University of Southampton

Faculty of Social Sciences

School of Economic, Social and Political Sciences

Understanding Access to Public Healthcare services in Guatemala

by

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Abstract

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Understanding access to healthcare is relevant to assess the efficiency of healthcare services and to identify inequalities. Access to healthcare represents the outcome of a complex phenomenon that involves the structural characteristics of the healthcare system and multiple processes for providing services. Measuring access to healthcare requires the consideration of various outcomes while understanding the interrelationship between the characteristics of the healthcare system. Analysing the interrelation between the attributes of the health system and the outcomes frequently is frequently overlooked, its measurement represents a significant challenge in many countries.

This thesis provides a unique contribution to the literature by exploring access to healthcare services using a health system perspective in a Global South country. The research studied the interrelation between access to healthcare and structural factors of public service provision. The analysis measures access to healthcare for users of public healthcare facilities to identify who benefits from services provided at two levels of the healthcare organisation. Guatemala represents a suitable scenario to explore access to healthcare, with a public healthcare system that is comparable to many Global South countries.

Access to diverse and comprehensive healthcare services is essential for the wellbeing and social development of the population in Guatemala. The findings indicate fundamental inequalities in access, with certain demographic groups and rural areas facing significant barriers. This research provides empirical evidence that access to public healthcare services in Guatemala is highly influenced by the structural characteristics of the service provision.

"*Time is the substance I am made of. Time is a river which sweeps me along but I am the river; it is a tiger which destroys me but I am the tiger; it is a fire which consumes me but I am the fire. The world, unfortunately, is real; I, unfortunately, am….*"

Borges, J. L. (1962). The garden of forking paths. *Collected fictions*, *119*.

"Death (or its illusion) makes men precious and pathetic. They are moving because of their phantom condition; every act they execute may be their last, there is not a face that is not on the verge of dissolving like a face in a dream. Everything among the mortals has the value of the irretrievable and the perilous"

Borges, J. L. (1962). The garden of forking paths. *Collected fictions*, *119*.

"But the desire for knowledge has another form, belonging to an entirely different set of emotions. The mystic, the lover, and the poet are also seekers after knowledge-not perhaps very successful seekers, but none the less worthy of respect on that account. In all forms of love we wish to have knowledge of what is loved, not for purposes of power but for the ecstasy of contemplation… Wherever there is ecstasy or joy or delight derived from an object there is the desire to know that object… "

Russell, B. (2009). *The scientific outlook*. Routledge.

''Systems awareness and systems design are important for health professionals but are not enough. They are enabling mechanisms only. It is the ethical dimension of individuals that is essential to a system's success. Ultimately, the secret of quality is love"

Donabedian, A. (1986)

Table of Contents

Table of Tables

Table of Tables

Table of Tables

Table of Figures

Table of Figures

Table of Figures

Research Thesis: Declaration of Authorship

Print name: Astrid Maria Arriaza Solares

Title of thesis: Understanding Access to Public Healthcare Services in Guatemala

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

Signature: ..... Date……..……

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Definitions and Abbreviations

ADM	Geopolitical administrative unit
ADM-0	National-level administrative unit
ADM-1	Department-level administrative unit
ADM-2	Municipality-level administrative unit
ADM-3	Populated settlement administrative unit
ACG	Adjusted Clinical Groups
AIC	Akaike's Information Criterion
ANC	Antenatal Care
CI	Confidence Interval
DEM	Digital Elevation Model
DHS	Demographic and Health Survey
EmOC	Emergency Obstetric Care
ERGO	Ethics and Research Governance Online
FCA	Float Catchment Area
GBD	Global Burden of Diseases
GDP	Gross Domestic Product
GIS	Geographic Information System
GP	General Practitioner
GPS	Geographic Position System
HDSS	Health Demographic Surveillance Site
HIS	Health Information System
HIV	Human Immunodeficiency Viruses
ICC	Intra Cluster Correlation
ICD-10	International Classification of diseases
ID	Individual identifier
IGSS	Guatemalan Social Security (Spanish acronym)
INE	Guatemalan National Statistics Office (Spanish acronym)
LMICs	Low-and Middle-Income Countries

LSM	Living Standards Measurement
0M5	Under five years old child mortality rate
MAUP	Modifiable Areal Unit Problem
MDGs	Millennium Development Goals
MoH	Ministry of Health
MSPAS	Guatemalan Ministry of Public Health (Spanish acronym)
NHS	National Health Service
NSO	National Statistics Office
NHIS	National Health Interview Survey, United States
O-D	Origin Destination
PAHO	Pan American Health Organisation
PCA	Principal Component Analysis
RNB	Road Network Based
SD	Standard Deviation
SDGs	Sustainable Development Goals
SEGEPLAN	Guatemalan National Planning Office (Spanish acronym)
SPA	Service Provision Assessment
SE	Standard error
TB	Tuberculosis
TFR	Total Fertility Rate
TIN	Triangulated Irregular Networks
UHC	Universal Health Coverage
UN	United Nations
WHO	World Health Organization

Chapter 1 **Introduction**

1.1 Research overview

Healthcare is a relevant service to preserve the wellbeing of individuals. Access to healthcare services is relevant to prevent morbidities, treat ill-health conditions, and improve survival and a relief symptoms. Researchers aiming for the systematic study of access to healthcare have proposed different conceptual frameworks. Most of them acknowledge the relevance of exploring the influence of the healthcare delivery system. However, despite this recognition research exploring access to healthcare while adjusting for structural factors of the healthcare system remains rather limited. This thesis aims to explore access to healthcare using a health system perspective in a Global South country.

Access to healthcare services represents the outcome of multiple processes and the capacity to gain access is influenced by many factors. Exploring access to healthcare services provides relevant evidence about the performance of the health systems and illustrates the barriers obtaining medical care. The conditions to gain access to healthcare services are likely to vary across regions of the world. Many Global South countries, current or formerly colonised countries (Dados and Connell, 2012) frequently have low healthcare coverage compared to Global North countries (Wagstaff and Neelsen, 2020). Many studies in this context have missed to comprehensively explore access to healthcare. Previous research has mostly focused on selected outcomes related to antenatal care and child health, these studies have ignored aspects of the service provision providing a restricted description of the phenomenon.

Health is a fundamental human right and attaining the highest possible standard is desirable (WHO, 2014a). Public health interventions and healthcare technologies, such as vaccination programs, have prevented child mortality (van Wijhe et al., 2016), likely increasing life expectancy increase across the globe (Halfon et al., 2014, Vaupel, 2010). The reduction of preventable causes of death and the increase in life expectancy explain the demographic and epidemiology transitions theories observed in many Global South countries (Kirk, 1996, Wilkinson, 1994). In recent decades, many Global South countries have been experiencing these demographic and epidemiological changes (Wang et al., 2020). Despite this evolution, access to healthcare services that can prevent mortality and preserve health status across the life cycle remains a challenge in many countries (Kindig and Stoddart, 2003).

The systematic study of access to healthcare services requires having a conceptual framework, the Behavioural model being one of the most used concepts. This framework describes access as an interrelated set of dimensions that influences seeking behaviour, the potential to gain entry to the healthcare system and the use of healthcare services as the realised outcome of access (Andersen, 1995, Aday and Andersen, 1974). The dichotomised concept, potential and realised access, has reduced the concept. Realised access is the actual use of services and being influenced by predisposing factors and the need for healthcare services. While potential access explores the distribution of resources (Andersen et al., 1983). This thesis argues that access to healthcare is the outcome of multiple processes involved in the service provision and the distribution of resources, “potential access” is an auxiliary dimension explaining differences in gaining access to healthcare.

Different outcomes can be used to explore access to healthcare services; these can be outcomes related to the health system provision and outcomes observed among the users of the services. The ultimate aim of these processes is to obtain healthcare, and this outcome is observed among the users. The outcomes that can be explored include: contact coverage or entrance to the services, seeking behaviour, level of use of healthcare services, continuity of care, trust and perceived satisfaction, among others. A comprehensive understanding of access to healthcare services requires using different methodologies and data sources, with detailed individual level data being a scarce resource in many countries.

There are diverse factors that can influence access to healthcare, including the availability of resources and the distance to the facilities providing healthcare services. The effect of factors might

vary according to contextual differences, for example there is no a general consensus about the effect of distance over the use of healthcare services. Research exploring the willingness to travel when seeking services for maternal health outcomes in Global South countries identified individuals bypassed the nearest facility. Despite this finding, there is limited evidence that explains this behaviour in association with structural factors of the healthcare service provision, such as the regionalisation of healthcare services. This thesis contributes to fill gaps in the literature by measuring access to public healthcare services while controlling for characteristics of the healthcare system provision in Guatemala a Global South Country.

Guatemala represents a suitable scenario for exploring access to public healthcare. The constitution of Guatemala recognises health as a fundamental human right (Yamin and Frisancho, 2015). The health policy allows different types of healthcare providers, the Ministry of Health being the public institution entitled to provide services across the population (Congreso de la República de Guatemala, 1985). The performance of the public health system has been considered limited, having made reduced progress towards Universal Health Care coverage, the country's performance is comparable to many African health systems (Wagstaff et al., 2016). Measuring access to public healthcare in Guatemala can be useful to provide recommendations to guide public health interventions to improve access to healthcare.

1.2 Research aim

This thesis explores access beyond a specific service or a selected population group providing evidence about access to public healthcare services across the population, including the reasons for using primary and second level public healthcare facilities. This research provides evidence about the influence of structural factors, the regionalisation of healthcare services, on access to healthcare. This research provides a unique contribution by exploring access to healthcare services using a health system perspective in a Global South country. Using administrative healthcare records for all the visits to public healthcare facilities is possible to identify who gains access to public healthcare and the barriers to benefit from the services.

This thesis explores access to healthcare as the outcome of diverse processes and factors of the health service provision in Guatemala. This research considers the individuals using healthcare services for all age groups and for two levels of the public service organisation, aspects that allow

exploring the topic considering a health system approach. The analysis focuses on access to primary healthcare services, the closest contact with the public healthcare system and access to second level healthcare services, services having professional healthcare workers.

The aim of this research is to explore access to public healthcare services in Guatemala using a health system perspective by adjusting for users across age groups at two levels of the service provision. This research aim is guided by the following specific research questions:

1. What are the gaps in the literature about access to healthcare and which methodological aspects could limit the study of this phenomenon in Global South countries?

2. Who are the individuals capable to gain access and benefit from services provided at primary and second level public healthcare facilities in rural Guatemala?

3. Are there structural inequalities in the use of public healthcare services, such as Tudor's inverse care law in rural Guatemala?

4. Can the regionalisation of healthcare services, a structural factor organising the service provision, explain bypassing behaviour at public healthcare services in rural Guatemala?

5. Does the spatial distribution of the health facilities has an effect on the annual demand of primary and second level healthcare services in rural Guatemala?

6. What are the potential access barriers that can explain different levels of under–five mortality rates, deaths highly preventable by healthcare services, in Guatemala?

1.3 Document structure

The thesis is organised into ten chapters, this chapter is the introductory chapter of the thesis providing the reach topic, the argument and the research aims explored by this research. Chapter two contains the literature review and contains concepts that are relevant to guide the thesis. Chapter two describes the conceptual framework to understand access to healthcare services, including methodological considerations and data sources available for the analysis. Chapter three describes Guatemala's socioeconomic context alongside the healthcare sector and previous research conducted in the country exploring health inequalities and access to healthcare.

Chapter four describes the unique data source used to elaborate the thesis. This chapter describes the administrative healthcare records used for the analysis and the data collection procedures of selected study sites where. The data described in this chapter is used in subsequent analysis of this thesis and provides the context of the rural areas under study. This chapter includes a description of the sociodemographic characteristics of the study sites and the procedure follow to derive auxiliary variables, including estimates for travel times and the validity of the derived times.

The five chapters that follow answer each of the specific research aims, four of them exploring outcomes of access to healthcare services under a health system perspective in the study sites and the other exploring access to healthcare barriers across the country. Chapter five explores who can benefit from the services provided by primary and second level facilitates. Chapter six explores utilisation levels to determine inequalities in the capacity to use healthcare services. Chapter seven explores bypassing behaviour explained by organisation of the healthcare service provision. Chapter eight focuses on understanding the factors that can influence the demand for public healthcare, including the spatial distribution of primary and second level facilities. Chapter nine explores potential access barriers across geographic areas of Guatemala using under-five mortality rates as a population health outcome. The final chapter of this document is the conclusion of this thesis and provides policy recommendations applicable to Guatemala.

Chapter 2 Access to healthcare services conceptual framework

2.1 Introduction

Healthcare services are relevant to treat morbidities across the lifespan, for preserving the wellbeing and preventing mortality. Access to healthcare services is the outcome of multiple processes involved in delivering healthcare and using the services, in which barriers exists to benefit from the services. The capacity to access healthcare services might vary across counties and types of health systems. Limited access to healthcare services might have effects beyond the individual health status, including the risk of falling into poverty and having governance implications (Birn and Nervi, 2015, Greer and Mendez, 2015, Aslany, 2021). This chapter provides the literature review of relevant concepts involved in studying access to healthcare services, concepts used throughout the thesis.

The chapter begins by presenting the Global Health Policy context, briefly describing public policy efforts, including Universal Healthcare Coverage. This global policy context is followed by a review of relevant academic references whose main contribution was conceptualising access to healthcare. This section is followed by the introduction of complementary concepts that are related to the phenomenon under study; these concepts are defining access to healthcare barriers, the structural characteristics of healthcare systems, the spatial dimension of access to healthcare and healthcare equity. Following a quantitative approach, this chapter introduces the different data sources available as well as relevant methodological considerations to study access to healthcare with a Global South focus.

2.2 Global health policy

The World Health Organization (WHO) constitution acknowledged health as *"A state of complete physical, mental and social well-being and not merely the absence of disease or infirmity. The enjoyment of the highest attainable standard of health is one of the fundamental rights of every human being without distinction of race, religion, political belief, economic or social condition" Page 1:* (WHO, 2014a). An operational definition considers health as a dynamic state between two dimensions, the function and the prognosis (Patrick et al., 1973). The function dimension considers physical, mental wellbeing and the ability to perform usual activities, while the prognosis is a transitory state from welling to ill-health (Patrick et al., 1973, Patrick and Deyo, 1989). Health is a dynamic state for which diverse ill-health conditions or morbidities are likely to be observed across the individual's lifespan (Halfon et al., 2014, Kuan et al., 2019).

After the end of the Second World War, the WHO and the United Nations member states recognised health as a fundamental human right, which it is desirable to attain the highest possible standard (WHO, 2014a). Some years after, in the context of the Cold War, the Alma Ata Declaration became the first milestone for Global Health policy (WHO, 1978). This declaration was a relevant global effort promoting primary healthcare services, particularly aiming to prevent communicable diseases and improve health status in developing countries (WHO, 1978). The strategy enabled access to healthcare services by providing essential primary care services, such as child rehydration and immunisation (Lawn et al., 2008). These cost-effective interventions have successfully reduced the prevalence of several of communicable diseases, have increased child survival across the globe (Cueto, 2004) and have supported efforts related to virus eradication (Taylor, 2009).

The global interest in primary healthcare gained further relevance at the turn of the 21st century with the Millennium Development Goals (MDGs). The MDGs were a global policy aiming to improve population development, including indicators related to child mortality, antenatal care, malaria and human immunodeficiency virus (HIV) (UN, 2015). Different challenges in the implementation of this policies have highlighted the relevance of strengthening the health sector (Frenk, 2009), including data collection processes for monitoring and evaluation (Sachs, 2012). The MDGs evolved into Sustainable Development Goals (SDGs), aims that have expanded the number of goals and aim for "Health for all" (UN, 2013). "Universal Health Coverage" (UHC) is a global initiative encouraging financial risk protection and access to services across age groups and communities, alongside providing quality healthcare services (UNDP, 2018).

Access to primary healthcare services remains a relevant policy topic, the United Nations (UN) member states recently ratified the interest in the Declaration of Astana (WHO, 2018a). This agreement expands on the Alma Ata principles by providing a more comprehensive framework. The Astana Declaration calls to reinforce the capacity of healthcare services by following quality of healthcare principles, avoiding the fragmentation of services, alongside involving sectors beyond public healthcare providers (WHO, 2018a). These policies are a global effort, still, National and local governments are responsible for establishing targets, designing interventions and enabling interventions toward UHC (UN, 2019). The comprehensive understanding of access to healthcare services can support public health initiatives, however this study might need to consider multiple disciplines, including geography, social science and others (Baltussen and Niessen, 2006, Bradley et al., 2011, Kim et al., 2013).

2.3 Access to healthcare framework

The systematic study requires having a concept of access to healthcare, for which many scholars have been interested in developing conceptual frameworks, the "Behavioural model" being one of the most referenced. The framework originated from a Ronald Andersen's research project entitled "*A Behavioural Model of Predisposing, Enabling and Need Components*" at the end of the 1960s (Andersen, 1968b). The research explored the use of healthcare services in the United States analysing families with data collected by the National Health Interview Survey (Andersen, 1968a). The author argued that the use of healthcare services was similar to any other form of human behaviour, therefore psychosocial and demographic characteristics explain different access to healthcare behaviours (Andersen, 1968a). This academic contribution evolved some years later to originate the "Behavioural model" for access to healthcare (Aday and Andersen, 1974).

The behavioural model initially conceptualised access to healthcare in terms of the health system, recognising that the structural proprieties and organisation of the system influence access (Aday and Andersen, 1974). This concept distinguished between the users and the factors for service provision, including resources for rendering the services and enabling the use of healthcare (Aday and Andersen, 1974). The actual entry and the levels of healthcare services utilisation are the outcomes of realised access to medical services (Aday and Andersen, 1974). This concept has been widely and has been subject of several modifications (Andersen, 1995).

The behavioural model was updated at the beginning of the 1980s to incorporate the concept of the need for healthcare (Aday and Andersen, 1981). This concept described access as an interrelated set of dimensions that influence seeking behaviour and utilisation of healthcare services at the time of need (Aday and Andersen, 1981, Andersen et al., 1983). Seeking behaviour focuses on the probability of entering the system, while utilisation is concerned with the frequency and continuity of the services (Agerholm et al., 2013, Gerdtham, 1997, Rosenberg and Hanlon, 1996, Mohan et al., 2019). These access outcomes depend from interrelated set of dimensions, the characteristics of the delivery system and the users attributes (Aday and Andersen, 1981). Enabling factors are the system components and resources to provide healthcare services. In contrast predisposing factors are the characteristics of the individuals and their need for healthcare, including their perceived health status (Aday and Andersen, 1981).

The Behavioural Model was reviewed again, aiming to operationalise the concept by selected indicators (Andersen et al., 1983). The author argued that it was relevant to identify a limited number of variables to operationalise access to healthcare (Andersen et al., 1983), given the limited data constraining policymakers and the programmatic governmental cuts related to the Neoliberal reform (Gaffney, 2015, Andersen et al., 1983). This analysis reduced the concept by distinguishing two dimensions, potential and realised access (Andersen et al., 1983). *"Potential access is simply the presence of enabling resources. More enabling resources provide the means for use, and increase the likelihood that use will take place. Realised access is the actual use", Page 4:* (Andersen, 1995). The revised model highlighted the multiple factors involved in realised access to healthcare and provided a diagram (see Figure 2-1) to illustrate the dynamics and subsequent effects of process indicators and outcomes relevant for public policy (Andersen, 1995, Andersen, 2008, Phillips et al., 1998).

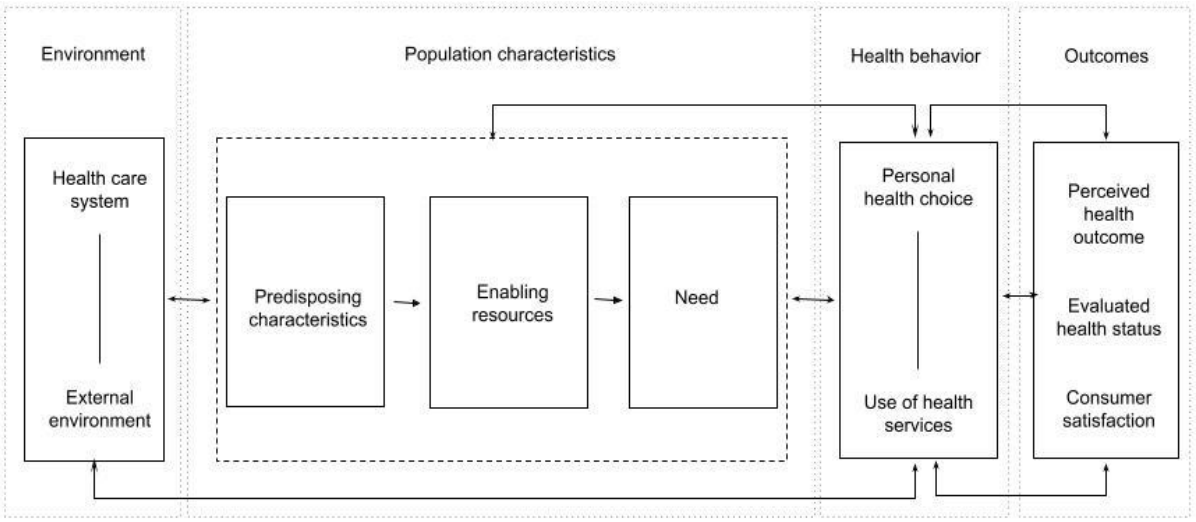

Figure 2-1: Conceptual framework for realised access to healthcare services

Source: Adapted from (Phillips et al., 1998)

The behavioural model has been widely adopted; researchers have used this framework to explore access to healthcare distinguishing enabling and predisposing factors in different country settings (Lopez-Cevallos and Chi, 2010, Mohan et al., 2019, Brzoska et al., 2017). Previous research exploring access to healthcare has identified that demographic characteristics, sex and age, are relevant predisposing factors (Hohn et al., 2020, Ranstad et al., 2017). Access to healthcare measured by utilisation levels, has identified increased healthcare service utilisation among females compared to males (Ladwig et al., 2000, Field and Briggs, 2001, Rosenberg and Hanlon, 1996) and for older age groups (Rosenberg and Hanlon, 1996, Ladwig et al., 2000, Ranstad et al., 2017). While research exploring enabling factors of access to healthcare has explored attributes of the referral system (Christensen et al., 2012) and access to transport (Arcury et al., 2005b).

2.4 Coverage and barriers to access healthcare

Parallel to the development of the behavioural model, other scholars suggested explaining access to healthcare from a public health and management perspective. Similar to the behavioural model, these concepts recognise access to healthcare as a complex system, however, explaining it using different analytical categories. These frameworks explore access to healthcare in terms of coverage (Tanahashi, 1978), barriers (Penchansky and Thomas, 1981) or utilization power (Frenk, 1985). Access to healthcare can be explored by different processes to provide services and achieve the desired objective (Tanahashi, 1978). The coverage has been proposed as the main concept to measure the interaction between services and the target population (Tanahashi, 1978).

Healthcare services coverage is conceptualised in terms of capacity, a population-based measure estimating the potential number of people that can benefit from the service (Tanahashi, 1978)., Tanahashi distinguished two types of coverage categories, actual coverage and potential coverage, similarly to the behavioural model (Tanahashi, 1978). Actual healthcare coverage represents the number of people within a population that received the service, while potential coverage refers to the capacity of the service to be used by the individuals (Tanahashi, 1978). The distinction suggests that a single measure cannot describe the complex interaction between the factors related to the service provision and the actual use of services by the population. The author proposed studying access to healthcare in five successive stages: availability coverage, accessibility coverage, acceptability coverage, contact coverage and effectiveness coverage (Tanahashi, 1978); the coverage model is illustrated at Figure 2-2 and described in the following paragraph.

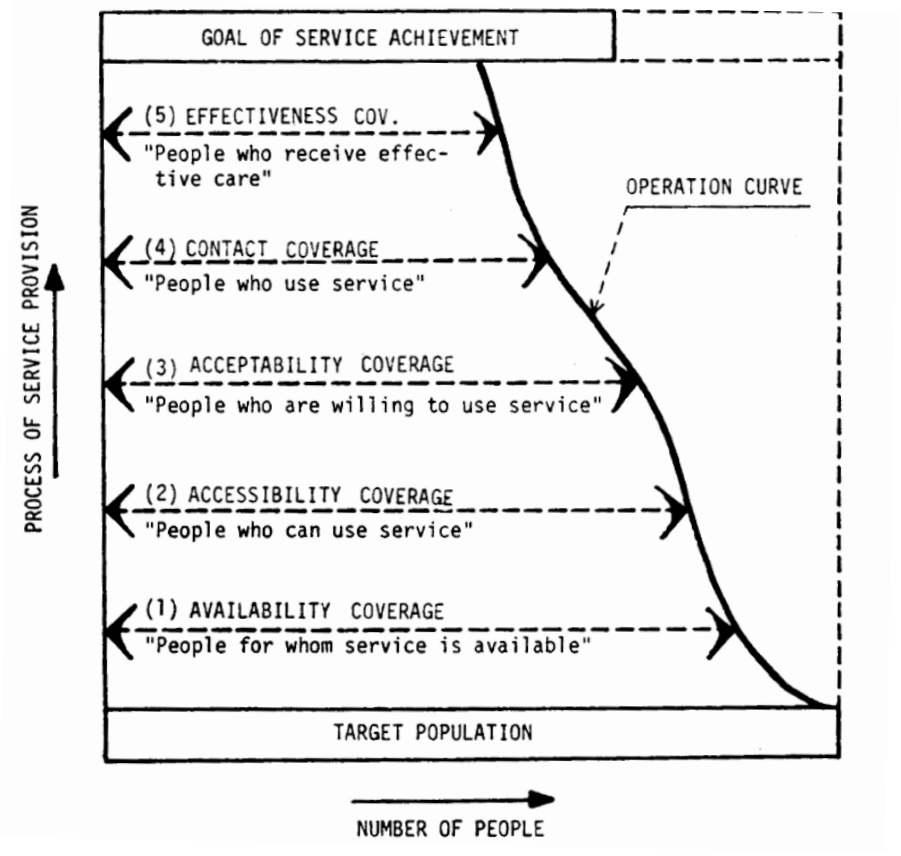

Figure 2-2: Healthcare coverage diagram-illustrating relationships between the process of service provision and coverage measurements

Source: Page 3: (Tanahashi, 1978)

The first stage is availability, which is the ground base for healthcare service provision and it is frequently represented by the available resources (Tanahashi, 1978). The second stage is accessibility, which considers that the available resources are within reach of the population for which they are offered (Tanahashi, 1978). The following stage is acceptability, the allocation of resources and accessibility is not enough, there are individual factors that can limit the coverage and use of healthcare services (Tanahashi, 1978). The contact coverage is the four stage, this concept represents the actual contact with the service, frequently observed by the number of people that used a service and the ratio between the users and the target population (Tanahashi, 1978). The final stage is effective coverage, aiming to explore the performance of the service once it gained entrance (Tanahashi, 1978). Tanahashi categorised availability, accessibility and acceptability as factors from potential coverage, while contact and effectiveness are classified in the actual coverage category (Tanahashi, 1978).

Tanahashi model and the behavioural model provide different concepts; however, having many categorical similarities. Both models conceptualise access to healthcare services as an outcome of multiple service provision processes. Tanahashi, alike the behavioural model, made a conceptual distinction between potential and actual coverage, both concepts making referring to enabling factors and the actual use of services. There are some conceptual differences between the two models; the behavioural model understands access as a set of interrelated dimensions, while Tanahashi describes the use of services in terms of coverage stages. This ordered framework can be useful to identify coverage issues, a significant difference between them will likely reduced the coverage of the following stages, these are used to identify bottlenecks in access to healthcare service (Tanahashi, 1978).

Following Tanahashi bottlenecks concept, other scholars have been explaining access to healthcare in terms of barriers. Penchansky and Thomas argued that the behavioural model had some ambiguity to operationalise the concepts and instead proposed a set of specific dimensions (Penchansky and Thomas, 1981). These dimensions intermediate between the healthcare system provision and the demand for healthcare services, the “degree of fit” (Penchansky and Thomas, 1981). Five dimensions were proposed from analysing survey data from employees at General Motors Corporation about the perceived satisfaction with healthcare services; the five dimensions are described as follows:

a. Availability: describes the relationship between the available healthcare resources to supply the needs of the users of the service. Diverse range and amount of healthcare resources have to be available for rendering services (Penchansky and Thomas, 1981). An example is the relationship between the number of healthcare professionals and health outcomes, such as the decline of avoidable causes of death with the increase coverage of physicians (Sundmacher and Busse, 2011).

b. Accessibility: explores the relationship between the spatial distribution of the population and the location of healthcare services (Penchansky and Thomas, 1981). Increased accessibility barriers are expected at greater travel distances (Buor, 2003, Mwaliko et al., 2014) or among households without transport (Syed et al., 2013), in which reduced utilisation of healthcare is observed.

c. Accommodation: explores the relationship between access to healthcare services and organisational characteristics of the health system (Penchansky and Thomas, 1981). The operational schedule times of healthcare services and the lengthy times between appointments are examples of this dimension (Frenk, 1985, Murray and Berwick, 2003).

d. Affordability: this dimension focus on understanding the relationship between financial factors and access to healthcare services (Berk and Schur, 1998, Knaul and Frenk, 2005). This dimension frequently refers to the individual's financial resources, however, different types of healthcare systems are likely to represent different financial barriers (Frenk, 1985). An example is increased affordability barriers to access in market-oriented healthcare sector, some individual's likely experiencing catastrophic expenditures (Peters et al., 2008, Whitehead et al., 2001).

e. Acceptability: this dimension explores the degree of fit between the patient attitude toward the healthcare service, including patients' satisfaction (Penchansky and Thomas, 1981). An example is the perceived satisfaction of the services, patients receiving greater benefits are more likely to increase their use (Fenton et al., 2012). Acceptability and accommodation barriers have been also explored in terms of quality (Akin and Hutchinson, 1999, Gulliver et al., 2010).

These dimensions represent the barriers between the service provider and the individuals to gain access to healthcare services, barriers that can be explored in terms of "resistance" and "utilisation

power" (Frenk, 1985). The author revised the concept arguing that access and accessibility are frequently interchangeable terms and proposed to understand accessibility as a process for seeking and receiving medical care (Frenk, 1985). For this process to occur, the author introduced two complementary terms, resistance and utilisation power (Frenk, 1985).

Resistance represents the obstacles to seeking healthcare and having the possibility to benefit from the services, while utilisation power represents the individuals with the real capability to overcome the obstacles, the users (Frenk, 1985). Resistances can be classified into ecological, financial and organisational obstacles: Ecological obstacles refer to difficulties in gaining access to healthcare due to the geographical location of resources (Frenk, 1985). Financial obstacles refer to the monetary resources that can limit healthcare services. Organisational obstacles refer to difficulties related to the structural characteristics of the healthcare delivery system (Frenk, 1985). The relevance of these obstacles is likely to differ, depending on individuals' characteristics and types of healthcare systems, for example, increased financial or affordability barriers are likely to be expected in settings highly dependent on private healthcare services (DeVoe et al., 2007, Falkingham, 2004).

2.5 Healthcare system delivery

Exploring the structural characteristics of the health system is relevant for understanding the context for accessing healthcare services. The performance of healthcare systems depends on essential functions to operate, these include service provision, health and epidemiological surveillance, monitoring outcomes, the development of human resources and other elementary functions (WHO, 2018b). The functioning of the system relies on multiple factors, including healthcare technologies that are organised and distributed across the infrastructure (WHO, 2007, WHO, 2014b). The structural components of a health system are described by the WHO "Building blocks" framework, describing the transversal components required to provide healthcare services (WHO, 2010). There are six building blocks for a functional health system: service delivery, health workforce, health information systems, access to medicines, financing and governance (WHO, 2010), the framework is illustrated in Figure 2-3.

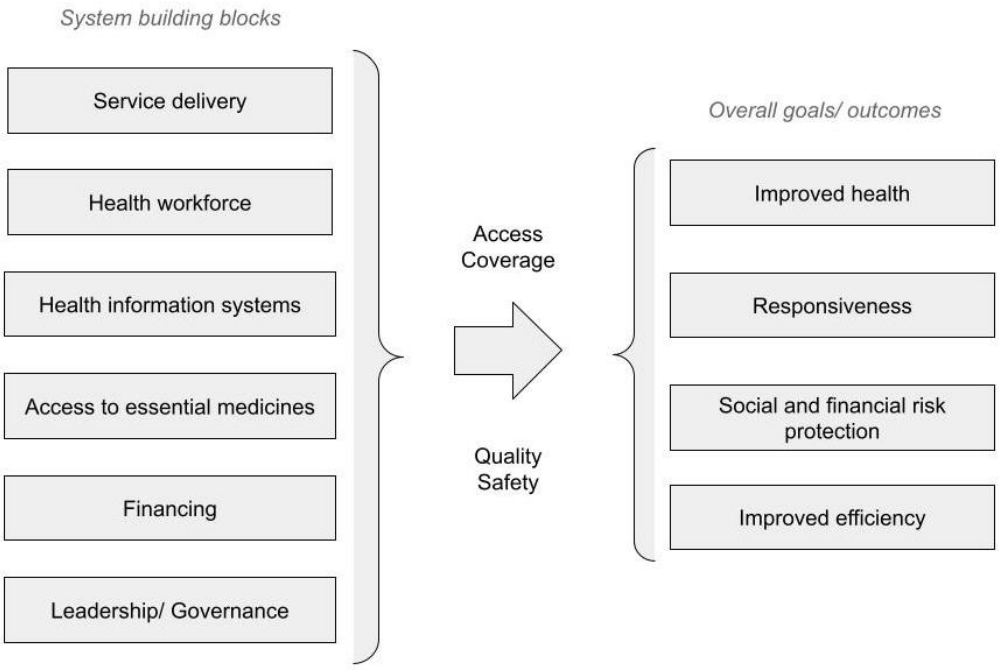

Figure 2-3: The WHO building blocks health systems framework

Source: (WHO, 2010)

Increasing the coverage of the services and access to healthcare requires that assets and, resources necessary for rendering services are distributed across geographic areas. The infrastructure and healthcare services are frequently organised under a regionalisation principle. Healthcare services regionalisation refers to the differentiated distribution or provision of services, this is encouraged by the efficient allocation of resources (Lewis, 1977). The efficient allocation principle was originated after observing escalation of costs related to the increased demand of expensive healthcare technologies, alongside the resource scarcity (Lewis, 1977, Lewis and Kouri, 2004). A three-level hierarchical structure is frequently used to represent the regionalisation of the health system: primary, secondary and tertiary health services (Lewis, 1977). The aim of regionalisation is to organise healthcare resources and technologies distinctively to ensure availability of different services and avoid duplication (Lewis, 1977, WHO, 2012).

The three-level structure is the most frequent regionalisation parameter of public health services in Global South countries (Kim et al., 2013). The hierarchical structure has the function to organise the demand and to serve as a referral system to higher levels (Hofmarcher et al., 2007). The first level has the function to expand the coverage of healthcare services representing the closest location to access healthcare services (Starfield et al., 2005). Primary level services usually provide cost-effective, preventive services and some out-patient interventions (Starfield et al., 2005, Gervas

et al., 2008). The second level has an extended range of services and healthcare technologies to provide ambulatory and specialised care (Jamison et al., 2006), such as services provided at community hospitals (Lewis, 1977). The third level is designed to treat complex conditions and costly interventions, service likely having reduced demand compared to the other levels (Jamison et al., 2006, Lewis, 1977). The description of the levels might vary across countries, in some Global South countries, the second level represents the closest contact with healthcare professionals and serves as a management hub (Kim et al., 2013).

The characteristics of the healthcare systems differ in the regulatory, political, social and economic context of countries (Fanjiang et al., 2005, Ferlie and Shortell, 2001, Wendt et al., 2009). The classification of healthcare systems has been the object of interest of many sociologists and political scientists (Freeman and Frisina, 2010). The traditional classification system is based on the funding scheme, distinguishing two types: National Health Services (NHS) and the Social Security system (van der Zee and Kroneman, 2007b), the following paragraph describes the main characteristics of these models.

The NHS, also known as the Beveridge model classifies the healthcare services financed by public taxes (van der Zee and Kroneman, 2007b). Healthcare services financed by public taxation can potentially alleviate financial risks, and this attribute likely to contribute to healthcare and health equity principles (WHO, 2007, UN, 2013). The Social Security system or Bismarck model classifies healthcare systems financed by individual contributions, such as fees and private institutions (van der Zee and Kroneman, 2007b). Many modern systems have deviated from the traditional Beveridge or Bismarck model (Reibling et al., 2019). The debate has been mostly focused on describing healthcare systems by a combination of aspects (Reibling et al., 2019). Financing mechanisms, supply characteristics, regulatory mechanisms and governance characteristics are relevant factors for describing healthcare systems (Reibling et al., 2019).

Exploring the structural characteristics of the healthcare service provision provides relevant information about factors that can modify access to healthcare outcomes. Multiple factors and processes are involved for individuals to gain access to healthcare, and some of these factors can be modified to favour access to healthcare. The capacity to amend the factors involved in the processes has been described in terms of mutability by the behavioural model (Aday and Andersen, 1974, Andersen, 1995). Low mutability represents access to healthcare factors that cannot be easily

modified (Andersen, 1995). Examples of low mutability are the individual need for healthcare and socioeconomic characteristics (Dixon et al., 2007, Elnegaard et al., 2017, Ladwig et al., 2000). High mutability represents factors that can greatly modify access to healthcare and the service provision (Andersen, 1995), health policies and the distribution of resources are examples (Currie et al., 2019, Knaul and Frenk, 2005, Lu and Hsiao, 2003).

2.6 Spatial dimension of access to healthcare services

Healthcare services are spatially distributed across geographies, and exploring the between the facilities spatial distribution and health-related outcomes are relevant to understand access to healthcare. The relationship between the location of healthcare facilities and access to healthcare services has been long explored by the "distance-decay" concept (Joseph and Phillips, 1984, Joseph, 1979). The distance-decay is a popular concept among medical geographers and it is grounded in the hypothesis that reduced levels of healthcare services utilisation are going to be observed at the increased travel distance to reach the healthcare service (Lowe and Sen, 1996, Knox, 1978). The distance-decay estimates a friction factor to describe this spatial interaction (Lowe and Sen, 1996, McGrail et al., 2015, Haynes et al., 2003) and the gravity model is frequently used: the spatial interaction (*I*) being inversely proportional to the increase of travel distance (*d*) and represented by the equation $(I) = 1/d^2$ (Guagliardo, 2004).

The spatial dimension of access to healthcare mainly focuses on exploring individuals' geographic accessibility to healthcare facilities, an ecological barrier. This relationship has been explored in different settings, identifying the distance-decay effect might be influenced by other factors beyond geographic accessibility (Guagliardo, 2004, McLafferty, 2003). The distance-decay effect can be modified in rural areas, where increased travel distances are higher than in urban areas (McLaren et al., 2014). However, consensus on distance-decay effect, some authors argue that there is no conclusive evidence to support the hypothesis (Kelly et al., 2016, McGrail et al., 2015). Some authors have identified that individuals that live in remote areas are used to traveling extended distances (McGrail et al., 2015). While other research has identified the willingness to travel longer distances while seeking emergency services in Global South context (Yaffee et al., 2012, Mubiri et al., 2020). This phenomena has been conceptually linked with the quality of care, yet, this is grounded on limited research mostly focusing on maternal and child care, further research should explore bypassing behaviour including factors related to the structural characteristics of the service provision.

