion about what the translator was trying to relay. To prevent the wrong interpretation of participants meanings, the translator was contacted for clarifications during the transcribing process to ensure full understanding of what participants were saying. The translator is also employed as a lecturer for the DPO and trains POs at the Exceed Phnom Penh clinic which could potentially have impacted the participants willingness to criticise the services. Social desirability bias occurs when participants present themselves or their social context in a way they perceive as more socially desirable and tends to be more common is research that is more sensitive (Bergen & Labonté, 2020). Participants were also given assurances that any criticisms that they may have would not impact their ability to use the services. In spite of this, there were also benefits from using a translator that works closely with the services as they were able to provide context and understand and empathise with participants.

6.6 Conclusion

This study has explored the pathways to P&O services that people with physical disabilities in Cambodia experience and negotiate and the barriers and facilitators that can prevent or enable utilisation. The participants provided valuable information into their experiences of using healthcare and physical rehabilitation centres in Cambodia, and how their assistive devices impact their lives. The knowledge created from this study improves our understanding of the barriers and facilitators and how people experience these barriers differently. It adds to the existing research on experiences of access to P&O services and emphasises the importance of facilitating access through outreach and community workers. It was demonstrated that community health workers play vital role in accessing P&O services for participants in Cambodia. It is important to build community health workers into CBR activities and recognise importance of educating and training community workers. However, the study also revealed that more support from the government is needed for users of assistive products in Cambodia. Experiences of discrimination due to disability and barriers to receiving physical rehabilitation services created challenges in the pathways to use of rehabilitation. For users of assistive products, services must be affordable, which includes the cost of the device, and also the indirect costs such as transport costs and loss of income from taking time outside of usual working hours. At policy level, changes need to be made to ensure that the UNCPRD is implemented in Cambodia, to ensure the rights of people with disabilities are met. Future research should aim to explore experiences of people that have abandoned their devices and uncover the reasons for this. Additionally, with telerehabilitation and digital consultations becoming more widely used in HICs to deliver health and rehabilitative care, future research could explore how telerehabilitation could be applied in low-resource settings.

Chapter 7 Thesis Discussion and Conclusion

This chapter will synthesise the key findings of the empirical Chapters 4, 5 and 6 (Section 7.1). It will outline the contributions to the literature (7.2), alongside a discussion of the methodological contributions (Section 7.3). This will then followed by a discussion of the limitations (Section 7.4), policy implications (Section 7.5), recommendations for future research (Section 7.6), publication plan (Section 7.7) and concluding remarks of the thesis (Section 7.8).

This thesis has used multiple methods to address the research questions posed in the first introductory chapter (Section 1.2). To answer the first six research questions (in Chapters 4 and 5), quantitative techniques have been operationalised using both survey and administrative data to examine predictors of utilisation of health services and physical rehabilitation centres which provide P&O services for people with physical impairments in Cambodia. To answer the remaining research questions (in Chapter 6), semi-structured in-depth interviews were used to explore how pathways to physical rehabilitation centres are negotiated and individual experiences of barriers and facilitators to using services.

The findings from this thesis assert that there are differences in healthcare seeking behaviours between people with physical disabilities and people without in Cambodia. Furthermore, the frequency of using physical rehabilitation services also demonstrates that people with physical impairments have different levels of frequency utilisation of P&O services for replacement orthoses depending on characteristics such as age and gender. These results are also supported by the qualitative data collected which demonstrated that people face numerous barriers to using P&O services for the purpose of receiving assistive products. The benefit of using multiple methods is that different research questions can be addressed which generate different understandings of access to health and rehabilitation services. Whilst this research project does not take a formal mixed methods approach, combining multiple methods allows for different perspectives to be examined (Hammond, 2005) and can produce evidence that is more robust than using a single method of data collection and analysis (Davis *et al.,* 2011). Therefore, combining them (albeit across discrete studies) allows for more nuanced understanding of access to the health system for people with physical disabilities.

7.1 Synthesis of key findings of this research

In this section, the results of the empirical chapters are triangulated and interlinked in order to better understand the interaction between disability and barriers to health and physical rehabilitation, such as P&O services.

Chapters 4 and 6 found that financial and transport demand-side barriers were substantial in preventing or facilitating access to health services and P&O services for people with Moderate or Severe Physical Disability (MSPD). Poor household status, a proxy measure for poverty, was found to be a significant predictor of not seeking treatment or advice after illness or injury, whereas disability was not found to be a significant predictor. However, an interaction term between disability and poor household status found significant differences in whether treatment or advice for illness or injury was sought and where people with MSPD seek healthcare compared to those without MSPD. Previous research has found differences between physical disability, poor household status and access to healthcare (Ahmad, 2013; Dassah *et al.,* 2018b). A study by Eide *et al.* (2015) found that for people with disabilities from Sudan, Namibia, Malawi and South Africa, the costs of healthcare services were one of four major barriers reported by respondents.

Additionally, people with MSPD from poor households were the most likely to seek treatment or advice from IPs, such as traditional *Kru Khmer* healers and informal drug sellers. This differs from people without MSPD from poor households, who were most likely to use public healthcare. In addition, people with MSPD from non-poor households were the most likely to use healthcare from private hospitals and clinics. IPs provide treatment and medicine often at lower cost than formal healthcare services which make them more accessible to low-income households (Shah *et al.,* 2011). IPs are also often unqualified and provide poorer quality healthcare compared to formal providers (Suy *et al.,* 2019). This impacts equity in health as those receiving poor quality healthcare may lead to poorer health outcomes (WHO, 2022a). The findings from Chapter 6 found that participants reported that when they first developed the condition which led to their impairment, a lack of funds to pay for medical treatment was a leading cause of not seeking healthcare or seeking only traditional healthcare services. Participants reported that parents sold assets such as land to fund healthcare when they first experienced their condition. A study conducted by Mitra *et al.* (2016) found that in Vietnam, the selling of household assets was a significant coping mechanism to deal with health shocks. The selling of assets, for example land or livestock, may increase economic vulnerability of a household in the medium to long term due to the importance of land and resources on a household's livelihood (McIntyre *et al.*, 2006).

To remove the demand-side financial barriers to the health system, many LMICs have developed pro-poor financing initiatives or social assistance programmes to enable health service use for vulnerable populations. Cambodia introduced HEFs to ensure that public healthcare services are financially accessible to households that are poor. The results from Chapter 4 show that households that have access to HEFs, making them eligible to free or subsidised healthcare at public services, have lower odds of seeking treatment or advice after illness or injury, although this was not found to be significant. However, household access to HEFs is a significant predictor of public healthcare use, with people with MSPD and HEF card access having the highest probability of using public healthcare. This suggests that households that have access to a HEF card are opting to use public healthcare services as opposed to other private facilities or IPs after illness or injury. Whilst this is an encouraging finding, public health facilities in Cambodia are viewed as poorer in quality compared to private health facilities (Ozawa & Walker; Jacobs *et al.,* 2018; Koy *et al.,* 2023). This means that for poor households, access to poorer quality healthcare compared to non-poor households suggests that full equity in access to health services has not been achieved with the introduction of social assistance. To increase equity in health for people with disabilities, efforts should also include improving the quality of the healthcare received at public health facilities in addition to improving access to services.

The impact of HEFs have been previously assessed by different authors, which have demonstrated varying levels of success in improving access to public health services in Cambodia (Noirhomme *et al.,* 2007; Bigdeli & Annear, 2009; Flores *et al.,* 2013; Ensor *et al.,* 2017; Jacobs *et al.,* 2018). Korachais *et al.* (2019) found reimbursement of user fees for the poor through HEFs did not increase utilisation at public healthcare facilities for poor households**.** They attributed this lack of impact due to other factors influencing the use of services, for example distance to health facilities and the quality of services received (Korachais *et al.,* 2019). Nagpal *et al.* (2019) also noted that for people with NCDs, the benefits of access to HEFs to manage their conditions may be limited because of the inadequate availability of services and the competency of health facilities to manage NCDs. Furthermore, existing research has not explicitly focused on the impact of HEFs for people with disabilities in Cambodia. A report by the WHO (2017b) which focuses on disability and healthcare utilisation in Cambodia, using 2014 DHS data, did not include access to HEFs as a key variable of interest when attempting to explore utilisation. Controlling for access to HEFs could help explain some of the variation in healthcare utilisation which cannot be explained solely by health expenditure and disability.

Overall, the thesis found that HEFs impact the use of public healthcare services. This presents an opportunity for the government of Cambodia to provide support to access the health system for all people with disabilities, not just those from poor households. The current system for accessing HEFs is complex, and requires cooperation between the Ministry of Planning, who perform the identification of poor households and the Ministry of Health (MOH), who provide free or subsidised healthcare through public health facilities. Chapter 3 of this thesis provided a description of eligibility to HEFs, and how poor households are identified through a process of household interviews to assess for a range of subjects such as income, living standards and health (GIZ, 2022). Eligibility for HEFs is determined by household characteristics, rather than by individual characteristics meaning that people with disabilities are only eligible for free or subsidised healthcare if they meet the criteria in other areas such as household income, health of other household members and household assets. This suggests even if the person with a disability is unable to work or generate any income, they are completely reliant on others to support their healthcare seeking as disability allowances in Cambodia are low and are limited to be people with severe disabilities (Palmer et al., 2019).

Furthermore, public health facilities do not get direct funding from the MOH for providing healthcare to those eligible for HEFs, but rather they provide free or subsidised healthcare to the service user and then must claim the expenditure back from the MOH (Koy *et al.,* 2023). This can be beneficial in preventing the mismanagement of funds at public health facilities by ensuring that public providers claim for the exact amount spent. On the other hand, this means public health services, which often face resource constraints, may struggle to provide the services without receiving funds upfront (Koy *et al.,* 2023). This limits the ability of health facilities to fund medical equipment and infrastructure that support people with disabilities in healthcare seeking. The impact of this on healthcare users with access to HEFs is that they receive poorer quality care due to patients paying OOP for services being prioritised. As a consequence, HEFs in their current format may not be able to address the healthcare needs of people with disabilities in Cambodia. Overall, despite the challenges and complexity of HEFs and the eligibility process, they provide an important opportunity to provide pro-poor financing to support healthcare seeking for people with disabilities in Cambodia. The MOH should continue to assess the how people with disabilities are supported by HEFs to ensure access to healthcare services.

In Chapter 6, nearly all participants mentioned that transport to and from the P&O clinics was a significant demand-side barrier to using services, even for participants living near Exceed's Phnom Penh P&O clinic. Public and private transport providers have been shown to be reluctant to transport people with disabilities, or they may charge them extra for requiring additional assistance or space in LMICs (Chintende *et al.,* 2017; Kabia *et al.,* 2018). The literature has previously shown that transport barriers significantly impede access to health and physical rehabilitation services in LMICs for people with physical impairments (Vergunst *et al.,* 2015; Magnusson & Ahlström, 2017; Järnhammer *et al.,* 2018; WHO, 2022a). In LMICs, there is a distinct lack of public and private transport which can enable access to services. Article nine of the UNRCPD states that people with disabilities should have access to accessible '*Buildings, roads, transportation and other indoor and outdoor facilities, including schools, housing, medical facilities and workplaces*' (UNb, n.d). For signatories, like Cambodia, accessible public transport to ensure people with disabilities have access to health care should be a key consideration to improve equity in health.

The issue of distance to health facilities was also found in other studies, and that close proximity to health and rehabilitation services increases likelihood of use for both people with and without disabilities (Peters *et al.,* 2008; Bright *et al.,* 2018; Muir, 2018; Zuurmond *et al.,* 2019). For Chapters 4 and 5, information on distance to health facilities was not available due to this data not being collected. This information, if available, may have helped to explain some of the variation in access to health and physical rehabilitation services. In Cambodia and other LMICs, physical rehabilitation services are typically few in numbers, with the majority located in major urban areas. So, for people with physical disabilities living in rural areas, access to physical rehabilitation and assistive products can be challenging as issues of transport and time to get to the service, and the costs of transportation and any accommodation costs, come to the fore. The results from the analysis in Chapter 5 highlight that almost all cases of spinal orthoses prescriptions were performed at the Exceed Phnom Penh clinic. This is due to the other two clinics not having the correctly trained staff to support spinal patients, alongside the need for patients to see an orthopaedic department that provides surgery located in Phnom Penh. Therefore, service users with spinal conditions from provinces outside Phnom Penh may have to travel long distances to access health and physical rehabilitation services. In the WHO (2017a) report, there are calls for greater integration of physical rehabilitation services within the remit of MOH and within hospitals. For Cambodia, this would require the MOH and MOSVY to work together to provide accessible physical rehabilitation services for people with disabilities. This would include incorporating physical rehabilitation services within different public health facilities, such as district or provincial level hospitals.

As mentioned, the WHO (2017a) recommend that rehabilitation activities are integrated into the health system. This also links into the WHO (2007) health system building blocks which states that strong health systems would have effective and efficient service delivery, information sharing and leadership and governance for all aspects of the health system, including the provisions of assistive products. This is further supported by this finding as having a limited number of facilities available where people can seek certain types of healthcare may create barriers to receiving services. Cambodia, and other LMICs, should work to diversify the services offered at district, provincial and national hospitals to increase access to services. Furthermore, more specialised rehabilitation healthcare workers would be needed to meet this. Currently, in Cambodia, Prosthetist & Orthotist (POs) and PO technicians are not classified as civil servants which does not entitle them to the same work benefits as nurses and midwives (Metcalf *et al.,* 2023). This means that working within physical rehabilitation is not seen as attractive as other allied health professions. Strong health systems also have a sufficiently trained health workforce to meet the needs of the entire population, not just in urban areas (WHO, 2007). Increasing benefits and ensuring civil servant status is vital for improving rehabilitation workforce to allow for the expansion of physical rehabilitation services in Cambodia.

Individual and community demand-side barriers can also impact access to health and rehabilitation services. This thesis found several differences between men and women in terms of interaction with healthcare services and use of physical rehabilitation centres. Women with MSPD had a higher probability of using of private hospitals and clinics, while men with MSPD had the lowest. Chapter 5 found a small imbalance in P&O service use between men and boys and women and girls using Exceed services for orthotic devices. For prosthetic service users at the same three P&O clinics in Cambodia, the difference between male and female clients is much larger, with less than one quarter of prosthetic service users being female (Dickinson *et al.,* 2022). The descriptive analysis also found distinct differences in the cause of impairments for men and boys and women and girls who use orthotic devices. Chapter 5 revealed that women and girls from three P&O clinics have a higher percentage of idiopathic scoliosis and other conditions causing a curvature of the spine compared to men and boys. This is consistent with other evidence which suggests that adolescent girls, in particular, are more likely to be diagnosed with idiopathic scoliosis (Janicki & Alman, 2007; Konieczny *et al.,* 2013; Hengwei *et al.,* 2016). In addition, Chapter 5 found that prevalence of clubfoot was greater in men and boys compared to women and girls at Exceed services. This occurrence is reported to be found in other populations, where studies have found that the prevalence of clubfoot is higher in males (Mathias *et al.,* 2010; Gibbons & Gray, 2013).

Chapter 5 also found differences in utilisation of P&O services between gender. Women were more likely to have their orthotics replaced compared to men. In contrast, girls were less likely to have their orthotics replaced compared to boys. It is important to understand why access to service use changes over time and investigate whether there are barriers preventing men from accessing services more frequently than women. No significant interactions between reasons for orthosis use and gender were found in the survival analysis models, however the data had limited categories for client's diagnosis leading to orthosis use due to the sample size which meant different causes had to be combined. This may have potentially impacted the ability to study differences in frequency of access to P&O services by gender and impairment.

For the in-depth interviews, the aim was to recruit an equal mix of men and women, to mirror the close parity between men and women using the orthotic services. However, using a convenience sampling approach of waiting for orthosis users to access services at Exceed led to an unbalanced sample, as fewer men attended the P&O clinic for orthotic services compared to women during the data collection period. This anecdotal evidence echoes the finding from Chapter 5, that women use Exceed services for orthotic device replacements more frequently. Chapter 6 revealed differences in the types of barriers to accessing P&O services for men and women. The men who were interviewed largely noted time away from work and distances to the P&O clinic as the biggest barriers to accessing services. In contrast women reported having to organise childcare or were unable to attend the clinic until childcare had been found, as well as other caring responsibilities such as taking care of elderly or sick parents in addition to transport and work-related barriers. Other research has found that caring and housework related responsibilities can impact women with disabilities ability to seek health and rehabilitation services (Kabia *et al.,* 2018; Dawkins *et al.,* 2021). The impact of this is that women may face more barriers to accessing the health system compared to men. In patriarchal societies, the power of decision-making predominately lies with men, and it may be inappropriate for women for express personal autonomy (Osamor & Grady, 2018). This means that women may be prevented for accessing the health system when needed. Overall, this thesis has found conflicting differences of the impact of gender on access to health and physical rehabilitation. More research is needed that disaggregates gender by age, as the results in Chapter 5 suggests there are interactions between gender and age.

Facilitators of access to P&O services for orthotic and wheelchair users were explored in Chapter 6. Participants spoke about how support from their family encourages them to use the services and enables them to get to the clinic. This included assistance in attending the clinics through transport and by encouraging and pushing them to attend services when needed. The role that families play in assisting people with disabilities attend health and rehabilitation in LMICs have been previously reported. Social networks were found to be an important way to find out information and knowledge about services, for example people with disabilities telling other people with disabilities and their families about services (Hashemi *et al.,* 2022). Furthermore, Chapter 6 revealed that

Exceed's community workers played a key role in helping people access physical rehabilitation in Cambodia, through outreach activities and information sharing about services, mobile repair workshops and deliveries of wheelchairs and mobility aids. Ahmed *et al.* (2022) found in a review of the literature on community health workers, multiple studies identified social support and social networks as improving uptake of community health worker promoted health behaviours. Furthermore, Holanda *et al.* (2015) found that families and social supports are vital for enabling access to health services and participation in society for people with disabilities in Brazil. Hence, people that have less social support available may have less access to health care services. The findings from Chapter 6 and from previous research indicate the importance of social networks, CBR and outreach activities to increase access to health and rehabilitation services. It suggests that information sharing, and outreach activities should involve communities as a whole, and not just specifically targeting people with disabilities in information sharing activities.

Exceed currently conduct mobile repair clinics and prescribe and deliver wheelchairs within local communities. Participants in Chapter 6 stated this service was important to them, and they would like a more frequent service. This suggests that providing more in community services could benefit orthosis and wheelchair users. A study by Battistella *et al.* (2015) found that in Brazil, mobile rehabilitation clinics made services more accessible and provided rehabilitation professionals with more training and awareness of assistive devices. The authors reported that the impact of actively attending local communities allowed for data to be gathered on demand for assistive products and the prevalence of health conditions which can help to inform decision making about potential need. Chapter 5 demonstrated the potential benefit of using administrative data, such as that from service users to investigate utilisation of services. Therefore, CBR activities could be introduced on a wider scale with support from the government and the public health sector, particularly to aid with data collection to provide estimates of the need for services. Whilst CBR and the use of community workers to deliver services within communities have been found to improve access to the delivery of services (Mauro *et al.,* 2014; Ahmed *et al.,* 2022; Trani *et al.,* 2022), it is unlikely that these programmes can overcome the substantial challenges faced by the health system in LMICs without significant investment and reform of health, rehabilitation and transport systems (Ahmed *et al.,* 2022). This aligns with the WHO guidelines that community health workers should not be used as a cost-effective means to replace primary healthcare services and should be integrated into the health system (WHO, 2010b).

The key findings from this thesis indicate that there are inequities in access to health and rehabilitative care for people with disabilities in Cambodia. This is not unique to Cambodia, as many health systems in HIC and LMICs are not fully equitable, and people with disabilities face barriers to seeking care (WHO, 2022a). In Cambodia, there are also some successes, for example, the near complete rebuilding of the health system after the 1970s with the assistance of IOs and NGOs. This has allowed private, public and NGO actors to cooperate to improve access to health and rehabilitation services for all. The People with Disabilities Foundation (PWDF), a department of the MOSVY, has delivered nearly 5,000 physical rehabilitation appointments in Cambodia (ACCESS Cambodia, 2021). In total, from 2016 to 2020 government funded services accounted for 30 percent of total physical rehabilitation appointments (ACCESS Cambodia, 2021). This is considerably more than pre-2015 before Veterans International (VI) handed over operations to the Cambodian government. This shows that the government have managed to maintain capacity. Furthermore, it also demonstrates the overall improvement of the capacity of the Cambodian health system, before 2010 the government was unable to operate and manage any physical rehabilitation services at all. Without private, public and NGO actors cooperating, this would not have achieved. NGOs such as Exceed have helped to establish the Faculty of Prosthetic & Orthotic Engineering at the National Institute of Social Affairs in Cambodia and providing training to POs and PO technicians alongside the government of Cambodia, the PWDF and other donors (Exceed Worldwide, 2022). These collaborations enable expertise and resources to be shared to benefit people with disabilities and enable their access to physical rehabilitation services.

Overall, the findings from all three chapters indicate that there are inequities in accessing health and rehabilitative care. The three empirical chapters illustrate the importance of research including people with disabilities to investigate differences in access. For instance, the findings show that being poor is a significant determinant of access to quality healthcare for people with disabilities, and also impacts the use of P&O services for orthotics and wheelchairs through direct and indirect costs. There is also a heavy reliance on NGOs in the delivery of physical rehabilitation services as IOs and NGOs are still significant providers of assistive products and physical rehabilitation in Cambodia. This leaves service users vulnerable to inconsistencies in services provisions, which can be particularly detrimental to individuals with low incomes that may be unable to pay for private physical rehabilitation services.

7.2 Contributions to the literature

This thesis has made a number of contributions to health, rehabilitation and assistive technology research within the field of disability and, more broadly, within global health research. This thesis has also contributed towards the literature on the achievement of the SDGs and UHC and recognises the important of a focus on disability to achieve these goals. Without research into the experiences of people with disabilities, the SDGs will not be met by 2030.

Whilst research on access to health and P&O services exists in LMIC contexts, there are limited studies that focus on inequities in access to the health system for people with physical disabilities in Cambodia. This study provides important information to help understand access for this population. Previous research on access to people with disabilities to health services used the 2014 Demographic and Health Survey (WHO, 2017b), however, no further studies have been found that use more recent Cambodian Socio-Economic Survey (CSES) data from 2019/20. In Cambodia, research on access to P&O services is largely focused on prosthetic users and has limited inclusion of orthosis or wheelchair users in qualitative studies (Hussain, 2011; Ramstrand *et al.,* 2021; Donovan-Hall *et al.,* unpublished), with some descriptive studies of patient data of prosthetics users also available (Barth *et al.,* 2020; Barth *et al.,* 2021; Dickinson *et al.,* 2022). In physical rehabilitation research, prosthetics research is more apparent and there is less priority placed researching orthoses and wheelchair users. ATscale (2020) created a product narrative report of the market landscape for P&O services, however, orthoses were mentioned infrequently, with the main focus being prostheses. Whilst the services do go hand in hand, there are differences between orthosis and prosthesis users which impacts how services should be delivered. Orthotic and wheelchair delivery are an important part of physical rehabilitation services (WHO, 2017c) and more research is needed to understand access. This study helps to fill that gap by examining differences in access to P&O services by service users, and by providing more comprehensive understanding of individual experiences of the barriers faced.

7.2.1 Poverty and access to health and physical rehabilitation services

This thesis has contributed towards the literature on access to health and physical rehabilitation in LMICs through finding significant differences in health service use for people with and without MSPD (Chapter 4) and P&O service use for orthosis and wheelchair users (Chapter 6). Limited access to education and employment opportunities can make it hard for people with disabilities, or families that have a person with a disability to earn a living or earn enough money for day-to-day life (Gudlavalleti *et al.,* 2014). This was identified by a participant in Chapter 6, who reported that in Cambodia, people with disabilities do not have disposable income outside of daily living expenses. Furthermore, in LMICs, informal employment is significant, with much of the population not paying income taxation or into social protection funds which can cover health expenditure and sickness and disability payments (Lee & Di Ruggiero, 2022). This means that, in many countries, informal workers have poorer access to healthcare services (Lee & Di Ruggiero, 2022).

The findings from this thesis show that poverty and MSPD increases the probability of using IPs, whereas people with MSPD from non-poor households are the least likely group to use IPs. This suggests that poverty causes people with MSPD to choose cheaper healthcare options, even though they are poorer in quality. This feeds into the disability-poverty nexus where there is a reinforcing cycle between poverty and disability (Groce *et al.,* 2011). Poor access to quality healthcare due to poverty makes people more vulnerable to certain health conditions and can exacerbate illness or health conditions (Kuper & Heydt, 2019). However, the inability to pay for health services can cause the worsening of health status, loss of employment or income from work or even death of the main household breadwinner (Peters *et al.,* 2008; WHO, OECD & WB, 2018). Therefore, disentangling the link between poverty, disability and access to health and rehabilitation services is vital for reducing inequities experienced by people with disabilities in LMICs. Consequently, without a focus on disability, the SDGs are unlikely to be achieved, as the exclusion of people with disabilities can lead to poverty, extreme hunger, unequal access to education and the labour market (Hashemi *et al.,* 2017).