Although many scholars have focused on the ecological barrier, others have been interested in exploring the spatial dimension beyond the distance-decay concept. Medical geographers in the 1990s developed a framework aiming to identify spatial dimension outcomes related to access to healthcare (Khan, 1992). The author argued that potential and realised access to healthcare could be explored with respect to spatial or non-spatial dimensions (Khan, 1992). The non-spatial dimension represents access to healthcare services factors related to the social context and other similar factors. In contrast, the spatial dimension refers to geographic accessibility and the spatial distribution of attributes (Khan, 1992). This distinction was proposed to identify specific indicators or outcomes using a 2x2 matrix, Table 2-1 describes the framework (Khan and Bhardwaj, 1994).

Table 2-1: Framework distinguishing the spatial and non-spatial dimension of access to healthcare

	Potential access	**Realised access**
Spatial dimension	Describes travel costs and spatial distribution of healthcare resources.	Studies the relationship between distance and access to healthcare outcomes.
Non-spatial dimension	Explores non-spatial factors related with potential access.	Explores access to healthcare outcome without a spatial factor.

Source: Adapted from (Guagliardo, 2004).

There are relevant methodological aspects to consider when understanding the relationship between the spatial dimension and potential access to healthcare. The spatial dimension of potential access can be explored using two types of methods, a place-based measurement and a travel cost approach (Talen and Anselin, 1998, Knox, 1978). The place-based approach spatially allocates attributes within defined boundaries or in a delimited area (Kwan, 2009). This approach corresponds to a spatially homogenised attribute and is a static concept, such as an attribute distributed in the geo-administrative unit area (Kwan, 2009). Therefore understanding attributes to access to healthcare under a place-based approach is limited to the spatial scale, a limitation known as the modifiable unit areal problem (MAUP). The MAUP is a concept describing potential measurement biases in relation to the spatial scale, the accuracy or precision of an attribute will be biased at an aggregate level, biased increasing at a higher spatial scale (Openshaw, 1984). In contrast, travel cost approach measures geographic accessibility across a travel path (Delamater et

al., 2012), providing travel times estimates used for spatial indicators of access (Ebener et al., 2019, Delamater et al., 2019).

2.7 Quality of healthcare services

Multiple processes and a range of different outcomes can be used to study access to healthcare, including trust and patient satisfaction (Kruk et al., 2018, Andersen, 1995). Research outcomes exploring patient satisfaction with healthcare services are frequently associated with the quality of medical care. Quality of healthcare explores the interaction between the attributes of the service provision and the individual experience with the service (Donabedian, 1978). Quality of care, observed by patient satisfaction, is a desired outcome for a patient to experience while in contact with the health system. Almost parallel to the development of the behavioural model, Donabedian proposed a conceptual framework to explore quality by distinguishing three domains: structure, process and outcome (Donabedian, 1966). The author's contribution was relevant to research and public healthcare management, the categories being applied for planning, monitoring and evaluation (Donabedian et al., 1982).

The structure refers to the characteristics of the healthcare system, including attributes of the healthcare organisation and resources (Donabedian, 1978). The process domain distinguishes various actions required for the provision and use of healthcare services, including training and qualification of personal (Donabedian, 1978). Processes are functional actions frequently linked with health management, organisational attributes and medical practice (Davies et al., 2000, Mant, 2001). The structure and processes influence the outcomes, outcomes related to quality of care include perceived satisfaction with healthcare service, continuity of the healthcare service, or an improved status (Haggerty et al., 2003, Donabedian, 2005, Kruk et al., 2018). The outcomes depend on the other two domains, and the link between domains has been used to develop logical frameworks for projects, including in healthcare management (Baccarini, 1999).

Access to quality healthcare services is a relevant global policy topic that gained further relevance with the Declaration of Astana (WHO, 2018a). The WHO recognises that quality of care is essential for achieving UHC, and quality of care should be: effective, providing evidence-based services; safe, avoiding harm; and people-centred, responding to individuals values and needs (WHO, 2022a). A wide-system action is required to achieve quality UHC, including a National strategic direction,

improving governance and allowing for multiple factors for healthcare delivery. This wide approach has been developed recently by the "high-quality health systems" framework, its development included previous concepts from Donabedian and the WHO building blocks framework (Kruk et al., 2018). This framework defines a relationship between the structural characteristics of the health system and the quality of care impacts, a concept that distinguishes three major domains: foundations, processes of care, and quality impacts (Kruk et al., 2018). The outcomes of quality of care are better health, confidence and economic benefit, Figure 2-4 illustrates the framework, including the components of each dimension.

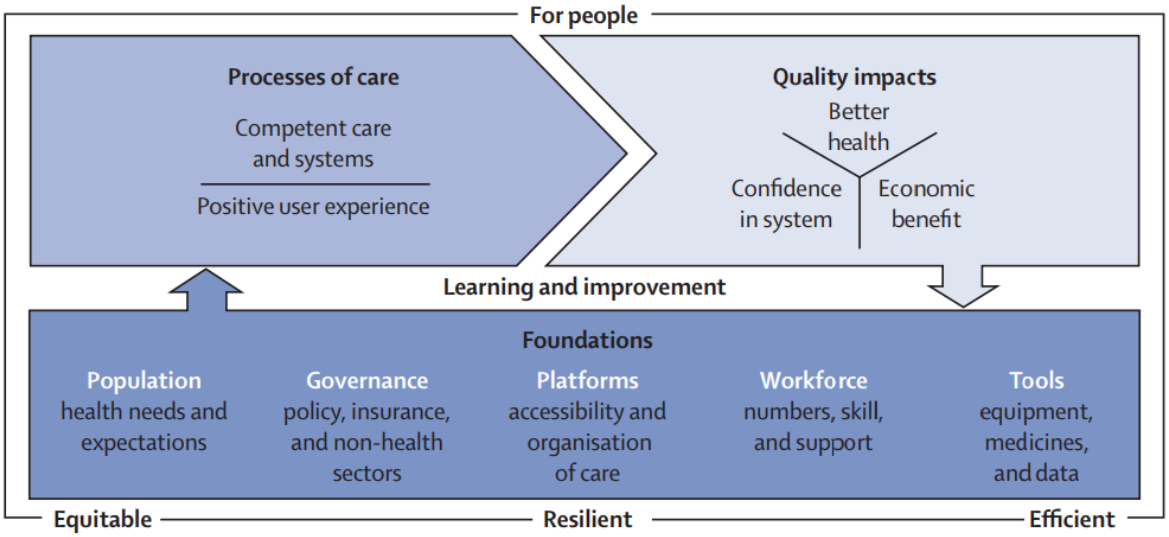

Figure 2-4 High-quality health system framework and components

Source: Page e1200 (Kruk et al., 2018)

2.8 Equity and need for healthcare services

Exploring access to public healthcare services frequently has to consider that there are equity and social justice principles that might influence planning services (Sen, 2002). The public health sector has a stewardship function that can potentially allow conditions to promote fairness and the use of healthcare services (WHO, 2000). Equity in access to healthcare services is grounded in a fair distributive principle distinguishing between a vertical and horizontal distributive approach (Culyer and Wagstaff, 1993). Both equity approaches are concerned with the fair distribution of healthcare however, with a different emphasis (Culyer, 2001), the following paragraph describes equity dimensions.

The horizontal equity principle argues that fair access should aim for every individual to obtain equal treatment for a given healthcare need irrespective of social and individual characteristics (Culyer, 2001, Mooney et al., 1991). Unlike horizontal equity, vertical equity focuses on a procedural principle (Mooney, 2000). The vertical equity fairness principle is a concept aiming for positive discrimination in the allocation of resources (Mooney, 2000). Positive discrimination favour interventions to benefit particular groups, likely those having greater disadvantages, vertical equity is d a mechanism to adjust outcomes, following a social justice concept (Mooney, 2000). Health equity principles guide policies and health systems across the globe; however, equity is a theoretical principle guiding interventions and inequalities exist even in countries with UHC (Goddard and Smith, 2001, Dixon et al., 2007, van Doorslaer et al., 2000).

A greater need for healthcare might not represent greater access or utilisation levels, the Inverse Care Law being frequently observed (Hart, 1971). This law was identified by Tudor Hart after studying the introduction of the England and Wales NHS, identifying that highly equipped facilities and qualified physicians are less likely to be located in remote or disadvantaged areas where services might be highly needed (Hart, 1971). A greater number of healthcare providers are found in affluent and highly urbanised areas, areas attracting students and professionals (Cookson et al., 2021, Hart, 1971). Years after the NHS creation, access to health services has increased across the country (Morris et al., 2005, Dixon et al., 2007), and vertical equity interventions, such as increasing resources in historically deprived areas support equity policies (Currie et al., 2019). This is an example of a health system in which both, vertical and horizontal equity public policies have been implemented (Culyer, 2001, Wagstaff et al., 1989).

Need is a relevant concept that requires further attention, not only because is a guiding principle in equity, but also influences seeking behaviour. The need for healthcare services and ill-health episodes are experienced individually, nevertheless, this concept is generally framed by four categorical distinctions: felt, expressed, normative, and comparative need (Bradshaw, 1972). Felt need is a self-assessment in which the individual perception and knowledge are involved in identifying symptoms and values (Bradshaw, 1972). The expressed need is the felt need turned into action or demand for healthcare that can either, be realised or be an unmet need (Bradshaw, 1972). Normative need refers to an external judgment conducted by an expert or a professional following a standard practice and providing an informed assessment (Bradshaw, 1972). Lastly, the comparative need is originated by contrast, it contrasts the need to a standard or the distribution of the event in a population (Bradshaw, 1972). The selection of a category will depend on the

research questions, felt and expressed need are more likely used for a subjective assessment (Hunt et al., 1980, Jylha, 2009), while a normative need assessment will be required by clinical or epidemiology studies (Barendregt et al., 2003).

There are external factors that can influence the perceived need and modify the seeking behaviour, including social norms (Kawachi et al., 1999, Rosenstock, 2005) and education or knowledge (McDonnell et al., 2014). Kenneth Boulding, a post-war evolutionary economist, proposed to explore the need for healthcare as the demand for knowledge (Boulding, 1966). The author argued that the individual need for healthcare services corresponds to the need for an informed judgment; this evaluation is turned into a demand for healthcare technologies (Boulding, 1966). Boulding conceptualised the need for healthcare similar to an informed choice for which varying individual preferences and demands are expected, introducing an economic utility criterion (Boulding, 1966). Nevertheless, ill-health is not a rational decision driven by market trends, and the demand can be limited by other factors, including access to healthcare (Burstrom, 2009, Bradshaw, 1972).

The need for healthcare services and health outcomes are likely to be influenced by different factors; these factors can be conceptually framed as the social determinants of health. The social determinants framework was developed to explain the root causes or mechanisms behind inequities in health outcomes (Whitehead, 1991, Dahlgren and Whitehead, 2007, Marmot, 2005). The framework proposed to categorise the multiple factors into three levels of influence: 1) individual factors, 2) social or community factors, and 3) socio-structural factors (Bambra et al., 2010, Dahlgren and Whitehead, 2007). The social determinants of health provide a relevant framework to analyse health outcomes at different levels of influence, as well as for designing public policy interventions (Williams, 2003, Graham, 2004, Victora et al., 1997).

Diverse frameworks have been developed to describe processes and outcomes for access to healthcare services. These conceptual frameworks have evolved from different disciplinary approaches and methodological developments; Table 2-2 summarises the main conceptual contribution to the literature in chronological order. The summary table is useful to highlight the limited number of publications that have used empirical evidence to develop the framework, with only three measuring outcomes. There are multiple factors and frameworks that can be explored when studding access to healthcare services, despite the differences there is a common understanding about distinguishing two analytical domains: the service delivery structural factors

and the individual capacity to gain access. This differentiation is supported by the subject under analysis, the former exploring outcomes related to the health system and the latter analysing individual outcomes, including seeking behaviour, utilisation of healthcare services, trust and others.

Table 2-2: Summary of access to healthcare services conceptual frameworks

Conceptual framework	**Publication aim and reference**	**Data and methods**	**Main conceptual contribution**
Quality of medical care	Describe quality of medical care, (Donabedian, 1966)	Conceptual	The assessment of quality medical care has to consider the instrumentalities of the healthcare system, the structure. Quality of medical care is an evaluation or a judgment that involves three components: structure, processes and outcome. These components are linked.
Behavioural model	Understand utilisation of medical care, (Andersen, 1968b)	Empirical, using NHIS data was used to create a summary index "Dollar equivalents" to estimate the use of all types of health services.	The use of healthcare services is another form of human behaviour; it is the result of interrelated factors. Proposed to classify the factors in three components: 1) predisposition to receive medical care, 2) enabling conditions to use healthcare services and 3) perceived need for healthcare.
Behavioural model	Construct an integrated framework to study of access to healthcare services, (Aday and Andersen, 1974)	Conceptual	Multiple factors are involved in access to healthcare services. The unit of analysis in access to healthcare is the system, the organisation and the delivery of the service. The users represent the demand and the entrance to the system, utilisation and satisfaction are outcome indicators.
Quality of medical care	To classify the major approaches to assess quality of medical care (Donabedian, 1978)	Conceptual	Monitoring medical care serves the purpose to exercise constant surveillance to make amendments. This process distinguishes two domains: the technical performance and the management of the person.
Tanahshi model	Define healthcare service coverage	Conceptual	Healthcare coverage expresses a relationship between the service and the target population. A single measure does

Conceptual framework	Publication aim and reference	Data and methods	Main conceptual contribution
	relationship and key stages, (Tanahashi, 1978)		not reflect the complex interaction and prosed five key stages that include the whole process. The key stages are categorised in potential and actual coverage.
Behavioural model	To include equity in access to healthcare framework, (Aday and Andersen, 1981)	Conceptual	The criteria of social justice in access to healthcare services is related to utilisation of healthcare according to the need. The justice principle is mostly focused in the just allocation of scarce healthcare resources.
Access to healthcare barriers	Describe intermediate dimensions or barriers to healthcare demand, (Penchansky and Thomas, 1981)	Survey to employees from an assembly plant and their spouses. Satisfaction scales with healthcare services where constructed.	Access to health is a general concept that summarise a set of specific dimensions describing the fit between the patient and the healthcare system. Proposed a set of five dimensions, named barriers, which can be interrelated.
Behavioural model	Identify a set of indicators to describe access profile, measured in a relatively cost-efficient way (Andersen et al., 1983)	National survey of access to medical care in United States. Analysis of satisfaction with the most recent medical visit.	Access is defined by two dimensions describing potential and actual entry to the healthcare delivery system. Predisposing, enabling and need factors refer primarily to attributes of individuals, which ultimately influence their healthcare seeking behaviour. The use, relative need and satisfaction are measures of access to healthcare.
Access to healthcare barriers	Summarise access to medical care concept and accessibility, (Frenk, 1985)	Conceptual	Access is explored in terms of the characteristics of the potential or real users. An alternative access term is "Utilization power" is an alternative concept of access, a set of characteristics that enable to seek and obtain healthcare. "Utilization power" concept has a complementary term, “resistance”, a set of obstacles to overcome to gain access.
Spatial access to healthcare services	Describe an access framework in terms of geographic attributes,	Conceptual	Four dimensions to describe access; the dimensions dichotomised access in terms of spatial and non-spatial access indicators. Spatial access refers to

Conceptual framework	Publication aim and reference	Data and methods	Main conceptual contribution
	(Khan and Bhardwaj, 1994)		geographic attributes. Non-spatial access refers to social factors of access to healthcare services.
Behavioural model	Revise the Behavioural model, (Andersen, 1995)	Conceptual	Potential access is the presence of enabling resources. More enabling resources provide the means for use. Realised access is the actual use of services.
High-quality health systems	Redefine quality health systems and provide a conceptual framework (Kruk et al., 2018).	Conceptual	People should be the centre of the health system and system should aim be equitable, resilient and provide efficient care. There are three conceptual domains: foundation, processes of care and quality impacts.

Source: Author's own summary

The Behavioural model initially proposed to conceptualised access as multiple processes involved, including structural characteristics for the provision of healthcare services (Aday and Andersen, 1974). The quality of care framework made a similar conceptual contribution around the same period; however, proposing to explore three dimensions: structure, processes and outcomes (Donabedian, 1966). More recently, the High-quality health system framework was proposed, in which the structural characteristics of the health system and concepts of quality frameworks were combined (Kruk et al., 2018). This thesis uses the Donabedian Quality of care framework to explore access to healthcare services in a Global South country. This framework makes an explicit distinction between the structural factors and processes required for rendering healthcare services, these two dimensions having influence on access outcomes, including quality and utilisation of healthcare (Donabedian, 1966).

2.9 Data sources to explore access to healthcare

The comprehensive study of access to health requires extensive data about factors related to the health system provision, alongside individual data about need and access to healthcare outcomes. The data selection will vary according to the research questions; for example exploring access to healthcare services outcomes and barriers requires using individual level data. Data sources that

can be used to study individual level outcomes include: longitudinal data from cohort studies, National Health Surveys, administrative health records and Health and Demographic Surveillance Sites (HDSS). Exploring access in terms of the healthcare system attributes might require complementary data, such as the Service Provision Assessment (SPA), providing information about aspects related to the supply of medical services and the available resources (Jackson et al., 2015).

Different surveys can be considered when exploring access to healthcare services, including standardised health surveys. Many health surveys have been designed to explore access to healthcare services by applying retrospective methodologies for data collection (McLaren et al., 2014). These surveys collect different outcomes that vary according to the design, individual outcomes related to perceive need and healthcare satisfaction are examples of the type of information available (Agerholm et al., 2013, Aiken et al., 2002). Household surveys related to living standards measurements have been used to identify factors related to financial access to healthcare services, such as out-of-pocket expenditures (Wagstaff et al., 2007). The design, frequency and data collection of these surveys can vary between countries (Etches et al., 2006). These data sources usually are one point in time measures, still, longitudinal surveys can provide information for different periods (Ruzangi et al., 2020, McLaren et al., 2014).

The Demographic and Health Survey (DHS) is a standardised survey that can be used to explore some access to healthcare outcomes in Low-and-Middle-Income Countries (LMIC). The DHS is a nationally representative survey that collects sociodemographic and health data for a selected population group, mainly children under five and women at reproductive age (Andersen, 2008). The survey provides some evidence about access to healthcare services related to selected outcomes, such as antenatal care services (Magadi et al., 2007), child immunisation (Goldman and Heuveline, 2000), as well as morbidities related to epidemiological priorities of the country, such as malaria and HIV (Taylor et al., 2019, Wang et al., 2011). The data collected by this survey include displaced geographic coordinates of the sample clusters (ICF International, 2013), data that has been used to estimate geographic accessibility towards healthcare facilities (Wong et al., 2020, Alegana et al., 2017).

Health and Demographic Surveillance Sites (HDSS) located in some Global South countries have been designed to collect longitudinal demographic data and health outcomes of the population located within a specified geographic area (INDEPTH, 2002, UN, 2016). HDSS collects different data,

including a baseline census, regular household surveys and geographic coordinates (Ye et al., 2012, Kruk et al., 2009, Mwaliko et al., 2014). HDSS data has been used to explore access to healthcare outcomes related to antenatal care and childcare services in different African countries (Feikin et al., 2009, Malqvist et al., 2010, Sarrassat et al., 2019). In many countries, the HDSS collects sociodemographic data of the individuals, allowing to identify spatial inequalities at the individual level (Pena et al., 2008, Ye et al., 2012, Rutebemberwa et al., 2009).

Measuring or quantifying access to healthcare and the factors that influence the outcomes requires detailed individual data across the users of the services, making difficult to having a comprehensive study in many Global South countries. Access to healthcare services measures in these settings are limited partly by the available data. For example, measurements exploring the coverage of healthcare services frequently rely in the DHS data available for selected services, such births delivered at healthcare facilities and child immunisation coverage (Arsenault et al., 2017, Stanton et al., 2007). Attempts to measure UHC with household survey data and have proposed a summary measure that includes the service coverage and financial protection, providing evidence about country inequalities in access to healthcare (Wagstaff and Neelsen, 2020, Wagstaff et al., 2007). However, this aggregated indicator is far from capturing the range of treatments and do not provide evidence of individual level differences that are expected across population and age groups.

Administrative records can be used to explore access to healthcare at the individual level across age groups. Administrative records provide information about the use of healthcare services at different services of the healthcare infrastructure (de Montgomery et al., 2020). The extensive data collected by administrative records can be useful source of data for different population groups, and different types of morbidities or comorbidities (Sortso et al., 2017, Thygesen et al., 2011b). Administrative data can be linked with geographic coordinates, such as postcodes or enumeration areas that can serve to explore access to healthcare in terms of the spatial dimension (Haynes et al., 2003, Jones et al., 2008, Mohan et al., 2019, Comber et al., 2011, Monnet et al., 2008). These detailed databases having records at the individual level in occasions can be linked with other administrative databases or National Health Surveys (Thygesen et al., 2011a). Linked data sources are generally available in Global North countries, characterised by a long data collection tradition, such as Netherlands, Sweden and Denmark (van Oostrom et al., 2014, Eriksen et al., 2004, Agerholm et al., 2013).

Population counts data and demographic characteristics from census data and vital registration are another data source commonly used for health summary indicators (UN, 2016). Population counts are frequently used to estimate rates and indicators conceptually related to potential access. Research exploring spatial access to primary healthcare facilities requires spatially distributed population count data to assess the coverage of the infrastructure (Bauer et al., 2018, Langford and Higgs, 2006). Vital registration data, such as mortality data, can provide a relevant data source for health outcomes in the Global South (Etches et al., 2006, UN, 2016). Census data in Global South countries frequently enumerate the counts of large administrative units, decreasing the spatial detail or resolution. Spatial interpolation or dasymetric methods have been used to disaggregate counts into finer spatial areas (Lloyd et al., 2019, Albrecht, 2007).

Diverse geospatial covariates have been used to redistribute population counts from census data at a fine spatial resolution to produce a gridded or continuous population dataset (Stevens et al., 2015, Lloyd et al., 2019, Wardrop et al., 2018). This method has been applied to redistribute other demographic variables, such as age and sex structure (Alegana et al., 2015, Bosco et al., 2017, Pezzulo et al., 2017, Utazi et al., 2018) and maternal and new-born outcomes (Ali et al., 2016). Small areas are preferred for exploring differences in access to healthcare services and access inequalities at a finer scale (Cromley and McLafferty, 2012, Culyer, 2001, Wennberg and Gittelsohn, 1973). However, the redistribution of counts in unpopulated areas, the absence of time-accurate population data and geospatial covariates, are some methodological limitations that require to be considered (Lloyd et al., 2019, Archila Bustos et al., 2020).

2.10 Measuring access to healthcare services

Different methods and analytical tools can be used when exploring access to healthcare services, and the methodological selection should be guided by the research questions and likely limited by the available resources. This section describes methodologies that can be applied when measuring access to healthcare, a quantitative research approach. Generalised linear models and spatial analysis are frequent methodological tools used for this purpose. Generalised linear models are commonly used to explore the relationship and the effect of multiple factors over access to healthcare outcomes. The selection of the method depends on the characteristics of the explored outcomes, Poisson log-linear, Negative Binomial, Zero inflated and a two-part Hurdle model, are methods that can be used to analyse access to healthcare services at the individual level (Deb and Norton, 2018, Jones, 2000, Neelon et al., 2013, Agerholm et al., 2013, Gerdtham, 1997).

Potential access measurements frequently follow the container approach to estimate the availability of healthcare services or the distribution of some enabling factors (Culyer, 2001, Guagliardo, 2004, Joseph and Phillips, 1984). A simple method is used to estimate the coverage of enabling factors; the density of healthcare facilities or healthcare professionals per 1,000 individuals are the most common measures (Guagliardo, 2004, Joseph and Phillips, 1984). Other enabling factors that can be studied are the distribution of blood banks and other healthcare resources, some of these research questions focusing on healthcare management applications being the interest of operational research methodologies (Brailsford and Vissers, 2011, Zachariah et al., 2009, Smith et al., 2017).

Geographic accessibility and the distance-decay effect are relevant spatial measures of access to healthcare. The distance-decay effect requires estimating travel times between a location and a healthcare facility. Travel times are widely estimated using Geographic Information Systems (GIS (Guagliardo, 2004, Higgs, 2009, Joseph and Phillips, 1984, Cromley and McLafferty, 2012), from a pair of coordinates (Albrecht, 2007, Guo et al., 2012), a point of origin and a destination (O-D pair). The simplest method to estimate travel distance between the points is to measure the distance by Euclidean geometry, drawing a straight line between the points (Albrecht, 2007). However, this method will likely misrepresent the geographic attributes and the possible travel path (Albrecht, 2007, Sherman et al., 2005, McLafferty, 2003). A road network-based (RNB) analysis is a more accurate alternative for measuring travel trajectories toward healthcare facilities (Apparicio et al., 2008, Sherman et al., 2005).

The road network analysis estimate travel time by connecting lines and nodes of a road network (Albrecht, 2007). The travel trajectories represent the shortest path between the origin and the destination (Apparicio et al., 2008). This method is as a travel cost estimate; travel times are estimated by adjusting for varying speeds according to land-cover attributes (Delamater et al., 2012, Noor et al., 2006), topographic characteristics (Albrecht, 2007, Ray and Ebener, 2008, Ouma et al., 2018, Weiss et al., 2018) and transport modes (Apparicio et al., 2008, Lovett et al., 2002). This method provides more accurate travel times estimates; however, with limitations, the method ignores the actual travel route, and the precision depends on timely and high-resolution raster data (Guo et al., 2012). Travel times have been used to estimate catchment areas to delimit the potential geographic reach of the infrastructure, assuming that individuals will seek healthcare services at

the nearest facility (Alegana et al., 2017, Alegana et al., 2012, Ali et al., 2016); assumption that is not always observed (Akin and Hutchinson, 1999, Kruk et al., 2009, Ocholla et al., 2020). The accuracy of this method is limited to the spatial resolution of the data, smaller administrative units or finer resolution data being required (Langford and Higgs, 2006, McGrail and Humphreys, 2009, Bryant and Delamater, 2019).

Potential access to healthcare measurements have attempted to incorporate the concepts of spatial and non-spatial dimension in one measure. The 2-step float catchment area (2-FCA) method was proposed to integrate the two dimensions in two steps (Langford and Higgs, 2006, Wang and Luo, 2005). The first step represents the spatial dimension, using a travel time friction factor to delimit the geographic reach of the individuals (Luo and Qi, 2009, Wang and Luo, 2005). The second step integrates the non-spatial dimension by overlapping the previous step results with spatially distributed sociodemographic factors (Bauer et al., 2018, Delamater et al., 2019, Luo and Whippo, 2012). This method has been used to identify geographic areas likely to have reduced access to healthcare services in different contexts (Bauer et al., 2018, Bryant and Delamater, 2019, Paul and Edwards, 2019, Whitehead et al., 2020). However, identifying a suitable friction factor that represents the actual barrier is a complex task since multiple factors can influence travel distances and utilisation of services (Kelly et al., 2016, McGrail et al., 2015).

2.11 Chapter summary

This chapter provides the literature review about access to healthcare, describing concepts, methodological approaches and the data that can be used for studying access to healthcare. The literature review has been crucial to identify gaps in the literature and to consider what kind of research can contribute for the study of access to health in Global South contexts.

Diverse conceptual frameworks have described key concepts of access to healthcare, including the behavioural model, Tanahashi model, Quality of healthcare framework and others. Many of these frameworks were developed with limited empirical evidence. Despite this limitation, these frameworks have common concepts, they highlight the relevance of structural attributes of the health system required to provide healthcare. Although this central aspect is widely acknowledged this literature review identified, there are limited studies exploring the influence of structural

characteristics of the services over access to healthcare outcomes. These type of studies are further limited in Global South contexts.

A comprehensive understanding of access to healthcare services is relevant to support public policies and initiatives that aim to achieve UHC "*to leave no one behind*". The exploration of this topic requires the use of detailed individual data. Administrative healthcare records providing information across the users of the services is a valuable data source to explore access to healthcare using a health system approach. However, this data is scarce in many Global South countries. Most access to healthcare measures in Global South context have mostly focused on selected services and do not consider aspects of the service provision. Global South studies exploring access to healthcare services using a health system approach across age groups and for different types of services are rather limited.

Access to healthcare is the outcome of structural aspects of the system and multiple processes involved in service delivery. Access outcomes include seeking behaviour, level of use of healthcare services, continuity of care, trust and perceived satisfaction. Multiple factors can influence these outcomes, including the distance to healthcare facilities. Increased travel times to healthcare facilities are likely to reduce utilisation of healthcare services, an effect known as distance-decay. Research exploring the willingness to travel when seeking services for maternal health outcomes in Global South countries identified individuals who bypassed the nearest facility. However, this behaviour has been observed for selected health outcomes, aspect that might limit the understanding of the potential explanations, including the regionalisation of the services, a structural factor of the service provision.

This research contributes to fill the gaps in the literature by exploring access to public healthcare services considering the structural characteristics of health care provision by adjusting for users across age groups, for two levels of the health care service provision in a Global South country. Furthermore, it contributes in the identification of barriers in access to public health in Guatemala

Chapter 3 **Guatemala: context and the healthcare sector**

3.1 Introduction

Access to various healthcare services is relevant to prevent mortality and preserve the individual's health status across the lifespan. The capacity and conditions to gain access to healthcare services might vary across countries and types of health systems. Reduced coverage and greater difficulties to access healthcare are likely to be observed in Global South countries (Wagstaff and Neelsen, 2020). Research exploring access to healthcare services has primarily focused on antenatal care and child healthcare outcomes, such as birth delivery and immunisation. This research aims to explore access to healthcare while adjusting for factors related to the healthcare delivery system by adjusting for users across age groups and for two levels of services in Guatemala. Countries in the Latin-American region have made significant progress toward equitable access to healthcare services, but progress is not equal, and some countries have made little progress. Guatemala represents a suitable scenario to explore access to healthcare; its public healthcare system performance lags behind and is comparable to some African countries (Atun et al., 2015, Wagstaff et al., 2016).

This chapter aims to describe Guatemala's contemporary sociodemographic context and the conditions to access public healthcare services. The chapter is structured into seven sections, this section introduces the topic. The chapter content begins by describing the geopolitical division of the country and the population structure. This chapter expands previous research by understanding the socioeconomic context of Guatemala, alongside providing summary measures related to the social development of the population, such as the attained education level and poverty. After describing the population and the socioeconomic context, this chapter explores the structural characteristics of the public health system using the WHO building blocks framework. This section is followed by a review of research exploring population health outcomes, persistent health

inequalities, and barriers to access to healthcare in Guatemala. The concluding section of this chapter provides the summary of the review.

3.2 Population and territorial division

Guatemala is characterised by his biogeographical landscape having two mountain ranges and lowlands in the North and South coastal areas, with the economic activities organised according to the geography back in time during the Spanish colonialization (Kramer et al., 1990). The country territorial organisation was initiated around 1,825 after the independence and has changed throughout history. Guatemala territory covers 108,888 Km^2 and it is geo-administrative divided into three levels (INE, 2018). The administrative level zero (ADM-0), represents the total national territorial extension and international boundaries. The departments represent administrative level one (ADM-1), dividing the country into 22 units, and municipalities are administrative level two (ADM-2) (Congreso de la República de Guatemala, 1986). Figure 3-1 illustrates the 22 ADM-1 units by colour and identifies the boundaries of the ADM-2 units.

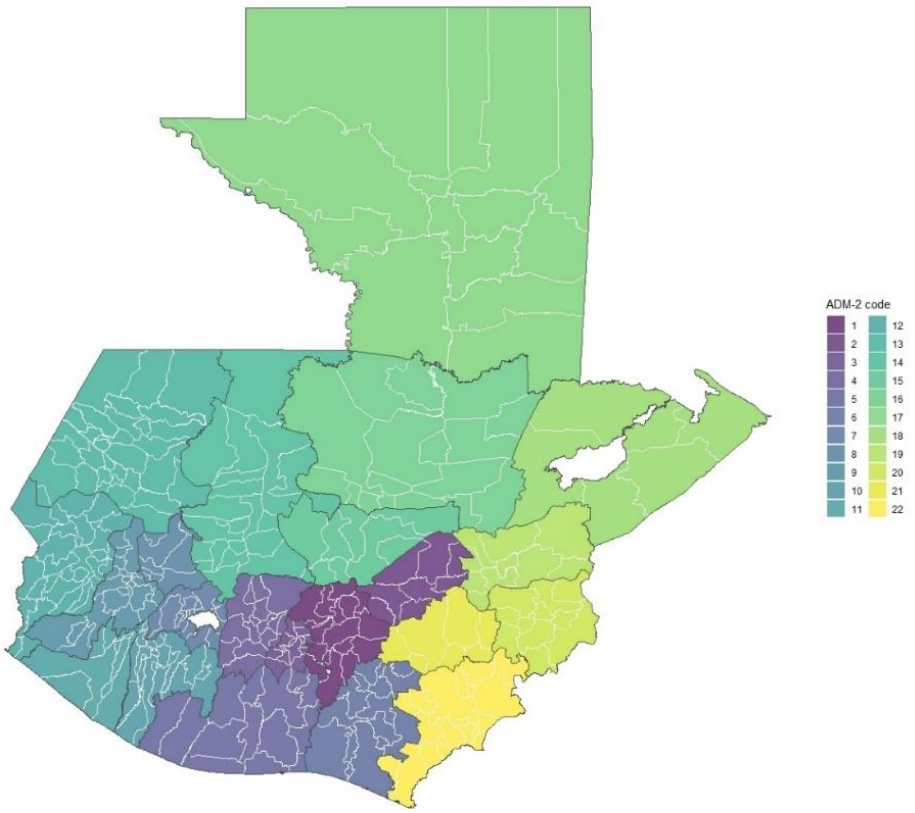

Figure 3-1: Guatemala territorial division by department (ADM-1 level) and municipalities (ADM-2 level), Guatemala 2018

Source: Author's map using census cartography (INE, 2018)

Municipalities are the smallest geo-administrative level for the allocation of public funds (Congreso de la República de Guatemala, 2010). Municipalities represent the lowest level of data available for the census population counts, vital registrations and cartographic data. The population and households living within the ADM-2 boundaries are organised at populated settlements; these settlements are categorically classified by villages, zones, micro-regions and other forms of territorial segmentation (Congreso de la República de Guatemala, 2010). The country is divided into 340 municipalities with variable territorial extension; the smallest ADM-2 unit has an extension of 4.7 Km^2, while the biggest has 8,270 Km^2. The average territorial extension is 317.8 Km^2 [± 74.9, 95% CI], with 75% of the municipalities having an extension smaller than the mean.

The last census in Guatemala was conducted in 2018, identifying 14,901,286 inhabitants across 26,867 settlements (INE, 2018). The National Statistics Office reported an undercount of 9% of the population (INE, 2018); while post-census projections estimate a total of 16,346,950 inhabitants in Guatemala for 2018 (INE, 2019). Census data estimates that 57% of the inhabitants lived in populated settlements classified as rural (INE, 2019). Rurality in Guatemala is identified by the reduced presence of essential services such as electricity, piped water and the labour dependence on agriculture (Congreso de la República de Guatemala, 2010). There are differences in the distribution of the population, Guatemala department, the main metropolitan area, hosts 3,015,081 inhabitants, representing 20% of the total population (INE, 2018).

Census and cartographic data were used to estimate the population density across the country's administrative units. The average population density was estimated to be 392.7 inhabitants/Km^2 [± 67.3, 95% CI] at the municipality level. Different levels of population density are observed across municipalities, with 50% of them having less than 213.3 inhabitants/Km^2. A contrast is observed for urban or metropolitan areas, with 27 municipalities in the country having population density values above 1,000 inhabitants/Km^2. Figure 3-2 illustrates the number of inhabitants/Km^2 for each municipality.

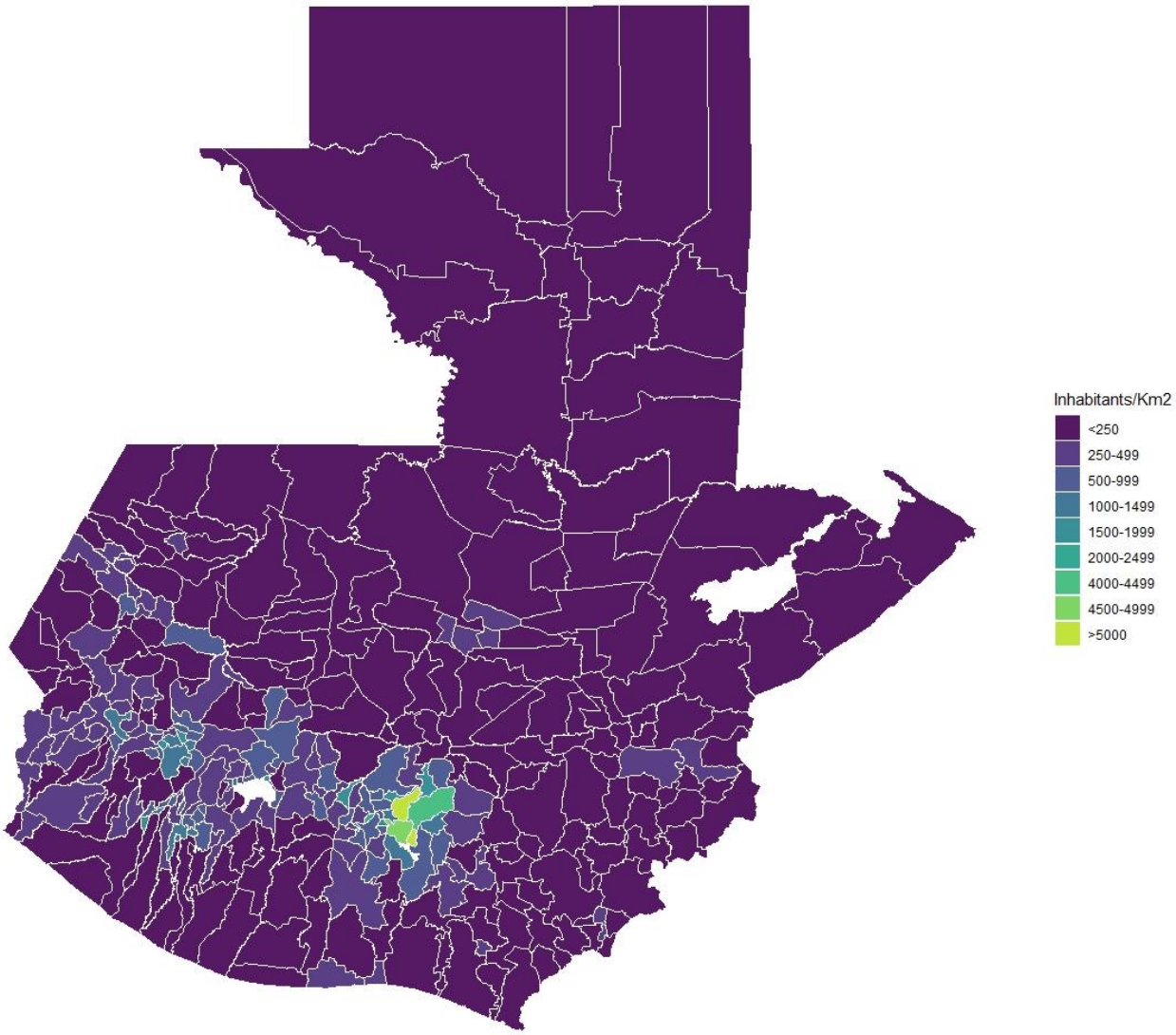

Figure 3-2: Population density estimated at municipality level (inhabitants per km^2), Guatemala 2018

Source: Author' own estimates using data from (INE, 2019)

The population in Guatemala has a predominantly young structure, with a mean age of 26.5 [± 1.1, 95% CI] years. Population counts from the 2018 census were used to estimate municipalities' dependency ratios. On average, 67.2% [±1.2, 95% CI] of the population is categorised at dependency age. The young age dependency ratio is higher than the old dependency ratios. On average, 57.8% [±1.3, 95% CI] of the municipalities' population are 15 years old children, while 9.5% [±0.2, 95% CI] is classified above as 64 years old. Different levels of dependency ratios are expected across administrative units; child and old dependency ratios are illustrated in Figure 3-3. The metropolitan area and highly urbanised municipalities have low child dependency ratios, while some municipalities in eastern Guatemala have higher old dependency ratios. Despite having a young population structure, Guatemala has been experiencing a change in the structure, child

dependency ratios have declined in the last two decades. The child dependency ratio was estimated using census data from 2002 (INE, 2003), identifying a dependency ratio of 87.3%, a value that declined to 57.8% in 2018.