7.2.2 Gender and access to health and physical rehabilitation services

This thesis also found differences between men and women in utilisation of both health and P&O services for people with physical impairments in Chapters 4, 5 and 6. Both conceptual frameworks theorise that gender can impact access to health services and is corroborated in this study (Andersen *et al.,* 2013; Levesque *et al.,* 2013). This is demonstrated in Chapter 4, where women were more likely to use health services after illness and injury, although this difference was not significant. Additionally, when gender and MSPD were included as an interaction term, women with MSPD were found to have a lower probability of healthcare utilisation compared to men with MSPD, which was significant at the 10% level. Existing research has also explored the link between gender and disability and how this impacts women. The burden of double discrimination was reported by Dhungana (2006) who wrote that women with disabilities have the lowest social level and face discrimination and stigmatisation from society. In comparison, men with disabilities are not afforded this same treatment. The double discrimination faced by women impacts their ability to access healthcare, employment and education. The findings from Chapter 6 also suggests differences in access between men and women. For women participants, caring responsibilities were reported as a barrier to use of physical rehabilitation services in Cambodia, whereas none of the men interviewed reported this as a barrier. This supports findings from other research which reported barriers to accessing the health system for women with disabilities because of their responsibilities within the home (Habib *et al.,* 2017; Dawkins *et al.,* 2021; Allen *et al.* 2022).

In contrast, the findings from Cox proportional hazards models for those over the age of 18 challenges the assumption that women have lower access to physical rehabilitation services than men. In fact, Chapter 5 found that women have their orthotic devices replaced significantly more frequently compared to men. In comparison to orthotic users under the age of 18, boys have more frequent use of services for orthotic devices. Other research has also found no difference in access between men and women with disabilities, for instance Gudlavaletti *et al*. (2014) found no differences in health service use between men and women with disabilities. Overall, the findings highlight that gender and access are highly interlinked and likely to be impacted by confounding variables or other characteristics. It indicates the importance of disaggregating by gender and age when researching access to healthcare, physical rehabilitation and assistive products. This thesis supports the notion that women and men with physical impairments have differential access to health and rehabilitation services. More research is needed to uncover this dynamic further.

7.2.3 Temporal patterns of P&O service use for orthosis users

In Chapter 5, differences in utilisation of P&O services for orthosis were studied by applying methods that allowed for data analysis over time, i.e., survival analysis. Temporal changes over time have also been studied through descriptive statistics which enabled trends over time to be displayed graphically to assess for changes in service use. This study found that since the 1990s the type of orthoses prescribed has changed, as well as changes to the most frequent diagnoses for service users. Physical rehabilitation services and provisions of assistive products in LMICs are sensitive to the wider, rapidly changing social and economic landscape that can impact service delivery (WHO-UNICEF, 2022). Therefore, understanding changes over time can provide vital information to service providers, donors and governments who can adapt to the changing need of clients (WHO-UNICEF, 2022).

Chapter 5 showed that prescription of KAFOs has decreased over time, with prescriptions of AFOs increasing at Exceed clinics. It is important for AT providers to be aware of these changes so services and rehabilitation professionals have adequate supplies, resources and skills to make high-quality assistive products. This study was also able to provide information about how long individuals may wait until they have their orthosis replaced, something which is seldom studied using patient data. The findings indicated that there are high levels are variation in how frequently orthotics are replaced, with KAFOs tending to be replaced less frequently compared to other device types. Furthermore, the in-depth interviews found that many people have the same assistive product for a long period of time and opting for performing self-repairs on their orthosis or wheelchair. Understanding how long orthotics are used in a low resource setting provides important information to service providers and other physical rehabilitation actors about how long orthosis can be expected to last for in a real-world setting. The testing of assistive products is often performed in HICs in clinical setting conditions (Dickinson *et al.,* 2019). This means that, in a real-world setting, products may not last as long as expected due to how the device is used and maintained. For instance, if assistive products are being replaced more quickly than expected, this may indicate that the component parts used in making a device are substandard, or that service users are not provided with adequate care instructions. Hence, using client data to investigate frequency in orthotic device replacements can help to further understand device longevity to inform service delivery.

7.3 Methodological contributions

This thesis has made a number of contributions to research on access to health and rehabilitation services in Cambodia, with a focus on disability. Existing studies often have not drawn on conceptual frameworks of access to health services, therefore, this thesis applies two well-known and used conceptual frameworks to investigate differences in access to healthcare services and physical rehabilitation centres. In addition, recent data from the 2019/20 CSES has been used and administrative data where there limited studies investigating access to P&O services using this type of data.

7.3.1 Application of health service access frameworks in disability and physical rehabilitation research

To understand access, this thesis has used two different conceptual frameworks of health service use. Both of these frameworks conceptualise access to health services and identify the barriers and facilitators which enable or impede health service use. In Chapters 4 and 5, the Andersen, Davidson and Baumeister (2013) model of health service use has been applied and in Chapter 6 Levesque, Harris and Russell (2013) model of patient-centred access to healthcare framework of access to healthcare was used. The Andersen, Davidson and Baumeister (2013) model has been used widely in health research, with many studies located in LMICs using this model to operationalise access to healthcare, maternal care and sexual and reproductive health services (Zhang *et al.,* 2019; Tolera *et al.,* 2020; Mekonnen *et al.,* 2021; Ghimire *et al.,* 2022). To date, no studies have been found that operationalise the Andersen, Davidson and Baumeister (2013) model to examine access to physical rehabilitation such as P&O services and provisions of assistive products in LMICs. There is also limited application of the model specifically for people with physical disabilities. This PhD thesis has demonstrated how the model can be applied to access to both healthcare services and P&O services for people with disabilities in a LMIC. This model can be used to help understand P&O service use behaviours, and why service use is different between individuals.

In Chapters 4 and 5, an important characteristic was identified as missing from the Andersen, Davidson and Baumeister (2013) model which is relevant to the use of P&O services and provisions of assistive products. This characteristic is health literacy at the individual and community level. Whilst the Andersen, Davidson and Baumeister (2013) model includes educational level at the contextual and individual level, this does not necessarily mean adequate health literacy or awareness of services. The findings from Chapter 6 highlight that P&O service users often went many years without having access to services, in part due to their lack of knowledge about where to access services that provide orthotics or wheelchairs. Therefore, the Levesque, Harris and Russell (2013) model was deemed more appropriate for the qualitative study in Chapter 6 because knowledge of services impacts the ability of an individual to perceive services and the approachability of services. It was reasoned that this framework was more suitable because it specifically mentions health literacy and knowledge of services at the individual level. Previous research has suggested that in LMICs, there is a lack of knowledge and understanding about physical rehabilitation services and provisions of assistive products (Bright *et al.,* 2018; Allen *et al.,* 2022; WHO-UNICEF, 2022).

The Andersen, Davidson and Baumeister (2013) model was created in a HIC context to understand health services, however, here it has been applied to a LMIC settings. Some research has used the model to conceptualise access to the health system, including health and rehabilitation services for people with physical disabilities in both LMIC and HIC settings (e.g., Guilcher *et al.,* 2012; Dassah *et al.,* 2018a; Medeiros *et al.,* 2021; Kim *et al.,* 2023). However, the model has been more widely applied to studies of access to mental health services, healthcare seeking for different types of mental health disorders and the utilisation of services for older adults or those with chronic health conditions in LMICs and HICs (e.g., Reynolds *et al.,* 2012; Roberts *et al.,* 2018; Xiao *et al.,* 2021; Byansi *et al.,* 2023; Sundararajan *et al.,* 2023). The conceptual framework proposed by Levesque, Harris and Russell (2013) has been applied in LMIC contexts and has been more widely used in studies of disability (e.g., Pryn & Kuper, 2019; Casebolt, 2020; Asa *et al.,* 2021; Martin *et al.,* 2021; Mesiäislehto *et al.,* 2021; Hashemi *et al.,* 2022). It is important to ensure that the models are appropriate and suitable to the context they are being applied to. This thesis found that both the Andersen, Davidson and Baumeister (2013) and Levesque, Harris and Russell (2013) models were appropriate for conducting research in LMICs because both frameworks provide broad characteristics which can be adapted to certain contexts rather than being rigid in their inclusion of barriers and facilitators. Furthermore, the application of both frameworks to studies on physical rehabilitation research demonstrates their suitability for future applications.

7.3.2 Using administrative data in access to P&O services research

The use of administrative data, such as data from digital patient records, is not widely used in research on access to physical rehabilitation. A handful of recent studies have demonstrated how the data can be used to investigate use of P&O services over time for prosthetic users in LMICs and HICs (Kamrad *et al.,* 2020; Barth *et al.,* 2020; Barth *et al.,* 2021; Dickinson *et al.,* 2022). Yet, the author has been unable to find other existing studies that use administrative data to examine P&O service use for orthosis users. It was encouraged by Miller & Wurdeman (2021) that administrative data can be a useful tool in researching P&O services because it can provide real-world evidence on utilisation and has the potential to provide large sample sizes. This study has demonstrated that administrative data can be effective to understand service use for orthosis users in Cambodia. This thesis has provided several contributions to this field of research, previous studies have typically focused on use of prosthetic services and examined differences in prosthetic service users from a range of HICs and LMICs. Therefore, users of P&O services for orthotics have not had the same attention paid. Most of the studies use descriptive measures and there is limited use of inferential statistical measures to investigate access to P&O services. Chapter 5 has applied a novel approach to conducting research using administrative data by applying survival analysis methods to the data to find significant differences in use of P&O services for orthosis users. The findings from this Chapter also indicate the importance of collecting high-quality patient data, that is consistent and kept up to date. To do this, service providers and the health professionals working for these services must be willing to spend time asking questions to the service use and entering the data. However, in low resource contexts, a limited number of health professionals working may inhibit the time available for extensive data collection and entry.

7.4 Limitations

Within each of the individual empirical chapters specific limitations of that study have been addressed, nevertheless, there are broader limitations of this thesis that need to be considered.

The ICF framework of disability has been adopted by WHO member states and is the leading definition of disability, with many countries using ICF related sets of questions in national surveys and census (WHO, 2011; WHO, 2022a). Across Chapters 4, 5 and 6, the way that disability is recorded is varied and not consistent. In Chapter 4, disability is measured through functional impairments via the CSES and includes people with moving, hearing, speaking and seeing impairments which is consistent with the definition proposed by the ICF. However, Chapters 5 and 6 do not explicitly measure or collect data on disability or functional limitations, rather the data collected includes people that have physical impairments which has led to them using an orthotic or a wheelchair. In Chapter 5 specifically, it is unknown whether orthoses users have additional impairments or health conditions that impact their ability to use or access assistive products. It is important to avoid the medicalisation of disability and recognise that there is no information available about the person's disability status, rather the only information available pertains to their health condition or impairment where an assistive product may be used.

This study acknowledges both the demand and supply-side barriers to health and rehabilitation services for people with physical disabilities in the literature review and discussion. However, in Chapters 4, 5 and 6, the research primarily includes information about demand-side barriers, for example individual level characteristics such as disability, age, and gender, and there is limited data available to investigate supply-side barriers. Supply-side barriers do significantly impact the ability of people to access health and rehabilitation services. For instance, the availability of physical rehabilitation services of rural areas and absence of an adequate rehabilitation workforce acts as a barrier to access (WHO-UNICEF, 2022). The focus of individual level access to health and physical rehabilitation in this study also dictates how access can be understood. In this study, access is understood in terms of *realised* access and is measured through utilisation of health and P&O services. The absence of data and information on supply-side characteristics such as the number of rehabilitation professionals, the number of health facilities available and their location, i.e., for calculating distance and travel time to facilities, means that *potential* access was not examined. Including measures of *potential* access in this study would have allowed for a deeper understanding of the barriers to services by providing information about probable entry into the health system (Khan, 1992). Ideally, in this study *potential* access would have been included in one of the chapters in some way.

Additionally, access to health and rehabilitation services exists within the context of individual, households, and community characteristics. Chapter 4, 5 and 6 focus largely on individual factors that influence access, with some household information available in Chapter 4 when investigating access to different healthcare services for people with disabilities. In Chapter 5, there is a lack of information about socio-demographic characteristics that would be useful for investigating frequency of P&O service visits, for example education or wealth. This information is present in the dataset used in Chapter 4 and were found to be associated to healthcare seeking in Chi-square tests and regression analysis. Therefore, if this information were available in the patient database, it begs the question as to whether the same results would be found. It is also important to note that throughout all three chapters, there are likely to be confounding variables or barriers not described by participants that impact access to services. It is likely that access is impacted by a multitude of factors, not just disability and the other factors included in this research. Furthermore, this thesis does not allow casual mechanisms of access to health and physical rehabilitation for people with disabilities to be understood. A short reflexive section is provided in Appendix D, D1.

7.5 Policy implications

This research has key conclusions that contribute to Cambodian and wider development policy. As an LMIC, Cambodia in receipt of aid from different IOs and NGOs, many of which operate in the health and physical rehabilitation sectors. Ideally, for these organisations working in Cambodia, they should provide assistance by working alongside the Cambodian Government and health system, working in partnership with public and private health care providers, and with the MOH and the MOSVY. These partnerships would work to increase access and improve equity in health for people with disabilities in Cambodia. One potential framework is through Public-Private Partnerships (PPPs) in health which are used in LMICs to reduce pressure on the public health system and provide necessary funding to increase the quality of services received. However, there is currently limited research on the effectiveness of PPPs (Fanelli *et al.,* 2020). Evidence suggests that clear regulatory frameworks are necessary to ensure trust between public and private providers, this can be ensured by involving private health providers in policy and health decisions (Suchman *et al.,* 2018; Fanelli *et al.,* 2020). Therefore, Cambodia could explore the role of PPPs in providing health and physical rehabilitation services to the population. These PPPs could enable people with disabilities in Cambodia to access specialist services that may only be available at private facilities via the public health system. It also may remove some of the pressures faced by the public health system (Fanelli *et al.,* 2020). Although the government should ensure that PPPs align with the notion of improving equity in health and meeting the SDG goal of '*health for all by 2030*'. As critics of PPPs argue that PPPs channel already limited funds away from the public health system which further weakens the public sector and enables profiteering over people's health (Kumar, 2019).

Improving the quality of healthcare received in Cambodia has also been highlighted by this research. The government should work to create reliable and effective data which details service coverage and the quality of services for the health system as a whole. Data on health service quality should include patient safety, people-centredness, effectiveness and outcomes, and levels of integration (WHO, 2015a). As part of Cambodia's NSPP framework, the improvement of quality healthcare services is listed as a specific aim. Currently, the public health services are monitored by the MOH and provided with health service quality scores (Pheakday *et al.,* 2023). However, these quality assessments are only performed at public health facilities and there are limitations in how information used in the assessment is collected (Pheakday *et al.,* 2023). These limitations inhibit the effectiveness of the quality assessments to properly assess the quality of public health services. The government should also create assessments for private health facilities to ensure that people with disabilities can access quality and affordable healthcare in Cambodia. The government should also aim to increase training of health professionals in communicating and treating people with disabilities to improve equity. This extra training may remove some of the stigma-related and communication barriers to accessing health and rehabilitation services.

This thesis also notes that non-poor people with MSPD have the highest use of private health facilities, although poor people with MSPD have the highest use of IPs. Furthermore, users of P&O services for orthotics and wheelchairs reported facing several financial barriers to the utilisation of services. This indicates a need for social assistance programmes which can support health service access, with a specific focus on to disadvantaged groups, for example people with disabilities, women, elderly and migrant populations. A lack of focus on vulnerable groups in the design and implementation of financing support programmes means that they may not be effective (Plouffe *et al.,* 2020). For example, Kabia *et al.* (2018) found in Kenya, financing policies to aid healthcare seeking for the poor were disability-unfriendly, which in combination with negative healthcare worker attitudes, discouraged women with disabilities in Kenya from seeking healthcare.

In addition, there are no social assistance programmes that support access to assistive products in Cambodia. The government provides P&O services free of charge at the PWDF ran centres and the MOSVY mandates free services to all (Harte *et al.,* 2019). Nearly all LMICs have enacted the UNCRPD which states that access to rehabilitation and assistive products for people with disabilities is a human right (Bright & Kuper, 2018). Hence, in LMICs, policy should recognise this right. In Cambodia, HEFs could be extended to cover expenses faced by utilising physical rehabilitation centres, particularly from IOs. This could also help to improve knowledge of physical rehabilitation services within the health system as access to assistive products can be included in information about HEF entitlement. The findings in Chapter 6 revealed that no participants had been informed about where assistive products can be provided free of charge from health services or hospitals. This indicates that there is a need to specifically include people with disabilities in the design of financial support programmes to ensure information is shared with them. Governments, donors, NGOs and IOs working in global health should work to introduce specific disability inclusive social assistance programmes that support access to the health system. Without a focus on vulnerable groups the third SDG goal 'health for all' will remain unattainable as health inequities will remain impacting the ability of achieving UHC (WHO, 2022a).

7.6 Future research

In each of the individual chapters, suggestions for future research have been stated. In this section, some broader suggestions are provided for future research which are important for removing health inequities for people with physical disabilities in LMICs.

More research is needed at the health system-level to advance health equity for people with disabilities. The WHO (2022) report on equity in health systems to people with disabilities states that more health policy and systems research is necessary to understand the issues around the delivery and implementation of health services. This is important for the delivery of UHC and ensures that global health inequities experienced by people with disabilities are reduced. This echoes the WHO (2017a) report on rehabilitation which also recommends more research on the different service delivery models in rehabilitation and the different financing, management and governance structures. This is demonstrated by Exceed, who have shifted towards to social enterprise model to deliver physical rehabilitation in response to diminishing funding from aid sources (Exceed Worldwide, 2022b). More research on these different service delivery models is needed to examine whether they are effective alternatives to the traditional donation-based funding models. In addition to existing research on the barriers and facilitators for people with disabilities accessing health and physical rehabilitation services, system-level research will help to better understand why some of the barriers exist. Furthermore, there is limited research on the barriers to health and physical rehabilitation services for people with other types of disability, such as intellectual or psychological disabilities. It is important to investigate inequities in access and the experiences of people with different types of disabilities as their health and rehabilitation needs are different. Therefore, future research should investigate the barriers to health services and to physical rehabilitation and assistive products.

In Chapter 6, a handful of participants either chose not to use an orthotic device or did not wear their device daily. Often research assumes that people do not use assistive products because they are inaccessible or unsuitable for their environment. In Chapter 5, it is also unknown why service users do not return for further appointments. Hence, future research should investigate why service users stop engaging with services or their assistive products. The benefits of access to assistive products and physical rehabilitation services have been reported, including increased access to employment, education, social events and activities (WHO, 2011; WHO, 2017a; WHO-UNICEF, 2022). Investigating why people stop using physical rehabilitation services or assistive products will provide more information about the barriers to service users, as those who are not using services may face the greatest barriers to care.

This thesis has demonstrated how administrative patient data can be used to understanding access to P&O services for orthotic users. More research is required to understand the benefits of using administrative data to investigate the barriers to health and rehabilitation services in LMICs. Similarly, the data available from administrative data is limited, as highlighted in Chapter 5. Research should explore the best practices for administrative data collection by health and rehabilitation professionals. This also includes assessing what information about service users is the most useful to have. For instance, Chapter 4 found differences in healthcare seeking between poor households and those who were employed. This information could be important to gather at health and rehabilitation services which could then be used to examine for differences in service use. Although, collecting extra data on service users may create challenges for NGOS, IOs and governments, particularly in how the data should be stored and collected and how health professionals are trained in data collection and storage.

7.7 Publication plan

This thesis has investigated three different areas of access to the health system for people with disabilities in Cambodia. There will be published versions of each of the empirical chapters included in this thesis. The plans for these papers are to publish a paper based off the findings of this thesis in relation to differential access to the health system for people with physical disabilities in Cambodia, in comparison to people without physical disabilities. This is an area where there is currently very little research, and therefore publishing a paper on the topic has the potential to contribute to the literature on healthcare access for people with disabilities in Cambodia. Research on healthcare access for the general population is more widely available, with several studies published on Cambodia, and in the wider Southeast Asian region, on the impact of different demographic and socio-economic characteristics have been published.

A second paper about the successes of the rebuilding of the Cambodia health system also has the potential to be published. The health system, despite the many challenges it faces, has managed to improve access to health and physical rehabilitation in Cambodia through the cooperation of private, public and NGO providers. For example, in the 1990s and early 2000s, physical rehabilitation was provided solely by NGOs. However, several P&O services have been handed over to the PWDF, part of the Cambodian Government. Whilst there are challenges, the PWDF delivered nearly 5,000 appointments in 2020, with government operated and funded services accounting for 30% of total physical rehabilitation appointments in Cambodia (ACCESS Cambodia, 2021).

An additional paper based around Chapters 5 will also be submitted to a journal. This will be a descriptive paper on the demand for orthotics in Cambodia. Existing evidence on orthotic users is extremely limited globally, meaning that this paper is important for increasing understanding of who is accessing P&O services for orthotic devices in LMICs. This paper is relevant to countries outside of Cambodia, as the data base used to collect patient data is used across several countries in P&O centres operated by ICRC and other physical rehabilitation NGOs. This provides some consistency in how the data is collected, making it similar between countries.

There is also the potential for another paper about the finding of HEFs and their complexity in improving access for people with disabilities. As previously stated, studies have found that HEFs have increased access to healthcare for poor households in Cambodia. For households with disability, they are guaranteed an interview for assessment of eligibility of HEFs, but they are not guaranteed access to free or subsidised healthcare as eligibility depends on household income and assets. HEFs could be expanded to include assistance for physical rehabilitation services to support people with disabilities in Cambodia.

7.8 Concluding remarks

This thesis has explored the barriers to health and physical rehabilitation services for assistive products for people with physical disabilities in Cambodia. The noteworthy focus on orthotic and wheelchair users in Chapters 5 and 6 provides important evidence about the barriers they face to P&O services and provides an understanding their *realised* access. The main objectives of the thesis were to investigate access to health and rehabilitation services and understand how people with physical disabilities interact with services and the barriers and facilitators to use they encounter. Overall, the findings suggest people with physical disabilities in Cambodia face different demand-side barriers to accessing health services and assistive products.

In Chapter 4, health service use by people with physical, including sensory, disabilities was examined. This study found that people with MSPD disabilities had different utilisation of healthcare providers compared to people without. Disability was found to interact with gender, poverty and access to social assistance funds to either enable or impede access to formal public and private healthcare services. Chapter 5 then focused more specifically on utilisation of P&O services for orthotic devices to understand *realised* access to physical rehabilitation. Here it was found that changes over time in service users and use of services. Additionally, the frequency of service use was different between certain groups of users of Exceed clinics. Lastly, Chapter 6 then explored barriers to P&O services for orthosis and wheelchairs users in more detail, to gain a better understanding of pathways to physical rehabilitation and assistive products. Gender was a key consideration throughout each three Chapters with all studies finding differences between men and women. In disability and physical rehabilitation research in LMICs, gender is an understudied concept, therefore, this thesis has provided insights into the interactions of gender, impairment and use of health and physical.

The WHO (2022a) report on equity in health for people with disabilities state the importance of removing health inequities for people with disabilities and increasing access to assistive products and physical rehabilitation. Additionally, the WHO-UNICEF (2022) report on AT states that more research is needed on products, provisions, personnel and people to improve access to assistive products. This thesis adds to the growing pool of research in their area which seeks to understand and remove the barriers to health and rehabilitation for people with disabilities in LMICs. Furthermore, focusing on an understudied population such as orthosis and wheelchair users provides more in depth understanding of the utilisation of P&O services and the pathways to physical rehabilitation experienced. Whilst this research has helped to further understand access to health and physical rehabilitation service for people with physical disabilities, several questions remain which need to be addressed. For instance, future research should explore the impact of gender and physical disability and how the intersectionality impacts utilisation of services in Cambodia and other LMICs. Additionally, to further understand the barriers to access, more research into the supply-side barriers and facilitators to health and rehabilitation services for people with disabilities is needed. It is vital to build the capacity for research in LMICs and enable high-quality evidence to be created to support informed policy and decision-making.