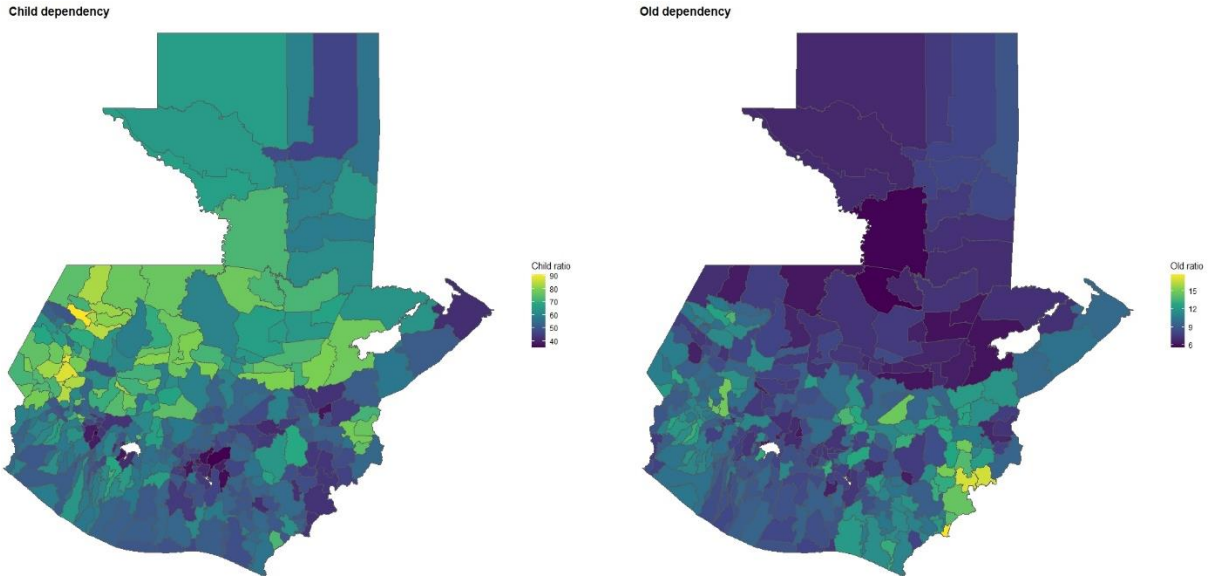

Figure 3-3: Child dependency ratio and old age dependency ratio at municipality level, Guatemala 2018

Source: Author' own estimates using data from (INE, 2019)

Changes in the population structure in Guatemala might be related to a decline in fertility rates. Guatemala was characterised by high fertility rates compared to other countries in the region and some researchers identified a stalled demographic transition (Grace and Sweeney, 2012). However, fertility rates have been declining in Guatemala since 1970s; previous research has identified that highly urbanised areas and women with ladino ethnic background are leading the shift and fertility decline (Grace and Sweeney, 2014, Grace and Sweeney, 2012). Total fertility rates (TFR) for each municipality were estimated using census data, identifying that the average number of children per woman between 10 to 49 years old for 2018 was 2.9 [± 0.07, 95% CI]. The TFR's are illustrated in Figure 3-4, with 81 municipalities reporting fertility values below the replacement level.

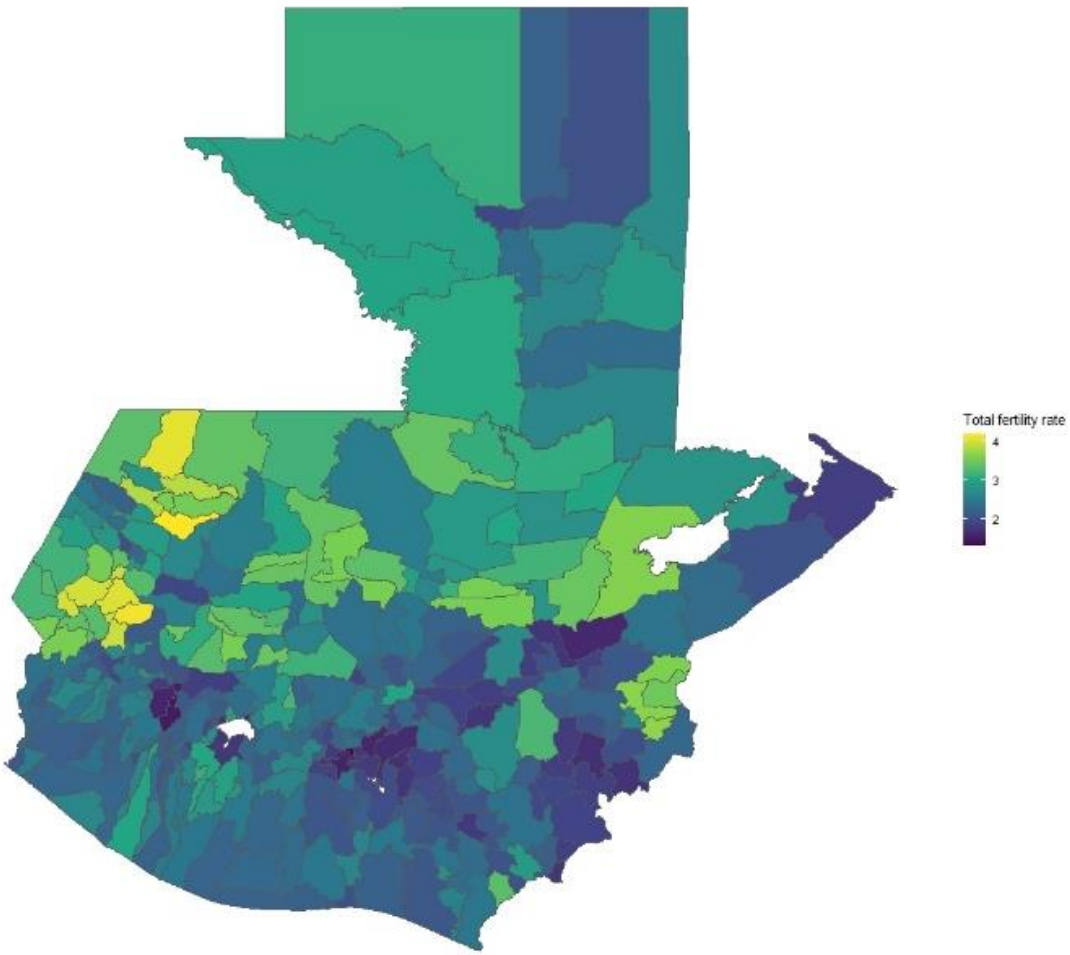

Figure 3-4: Total fertility rates at municipality level (average number of children born alive for women between 10 to 49 years old), Guatemala 2018

Source: Author' own estimates using data from (INE, 2019)

3.3 Socioeconomic context

Guatemala's population has two major ethnic groups, Ladinos and Mayan indigenous populations. The proportion of the population self-identified as Mayan indigenous in 2018 was 41.6% (INE, 2019). The ethnic background was estimated for each municipality in the country, identifying an average proportion of 44.7% indigenous population. The proportion of Mayan indigenous population varies across municipalities, with 96 municipalities having at least 90% of it is population self-identified as Mayan indigenous. Figure 3-5 illustrates the proportion of the population self-identified as Mayan indigenous for each municipality.

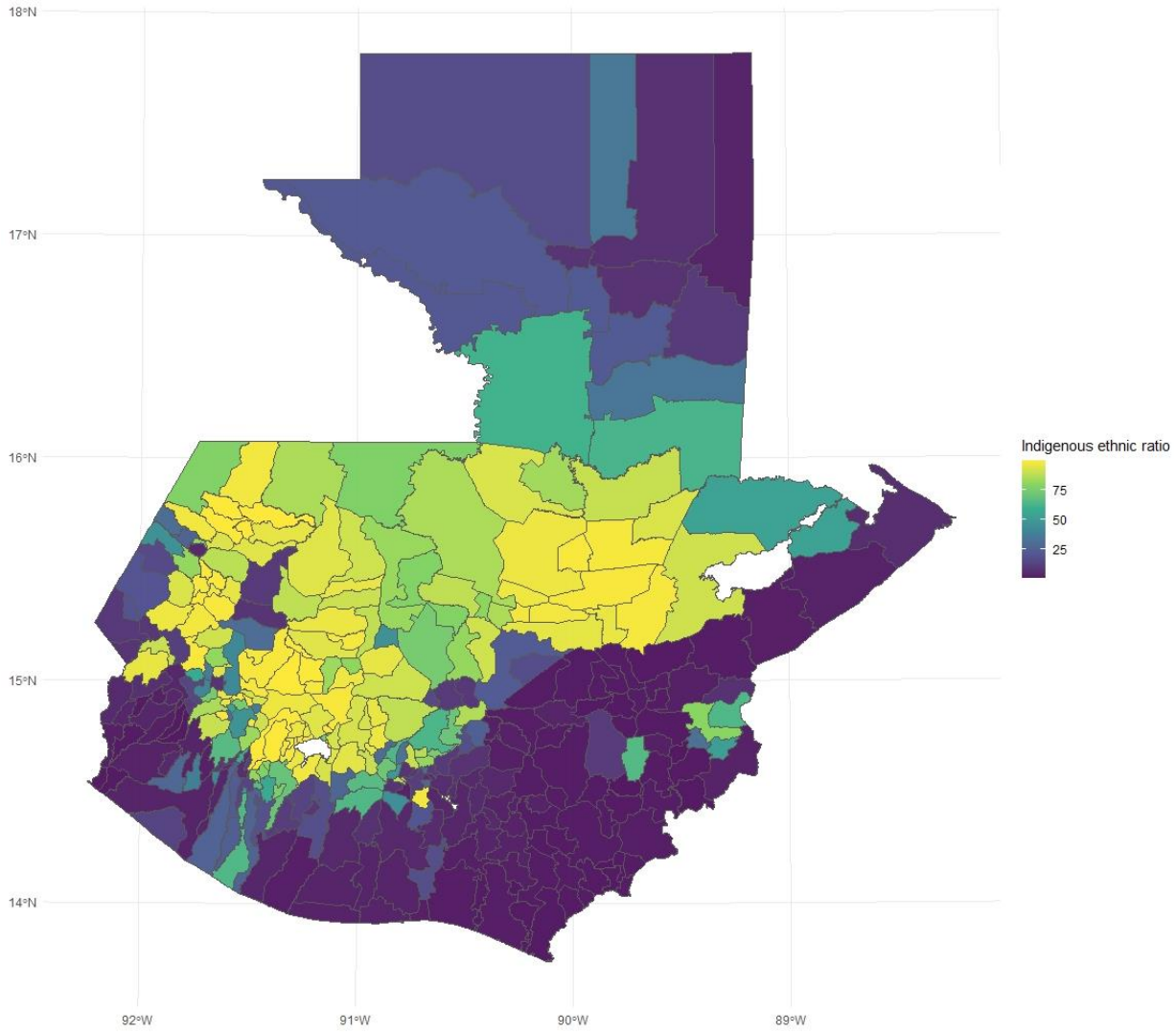

Figure 3-5: Proportion of the population self-identified as Mayan indigenous by ADM-2, Guatemala 2018

Source: Author' own estimates using data from (INE, 2019)

The modern socioeconomic system was grounded in agrarian production, including an agro-export elite class owning large-scale farms and non-traditional exports produced at small-scale farms (Krznaric, 2006). The modern socioeconomic history of the country is linked with violence, including dictatorships and civil conflicts ending in 1996 with a peace agreement (Benson et al., 2008). The end of the civil conflict was supported by Neoliberal policies (Robinson, 2000), enabling the exploitation of natural resources, including mining, oil extraction and hydropower (Nolin and Stephens, 2010, Pedersen, 2014). These industries have been linked with conflict, human rights abuse and increased environmental risks (Nolin and Stephens, 2010, Pedersen, 2014, Zarsky and Stanley, 2013). An increase in economic diversification has been observed in recent decades, with

manufacturing exports on occasions considered a more stable market compared to agriculture (Stanley and Bunnag, 2001).

Guatemala macro-economy has improved in recent decades, recently being classified as an Upper Middle Income country (The World Bank Group, 2021). Alongside the diversification of the country's economy, Guatemala has made some progress in education. The proportion of children enrolled in preschool and the proportion of students progressing from primary to secondary education increased between 1998 and 2005 (Bastos et al., 2017). The attained education level for the population above 24 years old was estimated using census data from 2018 to have updated education indicators. These estimates identified that 22.8% of the population had attained less than primary education, 40.3% primary education, 28.2% attained secondary education and 8.7% of the population reached a superior level.

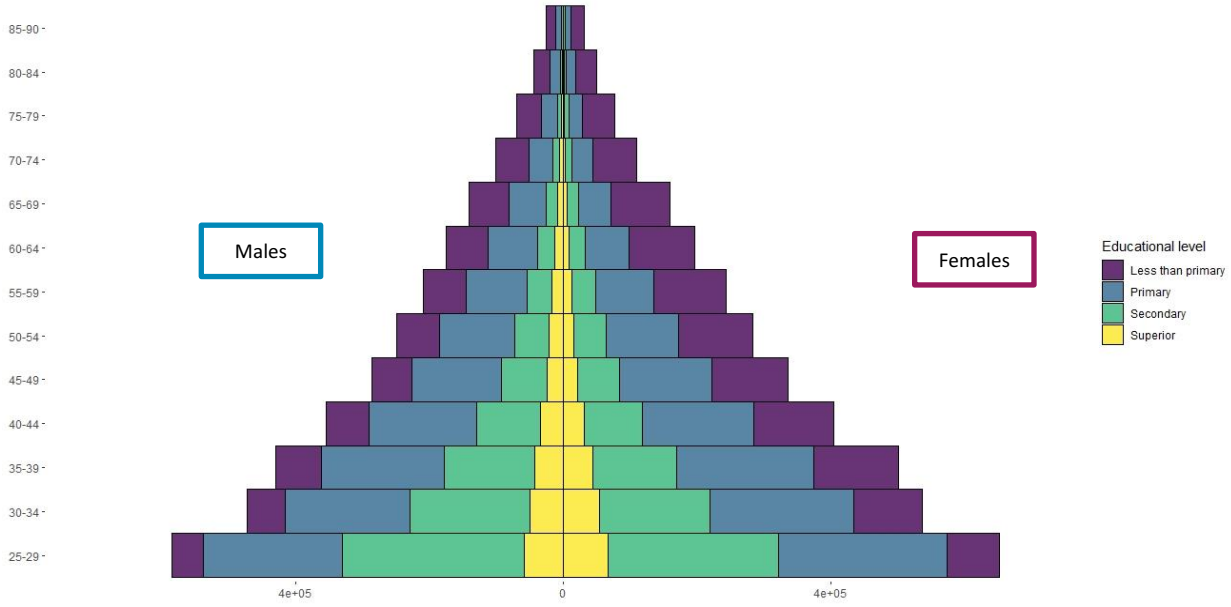

Figure 3-6: Attained education level for population above 24 years old by sex and age group, Guatemala 2018

Source: Author' own estimates using data from (INE, 2019)

The attained education level is hypothesized to be higher among younger cohorts. The population between 25 to 29 years displays a higher proportion of individuals who have completed tertiary and secondary education, with a lower proportion in older age groups; Figure 3-6 illustrates the attained education level by age and sex. Differences in the attained education level are expected

across geographic areas of the country. Attained education levels were estimated at each municipality; Figure 3-7 illustrates the proportion of individuals who completed secondary and tertiary education. A greater proportion of the population in the metropolitan area has achieved tertiary education, while lower levels of the population that reached secondary education are found in the western highlands. Despite the improvement of this human capital indicator, education inequalities are likely to persist, particularly among indigenous populations (Canelas and Gisselquist, 2018).

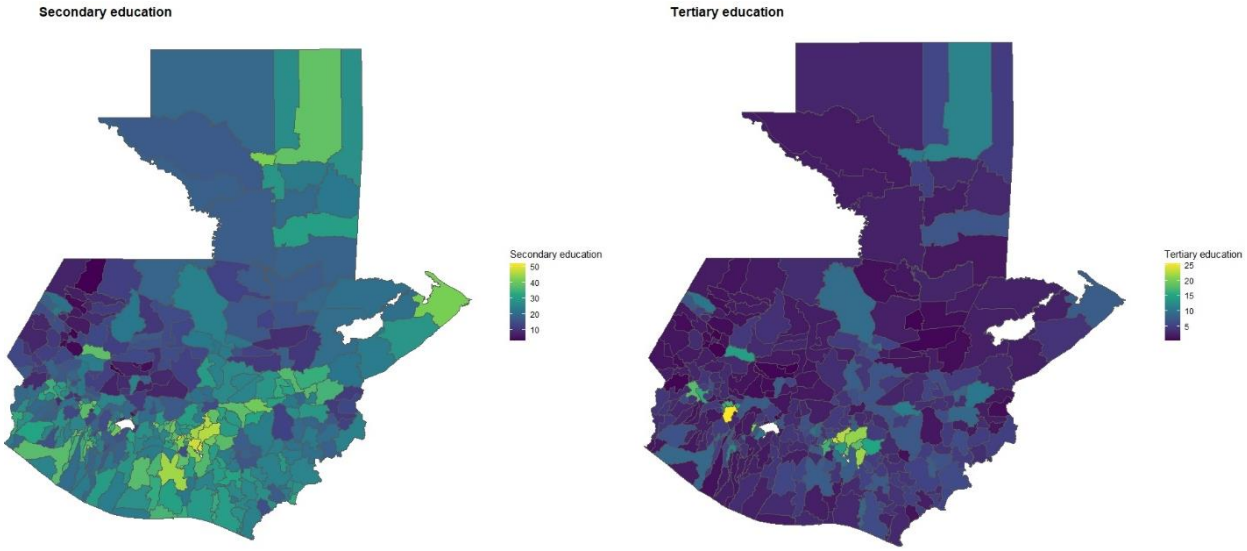

Figure 3-7: Proportion of the population that attained secondary and tertiary education at municipality level, Guatemala 2018

Source: Author' own estimates using data from (INE, 2019)

The recent economic growth has not necessarily implicated an improvement in the social benefits of the population. The population in Guatemala is likely experiencing socioeconomic exclusion and impoverishment (Robinson, 2010, Cabrera et al., 2015). Relative poverty measures from the latest LSM survey in 2014 estimate that 59.3% of the population is classified below the poverty line, while 23.4% of the population lives under extreme poverty conditions (INE, 2015). The proportion of the population living below the poverty line is higher for population groups living in rural areas (76.1%) and for the indigenous population (79.2%) (INE, 2015). Previous research exploring income distribution identified a decline in the proportion of the population classified as middle class in Guatemala from 2003 to 2013 (Stampini et al., 2016). This decline increased the proportion of the

population living in economic vulnerability (Stampini et al., 2016), vulnerability likely to be increased by the frequent exposure to geophysical hazards and meteorological threats, such as earthquakes and volcanic eruptions, hurricanes and droughts (Gill et al., 2020).

Recent urbanisation process in Guatemala might represent an additional health challenge in the country. Urbanisation has occurred with limited urban planning measures, the urban and peri-urban areas having an unsuitable water discharge and waste management system (Castillo Cabrera and Haase, 2018) and ground-level air pollution levels above WHO recommendations (Shendell and Naeher, 2002). Additionally from the environmental challenge, the legacy from the displaced population (Moser and McIlwaine, 2001) has increased the number of population living in poor and highly densely populated areas, having reduced social capital are exposed to urban violence (McIlwaine and Moser, 2001).

The persistence of poverty in the country has been relevant pushing factor for international migration (Heidbrink, 2019, Scarnato, 2019). International migration has been studied by several scholars identifying United States as the most desired destination (Alvarado and Massey, 2010). International migration has been observed across age groups, including children and adolescents, some of them migrating to escape from family debt or gang violence (Heidbrink, 2019). International remittances have a relevant role in the economy of the country, being representative of 14.6% of the Gross Domestic Product (GDP), and occupying first place in the economy (Banco de Guatemala, 2020). Remittances are relevant for household consumption and expenditures related to essential services (Adams and Cuecuecha, 2010), including food, housing, education and healthcare.

3.4 Guatemala healthcare sector and the public services

The Guatemalan Constitution recognises health as a fundamental human right and promotes healthcare equality across the inhabitants (Congreso de la República de Guatemala, 1985). The legal framework defines health as the product of different social determinants and warrants different institutions the capacity to provide healthcare services; including private and publically funded institutions (Congreso de la República de Guatemala, 1997). There are three major healthcare providers in the country: The Guatemalan Social Security (IGSS, Spanish acronym), the Ministry of Public Health and Social Assistance (MSPAS, Spanish acronym) and the private sector, these

providers are described in the following section. The diverse range of healthcare providers in Guatemala has been associated with a fragmented healthcare sector.

The Guatemalan Social Security (IGSS) is a public-private institution with similar characteristics to the Bismark model. The IGSS provides healthcare services and some social protection benefits, such as paid sick leave and pension (Congreso de la República de Guatemala, 1985, IGSS, 1946). The social insurance is financed by contributions from private employers and their employees, contributing every month and by the public budget (Congreso de la República de Guatemala, 1985, IGSS, 1946). Individuals employed by the formal private sector are the major beneficiaries, including their under-five year old children and wives (IGSS, 1946). The population that can have access to healthcare services in 2015 was estimated to be around 1.2 million individuals (IGSS, 2022). According to data collected by the DHS in 2014-15, it is estimated that 19% of adult males in the country are affiliated to this insurance, compared to 11% of adult females (INE, 2015).

The private healthcare sector in Guatemala corresponds to services financed by private funds, either by insurance companies or out-of-pocket expenditures. Private healthcare providers include independent clinical practitioners, pharmacies, non-governmental organisations, Mayan traditional midwives and others. The coverage of private healthcare services is likely to vary across population groups. Having private insurance or access IGSS is associated with socioeconomic status, with coverage increasing among individuals having superior levels of education and those classified in the highest socioeconomic level (Bowser and Mahal, 2011).

The coverage of private health insurance is limited, around 3% of the female population at reproductive age has access to a private insurance plan (INE, 2015), suggesting that the majority will seek healthcare assistance at public services or rely on out-of-pocket expenditures to cover healthcare-related costs. Other relevant providers are Mayan traditional midwives having a role in childbirth services, including antenatal care (Replogle, 2007, Chary et al., 2013). The latest DHS estimates that 29.1% of the childbirths in the country where assisted by Mayan traditional midwives, the proportion likely to be higher in rural areas (MSPAS, 2017).

The Ministry of Public Health (MoH) is a governmental institution with similar characteristics to the Beveridge model. The MoH has the stewardship function of Guatemala's healthcare sector, health

surveillance and regulation (Congreso de la República de Guatemala, 1997). The MoH is the governmental institution entitled to provide healthcare services to the country's population, "*giving priority to individuals and families not able to afford health care*" (Congreso de la República de Guatemala, 1997). Prioritising a population group, individuals at a greater economic disadvantage, is a public policy grounded in a vertical equity principle for healthcare service delivery. The Guatemalan MoH is financed by public funds from general taxation providing services free of charge (Congreso de la República de Guatemala, 1997) and every individual seeking services can get access without being on an active list system.

The MoH provides healthcare services at National Level with limited resources. The governmental expenditure in 2018 for healthcare is estimated to be 2.06% of the country's GDP (WHO, 2021a), being one of the lowest public expenditures in Latin America (Dmytraczenko and Almeida, 2015). The MoH distributes the limited budget between administrative activities, healthcare workers and resources to provide healthcare services across the health system organisation (Congreso de la República de Guatemala, 1999).

The services provided by the public healthcare sector follow a regionalisation to organise the delivery of services at three levels, primary healthcare, second level services and hospitals (Congreso de la República de Guatemala, 1999). Primary healthcare services are conceptualised as the population immediate contact to the healthcare system, therefore being widely distributed across geographic areas of the country (Congreso de la República de Guatemala, 1999). Figure 3-8 illustrates the geographic distribution of the infrastructure providing services by the MoH, using the most recent geo-referenced data available. Healthcare workers located in primary and second level healthcare services routinely collect the data using a standard forms, while technicians located at the second level facility upload the data into a health information system (HIS).

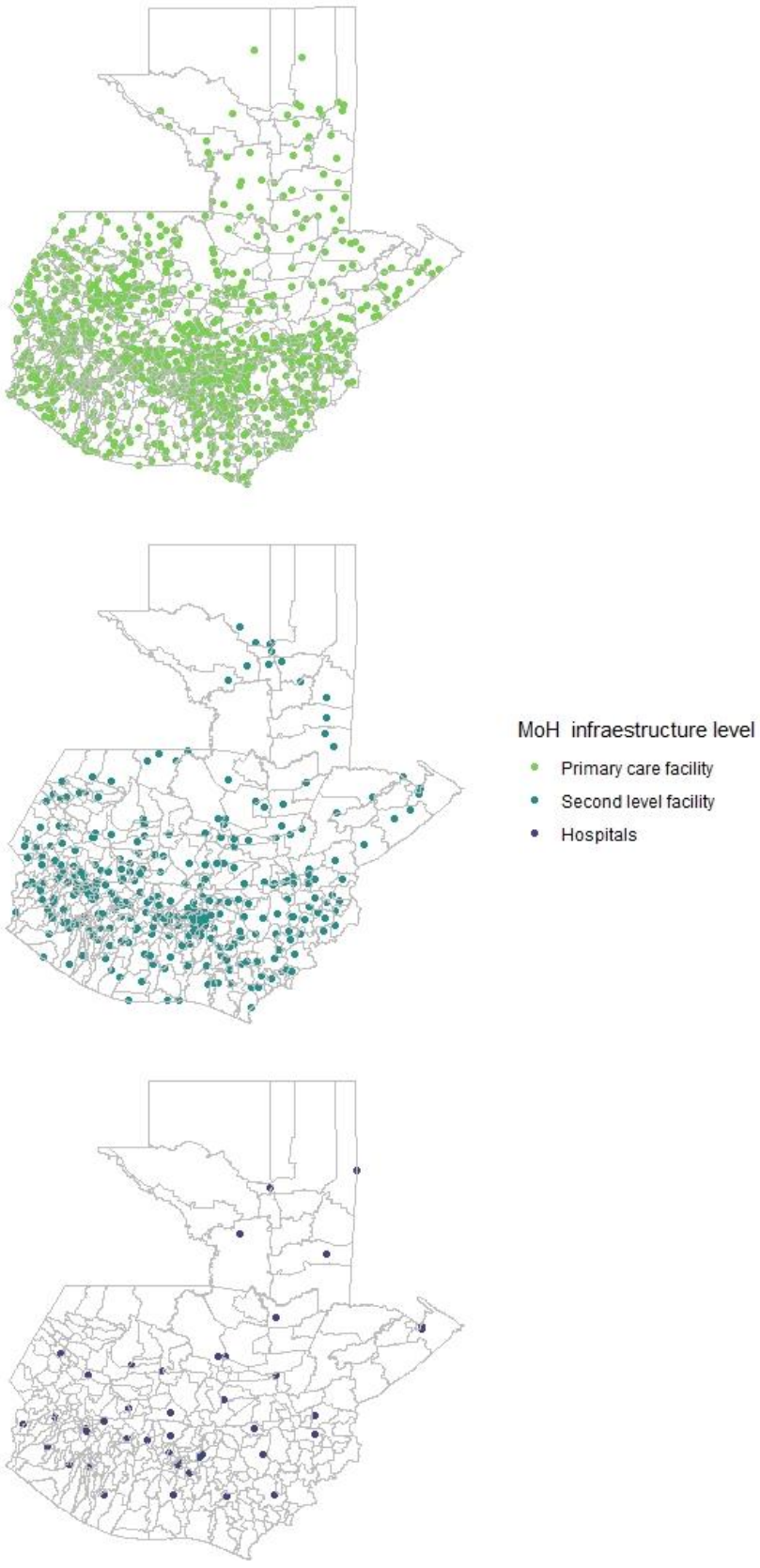

Figure 3-8: Geographic distribution of the MoH infrastructure by level of healthcare service, Guatemala 2009

Source: Author's own table the cited references (SEGEPLAN, 2018)

Primary healthcare services are designed to provide preventive health interventions and essential services provided by auxiliary nurses (Congreso de la República de Guatemala, 1999). Second level services are the nearest infrastructure in which services are delivered by a professional healthcare worker (Congreso de la República de Guatemala, 1999). This level has an extended healthcare workforce, including physicians, professional nurses and laboratory technicians (Congreso de la República de Guatemala, 1999). These services are likely to be equipped with resources to conduct selected diagnostics, essential surgical procedures and emergency obstetric care (Congreso de la República de Guatemala, 1999). The third level, hospitals, are conceived as the services proving specialised medical care, the complexity of the services can vary according to their reach, from local, departmental or reference hospitals (Congreso de la República de Guatemala, 1999). The organisation of the public healthcare services, including the target population coverage is summarised in Table 3-1.

Table 3-1: Summary of public health sector facilities and service provision in Guatemala

Service	**Facilities**	**Healthcare workforce**	**Service provision**	**Target coverage**	**Location**
Primary level	1,165 health posts	Auxiliary nurses	Limited package of services, from vertical programs and some rapid diagnostic tests.	One per 2,000 inhabitants	Selected populated settlements at rural areas.
Second level	333 health centres	Auxiliary nurses, professional nurses, general physicians, laboratory technicians.	Increased package of services including medical services, trauma, and obstetric care and minor surgery services.	One facility per 10,000 to 20,000 inhabitants	Urban centre at the municipality (ADM-2).
Hospitals	46 hospitals	Professional nurses, general and specialised physicians, laboratory professionals, others.	Specialised services, emergencies, hospitalisation and increased diagnostic capacity.	Not defined	Urban centre of the department (ADM-1) and Guatemala City.

Source: Author' table using the public health sector provision organisation (Congreso de la República de Guatemala, 1999) and administrative data from (MSPAS, 2015)

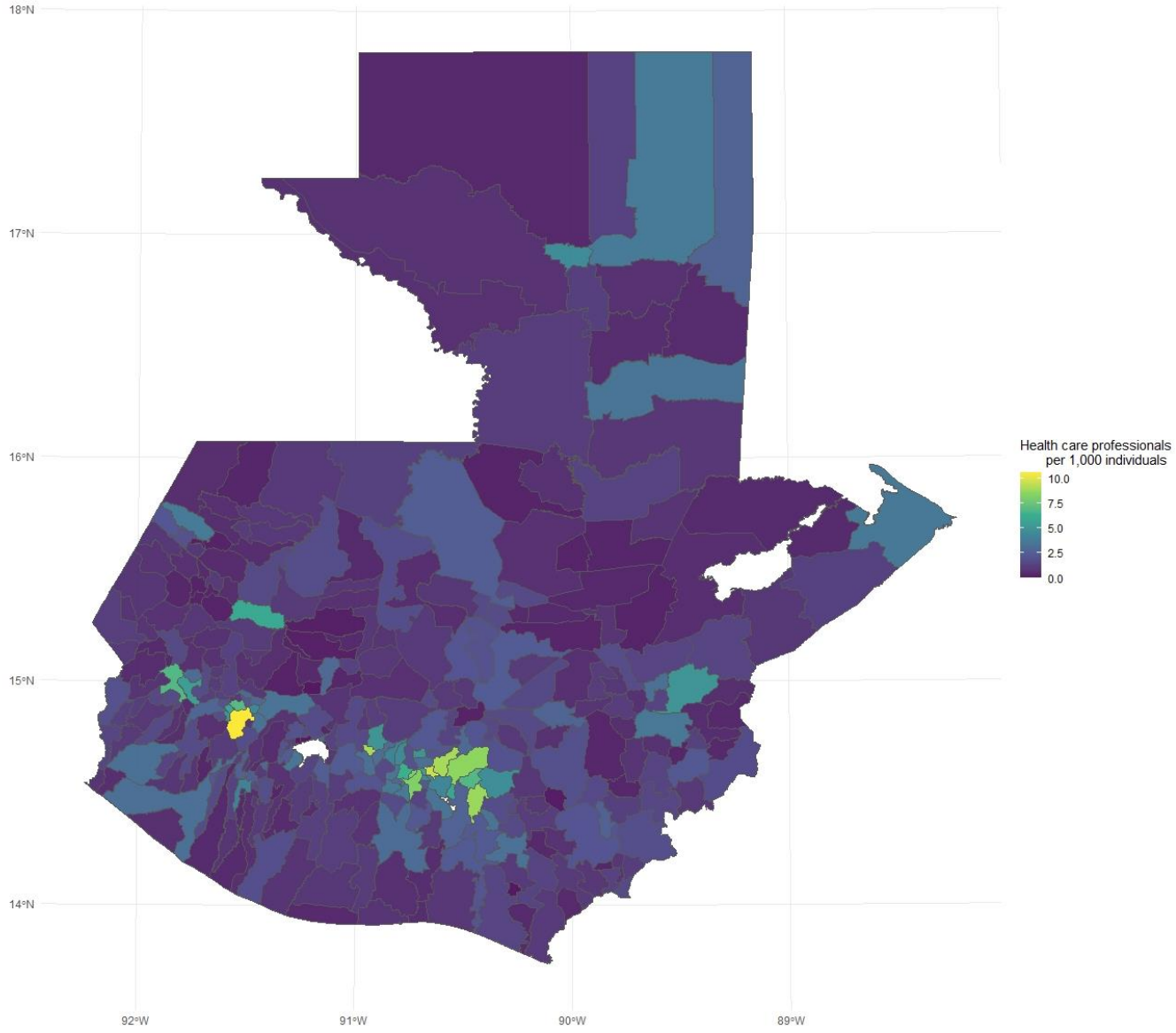

Figure 3-9: Number of healthcare professionals per 1,000 individuals for each ADM-2, Guatemala 2018

Source: Author' own estimates using data from (INE, 2019)

The MoH operates with a reduced number of healthcare professionals, and the provision of services is highly dependent on auxiliary nurses and technicians (Avila et al., 2015). Guatemala is one of the countries the Latin American region with the lowest density of healthcare workers per capita (WHO, 2021b). The estimated density of physicians in 2018 was 0.9 per 1,000 individuals, while the number of professional nurses was 1.2 per 1,000 individuals (WHO, 2021b). The density of professionals employed in the healthcare sector at the municipality level was estimated using census data. On average, there are 1.7 healthcare professionals per 1,000 individuals, value that varies within the country. Only 19 municipalities have more than 5.0 healthcare professionals per 1,000 individuals,

Guatemala department having municipalities having an increased value. Figure 3-9 illustrates the density of professionals in the healthcare sector across municipalities. The MoH is likely to have a limited budget and resources to provide healthcare services, despite the limitations, primary and second level public healthcare services are one of the most frequent places for seeking healthcare (INE, 2015, MSPAS, 2017).

3.5 Population health and health inequalities Guatemala

Some population health indicators in the country are similar to other countries in the region. Child mortality has been declining in recent decades, while life expectancy at birth has increased (MSPAS, 2017). Life expectancy at birth in 2018 was estimated to be 76 years for females and 69 years for males (Wang et al., 2012, IHME, 2020). The sex gap in life expectancy is a common phenomenon observed in other countries in the Latin American region (IHME, 2020, Vollset et al., 2020). However, the sex gap for premature deaths in Guatemala is related to a higher number of external causes of death among males, including injuries and violence (Canudas-Romo and Aburto, 2019). The ten most frequent causes of death reported by vital registrations in 2016 were: lower respiratory infections, violence, ischemic heart disease, neonatal disorders, diarrhoea, road injuries, cirrhosis, diabetes, congenital diseases and chronic kidney disease (Naghavi et al., 2017). Several of the causes of death listed above are classified as preventable or amendable deaths by continuity and quality healthcare services (Nolte, 2004).

Active epidemiological surveillance in Guatemala has mostly focused on infectious diseases, including Neglected Tropical Diseases and lower respiratory infections. There is extensive academic literature about vector-borne diseases, studies ranging from analysis of transmission, risk factors and treatment for Malaria, Chagas disease and others (Hotez et al., 2014). Epidemiological studies in Guatemala have widely explored lower respiratory tract infections, the first cause of death among children and adult population in the country (McCracken et al., 2013, Fischer Langley et al., 2013). Research exploring respiratory infections has identified sociodemographic factors associated with morbidities and mortality (Tomczyk et al., 2019), including environmental factors identifying the association between household indoor air pollution and child pneumonia (Smith et al., 2011). Despite some epidemiological studies exploring communicable diseases, measurements of

prevalence and incidence remain unknown, given the limitations of the public health system (Lindblade et al., 2011).

Guatemala is among the top ten countries in the world for child stunting (WHO, 2022b); this health and nutrition outcome has become the most popular outcome explored in the country. Child stunting has been highly prevalent; it is estimated that 46.5% under-five year old children in 2014 were stunted, however, declining in recent decades (Gatica-Dominguez et al., 2019). Child growth studies conducted in Guatemala have explored micronutrient absorption, psychosocial development, nutritional anthropology and social determinants, among other outcomes (Rivero Jiménez et al., 2021). Research exploring differences in social determinant factors associated with child stunting has provided evidence about health inequalities in Guatemala, inequalities likely to be more prevalent among the poor or indigenous population (Sweeney et al., 2013, Arriaza et al., 2022). Furthermore, research exploring health-related inequalities using a range of different outcomes has expanded in recent years. There is an increased number of publications providing evidence about factors associated with non-communicable and occupational diseases, such as impaired kidney function among sugarcane workers (Butler-Dawson et al., 2018) and health issues relate with chronic exposure to agrochemicals (Gamlin and Hesketh, 2007).

3.6 Access to healthcare services barriers in Guatemala

Various healthcare services are needed to prevent mortality and preserve the health status across the lifespan. A range of resources distributed through the infrastructure are required to provide services, as described in the Building blocks framework (WHO, 2007). The reduced resources available at the Guatemalan public health sector, such as financial and healthcare workers, are likely limiting the service provision and access to healthcare services. Consequently, multiple barriers to gain access to healthcare services, including individual and structural factors are expected. The following section describes previous works exploring access to healthcare in Guatemala and identifies barriers using the five dimensions proposed by Penchansky and Thomas as an analytical framework.

a. Accessibility:

There is some evidence about the relationship between distance and access to healthcare in Guatemala. Previous research explored geographic accessibility for one ADM-1 unit by measuring

travel times to primary, second level facilities and public hospitals (Owen et al., 2010). This research provided evidence about potential geographic accessibility barriers, with travel times increasing for hospital services, as expected (Owen et al., 2010). More recently, research exploring barriers to cervical cancer screening using DHS data identified distance to healthcare facilities as a perceived barrier (Gottschlich et al., 2020). Despite some evidence about geographic accessibility barriers, additional research is required to identify the relationship between the spatial distribution of the services, regionalisation, and realised access to healthcare outcomes.

b. Acceptability:

Research conducted primarily in rural Guatemala has identified acceptability barriers with public healthcare services. Research focusing on users of maternal and child services identified disapproval of public healthcare services and experiencing mistrust (Berry, 2008, Chary et al., 2018, Peca and Sandberg, 2018). Other scholars have identified that users experiencing mistrust are also likely to have language barriers and having previously experienced discrimination (Ceron et al., 2016, Ippolito et al., 2017). Reduced acceptability might further limit access to healthcare by influencing health-seeking behaviour and delaying visits to health services (Barrera et al., 2004, Berry, 2008). Public healthcare services in Guatemala are frequently considered unattractive, instead, individuals rely on private providers, including pharmacies and traditional midwives (Annis, 1981, Lindblade et al., 2011, van der Stuyft et al., 1997).

c. Affordability:

Studies exploring access barriers related to affordability or the financial capacity to use healthcare services in Guatemala are limited. The total health expenditure in the country is equivalent to 6.12% of the GDP, with 2.06% being covered by the public budget (World Bank, 2022). Affordability might represent a relevant barrier to access to healthcare services, especially among the poorest population groups. As an example, it has been found that essential medicines, such as antibiotics treatment for a common child respiratory infection, could cost the equivalent of 15 days of the minimum monthly wage (Anson et al., 2012). However, affordability might be a relevant barrier for most of the population; the 2014-15 DHS revealed that 37.2% of the interviewed women classified in the highest wealth quantile had difficulty affording healthcare services for themselves (MSPAS, 2017).