Appendix A Chapter four supplementary information

A.1 Different types of healthcare providers used

Variables	N	%
Treatment type		
Public		
National hospital (PP)	161	4.5
Provincial hospital (RH)	193	3.7
District hospital (RH)	168	3.9
Health centre	349	8.2
Health post	13	0.2
Provincial rehabilitation centre (PRC)	1	0.0
Other public	14	0.3
Private hospital or clinic		
Private hospital	572	13.3
Private clinic	1210	27.3
Private pharmacy or other private		
Private pharmacy	1137	25.0
Home/office of trained health worker	264	5.7
Visit of trained health worker	11	0.3
Other private medical	31	0.7
Traditional		
Shop selling drugs/market	261	5.9
Kru Khmer/Magician	40	0.8
Monk/religious leader	1	0.0
Total	4426	100

A.2 Counts and percentages for all categorical variables used

Variables	N	%
Physical disability		
None or mild physical disability	4118	86.4
Moderate or severe physical disability	665	13.6
Age groups		
18 – 39	1322	28.4
40 – 59	1832	38.3
60+	1629	33.3
Gender		
Male	1702	35.2
Female	3081	64.8
Relationship to head of household		
Head	2124	44.4
Spouse	1743	36.0
Son/Daughter	401	8.8
Stepchild	2	0.0
Parent	192	4.0
Sibling	30	0.6
Grandchild	3	0.0
Nephew/Niece	3	0.1
Son/Daughter-in-law	62	1.4

Brother/Sister-in-law	15	0.3
Parent-in-law	180	3.8
Other relatives	28	0.6
Ethnicity		
Khmer	4547	96.0
Cham	113	2.5
Other local ethnic group	99	1.1
Chinese	4	0.1
Vietnamese	11	0.2
Lao	7	0.1
Other	2	0.0
Marital status		
Married/living together	3390	70.1
Divorced or separated	99	2.1
Widowed	956	20.4
Never married or lived with partner	338	7.4
Ever attended school		
No	1316	27.4
Yes	3467	72.6
Ability to read a short sentence in any language		
No	1501	31.3
Yes	3282	68.7
Ability to write a short sentence in any language		
No	1560	32.3
Yes	3223	67.6
Highest education level		
Class one completed	110	3.2
Class two completed	384	10.8
Class three completed	572	15.8
Class four completed	453	12.7
Class five completed	401	11.7
Class six completed	332	9.8
Class seven completed	337	10.1
Class eight completed	230	6.8
Class nine completed without certificate	169	4.9
Class ten completed	103	3.0
Class eleven completed	53	1.7
Class twelve completed without certificate	66	1.9
Lower education certificate (diploma)	71	2.1
Higher education certificate (BacII)	79	2.6
Technical/vocational pre-secondary diploma	5	0.2
Technical/vocational post-secondary diploma	12	0.2
College/university undergraduate but not completed	23	0.6
Bachelor’s degree (BA, BSc, etc)	51	1.7
Master’s degree (MA, MSc, etc)	8	0.2
Other	3	0.1
No class completed	4	0.1
Don’t know	1	0.0
Missing*	1316	
Poor household status		
Non poor	4330	90.9
Poor	453	9.1
Main activity in the last 12 months		
Employed	3667	76.4

Unemployed but employed any time before	19	0.4
Unemployed and never employed any time	38	0.7
Home maker	371	7.9
Student	61	1.2
Dependent	585	12.5
Retired from service	38	0.9
Rent receiver or other income recipient	2	0.0
Other	2	0.1
Possess HEF card		
No	4179	87.5
Yes	604	12.6
Household debt		
No	2919	61.5
Yes	1861	38.5
Missing*	3	
Urban/Rural		
Urban	1625	34.4
Rural	3158	65.6
Zone of residence		
Phnom Penh	287	8.4
Plains	1667	39.1
Tonle Sap	1455	31.3
Coastal	395	6.1
Plateau/mountains	979	15.1
Total	4783	100

A.3 Crosstabulations between treatment or advice seeking and explanatory variables

	Sought treatment		**Did not seek treatment**			
Variables	**N**	**%**	**N**	**%**	**Total %**	**P-value**[10]
Physical disability						0.204
None or mild physical disability	3821	92.5	297	7.5	100	
Moderate or severe physical disability	605	90.0	60	9.1	100	
Age groups						0.038*
18 – 39	1239	93.1	83	6.9	100	
40 – 59	1708	93.2	124	6.9	100	
60+	1479	90.6	357	9.4	100	
Gender						0.319
Male	1567	91.8	135	8.2	100	
Female	2859	92.6	222	7.4	100	
Female Head of Household						0.296
No	3476	92.6	269	7.4	100	
Yes	950	91.4	88	8.6	100	
Marital status						0.695

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[10] The P-value is related to the results of the Chi-square tests

Married/cohabiting	3146	92.5	244	7.5	100	
Divorced/separated/widowed	968	91.6	87	8.4	100	
Never married/cohabited	312	92.6	26	7.4	100	
Ever attended school						0.052
No	1194	91.0	122	9.0	100	
Yes	3232	92.8	235	7.2	100	
Ability to read a short sentence in any language						0.337
No	1375	91.7	126	8.3	100	
Yes	3051	92.6	231	7.4	100	
Ability to write a short sentence in any language						0.337
No	1430	91.7	130	8.3	100	
Yes	2996	92.6	227	7.4	100	
Poor household status						0.016*
Non poor	4021	92.7	309	7.4	100	
Poor	405	88.9	48	11.1	100	
Main activity in the last 12 months						0.012*
Employed	3418	93.0	249	7.0	100	
Unemployed/student	112	94.1	6	6.0	100	
Homemaker	342	92.0	29	8.0	100	
Retired/dependent/other	554	88.3	73	11.7	100	
Possess IDpoor or priority access card						0.107
No	3875	92.6	304	7.4	100	
Yes	551	90.4	53	9.6	100	
Household debt						0.014*
No	2676	91.4	243	8.6	100	
Yes	1747	93.8	114	6.2	100	
Urban/Rural						0.430
Urban	1497	91.7	128	8.3	100	
Rural	2929	92.6	229	7.4	100	
Ecozone of residence						0.101
Phnom Penh	253	88.3	34	11.7	100	
Plains	1559	93.7	108	6.3	100	
Tonle Sap	1337	91.7	118	8.3	100	
Coastal	372	92.9	23	7.1	100	
Mountains	905	91.9	74	8.1	100	
Household bicycle ownership						0.534
No	2103	92.0	167	8.0	100	
Yes	2323	92.6	190	7.4	100	
Household motorbike ownership						0.210
No	803	91.1	77	8.9	100	
Yes	3623	92.6	280	7.4	100	
Household car ownership						0.645
No	4041	92.4	329	7.6	100	
Yes	385	91.5	28	8.5	100	
Total	**4426**	**92.3**	**357**	**7.7**		

**p-value significant at 5% level, **p-value significant at 1% level*

A.4 Hurdle Model Stage 1: Three logistic regression models

	Model 1		Model 2		Model 3	
Covariates	OR (95% CIs)	P-value	OR (95% CIs)	P-value	OR (95% CIs)	P-value
Cons	29.0 (22.2, 38.0)	<0.001**	24.55 (13.05, 46.21)	<0.001**	22.75 (12.13, 42.67)	<0.001**
Physical disability						
No MSPD			1		1	
MSPD			1.22 (0.80, 1.88)	0.348	2.33 (1.19, 4.58)	0.014*
Age groups						
18-39			1		1	
40-59			1.08 (0.73, 1.59)	0.712	1.07 (0.73, 1.58)	0.732
60+			0.94 (0.61, 1.45)	0.796	0.94 (0.61, 1.45)	0.772
Gender						
Male			1		1	
Female			1.20 (0.88, 1.63)	0.247	1.30 (0.94, 180)	0.114
Female headed household						
No			1		1	
Yes			0.87 (0.61, 1.25)	0.450	0.88 (0.62, 1.27)	0.505
Ever attended school?						
No			1		1	
Yes			1.29 (0.95, 1.74)	0.107	1.29 (0.95, 1.76)	0.107
Poor						
Non-poor			1		1	
Poor			0.61 (0.38, 0.97)	0.035*	0.84 (0.45, 1.47)	0.536
Access to health equity card?						
No			1		1	
Yes			0.68 (0.44, 1.04)	0.078	0.69 (0.45, 1.07)	0.095

Employment					
Employed		1			
Unemployed/student		1.36 (0.50, 3.69)	0.545	1.28 (0.47, 3.50)	0.629
Homemaker		0.90 (0.53, 1.55)	0.712	0.90 (0.52, 1.56)	0.709
Retired, dependent, other		0.55 (0.35, 0.86)	0.009*	0.55 (0.35, 0.87)	0.010*
Zone					
Urban		1		1	
Rural		1.06 (0.73, 1.55)	0.748	1.05 (0.72, 1.53)	0.808
Disability*gender					
MSPD*female				0.53 (0.25, 1.12)	0.096
Disability*poor					
MSPD*poor				0.33 (0.12, 0.89)	0.028*
Variance(std.error)	2.27 (0.38)	2.36 (0.37)		2.35 (0.37)	
ICC(std.error)	0.41 (0.04)	0.42 (0.04)		0.42 (0.04)	

**p-value significant at 5% level, **p-value significant at 1% level*

A.5 Predicted probabilities for logistic regression model three

Variables	Predicted probabilities
Physical disability	
No MSPD	0.92
MSPD	0.94
Age	
18-39	0.92
40-59	0.93
60+	0.92
Gender	
Male	0.92
Female	0.93
Female headed household	
No	0.92
Yes	0.92
HEF card	
No	0.93
Yes	0.90
Ever attended school?	
No	0.91
Yes	0.93
Poor	
Non-poor	0.93
Poor	0.90
Employment status	
Employed	0.93
Unemployed/student	0.94
Homemaker	0.92
Retired, dependent, rent/income receiver/other	0.89
Disability*poor	
No MSPD *Non poor	0.92
No MSPD*Poor	0.91
MSPD*Non poor	0.94
MSPD*Poor	0.86
Disability*gender	
No MSPD *male	0.91
No MSPD*female	0.93
MSPD*male	0.95
MSPD*female	0.93

A.6 Hurdle Model Stage 2: model four

	Model 4					
	Private hospital or clinic vs. Public		Private pharmacy or private other vs. Public		IPs vs. Public	
Covariates	RRR (Std. Err)	P	RRR (95% CIs)	P	RRR (95% CIs)	P
Cons	2.75 (0.22)	<0.001**	1.83 (0.21)	0.005**	0.52 (0.25)	0.050*
Physical disability						
None or mild	1		1		1	
Moderate or severe	0.80 (0.16)	0.168	0.56 (0.17)	0.001**	0.79 (0.27)	0.388
Age groups						
18-39	1		1		1	
40-59	0.81 (0.14)	0.127	0.87 (0.14)	0.325	0.86 (0.20)	0.441
60+	1.00 (0.15)	0.990	1.25 (0.16)	0.166	1.05 (0.25)	0.829
Gender						
Male	1		1		1	
Female	1.12 (0.11)	0.312	1.05 (0.11)	0.655	1.25 (0.15)	0.137
Female Headed Household						
No	1		1		1	
Yes	1.11 (0.15)	0.512	1.05 (0.15)	0.753	0.76 (0.22)	0.213
Ever attended school?						
No	1		1		1	
Yes	1.11 (0.12)	0.397	0.97 (0.12)	0.802	1.22 (0.20)	0.311
Employment status						
Employed	1		1		1	
Unemployed/student	0.70 (0.31)	0.262	0.67 (0.36)	0.265	1.14 (0.43)	0.759
Homemaker	0.57 (0.21)	0.006**	0.75 (0.21)	0.180	0.25 (0.38)	<0.001**
Retired, dependent, other	0.77 (0.18)	0.154	0.70 (0.18)	0.051	0.51 (0.30)	0.025*
Poor						
Non-poor	1		1		1	

Poor	0.94 (0.20)	0.758	1.25 (0.22)	0.295	2.78 (0.28)	<0.001**
Health equity fund card						
No	1		1		1	
Yes	0.31 (0.17)	<0.001**	0.45 (0.16)	<0.001**	0.30 (0.26)	<0.001**
Household debt						
No	1		1		1	
Yes	1.33 (0.12)	0.017*	1.51 (0.12)	0.001**	1.27 (0.18)	0.167
Household car ownership						
No	1		1		1	
Yes	1.81 (0.23)	0.009**	1.55 (0.24)	0.072	0.42 (0.44)	0.048*
Urban/Rural						
Urban	1		1		1	
Rural	1.00 (0.12)	0.986	1.22 (0.14)	0.142	1.43 (0.23)	0.124
Variance(std.error)	1.04 (0.16)					

**p-value significant at 5% level, **p-value significant at 1% level*

A.7 Predicted probabilities for multinomial model four

Variables	Public facilities	Private hospitals or clinics	Private pharmacies or other private	Informal providers (IPs)
Physical Disability				
No MSPD	0.17	0.46	0.31	0.05
MSPD	0.22	0.49	0.23	0.06
Age groups				
18-39	0.17	0.46	0.31	0.05
40-59	0.20	0.43	0.31	0.05
60+	0.16	0.43	0.36	0.05
Gender				
Male	0.17	0.46	0.31	0.05
Female	0.16	0.47	0.30	0.07
Female headed household				
No	0.17	0.46	0.31	0.05
Yes	0.16	0.49	0.31	0.04
Ever attended school				
No	0.17	0.46	0.31	0.05
Yes	0.16	0.49	0.29	0.06
Employment status				
Employed	0.17	0.46	0.31	0.05
Unemployed	0.20	0.38	0.35	0.07
Homemaker	0.25	0.39	0.34	0.02
Dependent	0.22	0.46	0.28	0.04
Poor household status				
Non-poor	0.17	0.46	0.31	0.05
Poor	0.15	0.38	0.34	0.13
Household Debt				
No Debt	0.17	0.46	0.31	0.05
Debt	0.13	0.47	0.35	0.05
HEF				
No HEF	0.17	0.46	0.31	0.05
HEF	0.36	0.31	0.30	0.04
Urban/Rural				
Urban	0.17	0.46	0.31	0.05
Rural	0.16	0.43	0.35	0.07
Car				
No Car	0.17	0.46	0.31	0.05
Car	0.11	0.56	0.32	0.01