Previous authors have identified that Guatemala has made little progress toward UHC with reduced public healthcare coverage (Wagstaff et al., 2016). Guatemala represents the country with the

highest out-of-pocket health expenditure in Latin America (Dmytraczenko and Almeida, 2015). Seeking private healthcare services in settings with low insurance coverage is likely to result in out-of-pocket payments, in some cases representing a catastrophic expenditure (Bowser and Mahal, 2011, Goldman et al., 2002). Out-of-pocket payments for healthcare services increase the risk of falling into poverty, especially for households in rural areas and with family members above 65 years old (Bowser and Mahal, 2011). As a result, poverty and limited access to healthcare services are pushing factors for out-migration in Guatemala and in other Latin American countries (Aslany, 2021).

3.7 Chapter summary

This chapter describes Guatemalan population's socioeconomic context and the characteristics of the healthcare sector. Demographic and social indicators have been changing in recent decades, which correspond to demographic transitions and changes in the economy and public policy. Despite the relative progress, there are different indicators related to population development that need to be improved. The high prevalence of stunting and the high number of preventable deaths by quality healthcare services, such as respiratory infections, are health conditions likely to be experienced across the population. High poverty levels limit access to essential services, including healthcare services, these aspects likely undermining the well-being and health of the population.

Guatemala has a mixed healthcare system, combining the presence of the Bismarck and Beveridge, models alongside having a significant private market sector. The comprehensive study of access to healthcare in Guatemala would require exploring three major providers, the IGSS, MoH and the private sector, however, this thesis focuses on access to healthcare services provided by the public sector. The public sector, financed by general taxation, provides services free of charge nationwide and represents the most popular healthcare service provider in the country. National estimates from DHS survey identify that 86% of adult women do not have access to health insurance, suggesting that individuals seek public services or rely on out-of-pocket expenditures.

This chapter provided some evidence about geographic accessibility barriers to public hospitals, acceptability barriers to public healthcare services and affordability barriers to access private healthcare. Furthermore, despite the barriers and the reduced healthcare resources and the limitations the public health sector remains a relevant healthcare provider in the country.

Strengthening public healthcare services is particularly relevant, especially in the context of high poverty and low insurance coverage.

Most of the research exploring access to healthcare outcomes in Guatemala focuses on child health and sexual and reproductive health outcomes, missing a comprehensive understanding of the structural factors that might influence the possibility to gain access to healthcare services. This thesis contributes to the literature by identifying who has access to public healthcare services, providing evidence about access to healthcare inequalities across age and sex groups, and exploring potential access barriers, including the availability of health services. Future research should explore how access to different healthcare providers modifies health-seeking behaviour, what structural factors of the service provision are relevant for gaining access in urban and rural areas and identifying access barriers among older age groups.

Chapter 4 Exploring access and accessibility to public healthcare: data source and deriving variables

4.1 Introduction

Access to healthcare studies can explore a range of different outcomes observed among the individuals that have gained access to services. The comprehensive understanding of access to healthcare requires exploring factors of the service delivery and the individuals across the population gaining access, these aspects can reveal information about structural aspects of access to healthcare services. This type of analysis requires individual-level data across the users, a scarce data resource in many Global South countries. This thesis overcomes the limitation and explores access to public healthcare in Guatemala while including factors of the health system provision using administrative healthcare records. The aim of this chapter is to describe the administrative healthcare records used for the analysis, alongside the demographic characteristics of the studied population and deriving variables.

Guatemala has made reduced progress toward UHC and its performance is mostly comparable to some African countries (Atun et al., 2015, Wagstaff et al., 2016). Exploring and understanding the factors influencing access to healthcare might be relevant to promote interventions that can strength the service provision and enable the use of healthcare. Guatemala represents a suitable scenario for exploring access to healthcare given the contextual commonalities with other Global South countries, including reduced UHC and the hierarchical organisation of the public health system. This analysis is possible when using administrative records including information about the users of primary and second level public healthcare facilities in rural areas of the country.

This chapter describes the individual and household level variables used to explore access to healthcare services in selected rural areas. The content of the chapter distinguishes four main sections, each one having a specific purpose. The first section describes the administrative healthcare records, including the data collection procedure and the available information. The second section provides the context by describing the sociodemographic characteristics of the study sites. Administrative records were complemented to include variables in the analysis that are representative of the living standards and geographic accessibility, this is described in the third section. The last section describes the validity of the origin-destination travel times by comparing the derived variables with a different method.

4.2 Data description

This thesis uses administrative data routinely collected at public healthcare facilities located within four delimited geographic areas. The four delimited areas correspond to selected geographic areas used as a reference for a pilot study conducted by the MoH and local authorities (Fort et al., 2011, Fort et al., 2012). Unlike the regular public healthcare facilities, these four study areas have a distinctive strategy for data collection. The pilot study planned for the data collection of demographic data across the population living within the catchment area and the registers of visits to healthcare facilities (Fort et al., 2011, Fort et al., 2012). The data allows to have population counts across age groups that can be used as denominators to estimate age-specific rates.

The administrative healthcare records include individual and household level information collected by the healthcare workers using standardised forms (Fort et al., 2011, Instituto de Salud Incluyente, 2012). The data is collected by an annual enumeration population exercise and by routine data collection procedures at healthcare facilities (Instituto de Salud Incluyente, 2012). The annual enumeration collects sociodemographic and household assets data, while. The routine records collect data by two different procedures: 1). Individual visits to public healthcare facilities or 2). Active epidemiological surveillance procedures (Instituto de Salud Incluyente, 2012). The individual records can be updated while visiting healthcare facilities, updates that include modifying the household members from events related to births, migration or deaths, see Figure 4-1.

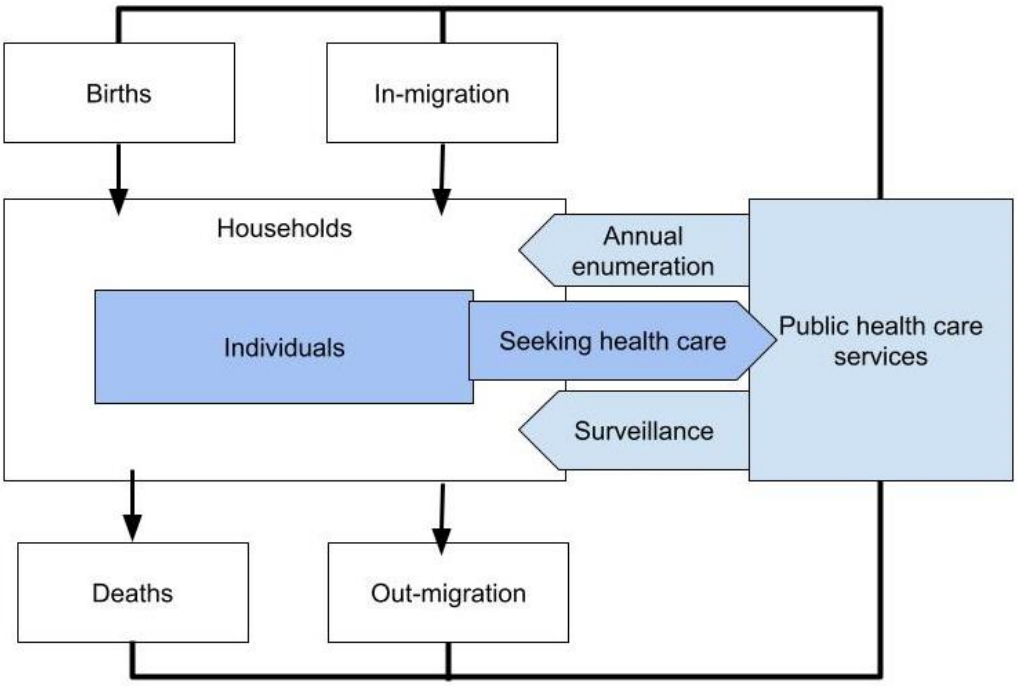

Figure 4-1: The flow of data collected at public healthcare services in the study areas

Source: Author's own diagram based on the data collection standard procedure (Instituto de Salud Incluyente, 2012)

This research used population data and healthcare records exclusively originated from individuals actively visiting healthcare facilities. The demographic, household and healthcare services provided at the time of the visit can be linked using an individual identifier (ID). Using the ID is possible to identify the characteristics of the individuals using the services provided at the public healthcare facilities located within the catchment areas. Despite the detailed individual level data, some limitations might arise, limitations related to the quality of the data. Administrative healthcare records are not exempt of errors, these include limitations in coding accuracy, data completeness and incorrect data entry, among other potential aspects (Smith et al., 2018).

The demographic data includes the date of birth, age, sex, ethnic background, spoken language, community and year. Age was identified by the individual's age in years estimated at the end of the year and classified into five-year age groups. Ethic background classifies individuals at two major groups, indigenous and non-indigenous, while spoken language categorises individuals as Indigenous-Spanish, Spanish or Indigenous speakers. This research analysed access to healthcare services including those individuals having complete demographic data, between 2013 and 2017, the period in which the four sites were simultaneously active. There are 181,768 unique individuals

across the four study sites and 696,992 records with complete demographic information, these represent 98.4% of the administrative healthcare records.

The completeness of the data was verified to identify systematic errors that might arise from the selection of individuals with complete demographic records. A binary dummy variable identified those records having complete sociodemographic data from those having missing values in at least one variable. A binary logistic regression was used to identify differences in sociodemographic predictors for incomplete records. The model provides a test to identify if data were missing completely at random, providing some evidence that the probability of having missing values is associated with older age individuals, the study site and for the year 2015, the findings are described in Table 4-1.

Table 4-1: Binary logistic regression testing missing demographic variables of the administrative healthcare records, Guatemala 2013-2017

	Odds ratio	**95% CI**		**p-value**
Intercept	0.314	0.297	0.330	<0.005
Age	0.777	0.773	0.781	<0.005
Sex female	Ref			
Male	0.947	0.898	0.963	0.018
Study Site 1	Ref			
Site 2	0.458	0.434	0.482	<0.005
Site 3	0.232	0.212	0.253	<0.005
Site 4	0.732	0.686	0.780	<0.005
Year 2013	Ref			
2014	0.419	0.389	0.452	<0.005
2015	1.158	1.094	1.226	<0.005
2016	0.519	0.486	0.554	<0.005
2017	1.045	0.988	1.106	0.125

Source: Author's own analysis using data from the study sites

The four study sites are mostly rural municipalities (ADM-2) and are located in different areas of the country. Study sites 1 and 2 have coverage for primary and second level public healthcare facilities. Study site 1 is located northwest region, neighbouring the Mexican frontier and includes the total territorial extension of the ADM-2. Study site 2 is located in the southwest region and covers only the south section of the ADM-2 unit, due to territorial disputes. Study sites 3 and 4 cover only users of primary healthcare facilities located in rural areas. These two sites are neighbouring municipalities located in the northcentral region of the country, these two catchments are characterised by experienced displacements during the civil war. Table 4-2

describes the territorial extension and the public healthcare facilities available within the catchment area of each study site.

Table 4-2: Number of populated settlements and public healthcare facilities located within the boundaries of the study areas, Guatemala 2017-2018

	Site 1	**Site 2**	**Site 3**	**Site 4**
Geographic area covered	Complete ADM-2	South ADM-2	Rural settlements	Rural settlements
ADM-2 extension*	453.8 Km^2	189.7Km^2	691.5 Km^2	311.8 Km^2
Population density * (habitants/Km^2)	133.1	300.2	79.3	130.8
Populated settlements**	109	51	62	68
Number of 1st level facilities**	22	14	10	12
Number of 2nd level facilities**	1	1	NA	NA

*Data from 2018 census and cartography

** Administrative healthcare records

NA= not available

Source: Author' own estimates using data from (INE, 2019)

4.3 Sociodemographic context of the study sites

This section describes the sociodemographic characteristics of the population living within the four catchment areas using administrative healthcare records. The data included only those records having complete demographic data, an aspect that reduced the analytical sample size. For example, the analysis for 2017 includes 93.1% of the individuals alive on the 1st of January and the 31st of December. The person-years contribution was estimated using the birth and death date. Person-years is the number of days alive to estimate the time that each individual contributed to the population, assuming that individuals do not migrate during the period (Vandenbroucke and Pearce, 2012). Table 4-3 describes the population counts with complete demographic data and the person-year contribution for 2017.

Table 4-3: Individuals with complete demographic records and person-year contribution for each study site, Guatemala 2017

	Site 1	Site 2	Site 3	Site 4
Number of individuals alive	65,534	43,094	22,881	29,527
Individuals with complete demographic records	61,914	39,531	20,863	27,543
Person-years contribution	61,796	39,151	20,842	27,288
Proportion of individuals with complete data	94.4%	91.7%	91.1%	93.3%

Source: Author's own calculations using administrative health records

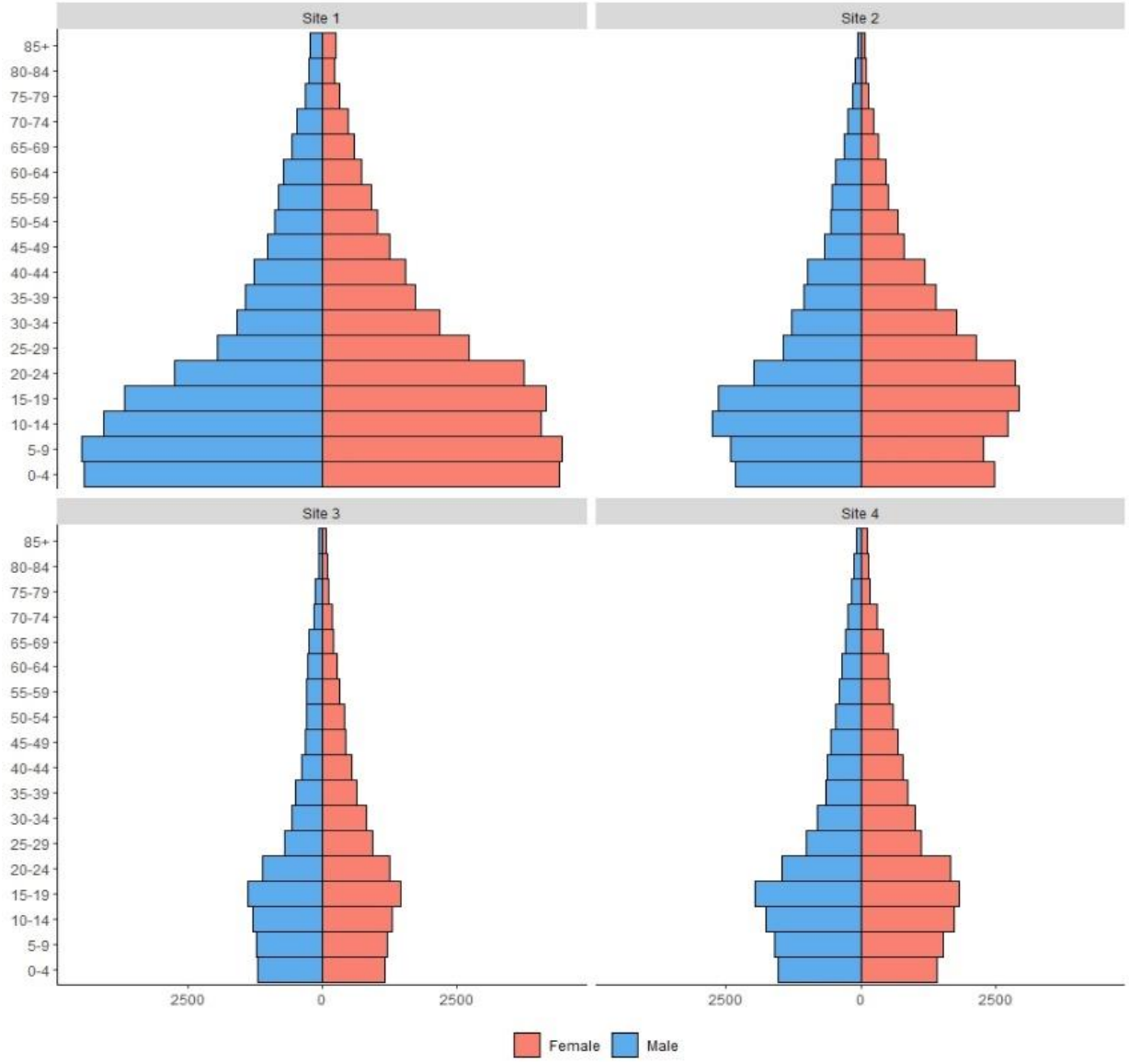

Figure 4-2: Population pyramids for each study site, Guatemala 2017

Source: Author's own analysis

There are differences in the demographic composition of the study sites. Study site 1 had 61,914 individuals in 2017, a higher number of individuals compared to the other sites. This site has a growing population, which observed by the characteristic pyramidal shape and therefore this population has an increased number of under 10 years old children. While study sites 2, 3 and 4 have a lower population size and a reduced growth compared to study site 1. Figure 4-2 illustrates the population pyramids for each study site. The proportion of the female population is higher compared to male population across the sites.

Table 4-4: Demographic characteristics of the individuals registered by the administrative healthcare records at the study sites, Guatemala 2017

	Site 1		**Site 2**		**Site 3**		**Site 4**	
	Counts	%	Counts	%	Counts	%	Counts	%
Population size	61914	100.0	39531	100.0	20863	100.0	27543	100.0
Age structure								
<5	7352	11.9	4390	11.1	2063	9.9	2814	10.2
5-9	7123	11.5	3530	8.9	1988	9.5	2315	8.4
10-19	15667	25.3	10456	26.5	5327	25.5	6886	25.0
20-29	11082	17.9	7570	19.1	4053	19.4	4928	17.9
30-39	6789	11.0	5055	12.8	2520	12.1	3084	11.2
40-49	5063	8.2	3581	9.1	1693	8.1	2602	9.4
40-59	3616	5.8	2248	5.7	1282	6.1	1950	7.1
60-69	2608	4.2	1568	4.0	1029	4.9	1547	5.6
70-79	1611	2.6	777	2.0	601	2.9	894	3.2
79>	1003	1.6	356	0.9	307	1.5	523	1.9
Sex								
Female	32804	53.0	21242	53.7	10969	52.6	14408	52.3
Male	29110	47.0	18289	46.3	9894	47.4	13135	47.7
Ethnicity								
Non-indigenous	51409	83.0	29	0.1	7142	34.2	3178	11.5
Indigenous	10159	16.4	39020	98.7	12907	61.9	24334	88.3
Unknown	346	0.6	482	1.2	814	3.9	31	0.1
Spoken language								
Spanish	52283	84.4	158	0.4	8174	39.2	5664	20.6
Indigenous-Spanish	9269	15.0	17058	43.2	11979	57.4	21423	77.8
Indigenous	362	0.6	22315	56.4	710	3.4	456	1.7
Community population								
<500	12624	20.4	3902	9.9	10012	48.0	7591	27.6
500-999	23366	37.7	9213	23.3	7085	34.0	10088	36.6
1000-1999	20372	32.9	16953	42.9	3766	18.1	9864	35.8
>2000	5552	9.0	9463	23.9				

Source: Author's own analysis using administrative healthcare records

There are contextual differences related to ethnicity, language and other contextual aspects (see Table 4-4). Study site 1 has the lowest proportion of indigenous population (16.4%). The population is predominantly Mayan indigenous at study sites 2, 3 and 4, the population at study site 2 being 98.7% indigenous. The proportion of Spanish speakers is another indicator of the ethnic background and potential communication barriers to access services, context that might differ across study sites. The majority of the population in the study site 1 is a Spanish speaker, while 56.4% of the population of study site 2 speaks only a Mayan language. Most communities have a population size lower than 2,000 individuals.

Other sociodemographic factors can be observed from summary measures derived from the population census and vital registration data for 2018. These factors include dependency rates, total fertility rate, internal migration, the attained education level, the place for birth delivery and the proportion of medically assisted deaths. The summary measures represent the population at the ADM-2 units to the corresponding study site, which are described in Table 4-5. These variables served to identify high rurality, and low proportion of internal migration, measured by the proportion of individuals living in the same municipality they were born, alongside identifying low levels of attained education and reduced medical assisted deaths across the selected municipalities.

Table 4-5: Summary of the sociodemographic characteristics of the population for the four selected municipalities, Guatemala 2018

	ADM-1	ADM-2	ADM-3	ADM-4	National
% of rural households	96.4	65.7	80.5	62.8	57.0
Sex ratio (males/females)	89.0	86.9	93.0	92.4	94.3
Young dependency ratio	75.2	60.0	59.6	52.6	57.7
Old dependency ratio	10.7	7.2	10.0	11.5	9.4
Total fertility rate	3.2	2.4	2.4	2.4	2.8
% of the population self-identified as indigenous	19.7	99.7	74.4	81.9	44.7
% of the population living at the ADM-2 of birth	90.0	95.0	95.6	92.0	82.9
% of adults with less than primary education	28.6	53.4	48.1	24.1	26.2
% of adults with primary education	61.8	30.1	35.9	37.3	45.2
% of medically assisted deaths	9.1	0.5	8.2	7.3	21.5
% of non-assisted deaths	84.2	97.9	89.7	88.0	70.1
% of births at public hospitals	32.0	15.2	50.4	37.2	46.1
% of births at households	32.2	42.4	27.2	33.6	27.4
Population counts	60,395	56,981	54,869	40,797	

Source: Author's own analysis using census and vital registration data

4.4 Household socioeconomic index

The administrative healthcare records collect data about the household characteristics; variables that can be used to create a summary index to be used as a proxy variable of socioeconomic stratification (Galobardes et al., 2006, Howe et al., 2008). A social stratification index was constructed using the following available information: type of floor, type of walls, type of ceiling, sewer system, main water source, having a separate room for the kitchen, having electricity, the number of people per room (a proxy measure for crowding) and rurality. The summary index was calculated independently for every year included in the analysis.

The categorical variables were transformed into binary dummy variables to construct an index using the Principal Component Analysis (PCA) as the data reduction method (Filmer and Pritchett, 2001, Vyas and Kumaranayake, 2006). The PCA method assigns a weight to each dummy variable, the weights are used to construct a summary variable or index for each household. Clumping is expected since most of the households are located in rural areas, these households are likely to have a similar infrastructure, factor that hinders the identification of differences across the distribution or the stratification (Vyas and Kumaranayake, 2006). Tertiles were used to divide the household index into three broad categories due to the clustering effect. These categorical derived variables are used in subsequent chapters as explanatory variables. There are methodological limitations, this index uses the material characteristics of the household, these factors do not represent an actual social stratification and are not a timely accurate measure, rather represents a long-term indicator of the standards of living (Filmer and Pritchett, 2001, Vyas and Kumaranayake, 2006).

Table 4-6 provides the mean value for each dummy variable and the score for the first component. The weights represent the first component explaining 18.7% of the total variation. This analysis identified negative scores for variables likely to represent poor quality of housing materials, such as dirt floor. This finding suggests that the summary measure can be used as a household indicator for social stratification. The distribution of the household socioeconomic index is illustrated in Figure 4-3, showing some evidence of clumping.

Clumping is expected since most of the households are located in rural areas, these households are likely to have a similar infrastructure, factor that hinders the identification of differences across the

distribution or the stratification (Vyas and Kumaranayake, 2006). Tertiles were used to divide the household index into three broad categories due to the clustering effect. These categorical derived variables are used in subsequent chapters as explanatory variables. There are methodological limitations, this index uses the material characteristics of the household, these factors do not represent an actual social stratification and are not a timely accurate measure, rather represents a long-term indicator of the standards of living (Filmer and Pritchett, 2001, Vyas and Kumaranayake, 2006).

Table 4-6: Summary statistics and PCA score for the household social stratification index for the study sites, Guatemala 2013-2017

Factor	Mean	SD	Factor score
Type of floor			
Tiles	0.125	0.331	0.134
Adobe	0.003	0.055	0.002
Dirt or earth	0.510	0.500	-0.532
Concrete	0.354	0.478	0.394
Other	0.008	0.090	0.003
Type of ceiling			
Zinc	0.760	0.427	-0.094
Leaves	0.002	0.048	-0.004
Tiles	0.174	0.379	-0.005
Concrete	0.058	0.234	0.099
Other	0.006	0.076	0.004
Type of wall			
Adobe	0.541	0.498	-0.132
Dung	0.020	0.138	-0.025
Bricks	0.254	0.435	0.338
Wood	0.165	0.371	-0.165
Other	0.021	0.145	-0.016
Sanitation facility			
Toilet to sewer	0.073	0.261	0.096
Toilet to open space	0.102	0.302	0.073
Improved latrine	0.143	0.350	0.134
Latrine	0.531	0.499	-0.249
No facility	0.150	0.357	-0.054
Water source			
Own tank	0.027	0.163	-0.009
Piped into the residence	0.762	0.426	0.150
Shared tank	0.052	0.222	-0.027
Well	0.034	0.181	-0.016
Community well	0.011	0.106	-0.009

Factor	Mean	SD	Factor score
River / lake /rain	0.086	0.280	-0.072
Other	0.028	0.164	-0.017
Number of people per room			
Less than one person per room	0.097	0.296	0.025
One per room	0.231	0.421	0.129
Two per room	0.224	0.417	0.046
Three per room	0.163	0.369	-0.030
Four per room	0.107	0.309	-0.043
Five per room	0.069	0.253	-0.041
More than five per room	0.109	0.312	-0.086
Stove location			
Separate room	0.921	0.269	0.062
No room	0.049	0.217	-0.057
Other	0.029	0.169	-0.004
Other characteristics			
Urban	0.039	0.193	0.042
Rural	0.961	0.193	-0.042
Having electricity	0.789	0.408	0.314
No electricity	0.211	0.408	-0.314

Source: Author's own analysis using administrative healthcare records

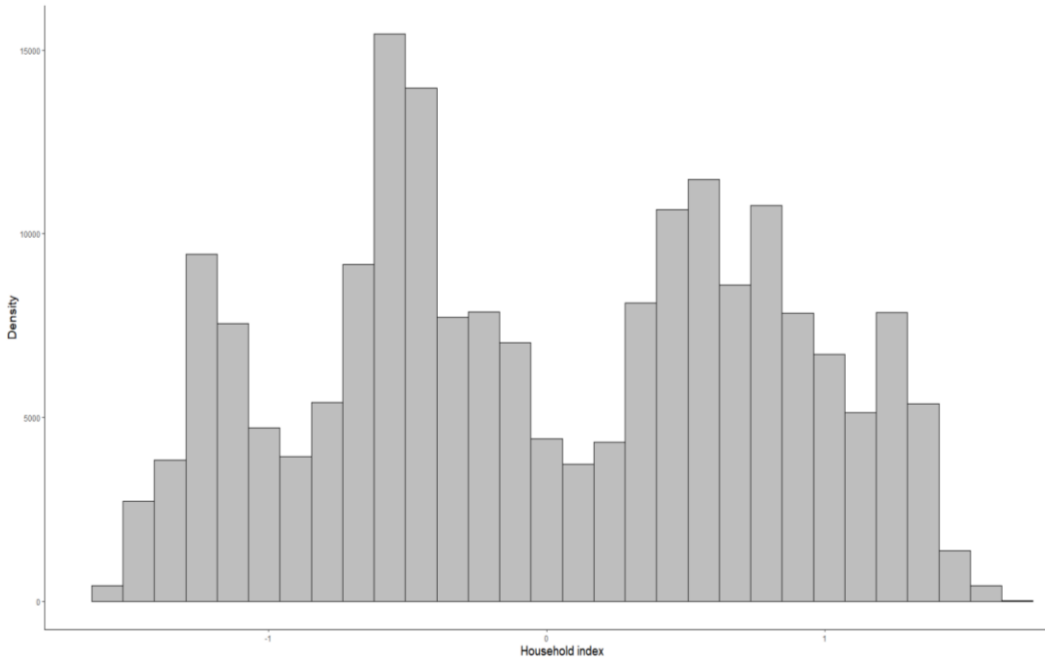

Figure 4-3: Distribution of the household index for the study sites, Guatemala 2013-2017

Source: Author's own analysis using administrative health records

4.5 Estimating travel times to the nearest public healthcare facility

Exploring access to healthcare services includes exploring geographical attributes while traveling to healthcare infrastructure. GIS can be used to derive a geography accessibility measure from the community's point coordinates and the health facilities. The routine data collection process in the study sites misses to include information about the geographic location, therefore additional data was required. The geographic location of the settlements and the public healthcare facilities was obtained from secondary data available and fieldwork. The secondary data includes the national cartography and the latest public healthcare facilities database (SEGEPLAN, 2018). The point coordinates of the settlements and facilities were used to estimate travel times to healthcare facilities and linked to the administrative healthcare records.

The administrative records contain 290 populated settlements across four ADM-2 units. The names of the populated settlements in the administrative records were revised and compared to the official names. The revised communities list was linked to the 2002 cartographic data at the settlement level, the latest available (SEGEPLAN, 2018) to identify the geographic coordinates of the communities. The centroid of polygon data was used to derive point coordinates representative of the geographic location of the community. This procedure identified 191 point coordinates and fieldwork was necessary to obtain coordinates for 99 settlements.

The fieldwork involved traveling to the communities accompanied by a community healthcare worker to obtain *in situ* coordinates. The collected point coordinate represents the geographic entry to the settlement as defined by the National Statistics Office. The point was identified as the location of the first built infrastructure encountered when entering by traveling using the official road network (INE, 2011). The point coordinates were obtained using a Geographic Positioning System (GPS) at decimal degrees in NAD83. The latitude and longitude coordinates were measured within a 15 meters accuracy, the value of the Standard Positioning Service. Figure 4-4 illustrates the geographic location of the settlements and the public health facilities. The mismatch between the points and the ADM-2 boundaries are likely explained by the outdated cartography.

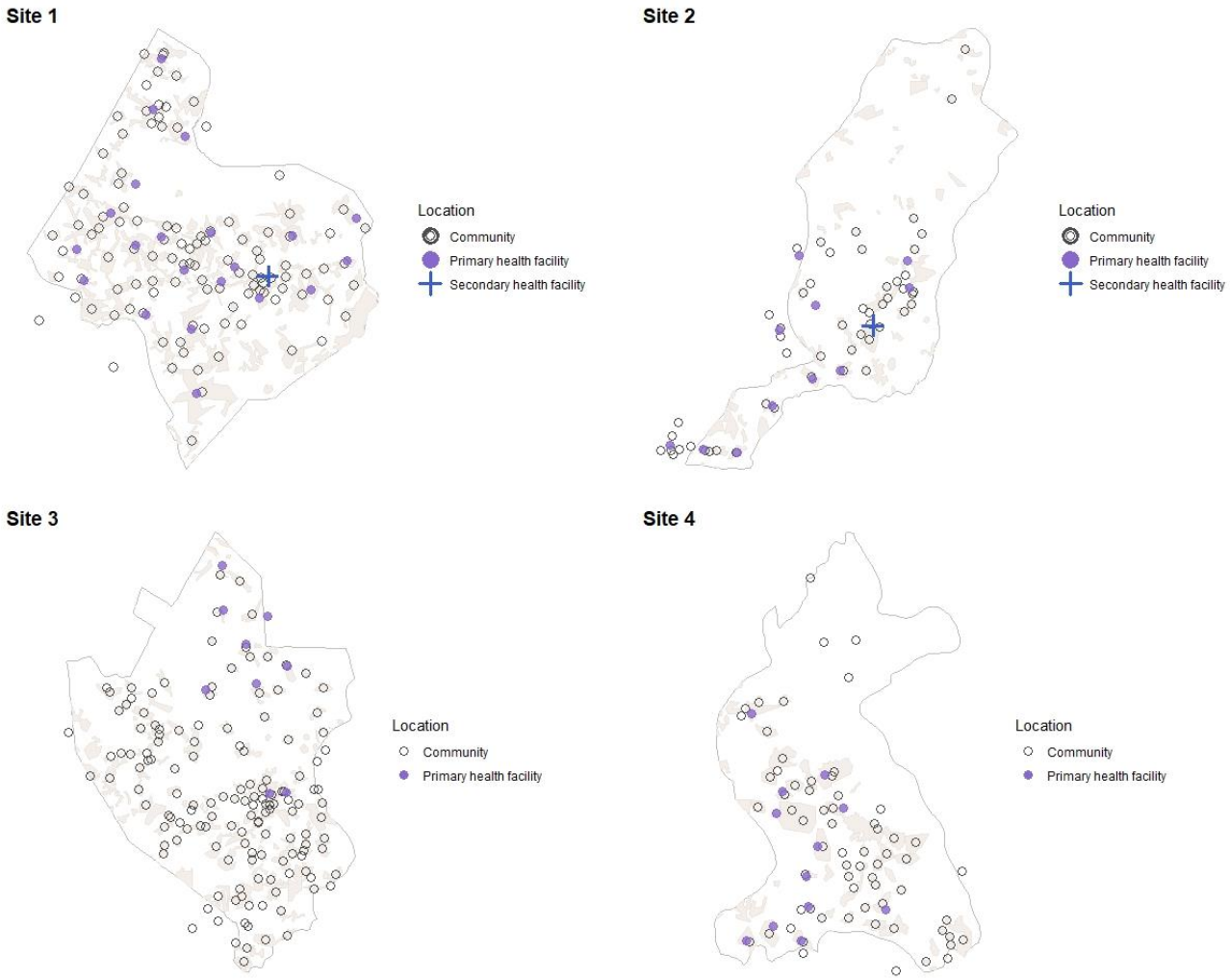

Figure 4-4: Geographic location of communities and public healthcare facilities of each study area, Guatemala 2018

Source: Author's own map using secondary data sources and fieldwork points

A similar procedure was used to gather the public healthcare facilities coordinates. The administrative healthcare records provided a list of 60 healthcare facilities reporting visits to the services during the analysed period. The list of healthcare facilities was linked with the latest available geo-referenced infrastructure database from 2009 (SEGEPLAN, 2018). The geographic location of 42 facilities was identified and fieldwork was required for the remaining 18 facilities. The point coordinate identified during fieldwork represents the entrance to the healthcare infrastructure. Fieldwork was conducted between June and August 2019, under the approval of the University of Southampton Ethics and Research Governance Committee (ERGO 47649), approval was granted for using administrative healthcare records to explore access to healthcare outcomes in rural Guatemala.

This thesis is interested in exploring multiple factors influencing access to public healthcare in Guatemala, including the spatial dimension. Geographic accessibility to public healthcare facilities is explored using travel times to control for the spatial dimension. This section describes the method used to estimate travel times to the nearest facility and the chosen infrastructure, data used in subsequent analysis. Travel time represent a cost measure estimated using RNB analysis, a method that increases the accuracy of traditional Euclidean distance estimates by adjusting for topographic characteristics (Apparicio et al., 2008, Cromley and McLafferty, 2012, Delamater et al., 2012, Owen et al., 2010).

The RNB analysis estimates the time following the least-cost-path using raster data. The cost to travel between the grid cells is adjusted while considering geographic attributes, therefore this method requires different spatial data sources (see Table 4-7). The travel times adjust for topographic features using a Digital Elevation Model (DEM) (de Ferranti, 2017), the mobility across the terrain by including Land-cover data (Lloyd et al., 2019) and the available road network. These factors allow adjust for different travel speed scenarios, while the algorithm directs the mobility to the least-coast path to estimate travel times. The travel times assume that individuals depart from the populated settlement point coordinates and follow the least-cost-path for ideal circumstances. This research estimated two different geographic accessibility measures: travel time to the nearest facility and O-D travel time.

Table 4-7: Description of the data sources used to estimate travel times to public healthcare facilities in Guatemala

Data source	Description	Year	Spatial attribute	Reference
Digital Elevation Model (DEM)	Viewfinder panorama for topography	2012	Raster at 3 arc seconds (≈100 m)	(de Ferranti, 2017)
Land-cover, European Space Agency	Land cover spatially harmonised by WorldPop	2015	Raster at 3 arc seconds (≈100 m)	(Lloyd et al., 2019)
Road network	Road network by type of surface	2018	Polylines	(SEGEPLAN, 2018)

Various travel speed scenarios were considered based on land use and the availability of a road network. Motorised transport was used for grid cells having the presence of a road network. The travel speed for primary and secondary roads corresponds to the defined Guatemalan speed (Congreso de la República de Guatemala, 1996). The travel speed for tertiary roads or paths used empirical speeds parameters determined for mountainous trails (Chary et al., 2018), selection based on the characteristic topography of the country. The travel speed scenario for grid cells without roads used self-reported walking speeds for different Land-cover types (Weiss et al., 2018). Table 4-8 describes the travel speed scenario, while Figure 4-5 illustrates the road network of the study sites. The RNB analysis was conducted using the open-source software AccessMod 5.6.0 (WHO, 2017, Ray and Ebener, 2008).