A.8 Predicted probabilities for multinomial model five

Variables	Public facilities	Private hospitals or clinics	Private pharmacies or other private	Informal providers (IPs)
Physical Disability				
No MSPD	0.17	0.47	0.31	0.05
MSPD	0.29	0.43	0.20	0.08
Age groups				
18-39	0.17	0.47	0.31	0.05

40-59	0.19	0.44	0.32	0.05
60+	0.15	0.43	0.36	0.05
Gender				
Male	0.17	0.47	0.31	0.05
Female	0.18	0.42	0.33	0.08
Female headed household				
No	0.17	0.47	0.31	0.05
Yes	0.16	0.49	0.31	0.04
Ever attended school				
No	0.17	0.47	0.31	0.05
Yes	0.15	0.50	0.29	0.06
Employment status				
Employed	0.17	0.47	0.31	0.05
Unemployed	0.22	0.43	0.28	0.08
Homemaker	0.24	0.39	0.35	0.02
Dependent	0.21	0.47	0.28	0.03
Poor household status				
Non-poor	0.17	0.47	0.31	0.05
Poor	0.13	0.40	0.34	0.13
Household Debt				
No Debt	0.17	0.47	0.31	0.05
Debt	0.12	0.47	0.36	0.05
HEF				
No HEF	0.17	0.47	0.31	0.05
HEF	0.38	0.30	0.29	0.03
Urban/Rural				
Urban	0.17	0.47	0.31	0.05
Rural	0.14	0.45	0.34	0.06
Car				
No Car	0.17	0.47	0.31	0.05
Car	0.11	0.56	0.32	0.01
Physical Disability*Gender				
No MSPD and Male	0.17	0.47	0.31	0.05
No MSPD and Female	0.17	0.47	0.30	0.06
MSPD and Male	0.29	0.44	0.19	0.08
MSPD and Female	0.19	0.54	0.22	0.05
Physical Disability*Poor				
No MSPD and Non-poor	0.17	0.47	0.31	0.05
No MSPD and Poor	0.13	0.40	0.34	0.13
MSPD and Non-Poor	0.29	0.44	0.19	0.08
MSPD and Poor	0.33	0.29	0.23	0.15
Physical Disability*HEF				
No MSPD and No HEF	0.17	0.47	0.31	0.05
No MSPD and HEF	0.38	0.30	0.29	0.03
MSPD and No HEF	0.29	0.44	0.19	0.08
MSPD and HEF	0.44	0.31	0.21	0.05

Appendix B Chapter five supplementary materials

B.1 Categories for diagnosis variable for all clients

Diagnosis	Count	Categories used to make the variable	Count
Infection or other disease	694	Infection	103
		Other disease	226
		T.B	54
		Epilepsy	10
		Meningitis	301
Trauma or injury	367	Injury	56
		Nerve injury	82
		Trauma	221
Other congenital or genetic condition	419	Other congenital	295
		Down syndrome	38
		Muscular dystrophy	53
		Spina Bifida	33
Cerebral Palsy	2450	Cerebral Palsy	2450
Clubfoot	805	Clubfoot	805
Paralysis	1320	Diplegia	17
		Foot drop	33
		Drop wrist	2
		Hemiplegia	776
		Paralysis	183
		Paraplegia	256
		Quadriplegia	11
		Tetraplegia	40
Dislocation or fracture	1060	Dislocation	348
		Fracture	712
Polio	1981	Polio	1981
Scoliosis or curved spine	304	Scoliosis or curved spine	304
Short leg	268	Short leg	268
Stroke	344	Stroke	344
Other	1934	Valgus	39
		Malnutrition	31
		Bowleg	85
		Pain	54
		Visual impairment	40
		Contracture	246
		Hearing impairment	39
		Equinus	26
		Flat foot	25
		Torticollis	200
		Unknown	198
		Other	926
		Varus	25
Missing	386	Missing	386
	12332		**12332**

B.2 Categories for type of orthosis variable

Type of orthosis	Count	Categories used to make the variable	Count
Ankle-Foot Orthosis	7811	A.F.O	7811
Foot Orthosis	971	F.O	971
Knee-Ankle-Foot Orthosis	4265	K.A.F.O	4265
Shoe Raise	2002	Shoe Raise	2002
Steenbeek Foot Abduction Brace	635	S.F.A.B	635
Lower Limb Orthosis	453	D.A.F.O	6
		H.O	19
		I.K.A.F.O	14
		H.K.A.F.O	30
		Insole	272
		K.O	36
		PTB Brace	76
Upper Limb Orthosis	670	E.O	20
		E.W.H.O	11
		Finger orthosis	4
		S.O	221
		W.H.O	359
		W.O	55
Spinal Orthosis	620	C.O	111
		C.T.L.S.O	17
		Helmet	12
		L.S.O	28
		T.L.S.O	452
Other	205	Abduction Brace	11
		Corner Seat	140
		Fracture O	1
		Ortho Prosthesis	5
		Other	10
		Trolley chair	18
		Toilet chair	3
Missing	19	Missing	19
	17651		**17651**

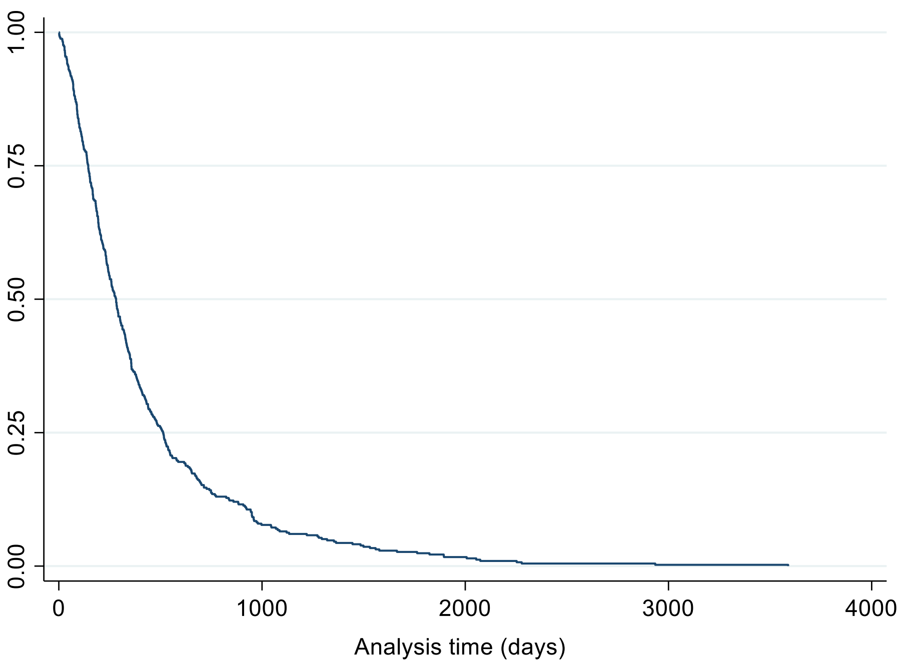
B.3 Test of the proportional hazards assumption

Under 18s			**Over 18s**		
Variables	**R**	**P-value**	**Variables**	**R**	**P-value**
Sex			Sex		
Female			Female		
Male	-0.024	0.446	Male	0.018	0.570
Clinic			Clinic		
Phnom Penh			Phnom Penh		
Kampong Chhnang	0.006	0.856	Kampong Chhnang	-0.004	0.906
Sihanoukville	0.014	0.654	Sihanoukville	-0.076	0.009
Diagnosis under 18s			Diagnosis over 18		
Cerebral Palsy			Polio		

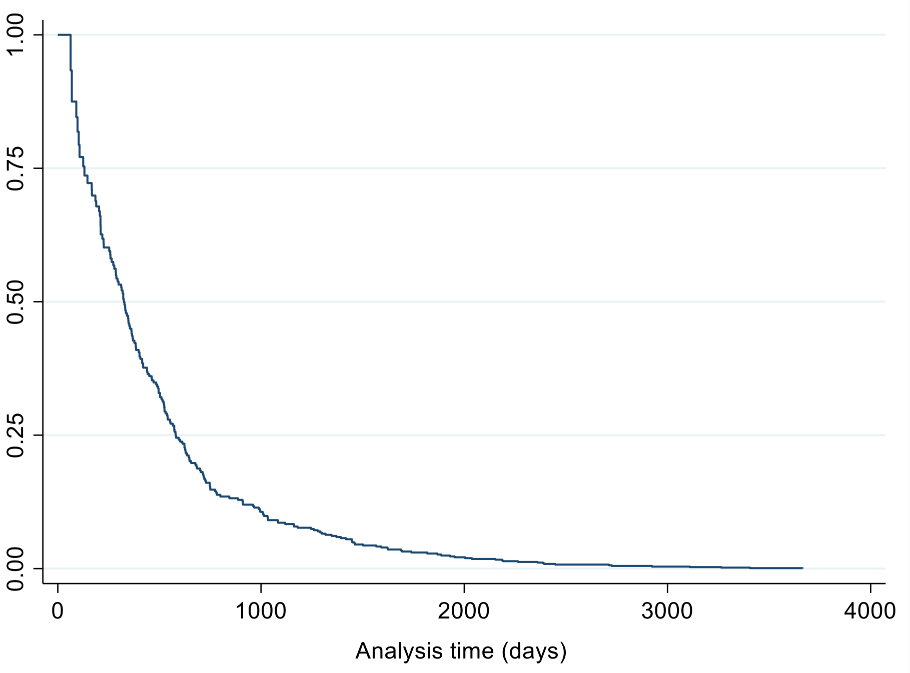
Clubfoot/short leg/ other congenital	0.005	0.875	Trauma/paralysis/fracture/ dislocation	-0.024	0.412
Infection/other disease/ polio	-0.034	0.266	Clubfoot/short leg/scoliosis	-0.043	0.167
Trauma/paralysis/fracture/ dislocation	-0.024	0.445	Other/missing	-0.009	0.752
Scoliosis/curved spine	0.032	0.232	Type of device		
Other/missing	-0.026	0.387	AFO/FO		
Type of device			KAFO	-0.027	0.412
AFO/FO			SR/spinal/other	0.015	0.610
KAFO	0.029	0.401			
SR/other	-0.003	0.908	Age at appointment	0.040	0.297
SFAB	-0.014	0.639	Age at first appointment	-0.034	0.360
Spinal	-0.028	0.262	Previously received WC or MA		
Age at appointment	-0.004	0.897	No		
Age at first appointment	0.015	0.649	Yes	-0.014	0.690
Previously received WC or MA			Number of repairs		
No			No repairs		
Yes	0.010	0.758	Repairs sought	-0.005	0.872
Number of repairs					
No repairs					
Sought repairs previously	-0.015	0.616			
Global test		**0.950**	**Global test**		**0.329**

B.4 Kaplan-Meier survival estimates

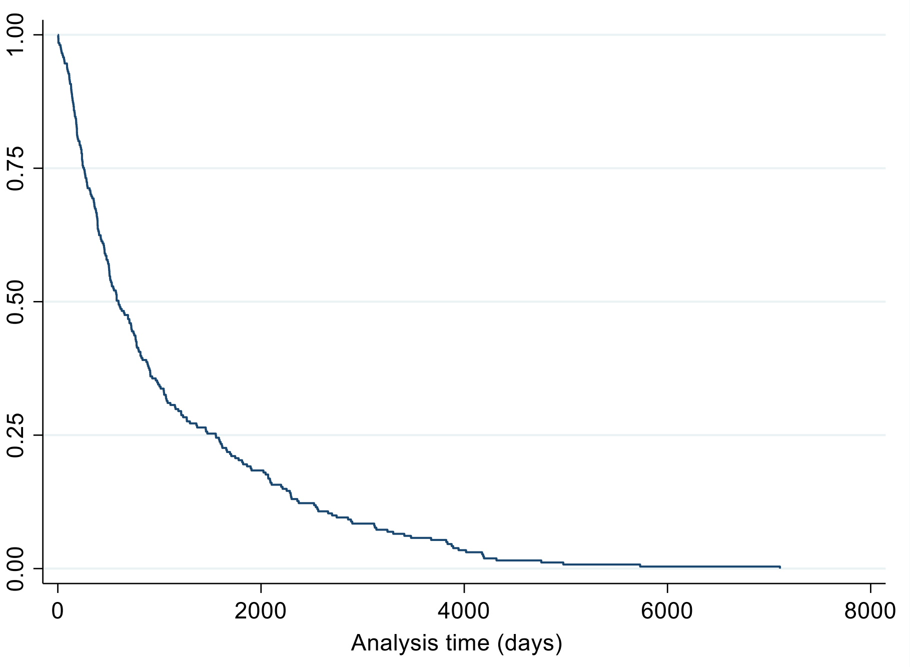
B.4.1 Kaplan-Meier plot for 1st to 2nd orthotic delivery for under 18s



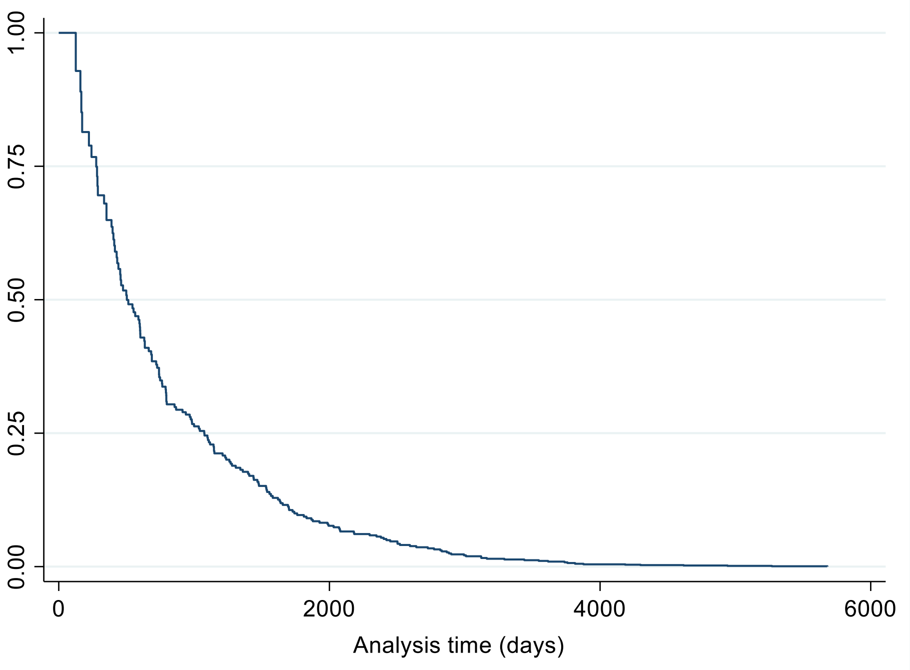
B.4.2 Kaplan-Meier plot for 2nd to 3rd orthotic delivery for under 18s



B.4.3 Kaplan-Meier plot for 1st to 2nd orthotic delivery for over 18s



B.4.4 Kaplan-Meier plot for 2nd to 3rd orthotic delivery for over 18s



Appendix C Chapter six supplementary materials

C.1 Participant information sheet (English version)

Participant Information Sheet

Study Title: Exploring barriers and decision-making process in Prosthetic and Orthotic services in Cambodia

ERGO number: 68254.A1

Invitation
We would like to invite you to take part in our research study. Before you decide whether or not to take part, we would like you to understand why the research is being done and what it would involve for you. Please read the information below and ask questions if anything is not clear or you would like more information before you decide to take part in this research. You may like to ask the main researcher (Charlotte). If you are happy to participate you will be asked to sign a consent form.

What is the research about?
This study is part of a PhD thesis. The main researcher is a student from University of Southampton in the United Kingdom (UK). The research is about orthotic services in Cambodia and impact of orthoses on an individual's life and the decision-making processes they made when deciding when and where to seek rehabilitative care.

Why have I been asked to participate?
You have been asked to take part in this study because you currently use an orthotic device and have recently attended an Exceed Worldwide clinic.

What will happen to me if I take part?
If you decide to take part in this research study, you will participate in an interview with the main researcher (Charlotte) and a translator. You will be asked questions from a list of questions but there would be the chance to talk about other experiences and barriers. The interviews will last for a maximum of 90 minutes and will focus on your experiences of seeking healthcare for your medical condition, when and where you sought rehabilitative care first, as well as subsequent seeking of rehabilitative care, the impact of having and utilising your orthotic devices and the barriers to seeking orthotic services in Cambodia. The interviews will be audio-recorded, this means that your voice will be recorded on to an audio device for research purposes. The voice recordings will be transcribed, or written out, after the interview, and the original voice recording will be destroyed.

Are there any benefits in my taking part?
If you decide to take part, you will be compensated $3.

Are there any risks involved?
There should be no risks associated with this study beyond your normal clinical visit. The interviewer may ask questions about your medical condition or injury, and should you have any concern that this will be upsetting, you can withdraw from the research.

What data will be collected?
The interviews aim to collected different data. These are listed below in the bullet points:

- Information about you, including age, sex, occupation, education, marital status and household composition and medical condition or cause of injury requiring the use of an orthosis
- Information about healthcare seeking behaviours, such as when medical care was first sought and about your patterns of orthotic service use.
- The impact of the orthotic device on your everyday life and quality of life.
- The barriers experienced to seeking rehabilitative care and the enabling factors

Any information collected from you will be stored in a password protected electronic file on the University of Southampton's networked drive.

Will my participation be confidential?
Yes.

Your participation and the information we collect about you during the interview will be kept strictly confidential. Only members of the research team and responsible members of the University of Southampton may be given access to data about you for monitoring purposes and/or to carry out an audit of the study to ensure that the research is complying with applicable regulations.
Individuals from regulatory authorities (people who check that we are carrying out the study correctly) may require access to your data. All of these people have a duty to keep your information, as a research participant, strictly confidential.

The study is part of a PhD thesis which will eventually be published online, and the research may also be published in scientific journals, but all participants will be kept anonymous, and direct quotes included in the reports will have no names or identifiable information. You will be given a unique number, which will be used instead of your name to identify all your data.

Do I have to take part?
No, it is up to you whether or not to take part. If you decide you want to take part, you will need to sign a consent form to show you have agreed to take part.

What happens if I change my mind?
You can leave the study during the research by telling the researcher that you do not wish to continue. You have the right to change your mind and withdraw at any time without giving a reason and without your participant rights (or routine care if a patient) being affected.

If you withdraw from the study after PhD/paper submission we will keep the information about you that we have already obtained for the purposes of achieving the objectives of the study only.

What will happen to the results of the research?
Your personal details will remain strictly confidential. Research findings made available in any reports or publications will not include information that can directly identify you without your specific consent.

Where can I get more information?

- If you would like more information about the study, you can email Charlotte Owen (UK, co5g14@soton.ac.uk)
- Kheng Sisary (Cambodia, Country Director, Exceed Worldwide, sisary@exceed-worldwide.org; +85523 881 494),

What happens if there is a problem?
If you have a concern about any aspect of this study, you should speak to the researchers who will do their best to answer your questions.

- Charlotte Owen (UK, co5g14@soton.ac.uk)
- Kheng Sisary (Cambodia, Country Director, Exceed Worldwide, sisary@exceed-worldwide.org; +85523 881 494),

If you remain unhappy or have a complaint about any aspect of this study, please contact the University of Southampton Research Integrity and Governance Manager (+44 (0)23 8059 5058, rgoinfo@soton.ac.uk).

Data Protection Privacy Notice
The University of Southampton conducts research to the highest standards of research integrity. As a publicly-funded organisation, the University has to ensure that it is in the public interest when we use personally-identifiable information about people who have agreed to take part in research. This means that when you agree to take part in a research study, we will use information about you in the ways needed, and for the purposes specified, to conduct and complete the research project. Under data protection law, 'Personal data' means any information that relates to and is capable of identifying a living individual. The University's data protection policy governing the use of personal data by the University can be found on its website (https://www.southampton.ac.uk/legalservices/what-we-do/data-protection-and-foi.page).

This Participant Information Sheet tells you what data will be collected for this project and whether this includes any personal data. Please ask the research team if you have any questions or are unclear what data is being collected about you.

Our privacy notice for research participants provides more information on how the University of Southampton collects and uses your personal data when you take part in one of our research projects and can be found at http://www.southampton.ac.uk/assets/sharepoint/intranet/ls/Public/Research%20and%20Integrity%20Privacy%20Notice/Privacy%20Notice%20for%20Research%20Participants.pdf

Any personal data we collect in this study will be used only for the purposes of carrying out our research and will be handled according to the University's policies in line with data protection law. The data collected will be pseudonymised as pseudonyms will be used instead of names. If any personal data is used from which you can be identified directly, it will not be disclosed to anyone else without your consent unless the University of Southampton is required by law to disclose it.
Data protection law requires us to have a valid legal reason ('lawful basis') to process and use your Personal data. The lawful basis for processing personal information in this research study is for the performance of a task carried out in the public interest. Personal data collected for research will not be used for any other purpose. For the purposes of data protection law, the University of Southampton is the 'Data Controller' for this study, which means that we are responsible for looking after your information and using it properly. The University of Southampton will keep identifiable information about you for 10 years after the study has finished after which time any link between you and your information will be removed.

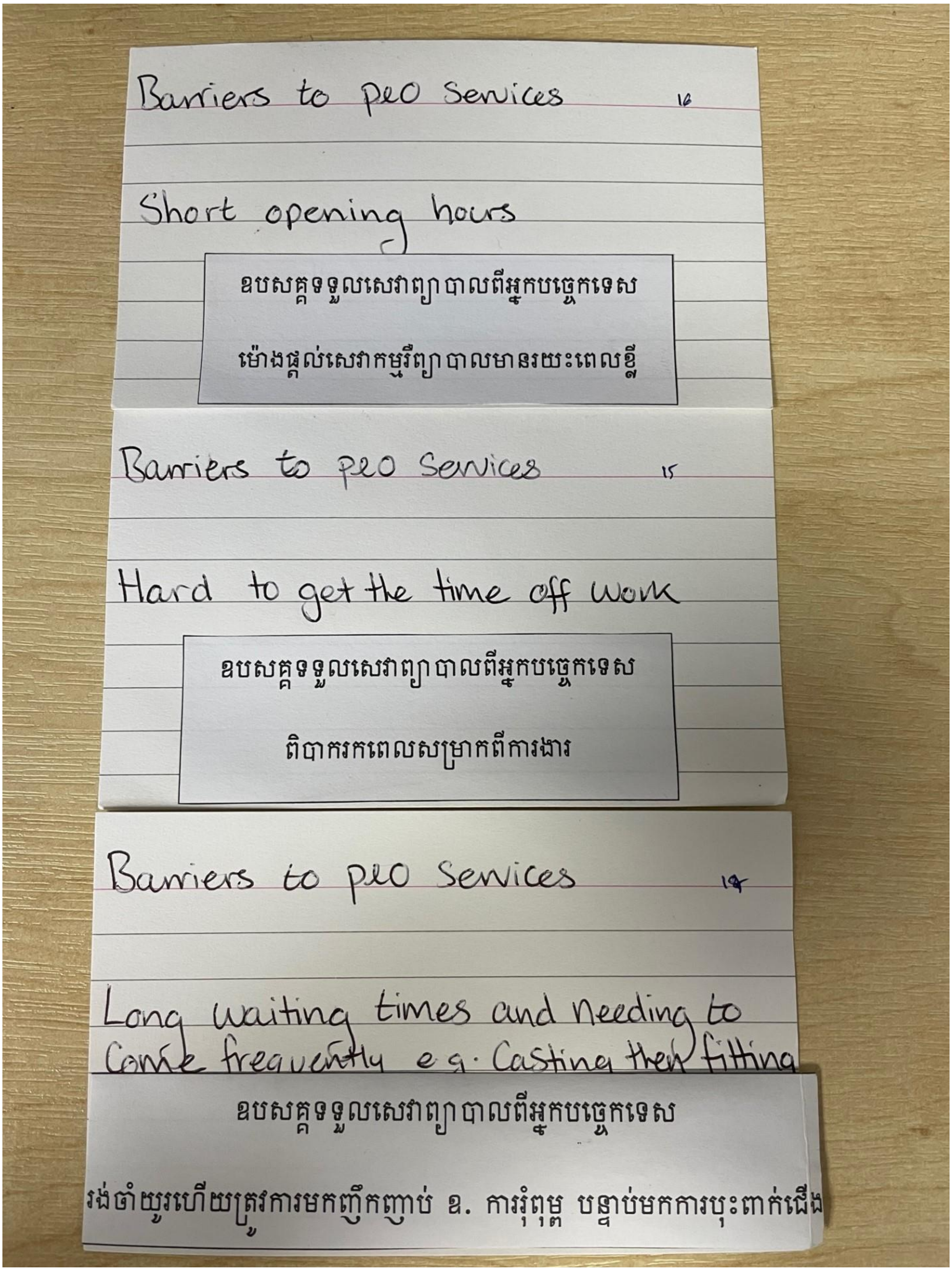
To safeguard your rights, we will use the minimum personal data necessary to achieve our research study objectives. Your data protection rights – such as to access, change, or transfer such information - may be limited, however, in order for the research output to be reliable and accurate. The University will not do anything with your personal data that you would not reasonably expect.