Table 4-8: Travel speeds scenario used to estimate travel times from populated settlements to public healthcare facilities for Guatemala

	Type of grid cell	Travel speed
Motorised	Primary road	80.00 km/h
	Secondary road	60.00 km/h
	Tertiary road or paths	17.00 km/h
Walking	Cultivated terrestrial areas and managed lands	3.24 km/h
	Woody/Trees	4.20 km/h
	Shrubs and herbaceous	4.86 km/h
	Natural and semi natural aquatic vegetation	2.00 km/h
	Artificial surfaces	5.00 km/h
	Bare areas	3.00 km/h
	In-land waterbodies	1.62 km/h

Source: (Ciesa et al., 2014, Congreso de la República de Guatemala, 1996, Weiss et al., 2018)

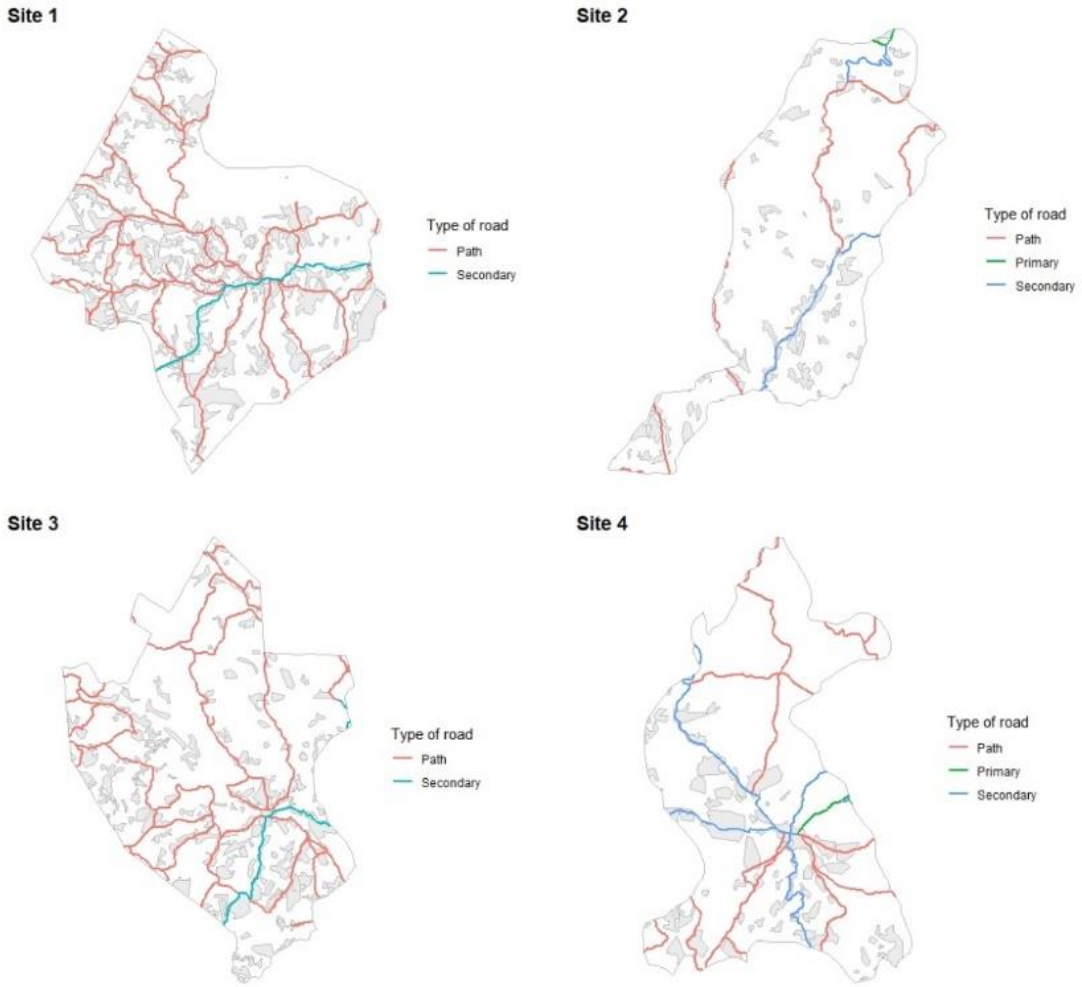

Figure 4-5: The road network of the four selected municipalities, Guatemala 2002

Source: Author's own map using the 2002 road network

The travel time to the nearest facility represents a measure of geographic proximity between the communities to the public services. Under ideal circumstances, the travel times to primary healthcare facilities are relatively short, while times increase for second level services. The mean travel times vary across study sites, Table 4-9 provides summary statistics. The estimated travel times to primary healthcare facilities are lower for sites 1 and 2. On average individuals at study site 1 travel 17.2 minutes [±6.8, CI 95%] to reach the nearest primary healthcare facility and 13.2 minutes [±8.8, CI 95%] for study site 2. Figure 4-6 provides a visualisation of the estimated travel times to the nearest primary healthcare facility for each populated settlement.

Table 4-9: Mean travel time (minutes) between the populated settlements and the nearest primary and second level public healthcare facility for the four study sites, Guatemala

	Mean	95%CI	Median	Anova and T-test P value
Primary level				
Site 1	17.2	±6.8	15	<0.001
Site 2	13.2	±8.8	7	
Site 3	44.1	±4.5	34	
Site 4	21.4	±7.9	13	
Second level				
Site 1	41.5	±5.1	36	0.002
Site 2	28.5	±9.2	26	

Source: Author's own travel times estimates

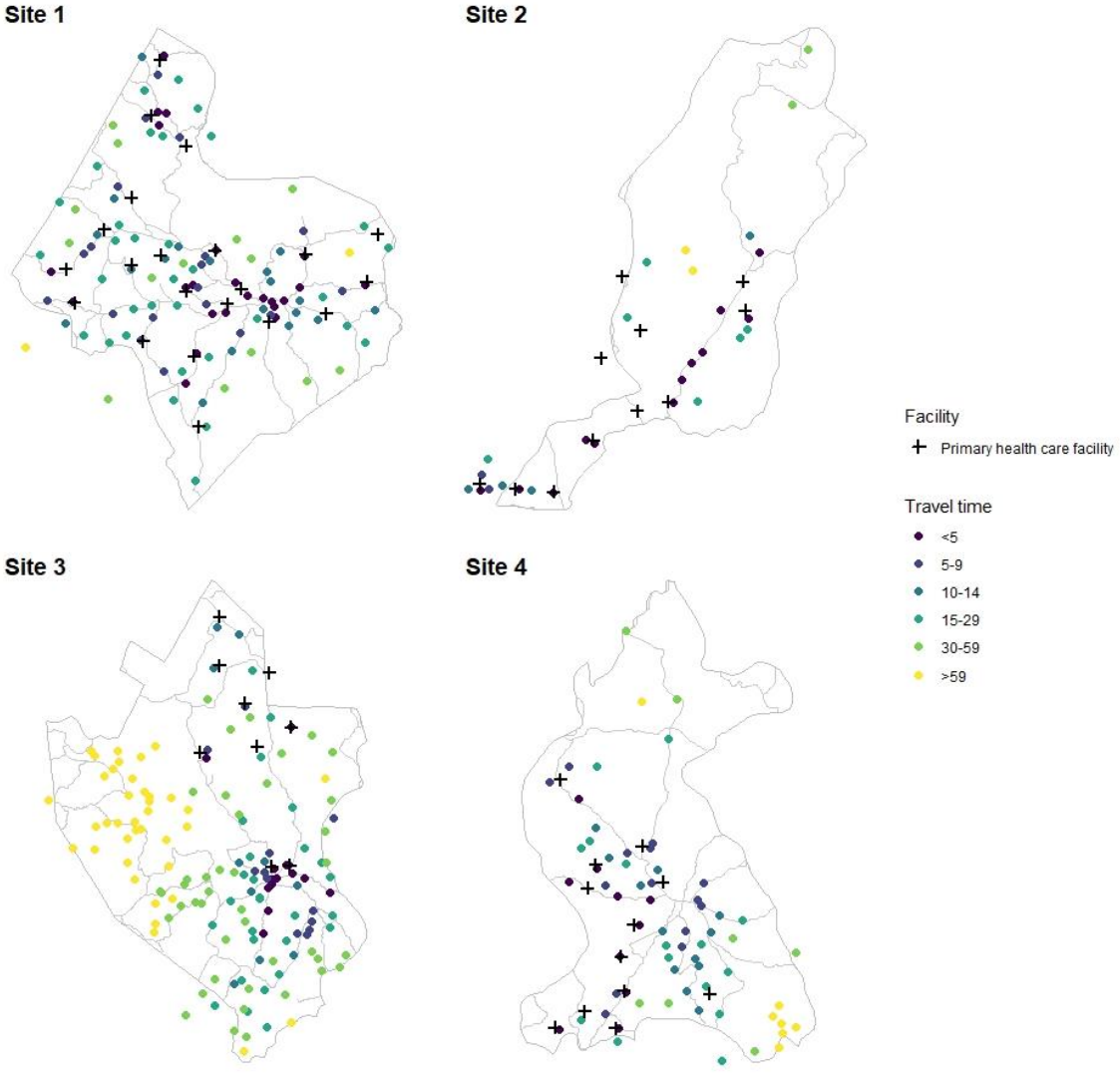

Figure 4-6: Travel time (minutes) between each populated settlement and the nearest primary healthcare facility for the each study site, Guatemala

Source: Author's own estimates

The estimated travel times were linked with the household level data reported at the administrative records to identify the population living within a determined travel time. Population is scattered across the territorial extension, however the major part of the individuals are located at a relatively short travel times to the nearest primary healthcare facility. Around 90% of the population live at less than 30 minutes from the nearest primary healthcare facility. The study sites 3 and 4 are the study sites having a greater number of individuals located at extended travel times or remotely from primary healthcare services. Table 4-10 indicates the population counts classified according to travel times to the nearest primary healthcare facility.

Table 4-10: Population counts according to travel time to the nearest primary healthcare facility for the study sites, Guatemala 2017

	Site 1		**Site 2**		**Site 3**		**Site 4**	
Minutes	Counts	Cumulative %	Counts	Cumulative %	Counts	Cumulative %	Counts	Cumulative %
<5	16,136	26.1	15,601	39.5	5,124	24.6	5,086	18.5
5-9	9,943	42.1	9,688	64.0	2,439	36.3	9,610	53.4
10-14	13,288	63.6	4,371	75.0	2,739	49.4	5,720	74.1
15-29	14,221	86.6	6,438	91.3	4,183	69.4	4,702	91.2
30-59	7,660	98.9	3,115	99.2	4,885	92.8	921	94.5
>59	666	100	318	100	1,493	100	1,504	100

Source: Author's own estimates

4.6 Origin-Destination travel times

Travel times to the nearest healthcare facility provide some evidence about geographic accessibility, however, it is important to note that individuals often travel to a different infrastructures. Travel time measured from origin to destination (O-D times) can provide a more accurate estimate of the time each individual travel while seeking healthcare services. O-D travel times are estimated based on the RNB analysis previously described and compared to travel times derived from a different method. This section describes the estimated O-D travel times and provides some evidence about the validity of the estimates.

This research identified the O-D travel times following the RNB analysis, estimates that follow the least-coast-path assumption (AccessMod estimates). This analysis was selected to ensure methodological consistency and equivalent travel times across various analysis of the thesis that incorporate a spatial variable. The RNB methodology provides standardized estimates by controlling the travel speeds based on land attributes, factors that remain constant enabling the comparison and the interpretation of the results for different geographic accessibility measures and across geographic areas.

The geographic coordinates of the populated settlement or the community were identified as the point of origin, while the chosen healthcare facility represents the destination. The list of the O-D pairs was obtained using data for every individual visiting the public healthcare facilities within the catchment area. Travel times were estimated for 1,547 O-D pairs, using the spatial covariates and travel speeds described in Table 4-7 and Table 4-8 and AccessMod 5.6.0 (WHO, 2017, Ray and Ebener, 2008). Figure 4-7 illustrates the O-D pairs for primary and second level public healthcare visits between 2013 and 2017 for study sites 1 and 2.

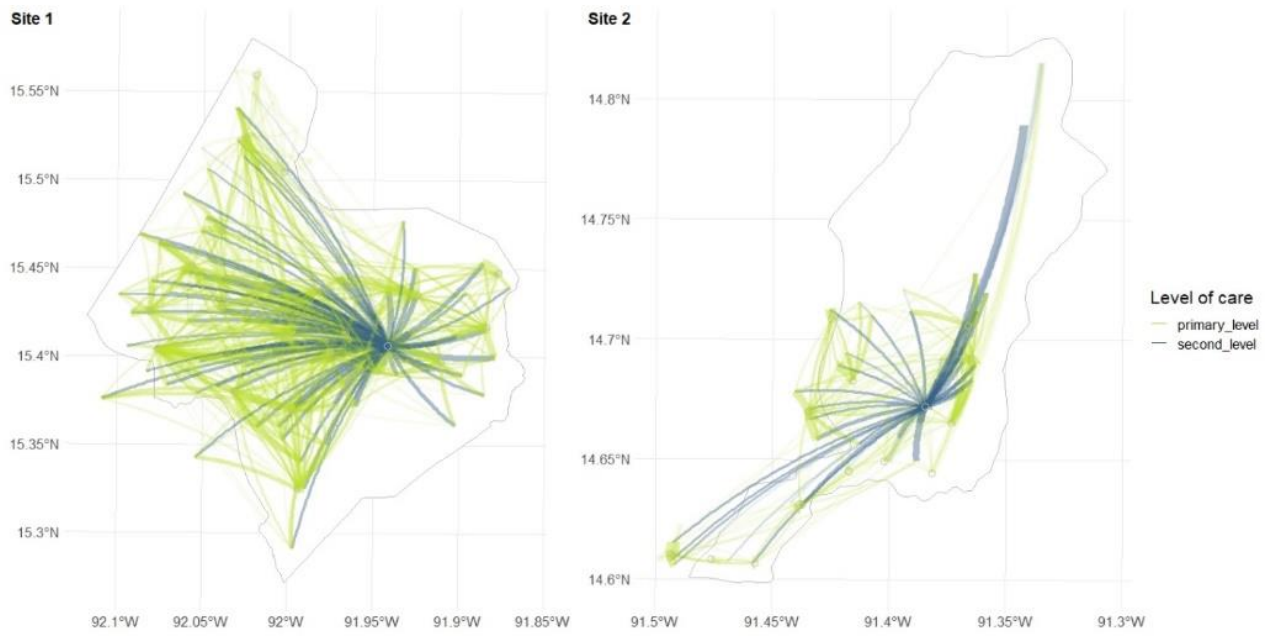

Figure 4-7: Origin-destination travel time for visits to primary or second level healthcare facilities at study sites 1 and 2, Guatemala 2013 - 2017

Source: Author's own analysis using data from the study sites

The O-D travel times derived from the RNB analysis were validated by comparing them with travel times derived from a different method. The O-D pairs were used to estimate the travel time using the Google Maps Application Programming Interface (API) (Wang and Xu, 2011). This selection considered different data sources used and methodological differences. Different from AccessMod, Google Maps API uses mobile GPS client data and prioritises the use of the roads (Wang and Xu, 2011). The Google Maps API can provide travel estimates for different scenarios, such as adjusting for heavy traffic compared to regular mobility or modifying the transport mode (Wang and Xu, 2011).

The comparison of the travel times derived from two different methodologies adjusted for two transport scenarios, motorised transport and walking. This analysis required to derive four sets of estimates, two with AccessMod and two with Google Maps API tool. The analysis identified that the average O-D travel time for motorised transport from AccessMod was 44.1 minutes [± 1.5, CI 95%]. The O-D travel times are higher for the Google Maps API estimates, the average time was 58.6 minutes [± 3.7, CI 95%] (see Table 4-11). Similar findings are observed for the walking scenario, the estimated time was 147.9 minutes [± 5.3, CI 95%] for AcccessMod and 263.0 minutes [± 15.8, CI 95%] for Google Maps API. The difference in the mean travel time estimated by the two methods is statistically significant.

Table 4-11: O-D travel times estimated with AccessMod and Google Maps API for the study sites, Guatemala 2013 - 2017.

	Motorised		**Walking**	
	AccessMod	**Google Maps API**	**AccessMod**	**Google Maps API**
Mean travel time	44.1 min	58.6 min	147.9 min	263.0 min
Median travel time	40 min	37 min	127 min	187 min
Standard deviation	29 min	73 min	106 min	317 min
T-test p value		<0.005		<0.005
Shapiro test p-value		<0.005		<0.005
Spearman rho		0.716		0.849
Mean absolute error		32.9 min		120.7 min
Mean squared error		4,129.9		81,011.1

Source: Author's own analysis

The comparative analysis of the two methods involved to assess the statistical relationship between the travel times. The Spearman Rank correlation coefficient was the chosen method, a non-

parametric test for the statistical dependence of the two variables assessing monotonic correlation. The findings identified a positive relationship between the two methods used to estimate O-D travel times. The Spearman rho correlation for motorised transport times identified was 0.716, with a mean absolute error of 32.9 minutes. The correlation increases for the comparison of travel times assuming walking speed for both methods. The Spearman rho correlation for walking scenario is 0.849 and has a higher mean squared error (120.7 min). Figure 4-8 illustrates the correlation between the travel time estimates for motorised transport and Figure 4-9 for the walking scenario.

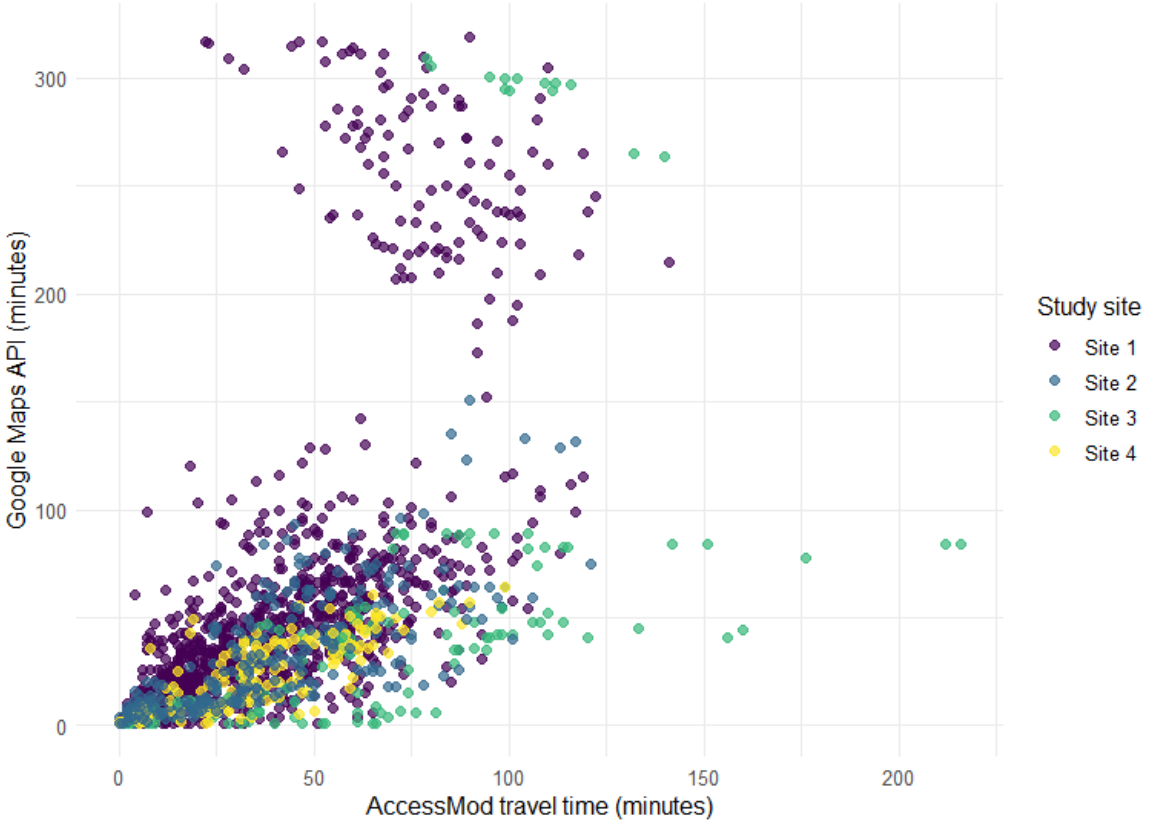

Figure 4-8: AccessMod vs Google Maps API O-D travel times for multiple transports for the study sites, Guatemala 2014-2017

Source: Author's own analysis

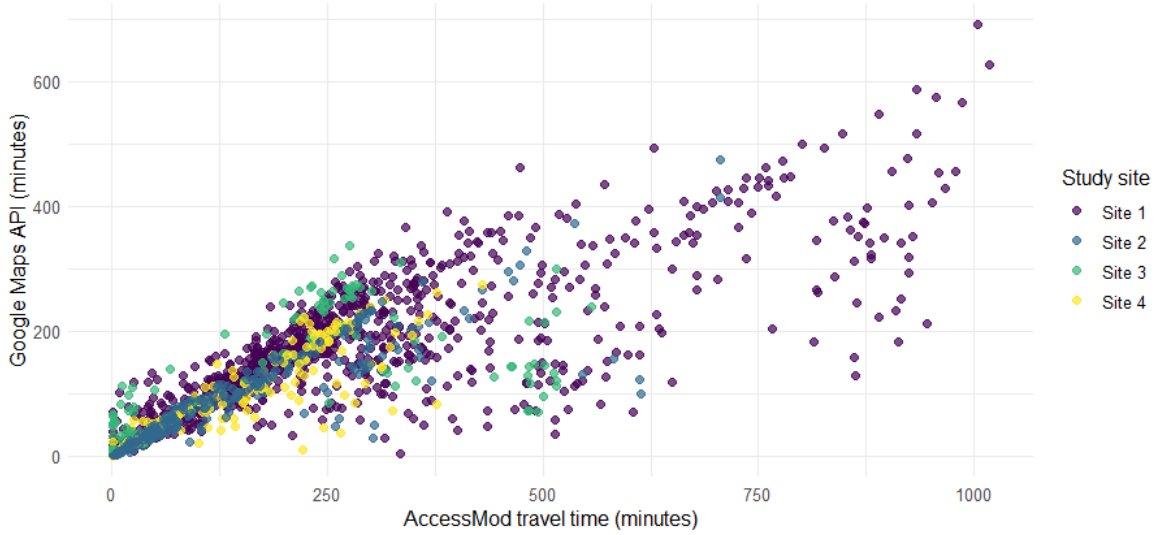

Figure 4-9: AccessMod vs Google Maps API O-D travel times walking scenario for the study sites, Guatemala 2014-2017

Source: Author's own analysis

The lower average travel time for AccessMod compared to Google Maps API might be explained by methodological differences. AccessMod travel time estimates are based on a raster-based method, prioritising the grid cell that represents the least-cost, therefore providing travel times for the most efficient scenario. Whereas Google Maps API prioritizes the road over efficiency, a selection that might imply extended travel times in areas where there is limited access to the road network. Figure 10-1 in Appendix B illustrates the O-D travel times for a community at study site 3 when measured using Google Maps API. Furthermore, extended travel times for Google MAPS API compared to RNB have previously been identified in other research settings (Wang and Xu, 2011).

This thesis used the times estimated using AccessMod software for motorised transport. This choice was grounded in the methodological consistency by the ability to control and produce standardized estimates for different geographic accessibility measures comparable across geographic areas. The selection of this method requires interpreting the findings under the most efficient travel scenario. Despite identifying lower travel times for AccessMod the estimates are suitable for the geographic accessibility analysis. Furthermore, the validity test identified a high correlation, considerably low mean absolute error and mean squared error, for the comparison with a different method.

The estimated travel times to the nearest primary healthcare facility and the proportion of individuals living within certain time thresholds might indicate a relative geographic proximity to public healthcare services in the four study areas. However, there might be some methodological laminations to be considered when analysing these travel times. The travel times are estimated following the assumption that individuals depart from the geographic point representing the populated settlement, missing reflecting the actual departure location. Travel speed scenarios might not reflect actual speeds or do not adjust for the road conditions due to changes in seasons. Finally is important to remember that the accuracy of RNB estimates using raster data will depend on high spatial resolution data.

4.7 Chapter summary

This chapter has described the administrative healthcare records used for the analysis and the sociodemographic characteristics of the four study sites used in this thesis to explore access to healthcare services. The unique data source provides individual level data allowing exploring access to healthcare services for two levels of healthcare services provided by the public sector in a Global South country. The data allows to measure multiple access to healthcare services, including age-specific coverage rates.

Demographics and social factors were used to identify the context of the study sites. The areas under study are representative of small size population settlements located in predominantly rural areas. The sociodemographic information identified population differences, including fertility rates and ethnic composition. Access to healthcare services in these study areas might be limited, this is hypothesised by observing the low proportion of medically assisted deaths and the prevalence of births attended by traditional midwives. Despite the differences there are similarities across the study sites, low internal migration, a similar attained education level and proportion of medical assisted deaths.

The data described in this chapter can be used explore different access to healthcare outcomes for different age groups alongside identifying their association with geographic accessibility factors. Geographic coordinates were obtained and used to derive two travel time estimates to adjust for accessibility measures in the analysis. This research estimated two different geographic accessibility measures: travel time to the nearest facility and O-D travel times using a standardized method.

Travel times were derived following the RNB analysis to estimate the least-cost-path using raster data and adjusting for geographic attributes and travel speeds using AccessMod Software. The estimates provide some evidence about the relatively short travel times to primary healthcare facilities, identifying 90% of the population located at less than 30 minutes from a primary healthcare facility under the most efficient scenario.

The estimated O-D travel times represent a spatial factor to identify the travel scenario for the chosen infrastructure while seeking public healthcare services. The O-D travel time's validity was tested by comparing the estimates with times obtained from a different method. Despite the differences, the analysis demonstrated a positive strong correlation between the two methods, indicating the interchangeability. The derived travel times described in this chapter are used to explore geographic accessibility to public healthcare services in the following chapters. The individual data described provides a unique source of information to identify who has access to healthcare and who is left behind.

Chapter 5 Who seeks services at primary and second level public healthcare facilities in rural Guatemala?

5.1 Introduction

Health is a dynamic state and diverse healthcare services to treat illnesses or ill-health conditions will likely be required across the lifespan (Kuan et al., 2019, Kuh et al., 2003). Consequently, access to healthcare services is essential to prevent mortality and preserve the health status of individuals. Access to healthcare services is determined by structural characteristics and diverse processes required to provide services, these domains influencing the outcomes (Kruk et al., 2018, Frenk, 1985). Access outcomes are observed among the users, for which a range of different outcomes can be distinguished, including: coverage, seeking behaviour, utilisation and perceived quality (Donabedian, 2005). This chapter explores access to healthcare outcomes, the contact coverage and the probability to seek services in rural Guatemala.

Healthcare systems are structured to provide healthcare services to the population and the evaluation of the reach of the services is frequently requited for public policy (Tanahashi, 1978, Ng et al., 2014). Contact coverage is the term used to describe the population who has received the services, and its measurement requires identifying the users and the size of the target population (Tanahashi, 1978, Shengelia et al., 2003). Population-specific coverage estimates using DHS data, such as child immunization coverage and the proportion of institutional births (Arsenault et al., 2017, Walker et al., 2021), are the most commonly explored indicators in Global South countries. This is the simplest indicator and is frequently used to identify the performance of the health system (WHO, 2018c). However, missing to provide evidence across age groups or to identify individual level attributes that might increase the probability to benefit from healthcare services.

Individual-level differences in access to healthcare services are likely to be expected, with a range of factors influencing seeking healthcare services. As an example, demographic characteristics, sex and age, are relevant to understand those having an increased contact with healthcare services (Ranstad et al., 2017, Hohn et al., 2020). These demographic differences in access and use of healthcare are explained by multiple factors, including important biological functions variations (Wingard, 1984, Kuan et al., 2019). Seeking healthcare services at a time of need is an individual event; however, seeking behaviour can be influenced by contextual factors, such as the environment, previous experiences and believes (Kawachi et al., 1999, Halfon and Hochstein, 2002, de Montgomery et al., 2020). Studying predisposing characteristics of the individuals seeking healthcare can provide evidence between the targeted population and the actual users of the services.

Understanding who has gained access to healthcare services across age groups provides evidence about the overall performance of the health system and information about access to health equity. Access to healthcare might be different according to the type of system, National Health Systems aiming for a wide coverage across population groups surged from a solidarity principle (Hejduková and Kureková, 2016, Van Der Zee and Kroneman, 2007a). Despite aiming for access for all, different barriers limiting access are likely to be encountered, for example, health inequalities can be observed in relation with geographical accessibility and allocation of resources (Garchitorena et al., 2021, Currie et al., 2019), these and other factors, including public policy, can influence accessibility. This research aims to identify the contact coverage across age groups to measure the performance of the system and to identify factors associated with the increased probability of benefiting from services provided at primary and second level public healthcare facilities in rural Guatemala. Identifying the factors related to the increased probability of gaining access to the health system can provide relevant evidence for public policy aiming to progress toward UHC.

5.2 Aim and research questions

Identify the annual population coverage and the factors associated with the individual probability to seek healthcare services at least once pear year at primary and second level public facilities in selected rural areas of Guatemala. This research aim is guided by the following questions:

1. What is the age-specific contact coverage of the services provided at primary and second level public healthcare facilities in selected areas of rural Guatemala between 2013 and 2017?

2. Which individual level characteristics are associated with increased probability to seek healthcare services at least once pear year at a primary or second level facilities in selected rural areas of Guatemala between 2013 and 2017?

3. What is the relationship between the travel time to the nearest facility and the probability to seek healthcare services at least once pear year at primary or second level facilities in selected rural areas of Guatemala between 2013 and 2017?

5.3 Data and methods

This research was conducted using administrative data collected by public healthcare services located within four delimited geographic areas (Fort et al., 2011). Healthcare workers routinely collect data about individuals visiting primary and second level public healthcare facilities, data and geographic areas previously described in Chapter 4. This research used individual and household level data of the overall population living within the geographic boundaries of the study sites.

The available data limited the analysis to understanding who has access to primary healthcare facilities for four study sites and access to second level facilities for two study sites. This research used poled data for the population reported at the catchment areas between 2013 and 2017 having complete demographic records. The use of administrative healthcare data is a strength of this research, allowing to measure access to healthcare outcomes without introducing recall bias, a common limitation in access to healthcare studies using self-reported survey data (Schneeweiss and Avorn, 2005, Hunger et al., 2013).

5.3.1 Variables

Individual level data is used to identify the age-specific contact coverage and the factors associated with seeking healthcare services provided at public healthcare facilities. The age-specific contact coverage estimates the proportion of the population that benefits from some healthcare services by age and sex for primary and second level services independently. This research estimates the age-specific contact coverage by identifying the number individuals in the population that have been in contact with the services at least once during the year and sex and the corresponding population counts as denominator. The annual users of the services are used to identify the probability to access public healthcare services. The following paragraphs describe the outcome and the explanatory variables used in this chapter.

Outcome

This research identifies who has the capacity to benefit from services provided at primary and second level public healthcare facilities. The users of the services are represented by a binary variable, identifying those individuals that have visited a facility at least once a health service located within the catchment areas during the calendar year. Differences in the annual probability to seek healthcare services at public facilities were associated with the following explanatory variables.

Explanatory variables

The individual probability to seek healthcare services at least once per year is explained by the individuals' demographic characteristics and household level variables, the information available for every member of the population located within the limits of the catchment area. The individual level data controlled for demographic characteristics, while household level data was used to adjust socioeconomic stratification and travel time to the nearest facility, both variables estimated as described in Chapter 4. Each of the variables used to explore the probability to gain access to healthcare is described in the following paragraph.

The sex, age group, Mayan ethnicity and spoken language are the variables used to control for the characteristics of the individuals, these variables can be conceptually classified as predisposing factors according to the behavioural model (Andersen, 1968b, Andersen, 1995). The household

socioeconomic stratification index and the travel time to the nearest facility, represent variables to account for affordability and accessibility barriers (Frenk, 1985, Penchansky and Thomas, 1981). Exploring health-seeking behaviour in relation to the need for healthcare services was limited by the available administrative data. This research used death during the period as a proxy variable for acute need for medical services, following the assumption that increased contact with healthcare services is expected among individuals likely to be ill (Au et al., 2006). Studying these variables for two levels provides a health system approach by adjusting for differences that can be explained by the organisation of the services.

5.3.2 Analysis

This research begins with estimating age-specific annual contact coverage for primary and second level services independently. The contact coverage is estimated by a ratio, the numerator is the number of individuals in an age group that has visited the services and the denominator is the number of persons in that age group in the population. The analysis includes descriptive statistics and bivariate tests, chi-square and ANOVA, to identify differences in the frequency of individuals seeking services according to the explanatory variables.

This is followed by multivariate analysis identifying the probability to visit healthcare services at least once per year and its association with the explanatory variables. The multivariate analysis used a multilevel regression given the nested structure of the data, with individuals at the first level and nested within populated settlements, at the second level. The individual probability of visiting public services was identified independently for primary and second level public healthcare facilities. The models were conducted with the pooled data, as well as independently for each study site.

A two-level model was used to account for the variance of the individuals (i) nested within population settlements (j). A random intercept models is used to estimate the individual probability (π_{ij}) of seeking care at a health facility at least once per year. Equation 5-1 represents the mixed effect model, including a fixed and a random part. The fixed part is given by the coefficients $\beta_0 + \beta_1 x_{ij1}$, being β_0 the average log-odds for the reference category, the average intercept for all the population settlements, and β_1 the effect on the log-odds compared to the reference category for the explanatory variable x. The random part allows the variability of the

estimates for the population settlements, is given by u_j being the residuals for the cluster effect at level two with $u_j \sim N(0, \sigma_u^2)$, where σ_u^2 is the between-group variance.

$$g\left(\pi_{ij}\right) = log\left(\frac{\pi_{ij}}{1 - \pi_{ij}}\right) = \beta_0 + \beta_1 x_{ij1} + u_j$$

Equation 5-1

A forward-stepwise method was used to include the explanatory variables. An additional model tested the interaction between age and sex in order to account for variations in health-seeking behaviour that might be associated with gender differentials. Model fit of the nested structure compares multiple models, null model including the population settlements random effects only (A), model with the explanatory variables (B) and a model with an interaction effect between age and sex (C). Age and sex interaction is included in order to test healthcare seeking behaviour for women at childbearing ages, such as seeking antenatal and maternal care. Model comparison is done using Akaike's Information Criterion (AIC), BIC statistics, and the likelihood ratio to test the differences between the nested models, for which a lower value reflects a better fit.

5.4 Results

This research explored two access to health outcomes, the age-specific contact coverage and the individual probability to seek services at primary and second level public facilities. This research was conducted using nominal data available at the administrative healthcare records for a 5 years period. The annual contact coverage of primary healthcare services is 20.8% and 9.8% for second level public healthcare services. The contact coverage changes by age and sex, age-specific contact coverage was estimated for the explored population, see Table 5-1. The age-specific coverage indicates that children under-five-year old are the population group having the greatest coverage. The contact coverage for under-five-year old children is higher for primary services, 39% of the children have visited primary healthcare facilities, while 17% have visited a second level facility at least once during the year. On average, children under 10 years old represent 33.2% of the annual users of primary services and 30.1% of the users of second level facilities. The adult population having the highest coverage are individuals classified between 30 to 39 years old.

Table 5-1: Individuals going at least once per year to primary or second level public healthcare facility in selected rural areas, Guatemala 2013 - 2017

	Primary healthcare			Second level healthcare		
	N	%	P value	N	%	P value
Population size	636115	100.0		464001	100.0	
Going at least once per year	132170	20.8		45532	9.8	
Age structure						
<5	30063	39.3	< 0.0001	9810	17.0	< 0.0001
5-9	13926	21.4		3945	8.1	
10-19	21332	12.6		6814	5.5	
20-29	22501	19.9		9464	11.5	
30-39	17755	24.2		6751	12.6	
40-49	11204	21.5		3615	9.7	
50-59	6768	18.3		2258	8.7	
60-69	4654	17.6		1528	8.5	
70-79	2744	18.0		894	8.6	
79>	1223	14.6		453	8.0	
Sex						
Female	90305	27.0	< 0.0001	31272	12.8	< 0.0001
Male	41865	13.9		14260	6.5	
Socioeconomic status						
Lower	55722	24.7	< 0.0001	12172	7.5	< 0.0001
Middle	42444	20.5		14728	9.9	
Upper	34004	16.7		18632	12.1	
Ethnicity						
Non-indigenous	61851	22.4	< 0.0001	25868	10.7	< 0.0001
Indigenous	67971	19.3		19346	8.9	
Unknown	2348	28.2		318	6.1	
Spoken language						
Spanish	64201	22.0	< 0.0001	26333	10.7	< 0.0001
Indigenous-Spanish	40353	16.7		10324	8.6	
Indigenous	27616	27.0		8875	9.1	
Death during the period						
Yes	289	15.9	< 0.0001	174	12.8	0.0003
No	131881	20.8		45358	9.8	
Time to nearest facility						
<5	44167	22.93	< 0.0001	12555	23.3	< 0.0001
5-9	27528	21.2		7251	15.6	
10-14	21362	19.6		5325	11.1	
15-29	27812	22.2		9647	8.7	
30-59	9996	15.2		7996	6.0	
>59	1305	9.9		2758	0.4	
Year						
2013	30026	30.6	< 0.0001	7351	9.2	< 0.0001
2014	27707	27.4		8059	9.7	
2015	22467	16.8		8591	8.9	
2016	22413	14.6		10085	9.7	
2017	29557	19.7		11446	11.3	
Study site						
Site 1	63197	21.6	< 0.0001	30671	10.47	< 0.0001
Site 2	38151	22.3		14861	8.69	
Site 3	15386	22.0				
Site 4	15436	15.1				

Source: Author's own analysis using data from the study sites

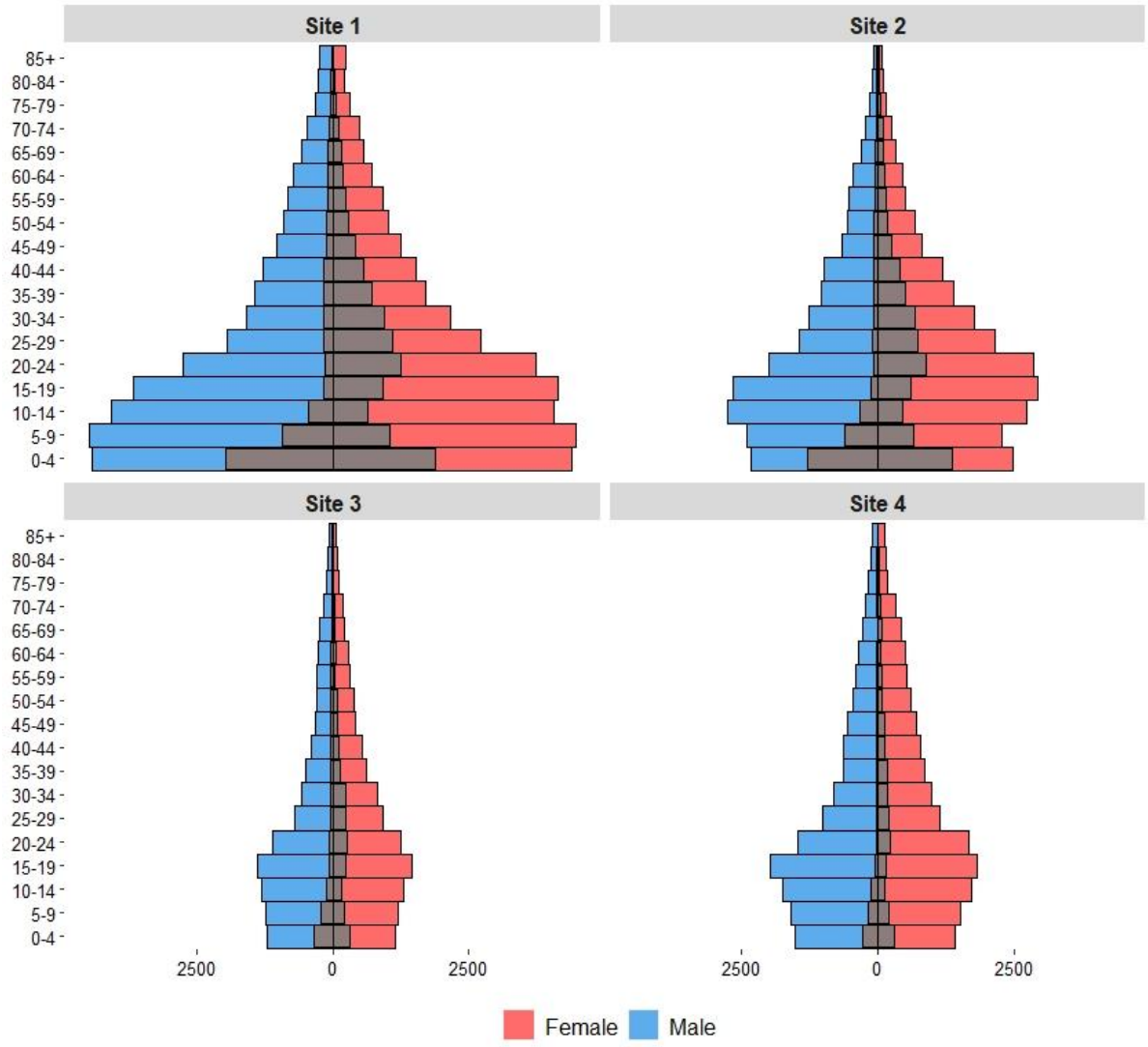

Figure 5-1: Population counts and number of individuals that have visited at least once a primary healthcare facility, Guatemala selected rural areas 2017

Source: Author's own analysis using data from the study site

The contact coverage differences are observed by sex and other sociodemographic factors. The contact coverage of primary services for females is 27.0% and 13.9% for males, the proportion being lower for second level healthcare services. Children and females represent the population groups with increased coverage and are the greatest beneficiaries of the services provided at public healthcare facilities. These findings are consistently observed for each study site, Figure 5-1 illustrates the total population and the number of individuals that uses primary healthcare services according to the age group, and the darker area represents the users in 2017.