If you have any questions about how your personal data is used, or wish to exercise any of your rights, please consult the University’s data protection webpage (https://www.southampton.ac.uk/legalservices/what-we-do/data-protection-and-foi.page) where you can make a request using our online form. If you need further assistance, please contact the University’s Data Protection Officer (data.protection@soton.ac.uk)

C.2 Participant consent form (English version)

CONSENT FORM

C.3 Example interview facilitation cards



Barriers to pro Services 16

Short opening hours

ឧបសគ្គទទួលសេវាព្យាបាលពីអ្នកបច្ចេកទេស

ម៉ោងផ្តល់សេវាកម្មរីព្យាបាលមានរយះពេលខ្លី

Barriers to pro Services 15

Hard to get the time off work

ឧបសគ្គទទួលសេវាព្យាបាលពីអ្នកបច្ចេកទេស

ពិបាករកពេលសម្រាកពីការងារ

Barriers to pro Services 14

Long waiting times and needing to Come frequently e.g. Casting then fitting

ឧបសគ្គទទួលសេវាព្យាបាលពីអ្នកបច្ចេកទេស

រង់ចាំយូរហើយត្រូវការមកញឹកញាប់ ឧ. ការរុំពុម្ព បន្ទាប់មកការបុះពាក់ជើង

C.4 Semi-structured interview guide

Theme	Main questions	Probing questions/phrases
Background	• Please tell me a bit about yourself, for example your age, schooling and occupation. • How many people are in your household and what is your relationship to them?	•
Impairment	I would like to hear more about your impairment: • Please could you describe the challenges you face at home when not using an assistive product? • Please could you describe the challenges you face at work when not using an assistive product? • Please could you describe the challenges you face outside the home when not using an assistive product? • When not using an assistive product, how do people treat you? • Have you had any negative experiences with people due to your impairment? I would now like to ask some questions about your experiences of using an assistive product. • When you use an assistive product, how does it make you feel? • How does your assistive product impact you? • Do people treat you differently when you use your assistive product? • Do you know about any Disabled People Organisations? Have you had contact with them?	• How does this make you feel? • Why do you think this is? • Do you have to rely on other people for anything? E.g., self-care, cooking, cleaning. • Why do you think people treat you differently?
Care seeking behaviour – including orthotics	• When and why did you first seek healthcare, including both modern and traditional, for your condition? • Did you seek healthcare when you first became ill? • Tell me about your first experience at a P&O clinic • Did the P&O clinic follow up after your first visit? For example, telephone calls or community visits.	• Was this a decision made solely by you, or also by family members? • Where are all the places you sought care? • How was your experience? How did it make you feel?

	• Have you attended any other physical rehabilitation centres? E.g., those not operated by Exceed Worldwide • When did you become aware of the service offered by Exceed Worldwide? • How did you hear about the services?	• How was your experience? • Were you referred by a doctor/ medical professional? • Were you aware of your options for physical rehabilitation?
Decision-making process	I would now like to ask about your most recent visit to the clinic and any barriers that you face. • Thinking of your most recent visit, what did you attend the clinic for? • How long did you wait before going to the clinic? • When did you start to have issues with your assistive product? • Is the Phnom Penh clinic the closest to your home? • Is there anything that stops you attending Exceed's clinic? • Does your family help you with attending the clinic? I would like to ask you about how you think the services can be improved? • Do you have any opinions about the service from Exceed you've received so far? • Do you have any suggestions for improving the services? • Is there anything Exceed could do more of?	• Did you require a repair or delivery of new assistive product? • If delaying, why did you not come to the clinic after your device broke? • How long does it take you to travel to the clinic? • If this is not the closest clinic to your home, what made you decide to come to this clinic, instead of the one closest? • Were you able to get the time off work?
Impact of assistive product	• What impact has the assistive product had on your everyday life? • Do people treat you differently now you have your assistive product, compared to your life without it?	• Work, schooling, community participation.

	• Has your assistive product had an impact on your quality of life?	
Closing	• Is there anything else that you would like to about your experiences using physical rehabilitation services, your device or impairment?	

C.5 Thematic analysis themes and codes

Themes	Theme description	Sub-themes	Codes	Code description
Background context to impairment	This theme explores the reasons, such as medical conditions, which have led to participants orthosis or wheelchair use and their experiences of using healthcare for this condition.	Medical conditions	Cause of impairment	Reasons for use of orthosis or wheelchair
			Unsure about cause of Impairment	Participants had limited knowledge of their medical history
			Impairment caused by treatment received	Belief that their impairment was caused by injection or treatment received from health facility.
			Used multiple health facilities	Accessing various forms of allopathic and traditional medicine to treat the medical condition
			Khmer traditional treatments	Accessing only Khmer medicine to treat their medical condition
			Location of healthcare	Where healthcare was sought first, i.e., hospital, location health clinic or was seen at home.
			Healthcare not available	Healthcare not sought due to a lack of availability at the time.
		Experience of (first or additional) treatments	No condition improvement	Participants reported not seeing their condition improve after first using healthcare
			Physical therapy	Treatment consisted of physical therapy

			Referral to hospital	Health centre referred the participant to a hospital for further treatment or testing
			Long time spent in hospital	Participant spent an extended period of time in hospital as part of their treatment
			Missing follow up appointments	Further appointments at a health centre or hospital were missed, meaning that participants did not receive all the prescribed treatment
			Parent refused further treatment	Participants parent refused further treatments proposed by hospital or health centre
			Return to hospital for further treatments	Participant went to the hospital more than once to receive treatment
Experiences and impact of P&O services	The second theme relates to participants P&O service experiences and how they interact with Exceed or other P&O services. The impact of P&O service use and assistive products is also explored in this theme, alongside issues related to impairments.	Initial P&O service appointments	Delay in getting P&O services	Long delays were experienced for participants in receiving an orthosis or wheelchair
			First sought P&O services	First P&O experiences
			Pain with first device	The first assistive product used by participants caused pain
			Device abandonment	The first assistive product used was abandoned
			Hard to adapt	Adjusting to using an assistive product was challenging at first
			Feeling scared	Participants expressed feelings of scared or nervousness when using services for the first time

			Adapted to assistive product	No problems adjusting to using an assistive product
		Impact of P&O service use	Feeling happy	Feelings of happiness due to using an assistive product
			Treatment from others improved	Other people started treating participant better after they started using an assistive product
			Independence	Using an assistive product enables independence i.e., housework
			Ability to work	Using an assistive product enables ability to work or earn a living
			Increased confidence	Using an assistive product increases participants self-confidence
			Improved mobility	Using an assistive product improves participants mobility
			Limited assistive product use	Participants report not always using their assistive product
			Self-repairs	Repairing own orthosis or wheelchair instead of accessing P&O clinic
			Quality of assistive product	Participant wants a better quality assistive product
			Takes time to don/doff	Removing and putting on an orthotic takes too much time
			Itchy/sweaty	Wearing an orthosis can be itchy or sweaty
			Impacts clothing	Participant is unable to wear certain types of clothing with an orthosis
			Limbs feels weaker using orthosis	Participant limb feels weaker when using device

			Assistive product impacted by weather/climate	Hot, rainy and humid weather creates challenges when using an assistive product
			Hard to use assistive product on certain ground	Uneven, sandy or muddy ground creates challenges when using an assistive product
			All-day use of assistive product	Wearing or using an assistive product for the whole day.
		Remaining issues with impairment	Unable to work	Stopped or unable to work due to condition or impairment
			Condition impacts mobility	Participants condition or physical impairment impacts their mobility
			Condition impacts social/community engagement	Participants condition or physical impairment impacts their ability to engage with social and community events
			Condition impacts housework/independence/carry water	Participants condition or physical impairment impacts their ability to carry out housework, carry water and be independent.
			Depression and hopelessness	Participants discussed feelings of depression and hopelessness due to their condition
			Suicidal ideation	Participants reported suicidal ideation due to their condition
			Lack of self-confidence	Participants reported a lack of self-confidence due to their condition
			Burden on family	Participants reported feeling like a burden to their family because of their condition

			Treatment of people with disabilities have improved over time	Participants discussed that treatment from other people had improved over time
			Treated well	Immediate family understand/treat well
			Limited discrimination	Participants felt no or very limited discrimination due to their impairment
			Better awareness about disability	People are more educated now about disability compared to before
			Disability not spoken about	Disability is not a topic that is widely spoken about
			More information about people with disabilities in media	Participants reported wanting more awareness raising of people with disabilities in the media
			Bullying	Participants teased or bullied by others because of their impairment
			People staring or judging	Participants felt like people judge or stare at them
			Able to do as others	Disability doesn't impact participants much, they are able to do the same as people with disabilities
Barriers to P&O services	The reasons people may delay or not access P&O services for orthoses or wheelchairs	Barriers to P&O services	COVID-19	COVID-19 delaying P&O service use
			Distance and travel time	Distance of travel and travel time to the clinic
			Cost of travel	High travel expenditure
			Exceed providing less help for transport	Less help available for the costs of travel to and from Exceed clinic

			Inaccessible transport	Transport available is inaccessible
			Work	Barriers due to work such as unable to get time off or too busy with work
			Loss of income	Loss of income due to being away from work or taking time off
			Cost recovery	Trial conducted by Exceed at Phnom Penh where service users were asked to pay for a portion of the assistive product depending on their income
			Cost of food and accommodation	Costs of paying for food and accommodation when using P&O services
			Caring responsibilities	Needing to care for sick or elderly parents and children
			Needing permission	Needing to seek permission from spouse or family to use services
			Family unable to assist access	Family are unable to help take to and from P&O services due to cost, work and other responsibilities
		Limited health knowledge	Limited knowledge of services	Participants had limited knowledge of P&O services and other providers
			No information from health facilities	Healthcare professionals not providing information about P&O services
			Limited knowledge of condition	Participants were often unsure about their diagnosis

Facilitators to P&O services	The enablers of P&O service use for orthosis and wheelchair users.	Importance of community workers	Information sharing	Participants learnt about services through community workers and outreach activities
			Outreach and community activities	Importance of outreach and community activities such as repair workshops, product delivery and appointment booking
			Good communication and follow-up	Community workers have good communication and follow-up practices
		Social support networks	Service users sharing information	Participants learnt about services through other service users
			School sharing information	Participants learnt about services through attending a school for children with disabilities
			Friends, acquaintances and family sharing information	Participants learnt about services through friends, family and other acquaintances
			Supportive networks	Participants are supported by the people around them, e.g., family, friends and neighbours
		Exceed enabling use	Transport provisions	Exceed providing transport to and from clinic
			Free services	Exceed provide services free of charge
			Good communication	Exceed are good at sharing information and communicating with service users
			Welcoming	Exceed staff are polite and welcoming

		Individual agency	Desire to use services	Participants have the desire to use P&O services and assistive products
			Used multiple P&O providers	Participants have used multiple P&O providers in their pathway to physical rehabilitation
			Searching for P&O services nearer to them	Participants continue to look for the services that are close to their homes and places of work

Appendix D Limitations section continued

D.1 Reflexivity

This section provides a short reflexive paragraph from the author’s perspective of the research carried out. Throughout the thesis, the third person has been used, however; in this section, the first person will be used. This thesis conducted research in a high income setting on people with disabilities in a low resource setting. In these contexts, it is important to understand my own impact on and position in the research (Akter *et al.,* 2022). The methods and analysis used in this thesis involved drawing upon my own previous academic studies in research methods, human geography, demography and global health. Hence, this research was undertaken with preconceived notions of methodological approaches and the generation of knowledge. In relation to the quantitative studies in Chapters 4 and 5, these notions included decisions about what to study and what methods and tests were used (Johnson & Onwuegbuzie, 2004). In particular reference to Chapter 6, data was collected using in-depth semi-structured interviews. The language barriers faced by the participant and I and having conversations facilitated by a translator may have impacted the ability to build rapport with participants.

This research was also impacted by COVID-19. There was a delay in the publishing of CSES data by the Cambodian National Institute of Statistics, although this impact largely did not affect the final outcomes. A more significant impact was on the data collection and publishing of the Cambodian General Population Census data and necessary materials. My initial research proposal contained a chapter on disability and health facility location using small area estimation and GIS mapping techniques to estimate the percentage of disability at commune level in Cambodia and distance to health facilities to investigate potential access to services. The delays caused by COVID-19 meant that the necessary census data and shapefiles were unavailable in time for this paper to progress. This led to this paper being abandoned and focus shifting to other empirical chapters. In addition, this thesis has been further shaped by my involvement with a project about digital technologies and prosthetics in Cambodia. During the course of this project, I encountered the challenges of access to physical rehabilitation services in Cambodia in more detail. This led me to explore how orthosis and wheelchair users engage and access services as evidence was sparse in comparison to research with users of prosthetics. Consequently, the direction of this thesis changed, with less focus on general access to healthcare for people with physical disabilities, and more focus on a specific group and type of health service.

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