Table 5-2: Predisposing factors associated with the probability of individuals visiting a primary or second level public healthcare facility at least once per year in selected rural areas, Guatemala 2013 - 2017.

	Primary level healthcare services				Second level healthcare services			
	Odds	**95% CI**		**P value**	**Odds**	**95% CI**		**P value**
Age structure								
<5	1.000				1.000			
5-9	0.347	0.334	0.360	<0.0001	0.397	0.384	0.432	<0.0001
10-19	0.253	0.246	0.261	<0.0001	0.389	0.341	0.366	<0.0001
20-29	0.790	0.766	0.814	<0.0001	1.151	1.048	1.122	<0.0001
30-39	1.054	1.020	1.090	0.002	1.230	1.137	1.226	<0.0001
40-49	0.743	0.716	0.772	<0.0001	0.779	0.731	0.799	<0.0001
50-59	0.508	0.486	0.530	<0.0001	0.598	0.543	0.603	<0.0001
60-69	0.452	0.429	0.475	<0.0001	0.527	0.469	0.530	<0.0001
70-79	0.402	0.376	0.429	<0.0001	0.483	0.425	0.495	<0.0001
79>	0.252	0.229	0.278	<0.0001	0.315	0.288	0.355	<0.0001
Sex								
Female	1.000				1.000			
Male	1.035	1.006	1.069	0.040	1.105	1.053	1.157	<0.0001
Age * Sex								
5-9 * male	0.828	0.785	0.873	<0.0001	0.928	0.854	0.009	0.0794
10-19 * male	0.384	0.367	0.402	<0.0001	0.418	0.390	0.449	<0.0001
20-29 * male	0.083	0.078	0.087	<0.0001	0.126	0.116	0.136	<0.0001
30-39 * male	0.111	0.104	0.117	<0.0001	0.164	0.150	0.178	<0.0001
40-49 * male	0.188	0.176	0.200	<0.0001	0.262	0.252	0.272	<0.0001
50-59 * male	0.302	0.282	0.324	<0.0001	0.402	0.385	0.420	<0.0001
60-69 * male	0.395	0.365	0.428	<0.0001	0.538	0.511	0.567	<0.0001
70-79 * male	0.529	0.480	0.428	<0.0001	0.694	0.653	0.737	<0.0001
79> * male	0.930	0.810	1.067	0.30075	1.003	0.812	1.238	0.980
Ethnicity								
Non-indigenous	1.000				1.000			
Indigenous	0.926	0.895	0.959	<0.0001	0.796	0.757	0.836	<0.0001
Unknown	0.812	0.763	0.864	<0.0001	1.047	0.988	1.121	0.117
Spoken language								
Spanish	1.000				1.000			
Indigenous-Spanish	0.902	0.872	0.933	<0.0001	0.795	0.757	0.836	<0.0001
Indigenous	1.165	1.116	1.216	<0.0001	1.053	0.988	1.121	0.117
Death period								
No	1.000				1.000			
Yes	0.698	0.606	0.766	<0.0001	1.490	1.245	1.765	0.002

Source: Author's own analysis using data from the study sites

A multilevel model was used to estimate the annual probability to seek healthcare services and to identify factors explaining differences in primary and second level services annual users. The analysis included an interaction between age and sex to adjust for important biological function

variations (Wingard, 1984, Kuan et al., 2019), being a parsimonious model. The model coefficients represent the odds to visit healthcare services and identify the effect of the association, the results of the pooled data are described in Table 5-2. This analysis provides evidence about predisposing factors and barriers that explain the probability to be a user of the public health sector.

The probability to seek healthcare services at least once per year is associated with age and sex profile. The probability to seek services at least once per year at primary and second level facilities significantly increases for two population groups: under-five-year-old children and females. This research identified a significant interaction between age and sex, the interaction is illustrated in Figure 5-2. Seeking healthcare services at the primary and second level increasing for females at reproductive age, females with between 20 and 39 years having higher or similar odds compared to children in the lowest group. Males across age groups have a lower probability to visit public healthcare services compared to under-five-year old females. Adult males between 20-29 years old being the population group less likely to assist to healthcare services, probability slowly increasing at older ages.

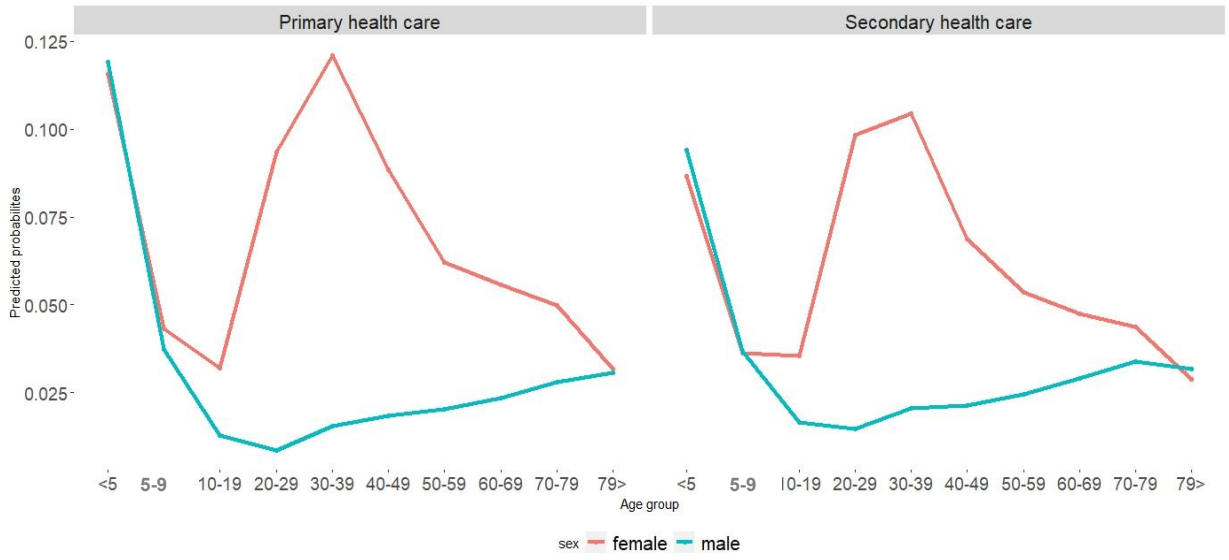

Figure 5-2: Predicted probabilities for the interaction effect between age and sex for the model exploring seeking services at primary and second level public health facilities in selected rural areas, Guatemala 2013 -2017.

Source: Author's own analysis using data from the study sites

Ethnic background is a sociodemographic considering as a predisposing factor for seeking healthcare services at public facilities. The probability to use both levels of the healthcare sector declined for Mayan indigenous individuals compared to the non-indigenous population and for those speaking only a Mayan language compared to those speaking Spanish. The results of analysis for each study site indicate that there might be contextual differences influencing differences in the relationship between ethnic background and the probability to seek healthcare services. As an example, the results from study site two, do not show a difference statistically significant between the Mayan indigenous users and the language. The model results for each study site are at presented in the appendix A, Table 10-1 and Table 10-2.

This research used death during the period as a proxy variable to adjust for the acute need for medical services. The analysis identified an increased probability to seek healthcare services at second level facilities among those individuals that have died during the analysed period, these individuals being 49% more likely to visit these services. An opposite behaviour was identified for primary services, the odds of visiting primary healthcare facilities decline for those individuals that dyed during the year compared to those remaining alive. These findings are consistent for study site 1, for both levels of the healthcare services. However, some contextual differences might be relevant to explore, mortality during the period not being significant for study sites two and three.

This research included the household socioeconomic index and travel distance to the nearest facility to adjust for potential accessibility and affordability barriers. The model coefficients for these factors are described in Table 5-3. The analysis identified an association between the annual probability to seek healthcare and the household socioeconomic group. The probability to be a user of primary healthcare services increases among the lowest wealth group and clines for those classified in the upper group. The affordability barrier has an inverse relationship with second level healthcare services, and the probability to seek healthcare increases for individuals classified at the highest socioeconomic group. These findings are consistent with the model coefficients from the analysis exploring the study sites independently.

Table 5-3: Accessibility and affordability barriers associated with the individual probability to visit public healthcare facilities at least once per year, Guatemala selected rural areas between 2013 and 2017.

	Primary level healthcare services				Second level healthcare services			
	Odds	**95% CI**		**P value**	**Odds**	**95% CI**		**P value**
Wealth								
Lower	1.000				1.000			
Middle	0.897	0.881	0.913	<0.0001	1.152	1.120	1.185	<0.0001
Upper	0.740	0.725	0.754	<0.0001	1.107	1.075	1.139	<0.0001
Time nearest								
<5	1.000				1.000			
5 -9	0.097	0.040	0.233	<0.0001	0.489	0.189	1.268	0.123
10-14	1.911	0.879	4.156	0.102	0.263	0.103	0.670	0.004
15-29	0.598	0.269	1.331	0.208	0.218	0.096	0.517	<0.0001
30-59	0.023	0.010	0.051	<0.0001	0.058	0.027	0.120	<0.0001
>59	0.076	0.009	0.660	0.020	0.020	0.009	0.043	<0.0001
Year								
2013	1.000				1.000			
2014	0.798	0.780	0.816	<0.0001	1.050	1.013	1.088	0.009
2015	0.527	0.515	0.540	<0.0001	1.091	1.053	1.130	<0.0001
2016	0.477	0.465	0.486	<0.0001	1.257	1.214	1.300	<0.0001
2017	0.797	0.779	0.814	<0.0001	1.570	1.518	1.623	<0.0001
Study site								
Site 1	1.000				1.000			
Site 2	0.807	0.326	1.996	0.674	0.347	0.216	0.557	<0.0001
Site 3	1.398	1.087	1.798	0.011				
Site 4	0.604	0.200	0.680	<0.0001				

Source: Author's own analysis using data from the study sites

Travel times represent the geographic remoteness between the populated settlements. This research used travel time to the nearest facility as a proxy variable for geographic accessibility barriers. The probability to seek services at a primary or second level healthcare facility decline with increased travel time. The findings of this analysis provide evidence of a significant decline in the individual probability to use healthcare services at a considerably short travel time. The probability declines for individuals that have to travel less than 10 minutes to reach the nearest primary facilities and those traveling more than 15 minutes to reach second level facilities. The effect of geographic accessibility in access to primary healthcare services is marginal and there are contextual differences that can be observed by the individual models.

The annual probability to seek healthcare services provided by public facilities is a time-variant phenomenon. This research identified a decline in the odds of visiting primary healthcare services during the four years of analysis, however, the probability increased for second level services. This research identified that the variability of seeking healthcare services at the individual level is correlated with the populated settlements. The multilevel regression identified a cluster effect for both levels of the service provision, and was particularly different for the primary healthcare services regression model. The Intra Cluster Correlation (ICC) for the selected model C, adjusting for the interaction, indicates that 52.2% of the total variance is explained by the between cluster variation for individuals seeking primary healthcare services. The ICC is lower for the second level healthcare services model 24.6% of the variation is explained by between cluster variations (see Table 5-4).

Table 5-4: Model fit comparison for the multilevel binary logistic regression for seeking services at primary and second level public healthcare facilities, Guatemala selected rural areas between 2013 and 2017.

	Primary healthcare services			**Second level healthcare services**		
	Null (A)	**Independent (B)**	**Interaction (C)**	**Null (A)**	**Independent (B)**	**Interaction (C)**
AIC	542835.5	485556.3	471784.4	257172.8	242556.3	238141.8
BIC	542858.3	485897.2	472227.6	257194.9	242876.7	238561.6
ICC	0.733	0.528	0.522	0.504	0.252	0.246
Cluster variance	9.048	10.88	11.1	3.343	1.791	1.795

Source: Author's own analysis using data from the study sites

The caterpillar plot visualises the variance of level-2 residuals for the model used to estimate the annual probability of primary and second level public healthcare services. The caterpillar plot illustrates differences in the predicted probabilities for each populated settlement or cluster, identifying wider confidence intervals for the predicted probabilities of primary healthcare services, see Figure 5-3 and Figure 5-4. Populated settlements with predicted values and confidence intervals below zero identify the settlements having lower odds to seek healthcare services during the year than the overall model estimates. While a reduced number of population settlements have significantly higher probabilities to seek healthcare at primary facilities, this cluster effect might represent those populated settlements in which health services are located.

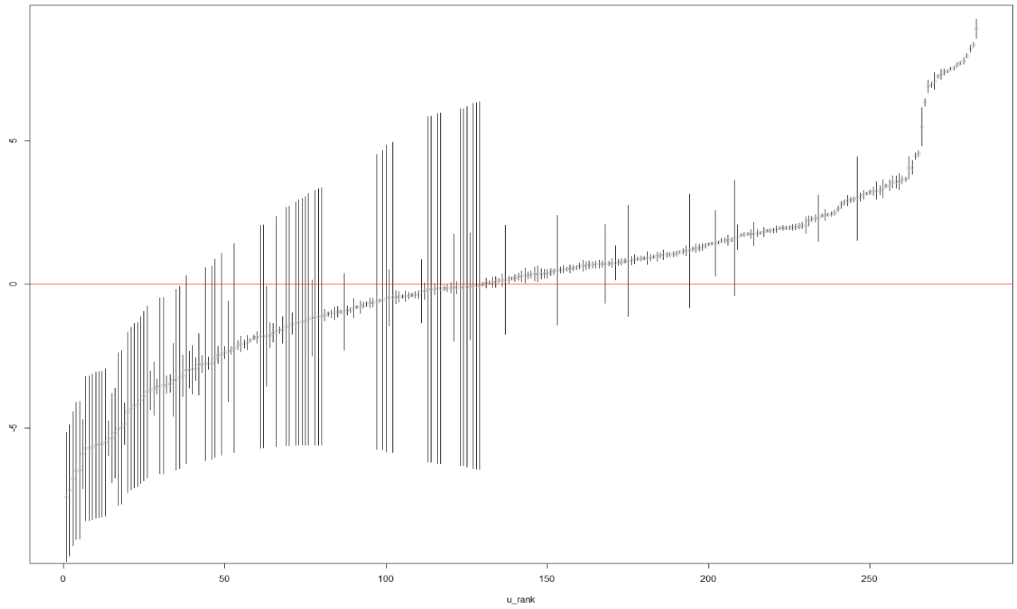

Figure 5-3: Level-2 residuals and 95% CI for the annual probability to visit a primary public healthcare facility, Guatemala selected rural areas 2013-2017

Source: Author's own analysis using data from the study sites

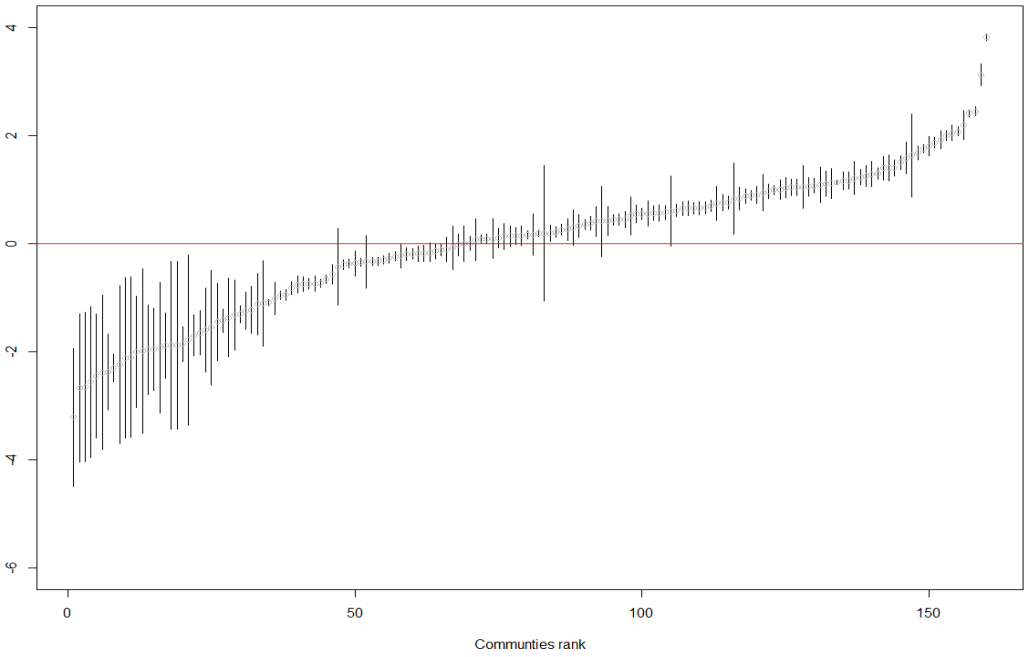

Figure 5-4: Level-2 residuals and 95% CI for the annual probability to visit a second level public healthcare facility, Guatemala selected rural areas 2013-2017

Source: Author's own analysis using administrative data

5.5 Discussion

Access to healthcare services is the outcome of structural characteristics and multiple processes required to provide a variety of healthcare services. This research explored two outcomes, the age-specific contact coverage of public healthcare services and the individual probability to visit at least once per year at primary and second level public health services. The analysis used a unique dataset providing nominal administrative healthcare records to identify the individuals visiting healthcare facilities and the proportion of the population that benefits from the public health system. The findings of this research provide evidence about the reach of public healthcare services across age groups and identify the individuals most likely to benefit from these services and potential population groups missing to have access to public healthcare services. This research provides a unique contribution to the academic literature by exploring health-seeking behaviour across age groups at two levels of the public service provision in a Global South Country, alongside providing useful evidence for public policy in Guatemala.

Contact coverage is the term used to describe the population who has received the services, and its measurement requires identifying the users and the size of the target population (Tanahashi, 1978, Shengelia et al., 2003). This research identified that the contact coverage of public healthcare services varies by the level of the service, age and sex profile. The coverage of primary healthcare services is estimated to represent 20.8% of the target population, while second level healthcare services cover less than 10% of the population. This population outcome can be interpreted as an evaluation of the extent of the reach of the services, finding a limited performance of the public health system in the context of rural Guatemala.

This research provides a unique contribution to the Global South literature by exploring age-specific contact coverage, identifying that two population groups are the major benefices, children under-five-year old and women. The findings of this research estimate that 23% of the female population annually uses public services, a proportion aligned with the results reported at the DHS, identifying that 73.7% of women of reproductive age have not had contact with healthcare services at a time of need (MSPAS, 2017). Identifying a reduced contact coverage in services conceptually grounded in a Beveridge system provides evidence about many individuals being excluded and inequalities in access to healthcare.

The analysis of the annual probability to seek healthcare provides evidence about who are the most frequent users of primary and second level public services in rural areas of Guatemala. This research identified that the annual probability is associated with the interaction of age and sex, identifying two population groups having the greatest chance to seek healthcare services at public facilities. Under-five-year-old children and women in reproductive age groups have an increased probability to enter the system, these groups match the prioritised groups by National and global public policy initiates, such as the targeted priorities in the Millennium Development Goals.

This research identified that males across age groups have a lower probability than females to gain access to public healthcare services, except for under-five-year-old children in which no difference is identified. Multiple factors can explain why males have a lower probability to visit public healthcare services during the year. Previous research conducted in other countries has identified that perceived health status, social norms reinforcing gender roles (Galdas et al., 2005) and behavioural differences (Denton et al., 2004) are relevant factors explaining the sex difference. The increased seeking behaviour or contact of females with healthcare services has been studied in different settings, finding similar results in Global North countries (Hohn et al., 2020, Ladwig et al., 2000, Ranstad et al., 2017, Wang et al., 2013).

The annual users of public healthcare services in Guatemala are associated with ethnic background. Individuals self-identified as Mayan indigenous and those speaking Mayan language have a lower probability to visit primary and second level public healthcare services compared to Spanish speakers and the non-indigenous population. Difficulties in gaining access among this population group include aspects related to communication, this barrier that was identified among those only speaking the native language. Previous research conducted in Guatemala has identified that differences in socioeconomic factors, individual preferences and mistrust can explain access barriers (Ceron et al., 2016, Berry, 2006b, Chary et al., 2018). These findings provide evidence about social inequalities to benefit from governmental services.

This research provided evidence about health-seeking behaviour with the acute need for medical services using a proxy variable, mortality. The analysis provided evidence about differentiated seeking behaviour according to regionalisation of the healthcare services. Individuals likely to need acute medical services have increased odds to conduct annual visits to second level facilities while seeking fewer services provided at primary healthcare facilities. These results provide some

evidence about how regionalisation of healthcare services can influence healthcare seeking behaviour. The increased probability to visit second level services at the end of life might be explained by the increased demand for medical care (Teno et al., 2013). However, vital registration records indicate a limited proportion of medically assisted deaths at the four study sites (see Table 4-5), future research should explore these findings about other factors, including geographic accessibility barriers.

Gaining access to public healthcare services in rural Guatemala is associated with socioeconomic factors and affordability barriers changing concerning to the service level. Households classified at the lower socioeconomic level are more likely to use primary healthcare services, while an increased proportion of individuals at the middle and upper level visit second level facilities. The services are provided free of charge enabling access to healthcare despite the socioeconomic level, however, increased seeking behaviour at second level facilities among the upper groups indicates that affordability might favour access to services at higher levels of the healthcare system. The interpretation of this finding requires bearing in mind the characteristics of the spatial distribution of the households, with an increased number of households with lower living standards located in rural areas where primary facilities are the nearest contact.

This research identified geographic accessibility barriers among individuals seeking services at primary and second level public healthcare facilities in Guatemala. The findings of this analysis provide evidence about a differentiated effect of geographic accessibility barriers, an effect that varies according to the regionalisation of the services. The population located in settlements at less than five minutes travel time to the nearest facility are the most frequent users of primary healthcare services. This finding highlights the reduced travel times that individuals are willing to travel to access these public services. The observed effect at primary healthcare facilities is likely to be marginal compared to the effect observed at second level facilities, for which the probability to seek care at second level services is inversely correlated with increased travel times, these findings providing new evidence in a Global South context.

The probability to visit public healthcare services changes across the five years analysed, the users of primary facilities have declined with time while increasing seeking behaviour was identified at second level facilities. Future research should aim to explain this trade-off, including exploring the increased demand for second level healthcare services associated to an increased need for

healthcare services derived from the change in the demographic structure and increased urban migration. This research provided evidence about predisposing factors and barriers that influence the annual probability to visit public healthcare services, however, other factors might influence seeking behaviour, including contextual factors. The predominance of indigenous population, social conflict aspects, geographic remoteness and changes in the composition of the population are contextual factors that might influence contact coverage.

Regardless of possible contextual variations, the findings of this research are likely to be comparable to other rural areas of the country. The analysis is representative of the indigenous and non-indigenous populations in rural areas and is illustrative of the regionalised public healthcare services, providing strong evidence across five years. Using retrospective data, this study explored an individual level outcome without recall bias. Despite there are some limitations, the analysis only explored access among individuals living within the reach of the catchment areas, missing other groups and the users of second level services at two study sites, other limitations are related to the method used to estimate travel times (see Chapter 4). Despite the limitations, the findings of this research provide a unique contribution exploring access to healthcare across age groups and adjusting for attributes of the healthcare system in a Global South country.

5.6 Conclusion

The coverage and the analysis of the users seeking care for two levels of the organisation provide evidence about the performance of the public healthcare system in Guatemala. The contact coverage of public healthcare services is reduced compared to the targeted population, limiting the capacity to benefit from the services. The reach of the public healthcare services varies according to the level of the services, second level services provided by professional healthcare workers have a lower coverage compared to primary healthcare services delivered by auxiliary nurses.

The probability to seek services provided at public healthcare facilities is an access outcome influenced by predisposing factors, access barriers and public policies. Age and sex are predisposing factors associated with the probability to be a user of public healthcare services. The capacity to be in contact with public healthcare services increases for under-five-year-old children and women at reproductive age, while adult males and older age groups are mostly excluded from the services.

The predominance of these two population groups over the rest population could be explored in terms of targeted interventions prioritised by public policy.

The need for healthcare modifies health-seeking behaviour, individuals' likely requiring services to prevent mortality or palliative care-seeking services at second level healthcare facilities, while the demand declines at primary facilities. Travel times have a marginal effect on the users of primary healthcare facilities while representing an increased barrier for individuals seeking care at second level services. These results reinforce the existing barriers to access healthcare among vulnerable individuals and the need to strengthen at both levels of the organisation to improve the performance of the public health system and progress toward UHC.

Chapter 6 The inverse care law: Utilisation levels of primary and second level public healthcare facilities in rural Guatemala

6.1 Introduction

The contact coverage describes the reach of the services and identifies who might be excluded or might enter the system, however, this analysis missing to provide evidence about structural inequalities in the use of the services. The utilisation of healthcare services is considered an outcome of access to healthcare (Aday and Andersen, 1974, Gerdtham, 1997) and this indicator reveals information about the demand for services (Ranstad et al., 2017, van Oostrom et al., 2014). The analysis of utilisation levels for the overall users of healthcare services has been used to evaluate structural inequalities of the health system performance (Gerdtham, 1997, Ranstad et al., 2017, Rosenberg and Hanlon, 1996). This comprehensive examination requires using administrative healthcare records at the individual level, a scarce resource in many Global South countries. This research identified structural inequalities in the performance of the public healthcare system by exploring utilisation levels across age groups in a Global South country, Guatemala.

Access to health and health equity are frequently linked concepts, the latter refers to the fair opportunity to attain the full health potential (Culyer, 2001, Oliver and Mossialos, 2004). Healthcare equity is frequently operationalised in terms of a fair distribution principle that is normed by the need for healthcare (Culyer and Wagstaff, 1993). Once a need for healthcare is identified it can be converted

into a demand, the expressed need, then this expressed need can be turned into the use of services, after gaining entrance to a functional health system (Boulding, 1966, Bradshaw, 1972). The need for healthcare is a factor incorporated in access to healthcare frameworks given the relationship with the use of services (Aday and Andersen, 1974, Oliver and Mossialos, 2004). As an example of this relationship, an increased number of visits to General Practitioners (GP) have been observed in the adult population with co-morbidities (Sortso et al., 2017, van Oostrom et al., 2014, Ranstad et al., 2014).

Healthcare utilisation levels can be influenced by different factors, demographic characteristics and the need for healthcare are predisposing factors observed at the individual level explaining differences in utilisation levels. Research conducted in Global North countries has identified greater levels of healthcare services utilisation among older age individuals compared to other population groups (Rosenberg and Hanlon, 1996, Ladwig et al., 2000, Ranstad et al., 2017). There are factors representative of contextual aspects that can influence the utilisation of healthcare services, including the distance-decay effect observed at extended travel distances and social factors (Arcury et al., 2005a, Lopez-Cevallos and Chi, 2010, Wong et al., 2020). While health knowledge, cultural practices and social norms are some social factors that influence the use of healthcare services (Kawachi et al., 1999, Rosenstock, 2005).

National Health Systems or publically funded health services reduce access barriers and enable the use of healthcare services favouring equity (LeGrand, 1987, van Doorslaer et al., 2000, Whitehead et al., 2001). Although, in many cases, a greater need for healthcare might not represent a greater use of healthcare services and inequalities might persist, following Tudor's inverse care law (Hart, 1971, Marmot et al., 2008). Exploring utilisation levels across age groups serves as a comparative need analysis (Boulding, 1966, Stevens and Gillam, 1998), lower use of healthcare services among individuals where increased use is expected highlights structural inequalities in a publically funded health system. This analytical approach requires to use of administrative healthcare records not frequently available in Global South contexts. This research aims to identify structural inequalities in the use of healthcare services for two levels of the public healthcare service provision in Guatemala.

6.2 Aim and research questions

The aim of this research is to identify differences in utilisation levels of public healthcare services provided at primary and second level facilities in selected rural areas of Guatemala. This research aim is guided by the following questions:

1. Which is the average annual number of times an individual visit a primary and second level public healthcare facilities in selected rural areas of Guatemala between 2013 and 2017?

2. Are those individuals classified at the oldest age groups having increased levels of utilisation of primary and second level healthcare services compared to other age groups in the areas of study?

3. What other contextual factors are associated with differences in utilisation levels of primary and second level public healthcare services in selected rural areas of Guatemala?

6.3 Data and methods

This research used administrative data collected by the public healthcare services located within four delimited geographic areas (Fort et al., 2011). Healthcare workers routinely collect data for each individual visiting a primary and second level public healthcare facility; the data and the geographic areas covered were previously described in Chapter 4. This research used data about the individuals that have visited the public healthcare services located within the catchment areas. The individual level data includes information about the demographic characteristics, the household socioeconomic index and the travel time to the nearest facility.

The available data limited the analysis to explore utilisation of primary healthcare facilities for four study sites and the use of second level facilities for two study sites. This research used poled data for the population reported at the catchment areas between 2013 and 2017 having complete demographic records. The use of administrative healthcare data is a strength of this research, allowing to measure access to healthcare outcomes without introducing recall bias, a common limitation in

access to healthcare studies using self-reported survey data (Schneeweiss and Avorn, 2005, Hunger et al., 2013). The analysis includes every individual that has visited a public healthcare facility having complete demographic records.

6.3.1 Variables

Individual level data is used to identify the utilisation levels of primary and second level public healthcare services independently. This research used the personal identifier code to identify every individual visit to public healthcare services during the calendar year. The following paragraphs describe the outcome and the explanatory variables used in this chapter.

Outcome variable

The outcome variable for this analysis is the annual number of visits to primary or second level facilities located within the delimited area. One visit is defined as an individual traveling to a selected facility to obtain a service in a given date. The annual number of visits corresponds to the total count of visits of the individual, independently estimated for each level, the annual count of visits being a value greater than zero. Annual counts are equivalent to an incidence rate, being the number of visits per person for the studied population in a comparable period (Vandenbroucke and Pearce, 2012). Variations in the annual use of public healthcare are explained by the following variables.

Explanatory variables

The differences in annual utilisation levels of healthcare services are explained by individual level and household level variables, the information available for every member of the population located within the limits of the catchment area. The individual level data controlled for demographic characteristics, while household level data was used to adjust socioeconomic stratification and travel time to the nearest facility, both variables estimated as described in Chapter 4.

The sex, age group, Mayan ethnicity and spoken language are the variables used to control for the characteristics of the individuals, following the behavioural model these variables can be conceptually classified as predisposing factors (Andersen, 1968b, Andersen, 1995). The household socioeconomic

stratification index is included to adjust for affordability barriers while categorical travel times control for the distance-decay effect (Frenk, 1985, Penchansky and Thomas, 1981). This research used death during the period as a proxy variable for the acute need for medical services, following the assumption that increased contact with healthcare services is expected among individuals likely to be ill (Au et al., 2006). These variables are limited to the available data collected by administrative records.

6.3.2 Analysis

An exploratory analysis using bivariate tests differences in the frequencies for the annual count visits. This is followed by multivariate analysis to identify the rate ratio of visits to healthcare services at least once per year and its association with the explanatory variables. The multivariate analysis was conducted independently for users of primary and second level public healthcare services. The analysis includes only individuals that have visited the services, the selection of non-zero count data as opposed to a zero-inflated distribution was based on the assumption that visits to healthcare services are likely to correspond to separate episodes of care. The models were conducted with the pooled data for the study sites, as well as independently for each site.

The analysis tested the ratios adjusting for a multilevel regression in order to account for the nested structure of the data, individuals at the first level nested within populated settlements for the second level. The ratio of utilisation of healthcare services (y_{ij}) is identified at individual level (i) and nested within the populated settlement (j) for N visits (N = 1, 2, 3 ...) during the calendar year are modelled using a random intercept multilevel regression. The multilevel model allows random variation across clusters.

The zero-truncated basic Poisson regression model (**Error! Reference source not found.**) has a log-l inear relationship with a canonical link $g(\mu) = \log(\mu)$. In this equation β represents the vector for the regression coefficients relative to the mean (μ) number of visits, X_{ij} the vector of explanatory variables, λ_{ij} the expected or mean number of visits for the given the set of covariates for the *ith* individual in the *jth* settlement and random effects normally distributed, $u_j \sim N(0, \sigma^2)$. For this model, y_{ij} follows a Poisson distribution conditional to the covariates and the cluster effect.

$$\log(\lambda_{ij}) = \beta X_{ij} + u_j$$

$$y_{ij} \sim Poisson\,(\lambda_{ij})$$

Equation 6-1

Poisson model follows the assumption that variance is equal to the mean, $var(\mu) = \mu$, with a fixed dispersion parameter at $\phi = 1$. This assumption was tested finding that the standardised residuals have a variance much greater, thus indicating over dispersion of the data. The model comparison to test the nested structure for the utilisation model found no statistically significant multilevel nested structure for the two-level model. The normal distribution of the second level residuals is illustrated using caterpillar plots; see appendix B Figure 10-2 and Figure 10-3.

A negative binomial model was used to account for the counts over dispersed distribution. The negative binomial model as an extension of the Poisson model was preferred. The negative binomial distribution is given by the Poisson-gamma mixture distribution (Hilbe, 2011):

$$\mathrm{p(y)} = \mathrm{P}(Y = y_i) = \frac{\Gamma(y_i + 1/\alpha)}{\Gamma(y_i + 1)\Gamma(1/\alpha)}\left(\frac{1}{1+\alpha\mu_i}\right)^{1/\alpha}\left(\frac{\alpha\mu_i}{1+\alpha\mu_i}\right)^{y_i}, \qquad y_i = 0,1,2,\ldots n > 0$$

Equation 6-2

Where y_i is the dependent non-negative integer for the *ith* subject, Γ is the gamma function, $\mu_i > 0$ is the mean of y_i and $\alpha = \frac{1}{\theta}$ is the over dispersion parameter, when $\alpha = 0$, the model reduces to Poisson specification. The variance of the negative binomial model $var(Y) = \mu + \frac{\mu^2}{\theta}$ is function of the mean and the dispersion parameter θ. The negative binomial regression model is:

$$\ln(\mu_i) = \beta_0 + \beta_1 x_1 + \beta_2 x_2 + \cdots + \beta_q x_q$$

Equation 6-3

Where $x_1, x_2, \ldots x_q$ are the predictor variables for q variables and $\beta_1, \beta_2, \ldots \beta_q$ are the estimated coefficients. The model selection was based on the lowest Akaike information criteria (AIC) since the parameters are maximum likelihood estimates. The exponent of $\ln(\mu_i)$ is the mean number of times an individual visit a healthcare facility for a given year. The models where conducted independent for each level of care and included an interaction effect between age and sex. The data processing and statistical analysis was conducted using R software (version 3.5.1).

6.4 Results

This research explored utilisation levels of healthcare across age groups for primary and second level public healthcare facilities in selected rural areas. A summary measure for the annual individual demand for public healthcare services was estimated using administrative data. The analysis indicate that individuals visit on average 2.4 (± 0.05, 95% CI) times a primary healthcare facility and 1.9 ((± 0.06, 95% CI) times a second level healthcare facility during a year. The median indicates that half of the individuals using public services have a lower value than the average annual visits, 58.7% of the individuals having visited only once per year a second level facility. Table 6-1 describes the distribution of annual visits to primary and second level public healthcare facilities for 2017.

This research explored differences in healthcare services utilisation levels associated with predisposing factors and affordability and geographic accessibility using applying a negative binomial regression model. The model coefficients represent rate ratios identifying the association for each explanatory variable and the magnitude of the effect, results are described in Table 6-2. The intercept is interpreted as the average annual number of visits to public healthcare services. This research indicate that on average, individuals visit 2.4 times a primary healthcare facility and 1.9 times a second level healthcare facility, for the selected rural areas in Guatemala between 2013 and 2017.

Table 6-1: Distribution of the annual number of visits to primary or second level public healthcare facilities in rural Guatemala 2017

Primary healthcare services			Second level healthcare services		
Number of visits	**Frequency**	**Percentage (%)**	**Number of visits**	**Frequency**	**Percentage (%)**
1	14158	47.9	1	6720	58.7
2	6106	20.7	2	2113	18.5
3	3394	11.5	3	1067	9.3
4	2258	7.6	4	661	5.8
5	1434	4.9	5	359	3.1
6	808	2.7	6	226	2.0
7	590	2.0	7	115	1.0
8	314	1.1	8	69	0.6
9	191	0.6	9	47	0.4
10	114	0.4	10	30	0.3
11	74	0.3	11	16	0.1
12	49	0.2	12	11	0.1
13	24	0.1	13	6	0.1
14	10	0.0	14	2	0.0
15	17	0.1	15	2	0.0
16	5	0.0	17	2	0.0
17	2	0.0			
18	4	0.0			
19	1	0.0			
21	2	0.0			
24	1	0.0			
32	1	0.0			
Mean	2.4			1.9	
Median	2.0			1.0	
SD	2.0			1.7	
Variance	4.14			2.95	

Source: Author's own analysis using data from the study sites

Table 6-2: Individual level factors associated with the annual rate of visits primary or second level public healthcare facilities, Guatemala selected rural areas between 2013 and 2017

	Primary health services				Second level health services			
	Rate ratio	95% CI		P value	Rate ratio	95% CI		P value
Intercept	2.419	2.293	2.558	<0.0001	1.907	1.764	2.061	<0.0001
Age structure								
<5	1.000				1.000			
5-9	0.617	0.603	0.628	<0.0001	0.666	0.636	0.696	<0.0001
10-19	0.733	0.720	0.741	<0.0001	0.860	0.834	0.887	<0.0001
20-29	1.182	1.165	1.196	<0.0001	1.202	1.171	1.234	<0.0001
30-39	1.190	1.171	1.206	<0.0001	1.142	1.110	1.174	<0.0001
40-49	1.016	0.998	1.034	0.087	0.949	0.916	0.984	0.004
50-59	0.865	0.844	0.884	<0.0001	0.795	0.760	0.832	<0.0001
60-69	0.876	0.851	0.900	<0.0001	0.789	0.745	0.834	<0.0001
70-79	0.883	0.851	0.916	<0.0001	0.890	0.828	0.957	0.002
79>	0.865	0.814	0.919	<0.0001	0.803	0.715	0.900	<0.0001
Sex								
Female	1.000				1.000			
Male	1.042	1.026	1.060	<0.0001	1.020	0.992	1.050	0.164
Age * Sex								
5-9 * male	0.930	0.900	0.960	<0.0001	1.019	0.957	1.085	0.555
10-19 * male	0.636	0.617	0.655	<0.0001	0.649	0.615	0.684	<0.0001
20-29 * male	0.418	0.401	0.434	<0.0001	0.476	0.447	0.508	<0.0001
30-39 * male	0.460	0.443	0.476	<0.0001	0.536	0.502	0.572	<0.0001
40-49 * male	0.558	0.535	0.579	<0.0001	0.649	0.601	0.700	<0.0001
50-59 * male	0.676	0.645	0.706	<0.0001	0.795	0.731	0.865	<0.0001
60-69 * male	0.773	0.734	0.811	<0.0001	0.825	0.751	0.907	<0.0001
70-79 * male	0.855	0.804	0.906	<0.0001	0.778	0.693	0.872	<0.0001
79> * male	0.931	0.853	1.016	0.114	0.938	0.798	1.102	0.435
Socioeconomic status								
Lower	1.000				1.000			
Middle	0.969	0.960	0.977	<0.0001	1.057	1.037	1.078	<0.0001
Upper	0.936	0.925	0.944	<0.0001	1.062	1.062	1.083	<0.0001
Ethnicity								
Non-indigenous	1.000				1.000			
Indigenous	0.983	0.963	1.003	0.016	0.961	0.928	0.995	0.025
Unknown	0.944	0.912	0.977	0.001	1.011	0.928	1.102	0.804
Spoken language								
Spanish	1.000				1.000			
Indigenous-Spanish	0.973	0.953	0.993	0.007	0.944	0.912	0.978	0.001
Indigenous	1.037	1.012	1.067	0.004	0.997	0.955	1.040	0.877
Death period								
No	1.000				1.000			
Yes	0.933	0.854	1.022	0.126	0.990	0.876	1.120	0.879

Source: Author's own analysis using data from the study sites

Differences in levels of utilisation rates of primary and second level public healthcare facilities are associated with demographic characteristics. This research identified a statistically significant interaction effect between age and sex, Figure 6-1 illustrates the predicted probabilities for this interaction. Females between 20 to 39 years old have the population groups with the highest number of visits to primary and second level facilities. The annual number of visits to primary and second level facilities is likely to increase 20% for 20 to 29 years old women compared to under-five-year-old females. Meanwhile, adolescents and males have significantly lower utilisation levels than under-five-year-old children. These age and sex pattern is similarly observed at each study site, see Table 10-3 and Table 10-4 at Appendix A.

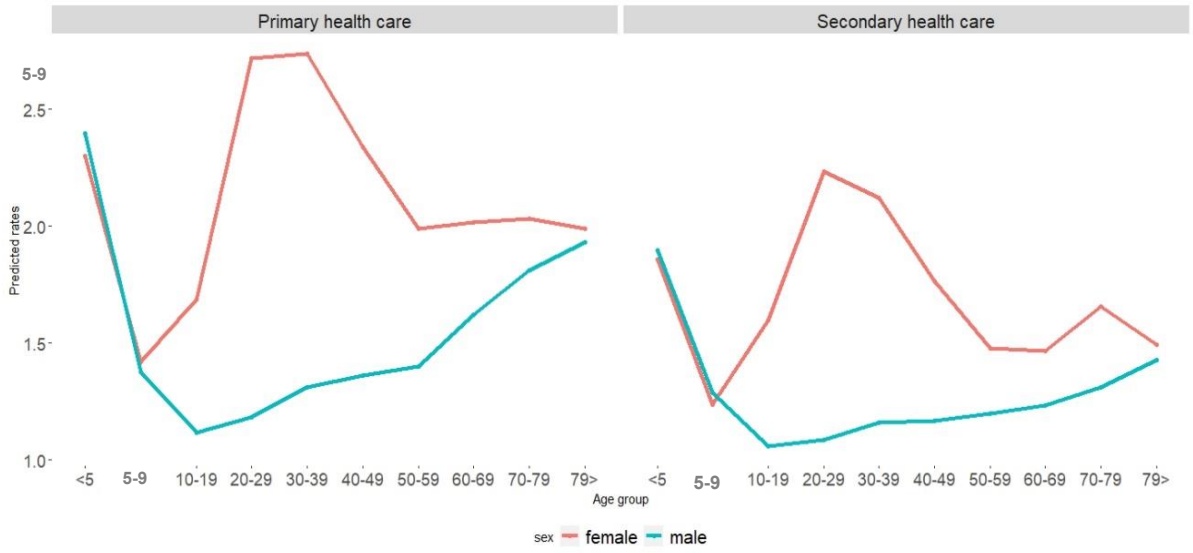

Figure 6-1: Predicted utilisation rates for the interaction between age and sex at primary and second level healthcare services in selected rural areas, Guatemala between 2013 and 2017

Source: Author's own analysis using data from the study sites

The acute need for healthcare and ethnic background are predisposing factors explaining differences in utilisation levels. The acute need for healthcare at the end of life was not associated with the utilisation rate of public healthcare services. However, ethnicity is another individual level characteristic that is associated with differences in the use of healthcare services. The annual utilisation rates for both levels of healthcare services are lower for Mayan indigenous individuals and those speaking only a Mayan language speakers compared to the non-indigenous population and individual's Spanish speakers. The results for the independent models might indicate that might be contextual differences influencing ethnic differences, the difference is only significant for primary

healthcare at study site four and the second level services for study site one (see appendix A Table 10-3 and Table 10-4).

This research explored the use of healthcare services in relationship with affordability and accessibility barriers. Utilisation of public healthcare services is associated with affordability a measure of the household socioeconomic level. The annual utilisation rates of primary healthcare facilities increase among individuals classified at the lowest socioeconomic level and decline in the upper categories. The opposite effect is observed for second level healthcare services; utilisation rates increase for individuals classified at the highest socioeconomic level. This association was equally observed for the models adjusted independently of each study site.

Table 6-3: Travel time to the nearest facility associated with the annual rate of visits primary or second level public healthcare facilities, Guatemala selected rural areas between 2013 and 2017

	Primary health services				Second level health services			
	Rate ratio	**95% CI**		**P value**	**Rate ratio**	**95% CI**		**P value**
Time nearest								
<10	1.000				1.000			
10-14	0.968	0.891	1.056	0.444	0.851	0.762	0.949	0.004
15-29	0.935	0.873	1.002	0.066	0.786	0.717	0.862	<0.0001
30-59	0.869	0.793	0.945	0.003	0.742	0.678	0.811	<0.0001
>59	0.824	0.704	0.963	0.016	0.675	0.601	0.759	<0.0001
Year								
2013	1.000				1.000			
2014	0.962	0.950	0.976	<0.0001	1.047	1.022	1.073	<0.0001
2015	0.903	0.891	0.917	<0.0001	1.092	1.066	1.119	<0.0001
2016	0.886	0.874	0.898	<0.0001	1.127	1.101	1.154	<0.0001
2017	0.967	0.955	0.979	<0.0001	1.144	1.118	1.171	<0.0001
Study site								
Site 1	1.000				1.000			
Site 2	1.120	1.038	1.189	0.003	1.165	0.983	1.154	0.123
Site 3	1.118	1.035	1.194	0.005				
Site 4	1.267	1.150	1.385	<0.0001				

Source: Author's own analysis using data from the study sites

A distance-decay effect, the reduced healthcare utilisation at increased travel times, was observed at the two levels of the service provision, results are described in Table 6-3. The distance-decay effect is

statistically significant among those individuals likely to travel more than 30 minutes to reach the nearest primary healthcare facility and more than 10 minutes to reach the nearest second level healthcare facility. There are differences in the distance-decay effect that are observed when exploring the independent models. The distance-decay effect for primary healthcare services is only statistically significant for study site three, while the effect for second level facilities remains significant across study sites.

Annual utilisation rates can change for a given year and across geo-administrative units. This analysis indicate that utilisation of primary healthcare services has been declining with time, while the use of second level healthcare facilities has been increasing. Furthermore, there might be contextual differences missing to be included that could explain the differences in annual utilisation rates across the study sites. As an example, utilisation rates significantly increased for study sites three and four compared to study site one. The results for the independent models for primary healthcare services indicate an average of 3.3 visits to facilities located in study site four, 2.9 visits to study site two and 2.5 visits to study site three.

6.5 Discussion

This research explored variations in healthcare services utilisation rates for the overall users of primary and second level public healthcare services in selected rural areas of Guatemala. Using administrative healthcare records this research explored variations in utilisation of healthcare services at two levels of the healthcare services provision by adjusting for predisposing factors, affordability and geographic barriers. Exploring utilisation levels across age groups provides a comparative need analysis to identify inequalities in the performance of the health system. This research provides a unique contribution to the academic literature by exploring utilisation at two levels of the organisation in a Global South context, alongside providing useful evidence for public policy in Guatemala.

There annual utilisation rates of public healthcare services change according to the level of the healthcare service and the demographic characteristics of the individual. Increased annual rates are expected for primary healthcare services compared to second level healthcare services. On average individuals have 2.4 visits to primary healthcare during a year. Nevertheless, the average number of

visits significantly changes when adjusting for the age and sex profile. Women between 20 and 49 years old are the individuals in the population having the highest annual utilisation rates of primary and second level public healthcare services. While the average number of annual visits declines significantly for adult males. Increased use of healthcare services for females compared to males has been observed in other countries. Multiple factors might explain the sex gap, including health disadvantages, gender roles, perceived health status and gendered systems among others (Morgan et al., 2018, Bertakis et al., 2000, Hohn et al., 2020).

This research aimed to explore utilisation levels across age groups as a comparative need analysis identifying structural inequalities in the performance of the public healthcare system. Reduced utilisation levels were identified for individuals above 50 years old, the individuals likely to need more healthcare services due to co-morbidities, and the annual number of visits being significantly lower than the utilisation rates for under-five-year-old children. Higher utilisation levels are expected with the increase in chronological age given the likelihood to experience more frequent ill-health episodes, chronic diseases and co-morbidities than other age groups (Salisbury et al., 2011, Thygesen et al., 2011b, Kuan et al., 2019). The findings of this research are opposite from what has been identified in previous research conducted in Global North countries (Ranstad et al., 2014, van Oostrom et al., 2014, Ranstad et al., 2018). These findings highlight structural inequalities among those at greater need and the reduced number of annual visits among adults might indicate limitations of the public healthcare system to ensure continuity of care.

Indigenous population not only have a lower probability to contact public services during the year, but also have lower utilisation rates at both levels of the healthcare provision. This finding is expected, previous research indicate that indigenous women have a preference for traditional midwives for services related to childbirth (Chary et al., 2018, Seiber and Bertrand, 2002, Chary et al., 2013), as well as likely experiencing other barriers such as communication and mistrust (Ceron et al., 2016, Berry, 2006b, Berry, 2008). However, contextual differences might illustrate a different relationship, utilisation levels in the study sites with an indigenous majority, likely having a lesser language barrier, do not have significant ethnic differences.

This research explored the distance-decay effect for two levels of the public healthcare service organisation, identifying a significant distance-decay effect for both levels of the services, however

varying according to the context. The distance-decay effect has a lesser influence on the use of primary healthcare services compared to the effect observed for second level facilities. Results from the previous chapter highlighted that most of the primary healthcare users are located at short travel times to the nearest facility. The users of healthcare services being at close proximity to the facility might explain the limited influence of the distance over utilisation of primary services. While an increased distance-decay was observed in the most rural catchment area. Future research should explore variations in travel times variations associated with the need for healthcare and the services organisation.

Annual utilisation rates are associated with household socioeconomic stratification, highlighting that affordability barriers might persist despite publically funded healthcare services free from charge. Users from the lowest socioeconomic level benefit more from primary healthcare services, however, inequalities might persist for services provided at higher levels of the organisation. The average number of visits to second level facilities increases with a greater household socioeconomic stratification index. However, cautions interpretation is required, individuals living in a close proximity to second level healthcare services are more likely to have greater living conditions than those located in rural areas in which primary healthcare facilities are the closes point of contact with the health system. Similar to the findings of the previous chapter, the annual utilisation rates vary across time, with the average number of visits to second level facilities increasing for second level healthcare services. This result might indicate that other factors might modify the demand that should be explored in future research.

This research explored differences in annual utilisation rates for two levels of the public healthcare service organisation, findings likely comparable to the performance of other rural areas of the country. The analysis is representative of all age groups, the two main ethnic communities and is illustrative of two levels, providing evidence for five years, however, there are some limitations. The analysis is limited to the available data and other explanatory factors might be relevant to be explored. There are limitations related to the method used to estimate travel times, as previously described in Chapter 4. Despite the limitations, this research provides a unique contribution by exploring utilisation of public healthcare services for two levels of service provision in a Global South context.

6.6 Conclusion

Exploring the annual number of visits across age groups provided a comparative need standard to identify healthcare inequities among those likely to be in greater need. Low levels of utilisation rates for older age individuals likely requiring a greater amount of healthcare services indicate structural inequalities in the performance of the public healthcare system. Access to healthcare in rural Guatemala follows Tudor-Hart's Inverse care law, highlighting structural inequalities and inequalities, as result individuals at lower socioeconomic groups, older age groups and those likely having an acute need before dying.

A lower number of visits to second level services compared to primary healthcare might indicate increased access barriers to physicians and other technologies. The low number of visits to primary and second level services among older age groups provides evidence about reduced continuity of care. The use of public healthcare services is highly driven by the visits of adult female at reproductive age. The increased probability to contact and use the services in this group can be used as an indicator of a directed or gendered healthcare service provision, with public policy priorities targeting females with vertical interventions.

Annual utilisation rates of healthcare services can vary due to contextual factors, including the ethnic composition of the communities. Mayan indigenous population has reduced utilisation levels than the non-indigenous population, an effect that is reduced when exploring areas in which the indigenous population are the majority. Utilisation of healthcare services is influenced by the territorial extension of the catchment area, where the distance-decay effect for the two levels of the healthcare services increases in remote areas. This spatial relationship might indicate a greater barrier to access to professional medical care for households located in remote areas or families with limited resources to travel.

Chapter 7 Bypassing facilities, between regionalisation and the demand for healthcare

7.1 Introduction

Access to healthcare and the performance of healthcare systems relies on building blocks and essential functions to operate, including the delivery of services (WHO, 2010). The delivery of healthcare services frequently follows a regionalisation principle to organise the demand (Lewis, 1977). The organisation for rendering healthcare services is a structural factor that might influence access to healthcare services. Despite the conceptual link, there is limited empirical evidence about the effect of regionalisation on access to healthcare outcomes, such as seeking behaviour. This research explores the differentiated demand for healthcare that results from regionalisation of the services by exploring the clinical reasons for bypassing healthcare facilities in a Global South country.

The resources to provide services, such as healthcare technologies and other complementary assets, are distributed across the healthcare system infrastructure. Healthcare delivery is frequently organised allowing for the efficient allocation principle of resources, resulting in a differentiated distribution of services across the infrastructure (Lewis, 1977). The regionalisation of healthcare services is operationalised by a hierarchical structure aiming to organise the demand at different levels (Hofmarcher et al., 2007, Lewis, 1977). Public healthcare systems in Global South countries are usually organised at three levels: primary healthcare services, second level services and hospitals (WHO, 2012). For many Global South countries, primary healthcare consist in essential cost-effective interventions (Starfield et al., 2005, Gervas et al., 2008), while second level facilities represent the closest access to a GP and other professional healthcare workers (WHO, 2012).

The differentiated allocation of healthcare resources across the infrastructure might influence healthcare seeking behaviour, including the willingness to travel longer distances when seeking healthcare. The willingness to travel longer distances than the nearest healthcare facility represents greater costs and it is conceptualised as bypassing behaviour (Akin and Hutchinson, 1999). Previous research conducted in Global North countries, has identified that traveling further distances is observed among individuals seeking specialised healthcare and hospitalisation services, a higher resolution capacity (Radcliff et al., 2003, Varkevisser and van der Geest, 2007, Flytkjaer Virgilsen et al., 2019).

Bypassing behaviour in Global South countries has mostly been explored in relation to Emergency Obstetric Care (EmOC) and antenatal care services (Amoro et al., 2021, Bell et al., 2020, Dotse-Gborgbortsi et al., 2020, McLaren et al., 2014). Research exploring bypassing behaviour in this context suggests reduce quality of care, however, the analysis has missed to consider the differentiated healthcare provision that results from regionalisation. Exploring the demographic characteristics and the clinical diagnostic at the time of visit among individuals that bypass the nearest facility in a Global South country can provide empirical evidence of the differentiated demand. This research aims to explore the probability to bypass the nearest facility while controlling for regionalisation of the healthcare services in rural Guatemala using administrative healthcare records.

7.2 Aim and research questions

This research aims to explore differences in the probability to bypass the nearest facility explained by the differentiated demand of healthcare services at primary and second level public health facilities in selected rural areas of Guatemala.

1. Which are the most frequent healthcare services delivered by age and sex at primary or second level public healthcare facilities in selected rural areas of Guatemala between 2013 and 2017?

2. What proportion of the total number of visits to primary and second public healthcare facilities correspond to individuals that have bypassed the nearest facility for the selected rural areas?

3. What is the relationship between the probability to bypass the nearest facility and the differentiated demand for healthcare services in selected rural areas of Guatemala between 2013 and 2017?

7.3 Data and methods

This research used administrative data collected at public healthcare services located within two delimited geographic areas, the characteristics of the data was previously described in Chapter 4. This research used data about the individuals that have visited the public healthcare services located within two catchment areas, for study site one and two, the sites having records for the two levels of care. The total number of visits registered during the five years across the healthcare infrastructure in the two study areas are 351,859 visits. This research used poled data for the population reported at the catchment areas between 2013 and 2017 having complete demographic records. The study included only the visits of the individuals having complete demographic records, reducing the analysis to 320,280 visits.

The individual level data includes information about the demographic characteristics, the household socioeconomic index, the clinical diagnostic defined by the healthcare worker when visiting a healthcare facility and the estimated travel time to reach the chosen healthcare facility. The travel times from populated settlement to the chosen facility (O-D pairs) were estimated following the least-cost-path method as described in chapter 4, Figure 10-4 and Figure 10-5 in the appendix B illustrates the O-D pairs for the two types of facilities.

The analytical sample of this research is limited to visits of individuals having one diagnostic registered during the visit. Multiple clinical needs or co-morbidities are likely to be identified by healthcare workers during the diagnostic or prognosis at the time of the visit. Research exploring access to healthcare using administrative healthcare records in Global North countries have proposed to create a summary measure to deal with co-morbidities (Thygesen et al., 2011b, Starfield and Kinder, 2011, Ranstad et al., 2018, Huntley et al., 2012). However, due to the lack of historical or complete healthcare records to create a summary measure, this research included only individuals having only one diagnostic recorded. The number of visits with complete records and with the number of

diagnostics are described in Table 7-1. The analytical sample included 251,428 records, representing 75.6% of visits to primary healthcare facilities and 87.1% of visits to second level facilities. These proportions are a considerable high, and can hypothetically be related to the limited diagnostic capacity of the public healthcare services.

Table 7-1: Number of visits to primary care and second level public healthcare facilities for selected rural areas between 2013 and 2017, Guatemala

	Primary healthcare facilities		Second level healthcare facilities	
	Visits	**%**	**Visits**	**%**
Total visits with complete records	239,096	100.0	81,184	100.0
Diagnostic codes registered per visit				
One code	180,565	75.6	70,520	87.1
Two codes	50,564	21.1	9,384	11.6
Three or more codes	7,778	3.3	1,126	1.4

Source: Author's own analysis using data from the study sites

7.3.1 Variables

Outcome variable

This research explores the individual probability to bypass the nearest facility while visiting primary or second level public healthcare services. An individual visit seeking healthcare was identified using the personal identifier code and the chosen healthcare facility in a given date. The estimated travel time from O-D pairs and the estimated travel times to reach the nearest facility were used to identify individuals that have travel longer times or have bypassed the nearest facility. The outcome represents a binary variable that identifies the individuals traveling to nearest facility when seeking care (0) or traveling further distances (1).

Explanatory variables

The probability to bypass the nearest facility is explained by individual level characteristics, sex, age group, Mayan indigenous ethnicity and spoken language, these variables can be conceptually classified as predisposing factors (Andersen, 1968b, Andersen, 1995). The household socioeconomic stratification index was included in the analysis to adjust for affordability barriers while categorical

travel times control for the distance-decay effect (Frenk, 1985, Penchansky and Thomas, 1981). Contextual level factors were controlled by including the level of the weekday of the visit as a proxy indicator of increased mobility and the calendar year. The inclusion of the variables was based on the data available for every individual using public healthcare services.

Clinical diagnostic at the time of the visit

This research aims to explore bypassing behaviour associated with regionalisation of the services, this relationship being operationalised by the clinical diagnostic or the reason to visit healthcare services provided at primary or second level facilities. Individuals traveling to healthcare facilities might have a demand that is converted into an expressed need for medical services. The expressed need serves to identify the demand for healthcare services, healthcare workers at the time of the visit are on charge to identify the correspondent clinical diagnostic, irrespective of being a new visit or a follow up. The diagnostic is registered using the International Classification of Diseases (ICD-10) as a standard (WHO, 2011), code that served to categorise the service provided at the time of visit.

The ICD-10 codes were grouped in categories using as a reference the proposed list of the Global Burden of Diseases (GBD) project (Murray et al., 2012), this list provides an expert assed hierarchical classification system for fatal and non-fatal ICD-10 health outcomes (Vos et al., 2020). The reference list was used to classify the diagnostics in this research, this classification used level one and level two groups. Level one classification identifies three major categories: (1) Communicable, maternal, neonatal and nutritional disorders; (2) Non-communicable diseases; and (3) Injuries (Murray et al., 2012). While the level two of the reference list was used to subdivide categories from level one.

This research subdivided the category “Communicable, maternal, neonatal and nutritional disorders” of the first level into three groups: (1) Respiratory infections and tuberculosis; (2) Other infectious diseases; (3) Maternal, neonatal and nutritional disorders. This sub-division was essential to differentiate visits related to respiratory infections, the most prevalent cause of death in the country (Naghavi et al., 2017). The other level two categories, communicable diseases and injuries remained the same. Four additional categories not described in the GBD reference list were incorporated to include every possible demanded healthcare service, including routine antenatal and child care. The

analysis included nine analytical categories to group the ICD-10 corresponding to the clinical reasons associated with the demand of healthcare services:

1. Respiratory infections and tuberculosis (TB);
2. Other infectious diseases;
3. Maternal, neonatal and nutritional disorders;
4. Non-communicable diseases;
5. Injuries;
6. Antenatal care (ANC) routine services;
7. Contraceptive services;
8. Routine child monitoring services and
9. Visits related to general symptoms.

7.3.2 Analysis

The analysis starts by describing the most frequent reasons for visiting public healthcare services for each level of the healthcare service. The clinical reasons for visit the services are described by age and sex of the individuals. This is followed by exploring the binary outcome representing bypassing behaviour. Descriptive statistics and bivariate analysis using chi-square test to identify differences in the distribution by the explanatory variables. The individual probability for bypassing the nearest public healthcare facility is explored by a multivariate analysis. This research used a binary logistic regression to identify the individual probability of bypassing or not (π), the binary logistic regression model equation is:

$$Log\left(\frac{\pi}{1-\pi}\right) = \beta_0 + \beta_1 x_1 + \cdots + \beta_n x_n$$

Equation 7-1

Where $Log\left(\frac{\pi}{1-\pi}\right)$ is the canonical link function for binomial model, β_i are the regression coefficients associated with the reference group, x_i are the explanatory variables, β_0 is the intercept, representing the probability of bypassing for the individuals in the reference category. The exponent of the coefficients, odds ratio, were used for the interpretation of relationship between the predictor and the response. The administrative data has a multilevel structure, with individuals nested within

population settlements; this analysis tested the nested structure finding that there is no significant clustering effect.

This thesis argues that bypassing behaviour in the context of rural Guatemala is associated with the differentiated demand for healthcare that results from the regionalisation of the services, a structural characteristic of the health system. The differentiated demand for healthcare services in this analysis is operationalised by adjusting for an interaction effect between the level of the healthcare facility that was visited while bypassing the nearest and the clinical diagnosis at the time of the visit. The analysis modelled the probability to bypass across the users and two additional models tested the probability independently for females and males.

7.4 Results

This research identified the most frequent clinical diagnostics recorded at primary and second level public healthcare facilities and the probability to bypass the nearest public healthcare services in association with the diagnostic at the time of visit, as a proxy variable to differentiate the demand. This research used healthcare records of visits having only one diagnostic code at the time of visit to identify the most demanded healthcare services during the five years of analysis. Around 50% of the total visits to primary healthcare services correspond to individuals being diagnosed or seeking services for conditions related to respiratory infections and communicable diseases. While more than 60% of visits to second level facilities correspond to services related to respiratory infections, antenatal care and non-communicable diseases, see Table 7-2 the visits classified by clinical diagnosis.

The frequency of the clinical diagnosis groups significantly vary according to the age and sex profile. Respiratory infections and communicable diseases being the two most prevalent diagnosis for under-five-year old children. Services related to sexual and reproductive health, such as antenatal care and contraception are the most frequent services demanded by adult females. This is followed by non-communicable diseases diagnosed mostly adult females and males. Communicable diseases and injuries are the most frequent diagnosis recorded for adult males; Figure 7-1 illustrates the number of visits by sex and age group reported during the five years.

Table 7-2: Visits to primary and second level public healthcare services classified by type of diagnosis for selected rural areas between 2013 and 2017, Guatemala.

	Primary care facilities		Second level facilities	
	Visits	%	Visits	%
Respiratory infections and TB	60,491	33.50	16,993	24.10
Communicable diseases	31,138	17.24	10,283	14.58
Non-communicable diseases	28,180	15.61	12,319	17.47
Maternal care supervision	23,485	13.01	15,740	22.32
Contraceptive management	18,557	10.28	8,617	12.22
Child monitoring	7,055	3.91	1,716	2.43
General symptoms	6,044	3.35	2,405	3.41
Injuries	3,486	1.93	1,965	2.79
Maternal, neonatal and nutritional disorders	2,129	1.18	482	0.68
Total	180,565		70,520	

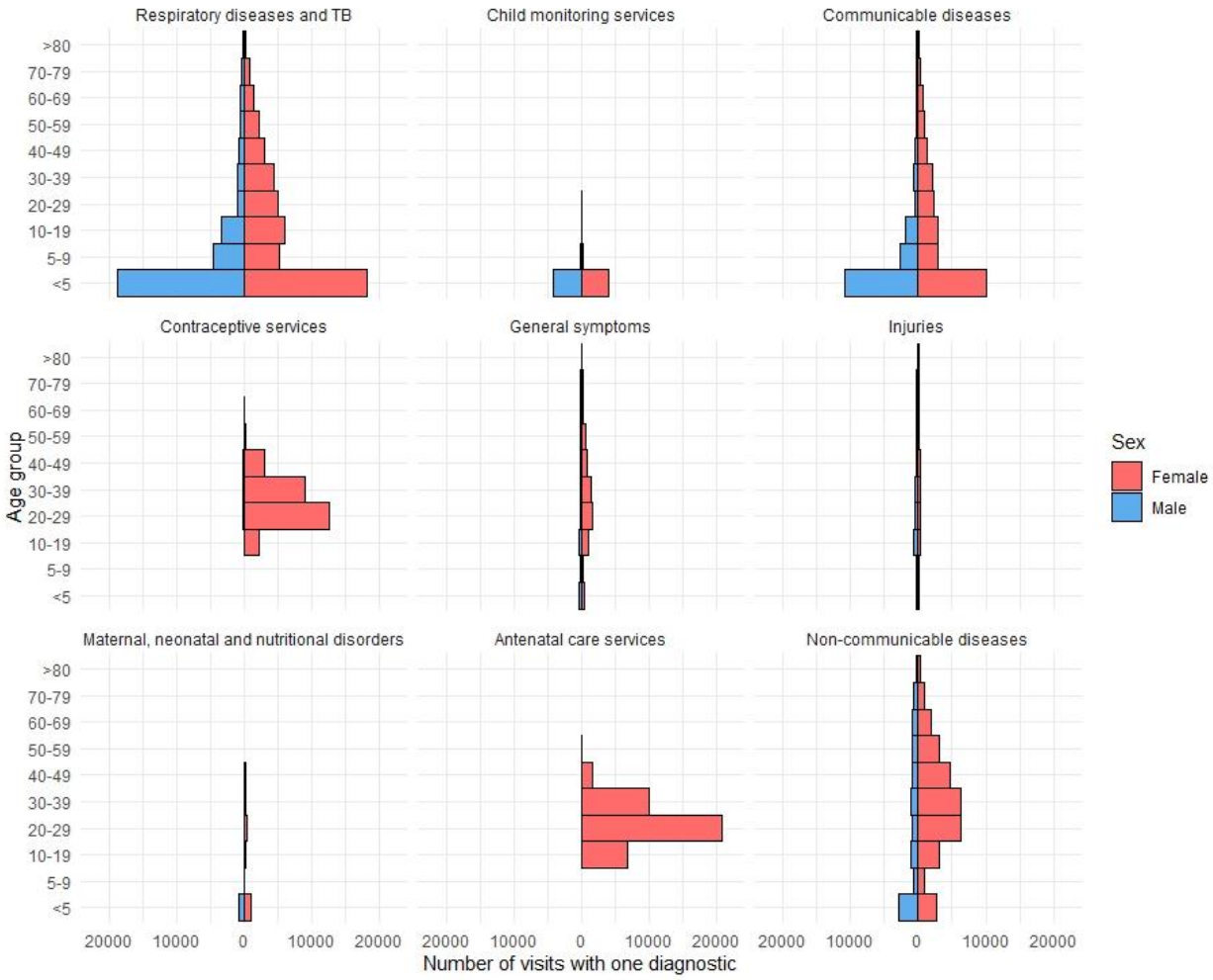

Figure 7-1: Visits to primary and second level public healthcare services classified by sex, age groups and type of diagnosis for selected rural areas between 2013 and 2017, Guatemala.

Source: Author's own analysis using data from the study sites

Travel times to the chosen healthcare facility were used to identify those visits corresponding to individuals bypassing the nearest public healthcare facility. Descriptive statistics indicate that 30.7% of the visits during the analysed period correspond to individuals bypassing the nearest facility, see Table 7-3. This proportion changes with the level of the service, 19.8% of total visits to primary care have bypassed, the proportion increasing to 58.2% of the total visits to second level facilities. The frequency of individuals bypassing changes according to other variables, including age, sex and the clinical diagnosis during the visit, the multivariate analysis explores these variables in more detail.

Table 7-3: Proportion of individuals bypassing the nearest facility when visiting primary and second level public facilities located in selected rural areas between 2013 and 2017, Guatemala.

	Bypassing	Percentage (%)	P value
Total	76,955	30.65	
Sex			
Female	56,647	31.46	<0.0001
Male	20,308	28.58	
Age			
<5	19,938	26.68	<0.0001
5-9	4,891	26.91	
10-19	9,687	32.45	
20-29	18,381	35.26	
30-39	12,160	32.64	
40-49	5,405	30.28	
50-59	2,915	31.38	
60-69	2,121	33.03	
70-79	1,010	26.63	
79>	447	28.01	
Household socioeconomic index			
Lower	26,870	29.03	<0.0001
Middle	25,573	31.43	
Upper	24,512	31.77	
Language			
Spanish	49,701	39.13	<0.0001
Spanish and Mayan	12,140	24.31	
Mayan	15,114	20.39	
Ethnicity			
Non-indigenous	48,352	38.82	<0.0001
Indigenous	28,092	22.73	
Unknown	511	17.45	

	Bypassing	Percentage (%)	P value
Level of healthcare service			
Primary care	35,912	19.89	<0.0001
Second level	41,043	58.20	
Diagnostic category			
Respiratory infections and TB	20,057	25.89	<0.0001
Other infectious diseases	12,561	30.33	
Maternal, neonatal and nutritional disorders	821	31.44	
Child monitoring	1,698	19.36	
Contraceptive management	6,990	25.72	
Antenatal care supervision	17,360	44.26	
Injuries	1,725	31.65	
General symptoms	2,654	31.41	
Non-communicable diseases	13,089	32.32	
Weekday			
Monday	19,186	30.67	<0.0001
Tuesday	16,612	30.31	
Wednesday	14,942	30.22	
Thursday	14,003	31.49	
Friday	10,105	28.89	
Saturday	1,194	45.71	
Sunday	913	41.50	
Study site			
Site 1	55,431	39.12	<0.0001
Site 2	21,524	19.68	
Level of healthcare service			
Primary care	35,912	19.89	<0.0001
Second level	41,043	58.20	
Year			
2013	14,457	28.16	<0.0001
2014	13,718	27.51	
2015	13,418	30.43	
2016	15,843	33.39	
2017	19,519	33.45	

Source: Author's own analysis using data from the study sites

This research used a binary logistic regression to identify the association between the explanatory variables and the individual probability to travel longer distances; the results of this model are described in Table 7-4. Predisposing factors at the individual level have influence over the probability to bypass the nearest facility. The age, sex, ethnic group and spoken language are individual level factors associated with bypassing. The odds for bypassing increasing significantly among adult

population, adults between 60 to 69 years old having the greatest odds and being 44% more likely to bypass than under-five-year-old children. This analysis indicate that individuals self-identified as indigenous are 20.3% more likely to bypass compared to non-indigenous individuals. However, the likelihood for bypassing is likely to decline 31% when individuals only speak Mayan compared Spanish speakers.

Table 7-4: Binary logistic regression coefficients for bypassing the nearest public healthcare facility for selected rural areas, Guatemala between 2013 and 2017.

	Odds ratio	95% CI		P value
Intercept	0.337	0.324	0.351	<0.0001
Sex				
Female	1.000			
Male	1.040	1.015	1.065	<0.01
Age				
<5	1.000			
5-9	0.949	0.912	0.988	0.0111
10-19	1.144	1.104	1.185	<0.0001
20-29	1.214	1.171	1.259	<0.0001
30-39	1.195	1.152	1.240	<0.0001
40-49	1.194	1.143	1.247	<0.0001
50-59	1.222	1.158	1.290	<0.0001
60-69	1.441	1.355	1.533	<0.0001
70-79	0.958	0.881	1.040	0.321
79>	1.007	0.890	1.137	0.818
Ethnicity				
Non-indigenous	1.000			
Indigenous	1.203	1.148	1.260	<0.0001
Language				
Spanish	1.000			
Mayan	0.684	0.652	0.718	<0.0001
Spanish and Mayan	1.027	0.968	1.089	0.3794
Socioeconomic group				
Lower	1.000			
Middle	0.859	0.840	0.879	<0.0001
Upper	0.754	0.736	0.772	<0.0001
Level of healthcare service				
First level	1.000			
Second level	5.909	5.685	6.142	<0.0001
Diagnostic category				
Respiratory infections and TB	1.000			
Child monitoring	0.900	0.833	0.971	<0.001
Antenatal care services	1.268	1.216	1.322	<0.0001

	Odds ratio	95% CI		P value
Other communicable diseases	1.087	1.050	1.126	<0.0001
Contraceptive services	0.909	0.866	0.954	<0.01
Injuries	0.796	0.723	0.876	<0.0001
Maternal, neonatal and nutritional disorders	1.157	1.042	1.283	<0.01
Non-communicable diseases	1.036	0.997	1.077	0.068
General symptoms	0.986	0.921	1.054	0.6756
Interaction* level 2 second level				
Child monitoring	0.893	0.786	1.014	<0.0001
Antenatal care services	1.266	1.192	1.345	<0.0001
Other communicable diseases	0.979	0.920	1.041	0.0812
Contraceptive services	0.735	0.685	0.789	<0.0001
Injuries	2.024	1.767	2.321	<0.0001
Maternal, neonatal and nutritional disorders	1.606	1.290	2.006	<0.0001
Non-communicable diseases	1.183	1.112	1.258	<0.0001
General symptoms	0.933	0.835	1.043	0.221
Weekday				
Monday	1.000			
Tuesday	0.973	0.946	1.001	0.055
Wednesday	0.974	0.946	1.002	0.071
Thursday	1.047	1.016	1.078	<0.01
Friday	1.018	0.986	1.051	0.243
Saturday	1.247	1.146	1.357	<0.0001
Sunday	1.064	0.969	1.167	0.131
Site				
Site 1	1.000			
Site 2	0.338	0.322	0.354	<0.0001
Year				
2013	1.000			
2014	0.987	0.957	1.017	0.386
2015	0.965	0.935	0.996	0.026
2016	1.049	1.017	1.081	0.001
2017	1.161	1.128	1.195	<0.0001

Source: Author's own analysis using data from the study sites

The individual probability to bypass the nearest facility significantly increases when individuals travel seeking healthcare services provided at second level facilities compared to bypassing to visit primary healthcare services. The odds of bypassing a second level service are almost five times the odds of bypassing primary facilities. This research argues that bypassing is associated with the differentiated demand for healthcare that results from the regionalisation of the services, this was operationalised by the interaction effect between the level of the healthcare facility and the clinical diagnosis. Finding a dependent relationship between the diagnostic determined during the visit and the level of the

service visited. Figure 7-2**Error! Reference source not found.** exemplifies the point of origin and the destination for those individuals traveling further distances than the nearest facility for selected groups in 2017.

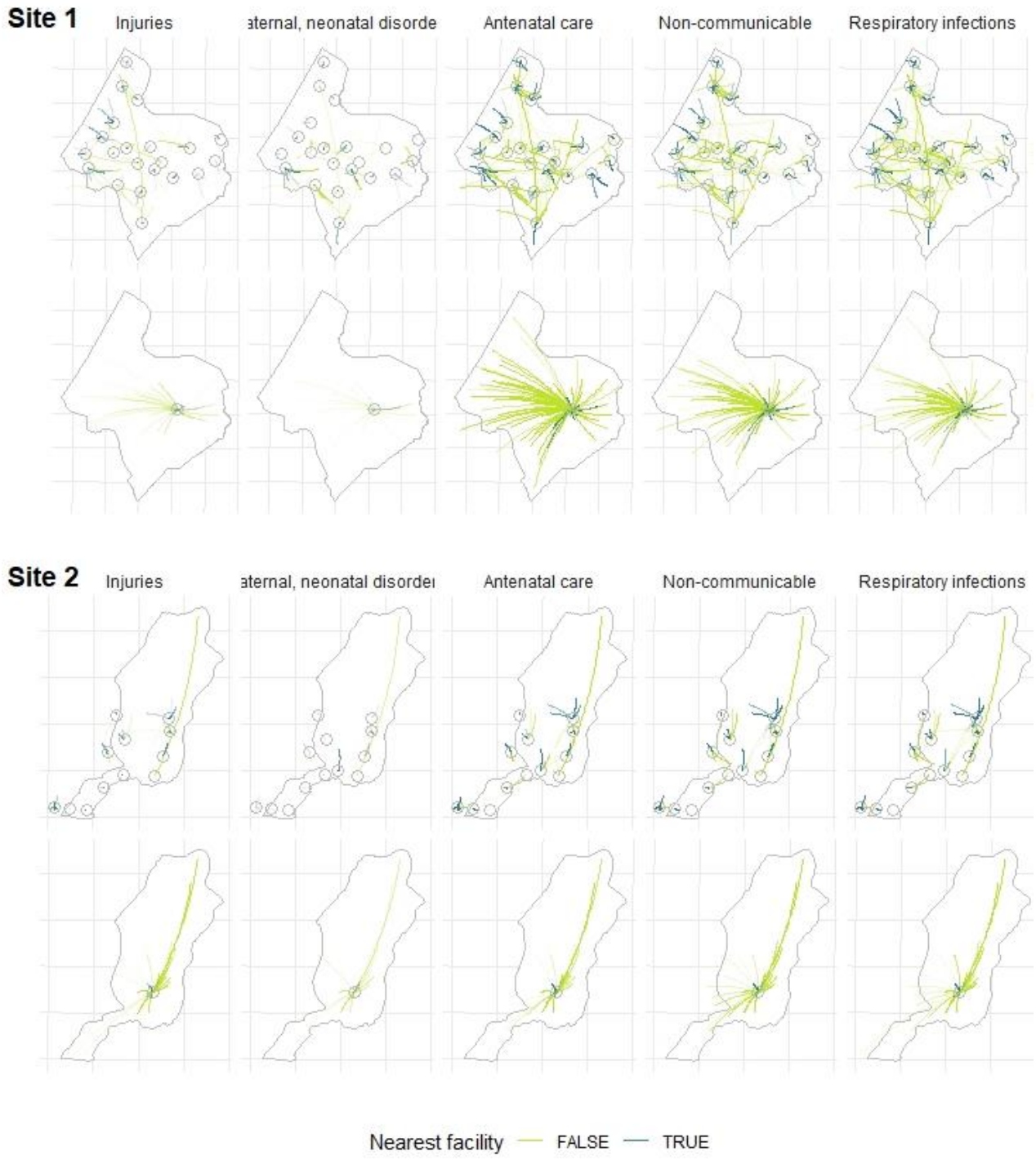

Figure 7-2: Origin-destination flows for individuals bypassing the nearest healthcare facility for selected diagnostic categories in rural areas, Guatemala 2017.

Source: Author's own analysis using data from the study sites

Maternal and child care services explain bypassing behaviour at primary healthcare facilities. Bypassing to primary facilities is observed among individuals seeking services primarily related to antenatal care, users being 26.3% more likely to bypass for this service compared to respiratory infections. The odds for bypassing to a primary healthcare facility also increasing for services related to maternal, neonatal and nutritional disorders. On the contrary, the probability to bypass primary healthcare facilities decline when individuals demand services related to routine child monitoring and contraception.

Bypassing the nearest facility to seek services at second level facilities is associated with healthcare services likely to require greater resolution capacity. Traveling further distances to reach a second level facility was associated with acute need for healthcare, this being exemplified by an increase in the odds for visits related with injuries and for services related with maternal, neonatal and nutritional disorders. Individuals are willing to travel longer distances to visit second level facilities when seeking services to treat chronic conditions or non-communicable diseases. Furthermore, bypassing to second level facilities for sexual and reproductive services is also observed, the odds for bypassing significantly increasing for antenatal care services. The independent models indicate that the probability to traveling longer distances to visit second level facilities for females is mostly associated with antenatal care and maternal, neonatal and nutritional disorders, while bypassing among males is associated with injuries and non-communicable diseases (see appendix A Table 10-5).

There are contextual level factors associated with the probability to travel longer distances than the nearest facility in rural Guatemala. The probability to bypass is associated with the weekday of the visit, the odds increasing for individuals traveling Saturdays and Thursdays compared to those traveling on Mondays. Bypassing behaviour has been increasing with time and the probability to travel further distances might vary across the study sites. Finally, bypassing healthcare services decline among individuals classified at the upper level of the socioeconomic index, a factor that might be related with increased living conditions near the urban centre and the geographic proximity of second level facilities.

7.5 Discussion

This research identified a differentiated demand of services that results from the system regionalisation by exploring the clinical reasons to bypass the nearest facility when seeking healthcare at public healthcare services in Guatemala. Using administrative healthcare records it was possible to identify the most frequent diagnosis across age groups and the clinical reasons associated with bypassing the nearest facility. The findings of this research represent a unique contribution in the academic literature by providing empirical evidence about the link between a structural factor, regionalisation, and bypassing behaviour in a Global South country.

The most frequent clinical diagnosis registered by the healthcare workers differs by level of the healthcare services, an indicator of the differentiated demand. Visits to public healthcare facilities are influenced by the service provision and the installed capacity to provide care. A significant proportion of the individuals seeking services at primary healthcare facilities, services provided by auxiliary nurses attend for communicable diseases, while individuals visiting second level facilities, where professional healthcare workers are available, mainly attend for respiratory infections, maternal care supervision and non-communicable diseases.

The analysis of the most frequent diagnosis by age and sex profile provides some evidence about a service provision that is non-gender neutral. Sexual and reproductive healthcare services for females represent the most demanded services among adult population groups and represent around a third of the visits to second level facilities. The non-gender neutral service provision might be the outcome of multiple factors, including increased healthcare seeking behaviour among females and public policy or organisational priorities (Laslett and Brenner, 1989). Previous authors have argued that prioritising maternal and child healthcare services might be a relevant model for agrarian societies that rely on reproductive strategies to support the structure of the society (Levine and Levine, 2018). However, these non-gender neutral findings are relevant when policies aim for UHC.

Bypassing the nearest facility was observed across age groups, however, the likelihood proportionally increases with age. The increased probability at older age groups can be an indicator of an increased need for services with a greater technical capacity. Previous research has identified that older age groups have increased requirements for healthcare services for chronic diseases (van Oostrom et al.,

2014), on many occasions requiring specialised healthcare provided at higher levels of the health service organisation (Li et al., 2021, Sanders et al., 2017). This research indicate that individuals above 70 years old are less likely to bypass, having similar odds than children bypassing for respiratory infections. This decline might be related to increased out-of-home mobility difficulties, previous research has identified that health status among older age groups reduced mobility factors that might limit the capacity to travel to healthcare services (Nordbakke and Schwanen, 2014).

The odds of bypassing increase for individuals seeking care at second level facilities compared to primary healthcare services. Traveling further distances to seek care at a higher level is an indicator of the increased demand for healthcare services provided by professional healthcare workers. Bypassing behaviour in Global South context has mostly been explored in terms of quality of care exploring antenatal care outcomes, however, this research argues that other factors, mainly regionalisation explain traveling further distances when seeking care. The differentiated demand was identified by exploring bypassing with respect to the clinical diagnostic at the time of the visit.

This research indicate increased probabilities to bypass to visit second level facilities when individuals are likely experiencing an acute need, required specialised services or due to public policy priorities. Traveling further distances for injures and maternal, neonatal and nutritional disorders illustrate bypassing in relationship with acute need of healthcare. Bypassing for diagnostics related to non-communicable diseases at older age groups is likely to indicate the need for specialised care or services provided by a professional healthcare worker. While traveling longer distances for antenatal care services could represent a behaviour from public policy priorities, such as following guidelines to prevent maternal and child mortality (MSPAS, 2010).

This analysis cannot provide information about prior knowledge or the individual's awareness of the healthcare service provision, including quality of care. However, people might make an informed choice based on their prior experience. The study sites involved in the analysis are mostly rural, with very little internal migration; the individuals are much familiarised with the local services, including public healthcare provision. The fact that the majority of users of public healthcare services are those living in the proximities (less than 15 minutes) might be an indicator of the reduce intention to invest much time to seek services at public healthcare facilities, however, there are willing to bypass when having a greater need.

Increasing geographic accessibility in limited resource settings can lead to a trade –off of accessibly above quality (Tanke and Ikkersheim, 2012). Research conducted in Global South countries frequently argues that bypassing facilities is an indicator of the quality of care. Research in this context has mainly focused on antenatal care outcomes, in which bypassing has been observed among visits related to EmOC (Amoro et al., 2021, Bell et al., 2020, Dotse-Gborgbortsi et al., 2020, McLaren et al., 2014). While research exploring individual's willingness to travel longer distances when seeking care for specialised services is mostly available in the Global North context (Wong et al., 2020, Flytkjaer Virgilsen et al., 2019, Aoki et al., 2018). By exploring individuals that have bypassed across age groups, this research provides empirical evidence to understand this phenomenon as an outcome of a structural factor of the system, this might contain aspects of quality of care, such as the availability of healthcare workers.

The probability to bypass the nearest facility can be influenced by factors beyond the individual level. Transport availability and mobility favour traveling longer distances to seek healthcare. This research identified that the probability to bypass increases on Thursday and Saturday, both being specific days for trading goods in the urban centre, this activity increasing the presence of transport. This finding highlights that there might be other contextual factors influencing access to health outcomes, factors related to the habitual activity space (Nemet and Bailey, 2000, Sherman et al., 2005). The probability of bypassing has increased over the analysed period; this phenomenon might be explained by different factors, including changes in the demographic and epidemiological profile.

This research explored the probability to bypass across age groups in relation to the service organisation, with findings likely to be comparable to other rural areas of the country. This research was conducted with some limitations. This analysis uses only those facilities located within the geographic boundaries of the catchment area, ignoring the influence of other public healthcare facilities or providers. There are several limitations related to the diagnostic variable that used the ICD-10 as a proxy indicator of the service provision. This analysis used this diagnostic code irrespective of being a visit for a newly diagnosis or a follow up. It is not possible to identity if patients had a prior health condition diagnosed by other provider. Furthermore, the clinical diagnosis was conceptualised using only individuals with one ICD-10, these disease-by-disease records might provide a distorted view of the morbidities profile (Starfield and Kinder, 2011). Despite this limitation, this research provides evidence about the reduced diagnostic capacity at lower levels of the healthcare services and the relationship between bypassing and regionalisation of healthcare services.

7.6 Conclusion

Bypassing the nearest facility is associated with the differentiated demand for healthcare services that results from the hierarchical organisation of the public health system, regionalisation. The majority of users of primary healthcare facilities in rural Guatemala tend to visit the nearest primary healthcare facility, highlighting a rational choice guided by the least cost. Bypassing the nearest facility not only represents the differentiated demand, it provides some evidence about an increased need for services provided by professional healthcare workers. Despite the rational behaviour, bypassing persists with higher odds to bypass when seeking healthcare services at second level facilities, the first point of contact with a professional healthcare worker.

The hierarchical structure organising the service provision modifies the willingness to travel further distances. Bypassing behaviour increasing significantly among adults, population group's likely to need extensive medical treatments for chronic diseases or co-morbidities. Individuals seeking healthcare services for acute conditions, chorionic illnesses and injuries are more likely to bypass the nearest facility to visit second level healthcare services. Bypassing primary healthcare services increases for cost-effective healthcare interventions, individuals seeking services for non-communicable diseases and antenatal care while declining for routine services such as child monitoring and contraceptive management.

Bypassing behaviour can be influenced by other factors beyond regionalisation, including individual and contextual factors beyond the individual choice. Barriers to bypass were identified among individuals in the oldest age groups, for those only speaking a Mayan indigenous language and with mobility restrictions. The probability to travel seeking care in facilities located at longer distance increases during the days of increased transport availability. Public policy priorities are a factor beyond the influence of the individuals that can modify bypassing behaviour. Public health priories, such as increased focus to prevent maternal mortality have an influence on traveling to second level facilities when seeking antenatal care and childbirth services in rural Guatemala.

Chapter 8 Population demand of primary and second level public healthcare services in rural Guatemala

8.1 Introduction

This thesis explores access to healthcare as the outcome of multiple processes (Donabedian, 1978, Frenk, 1985), however, other definitions are commonly encountered in the literature that the serve further attention. Some authors have framed the research distinguishing between two access dimensions: realised and potential access to healthcare services (Andersen, 1995). The dichotomised concept presented an opportunity, in which potential access to healthcare has been mostly explored in terms of the distribution of resources (Apparicio et al., 2017, Langford and Higgs, 2006, Schuurman et al., 2010). However, there are multiple factors involved in the possibility to gain access to healthcare services and these measures are only one factor to explore differences in the distribution of resources. Instead, this research analyse the demand as a measure of the possibility to gain access to healthcare services, while including factors that might explain differences in potential access, including the spatial distribution of healthcare facilities in Guatemala.

The origins of the Behavioural Model conceptualised access to healthcare as the outcome of dynamic processes between dimensions and structural factors of the health system (Aday and Andersen, 1974), a concept closely linked to the quality concept (Donabedian, 2005). The revised framework reduced the concept and proposed two access dimensions: potential and realised access to healthcare (Andersen et al., 1983). The author defined the potential access dimension as the presence of enabling

resources to provide healthcare services, arguing that the presence of more resources will be translated at a greater likelihood of healthcare utilisation (Andersen, 1995). This dichotomised concept has been widely used to explore access to health, with several authors framing the research within one dimension.

Potential access research has mostly focuses on exploring the distribution of resources. Previous research has focused on measuring the distribution of GPs following a place-based outcome (Haynes et al., 2003, Schuurman et al., 2010). While medical geographers have been concerned with incorporating geographic elements in the measurement, such as the spatial distribution of resources (Khan and Bhardwaj, 1994, Guagliardo, 2004). Methods delimiting the geographic area of influence of healthcare facilities have been commonly applied in studies exploring potential access in Global South countries (Macharia et al., 2021, Juran et al., 2018, Huerta and Kallestal, 2012, Alegana et al., 2020). While some methodological advancements have incorporated spatial and non-spatial attributes in one measure to identify geographic areas with reduced potential access to healthcare (Ebener et al., 2019). However, there are multiple factors involved in the possibility to gain access to healthcare services and these measures are only one factor to exploring differences in the distribution of resources.

The population demand can provide empirical evidence that can be conceptually linked with potential access to healthcare services. The population demand estimates the actual coverage of the healthcare services, it indicates the proportion of individuals that have gained access with respect to the population (Tanahashi, 1978). Different from the most common potential access measures, the demand represents an aggregated estimate of the possibility to gain access to healthcare services. Furthermore, these estimates can be used to identify what communities are likely to have greater potential access than others and to identify factors explaining the differences.

Empirical data about the users and the targeted population is required to estimate the demand, data not frequently available in many countries, therefore, medical geographers have discussed the use of spatial accessibility measures instead (Langford and Higgs, 2006). This research overcomes this limitation by using administrative data for selected rural areas of Guatemala. This research aims to explore the possibility to gain access to healthcare at the community level by estimating the demand for public healthcare services and identifying factors that explain variations, including the spatial distribution of facilities.

8.2 Aim and research questions

This research aims to explore the possibility to gain access to healthcare at the community level by estimating the demand for public healthcare services and identifying factors that explain variations, including the spatial distribution of facilities in selected rural areas of Guatemala.

1. What is the average annual population demand for primary and second level public healthcare services in selected rural areas of Guatemala?

2. Are there differences in the annual population demand for primary and second level public healthcare services that can be explained by sociodemographic characteristics of the population within the communities?

3. Is the annual population demand affected by the spatial distribution of the communities and the public healthcare facilities?

8.3 Data and methods

This research used data from administrative healthcare records routinely collected by healthcare workers at primary and second level facilities within two delimited geographic areas (Fort et al., 2011). The data used for the analysis was previously described in Chapter 4. This research used individual data about the users of public healthcare services and the population counts of individuals located within the catchment areas at least once per year. The analysis includes data from study sites one and two, these are the study areas having healthcare records available for both levels of the public healthcare services provision.

Beyond data about the users and population counts, this analysis used data of the sociodemographic characteristics of individuals. Individual data about the population demographic characteristics, household characteristics and household wealth index. This data was used to create explanatory variables, including travel times to adjust for the spatial distribution of healthcare facilities. Travel times to the nearest primary and second level facilities were estimated by the least-cost-path method

using a Road Based Network analysis using AccessMod 5.6.0 software (WHO, 2017, Ray and Ebener, 2008), as described in Chapter 4. . The healthcare records represents data for all the individuals reported at the catchments areas between 2013 and 2017.

8.3.1. Variables

Outcome variable

This research estimated the annual population demand by identifying the users of primary and second level public healthcare services. The demand represents a period prevalence measure of the proportion of the actual users for each community or populated settlement. The numerator represents the individuals that have visited a public healthcare facility during the year. While the denominator is the number of potential users of public health services, the total population measured in person-years for the same period of analysis in a given community. Person-years are used to account for the time that the individuals contributed while being alive during the year of analysis (Spronk et al., 2019). The prevalence represents the annual demand at community level per 1,000 person-years.

Explanatory variables

Sociodemographic characteristics representative at the community level are explanatory variables used to identify factors associated with differences in the annual population demand of primary and second level public healthcare facilities in rural Guatemala. Summary measures at community level provide information about demographic and social characteristics that are predominant at each community, Table 8-1 describes the indicators. The selection of the explanatory variables is limited to the data available at the administrative records, while the household socioeconomic variable was estimated as described in Chapter 4.

Table 8-1: Variables used to estimate the community sociodemographic index

Variable	Description
Sex ratio	The ratio of the total numbers of males divided total number of females multiplied by 100.
Old dependency ratio	The ratio of the number of counts aged 65 years and over divided the counts at working age (15 to 64 years old) multiplied by 100.
Young dependency ratio	The ratio of the number of population under 15 years old divided the counts at working age (15 to 64 years old) multiplied by 100.
Proportion of population without education	Number of population between 24 to 64 years old without institutionalised education for every other education level multiplied by 100.
Proportion of households at the lowest socioeconomic group	Number of households categorised in the lowest socioeconomic group for every other category multiplied by 100.
Proportion of households with access to electricity	Number of households having access to electricity for every household multiplied by 100.
Proportion of households with access to piped water	Number of households having access to piped water for every household multiplied by 100.

Source: Author's own table

8.3.1 Analysis

The annual population demand for primary and second level public health services was associated with the explanatory variables using Generalised Linear Models. Descriptive statistics for the proportion of population using public services are independently estimated for primary and second level facilities. T-test and ANOVA were used to test differences in the mean prevalence according to the multiple groups. A variance inflation factor less than 4 was used to test multicollinearity among the explanatory variables. Multivariate analysis started with a Poisson regression to model annual demand for primary and second level public services.

The Poisson model assumes that variance is equal to the mean $(\mu) = \mu$, with a fixed dispersion parameter at $\phi = 1$. The conditional variance of this model exceeded the conditional mean, indicating an over dispersed distribution and therefore applying a Negative Binomial model instead. The negative binomial distribution is given by the Poisson-gamma mixture distribution (Hilbe, 2011):

$$\mathrm{p(y)} = \mathrm{P}(Y = y_i) = \frac{\Gamma(y_i + 1/\alpha)}{\Gamma(y_i + 1)\Gamma(1/\alpha)}\left(\frac{1}{1 + \alpha\mu_i}\right)^{1/\alpha}\left(\frac{\alpha\mu_i}{1 + \alpha\mu_i}\right)^{y_i}, \qquad y_i = 0,1,2, \dots n > 0$$

Equation 8-1

Where y_i is the annual demand for services for the *ith* community, Γ is the gamma function, $\mu_i > 0$ is the mean of y_i and $\alpha = \frac{1}{\theta}$ is the over dispersion parameter, when $\alpha = 0$ the model is reduced to Poisson specification. The variance of the negative binomial model $var(Y) = \mu + \frac{\mu^2}{\theta}$ is function of the mean and the dispersion parameter θ. The negative binomial regression model is:

$$\ln(\mu_i) = \beta_0 + \beta_1 x_1 + \beta_2 x_2 + \cdots + \beta_q x_q$$

Equation 8-2

Where $x_1, x_2, \dots x_q$ are the predictor variables for q variables and $\beta_1, \beta_2, \dots \beta_q$ are the estimated coefficients. The model selection was based on the lowest Akaike information criteria (AIC) since the parameters are maximum likelihood estimates. The model coefficients are presented as prevalence ratio, the mean number of individuals actually seeking care at public health services per 1,000 individuals within the community. The models were conducted independently for the demand for primary or second level healthcare services. The data processing and statistical analysis was conducted using R software (version 3.5.1).

8.4 Results

This research aims to understand the possibility to gain access to public healthcare services by exploding the population demand at the community level using empirical data representative of rural Guatemala. The population demand represents an aggregated estimate of the possibility to gain access to healthcare services while identifying the proportion of individuals that have gained access to a targeted population. Differences in the annual population demand were identified in association

with the sociodemographic characteristics of the community and the spatial distribution of public healthcare facilities measured in travel times.

The average annual population demand at the community level of primary healthcare services was 210.2 users per 1,000 person-years [± 39.9, 95% CI] between 2013 and 2017. The annual demand for second level healthcare services is reduced compared to the demand for primary level facilities. The average demand during the period was 93.25 individuals per 1,000 person-years [±14.8, 95% CI]. There are differences in the annual demand for healthcare services for a given year. The average population demand for primary healthcare services for the latest year of the analysis was 223.4 individuals per 1,000 person-years [±19.8, 95% CI] and the average demand for second level services was 105.6 individuals per 1,000 person-years [±14.6, 95% CI]. Table 8-2 describes the average demand for primary and second level public healthcare services between 2013 and 2017.

Table 8-2: Average population demand number of users per 1,000 person-years for primary and second level public health facilities, selected rural areas of Guatemala between 2013 and 2017

	Year	Average demand	Median	± 95% CI	P value
Primary level	2013	276.1	308.1	25.6	<0.001
	2014	230.8	229.0	28.2	
	2015	174.9	161.2	21.1	
	2016	158.4	154.0	20.8	
	2017	223.4	235.3	19.8	
Second level	2013	87.4	55.7	17.4	<0.001
	2014	91.3	61.0	17.2	
	2015	90.2	68.9	16.8	
	2016	90.4	64.1	15.6	
	2017	105.6	78.6	14.6	

Source: Author's own analysis

Differences in the annual population demand at the community level are identified in association with the selected explanatory variables. The fitted coefficients for the multivariate analysis are listed in Table 8-3. The average population demand at the community level was 54.5 users per 1,000 person-years for primary healthcare facilities. The average annual population demand for second level facilities is higher compared to the demand for primary healthcare, there are 101.8 users of second level facilities per 1,000 person-years. The results of this analysis indicate variations in the annual

population demand for public healthcare services associated with multiple factors, including the sociodemographic characteristics of the communities and the spatial distribution of the healthcare facilities.

Higher demand for primary healthcare services is associated with a higher young dependency ratio, an increased proportion of Mayan speakers, an increased proportion of households classified as extended families and communities having a higher proportion of households classified at the lowest socioeconomic group. The demand for second level healthcare services is also associated with similar sociodemographic characteristics, however observing an opposite behaviour for some factors. A higher proportion of Mayan speakers and an increased dependency ratio have a negative effect on the demand for second level services. Other sociodemographic factors are not significantly associated with differences in the demand for second level services.

Table 8-3: Annual demand at the community level per 1,000 person-years of primary and second level public health services, selected rural areas Guatemala 2013-2017.

	Primary healthcare facilities				**Second level healthcare facilities**			
	Prevalence ratio	**95% CI**		**P value**	**Prevalence ratio**	**95% CI**		**P value**
Intercept	85.732	33.57	218.52	<0.0001	101.840	43.434	239.222	<0.0001
Old dependency ratio (%)	1.014	0.975	1.056	0.436	0.991	0.962	1.022	0.5442
Young dependency ratio (%)	1.010	1.001	1.019	<0.05	0.994	0.986	1.001	0.081
Mayan speakers (%)	1.019	1.009	1.029	<0.0001	0.992	0.984	1.000	<0.05
Households with electricity (%)	1.005	0.999	1.011	0.079	1.002	0.997	1.007	0.463
Household with piped water (%)	1.002	0.999	1.006	0.180	1.000	0.997	1.003	0.858
Lowest wealth households (%)	1.014	1.006	1.023	<0.0001	1.006	0.999	1.013	0.098
Time nearest primary facility	0.979	0.972	0.986	<0.0001	1.042	1.036	1.047	<0.0001
Time second level facility	1.016	1.012	1.021	<0.0001	0.958	0.955	0.962	<0.0001
Site 1	Reference				Reference			
Site2	0.416	0.225	0.781	<0.01	1.295	0.778	2.172	0.301
Year 2013	Reference				Reference			
Year 2014	0.845	0.660	1.082	0.179	1.137	0.924	1.399	0.222
Year 2015	0.575	0.450	0.733	<0.0001	0.820	0.668	1.007	<0.05
Year 2016	0.545	0.429	0.693	<0.0001	0.996	0.814	1.218	0.969
Year 2017	0.741	0.581	0.945	<0.01	0.951	0.771	1.172	0.628

Source: Author's own table

The spatial distribution between the communities and the public healthcare facilities is associated with the population demand for primary and second level public services. The annual population demand for primary healthcare services is higher among communities that are located at high travel times to the second level facility. While the demand of second level services increase among communities having to travel lower times and likely having extended travel times to primary healthcare facilities. The findings of this analysis provide evidence about a trade-off between the demand and the spatial distribution of the healthcare facilities. A higher demand for primary services might be influenced by the implications to gain access at higher-level service, including higher travel costs. Figure 8-2 and Figure 8-2 illustrates the trade-off between the demand primary and second level facilities and the spatial distribution of the communities for the 5 years period.

Figure 8-1: Population demand for primary and second level public healthcare facilities, number of users per 1,000 person-years, study site one between 2013 and 2017 Guatemala.

Source: Author's own analysis

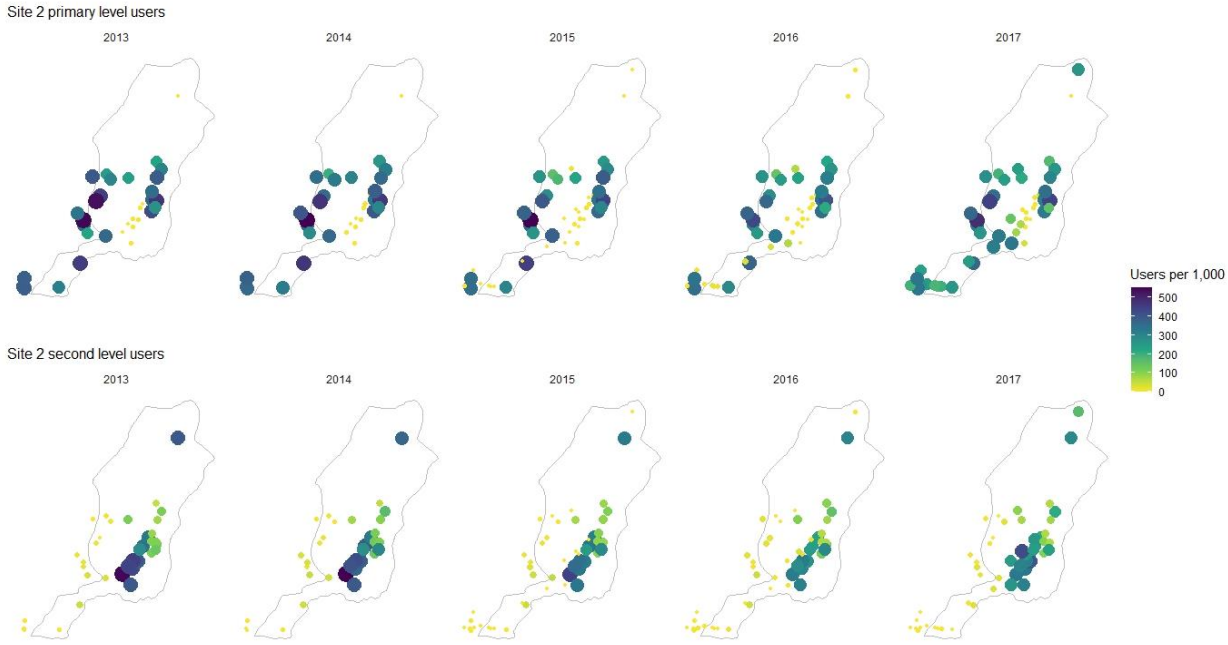

Figure 8-2: Population demand for primary and second level public healthcare facilities, number of users per 1,000 person-years, study site two between 2013 and 2017 Guatemala.

Source: Author's own analysis

The multivariate analysis identified differences in the annual demand associated with the year and study site. The demand for primary level services is lower in 2015, 2016 and 2017 compared to 2013. While the reduced demand for second level services has only been statistically significant for 2015. The demand for primary healthcare services is lower for study site two compared to the population demand at study site one. While the demand at second level facilities is not distinct between study sites one and two. Different aspects might explain these contextual variations, including satisfaction with the services and previous knowledge about the service provision at a given level, however, the data available for this analysis limits this understanding.

8.5 Discussion

This research explored the possibility to gain access to healthcare at the community level by estimating the demand for public healthcare services in the context of rural Guatemala. This research used the actual demand to identify the communities and factors that might enable potential access to healthcare services. Using empirical data on services utilisation and the targeted

population it was possible to determine a trade-off between the demand for primary or second level services and the spatial distribution of the facilities. This analysis contributes to the debate in which access is conceptualised as the outcome of multiple processes involved in the provision of healthcare and “potential access” is mostly conceived as an auxiliary dimension explaining differences in gaining access to healthcare.

On average, the demand for primary healthcare services is higher than the community demand for second level healthcare services. A higher demand indicates a higher number of individuals within a community having the potential access to public healthcare services. However, the models after adjusting for the explanatory variables identified an increased mean demand for second level public healthcare services. This finding might indicate that there are different factors influencing the potential demand and are relevant for explaining the possibility to gain access to second level facilities.

The demand for primary healthcare services can be modified by the sociodemographic characteristics of the communities. The demand for primary healthcare services is higher for communities having a younger population structure, having a higher young dependency rate. This finding might be related to a higher provision of maternal and child healthcare services. A higher capacity to supply these services might favour the demand. Furthermore, the demand for primary healthcare services increases among those communities likely to have greater socioeconomic disadvantages and a greater proportion of Mayan speakers. The increased demand for primary healthcare services among these communities likely having greater socioeconomic disadvantage might be associated with lower resources to travel to other providers.

This research indicate that the population demand for services provided at second level facilities is influenced by the spatial distribution of the communities and the healthcare infrastructure. Higher demand for primary services might be influenced by the implications that might represent gain access to at higher-level service, including higher travel costs and any other aspect that can restrict access. The demand for primary healthcare facilities increasing in highly remote areas while reducing at close proximity to a second level infrastructure. This finding provides evidence of rational behaviour for the trade-off between the demand at a given level and the proximity of the infrastructure.

Different aspects might explain these contextual variations, including satisfaction with the services and previous knowledge about the service provision at a given level, however, the data available for this analysis limits this understanding. Additionally, the decline in the demand for primary healthcare services across the years can possibly be related to changes in the demographic structure, higher demand for private services, among other phenomenon, understanding the decline of the demand in rural areas requires further attention.

The interpretation of the results of the potential demand analysis has to be done cautiously. This environmental level analysis can have co-founder effects and this analysis is limited to the data available, there might be other relevant factors explaining the possibility to gain access to healthcare that have not been considered. Despite the limitations, this research contributes by exploring the potential demand based on empirical data about the users of healthcare services and identifies factors that might explain differences in the population demand, including identifying a trade-off between the demand and the spatial distribution of the services.

8.6 Conclusion

This research identified the annual demand for primary and second level public healthcare facilities for selected rural areas of Guatemala. This measurement provides information about potential access to healthcare services to estimate the actual proportion of the population at the community level likely to visit the healthcare facilities. This analysis provide evidence about what communities are likely to have greater potential to access and identified factors that explain these variations.

This research indicate an increased demand for second level public health services, compared to the demand or primary healthcare services. The demand for primary healthcare services is influenced by the sociodemographic composition of the population. The demand for primary healthcare is influenced by the service provision, demand increasing at communities having a younger population structure. The increased demand for primary healthcare services among these communities likely having greater socioeconomic disadvantage might be associated with lower resources to travel to other providers.

The possibility to gain access to healthcare services is influenced by multiple factors, including the spatial distribution of the healthcare infrastructure and the service provision. This research identified a trade-off between the demand for services and the proximity to the infrastructure. The increased demand for primary services in remote areas might be influenced by the implications of potentially gaining access to services provided at higher-level, including higher travel costs. While the demand for second level facilities will be preferred compared to primary services among communities that are located at close proximity to the second level infrastructure.

Chapter 9 Under-five mortality and potential access barriers in Guatemala

9.1 Introduction

Access to diverse healthcare services can prevent mortality and improve health status across the lifespan (Kindig, 2007, Oliver and Mossialos, 2004). Population-based studies have identified that access to healthcare services, such as immunisation, has been a relevant healthcare intervention for reducing child mortality (UNIGME, 2020, van Wijhe et al., 2016) and for increasing life expectancy at birth (Ehreth, 2003, Salomon et al., 2012). Children in Low-income settings mostly die from pneumonia and diarrhoea, amendable causes of death by the use and timely access to healthcare services (Chopra et al., 2013, Perin et al., 2022, McAllister et al., 2019). Therefore, child mortality is a population health indicator that can be used to explore potential access barriers to healthcare. This research explains differences in under–five mortality rates associated with potential access to healthcare barriers in a Global South country, Guatemala.

Effective public health interventions and improved sanitation have had a relevant impact on child survival in the Global South context in the last three decades (Loaiza et al., 2008). Under-five mortality rates have declined to an average of 38 deaths per 1,000 live births in 2019, with expected variations across regions of the globe (UNIGME, 2020). Multiple factors can explain differences in child mortality levels, including birth spacing, living conditions and timely use of healthcare services (Chopra et al., 2013, Fink et al., 2011, Hobcraft et al., 2010). Timely access to healthcare services, including diagnostics and treatment, has proved to be relevant to prevent mortality from respiratory infections, one of the most frequent causes of child death (Nair et al., 2013, Troeger et al., 2020).

Different factors can delay the timely use of healthcare and multiple barriers are likely to be encountered when seeking healthcare services (Nair et al., 2013, Troeger et al., 2020), these barriers might positively or negatively influence the possibility to gain access to healthcare services (Penchansky and Thomas, 1981). Access to healthcare barriers might differ with respect to the context, for example, geographic accessibility might increase in remotely located areas (Buor, 2003, Mwaliko et al., 2014), while affordability might be a significant barrier among individuals seeking services at private providers (Peters et al., 2008, Falkingham, 2004). Additionally, differences in the distribution and the available healthcare resources can have a distinctive influence on access to healthcare and healthcare outcomes (Schuurman et al., 2010, Whitehead et al., 2020).

Exploring differences in child mortality can provide contextual evidence about difficulties to access healthcare across geographic areas. This research explores the association between potential access to healthcare barriers and under-five mortality across geographic areas in Guatemala. Guatemala was one of the top five countries in the Latin American region with the highest child mortality (You et al., 2010), however, the rates have been declining in recent decades (Wang et al., 2016). Nationally representative estimates have identified that the country has reached the target set for Sustainable Development Goals (You et al., 2015). Despite the significant progress in child survival, within the country differences are likely to be identified, these differences are likely to be explained by potential access to healthcare barriers, including geographic accessibility and availability of public healthcare services.

9.2 Aim and research questions

This research aims to identify variations in under–five mortality rates at municipality level associated with potential access barriers, including geographic accessibility to public healthcare services in Guatemala. This research aim is guided by the following questions:

1. What is the average travel time required to reach the nearest General Practitioner at second level public healthcare facilities from populated settlements in Guatemala?

2. What is the average number of second level facilities available and its association with under-five mortality rates in Guatemala?

3. Which potential access barriers are associated with variations under-five mortality rates at municipality level in Guatemala for 2018?

9.3 Data and methods

This research conducted an ecological analysis using different data sources nationally representative at the municipality level (ADM-2), the lowest level of data reported. The data used included census, vital registration records, land-cover and spatial attributes data. Census and vital registration provided information about population attributes, while spatial attributes data was used to estimate travel times to account for geographic accessibility barriers. Table 9-1 provides a summary of the different data sources used for this analysis.

Table 9-1: Data sources used to estimate the outcome and explanatory variables to identify potential access to healthcare barriers at ADM-2 level in Guatemala

Source: Author's own table the cited references

Data source	Description	Year	Spatial attribute	Reference
Vital registration	Nominal records of births	2018	ADM-2 level	(INE, 2020)
Population census	Nominal records of population and household characteristics	2018	ADM-2 level	(INE, 2019).
Land-cover European Space Agency	Land-cover spatially harmonised by WorldPop	2015	Raster at 3 arc seconds (≈100 m)	(Lloyd et al., 2019)
Population distribution	Spatially redistributed population counts UN projection	2018	Raster at 3 arc seconds (≈100 m)	(Lloyd et al., 2019)
National cartography	Geo-administrative units boundaries	2012	Polygon ADM-2 level	(SEGEPLAN, 2018)
Populated settlements	Geographic coordinates of the populated settlement centre	2002	Polygons and points	(SEGEPLAN, 2018)
Public health infrastructure	Second level public healthcare facilities	2009	Points	(SEGEPLAN, 2018)
Road network	Road network by type of surface	2012	Polylines	(SEGEPLAN, 2018)

Demographic and vital registration data was used to estimate mortality rates and non-spatial factors explaining the differences across geographic areas of the country. Raster data is used to estimate spatial factors explaining access to healthcare barriers, geographic accessibility and availability of second level public healthcare facilities, the nearest point of contact to General Practitioners. Accessibility is conceptualised as a geographic variable measured by travel time to reach the nearest facility and the facility geographic coverage (Delamater et al., 2012, Ray and Ebener, 2008). Figure 9-1 illustrates the use of the data distinguishing between spatial and non-spatial factors to operationalised potential barriers to healthcare.

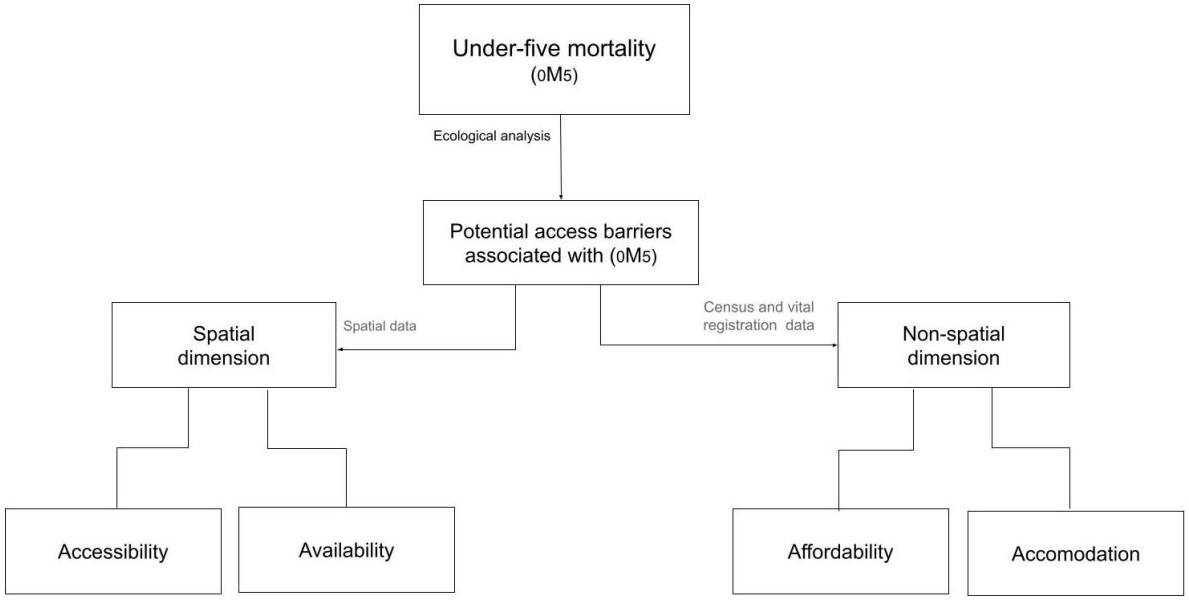

Figure 9-1: Operationalisation of potential access barriers associated with under-five mortality, Guatemala 2018

Source: Author's own diagram

The analysis is representative of the 2018 population census, the latest census available and the country and the covariates correspond to the same year or the closest data available at the time of the analysis. The University of Southampton Ethics and Research Governance Committee (ERGO 62233) approved the use of the secondary data sources to explore potential access barriers at ADM-2 level.

9.3.1 Variables

Outcome variable

Under-five mortality rate (${}_0M_5$) is defined as the probability of a child born in a specific year dying before reaching the age of five (${}_5q_0$) expressed as a rate per 1,000 live births. Under-five mortality rates at ADM-2 level are estimated using direct methods from vital registration and census data representative of 2018. The estimates are derived from a standard period-abridged life table using the number of deaths bellow age one (D_0), the deaths between 1-4 age (D_1) and the mid-year population for both age groups (P_0 and P_1). This estimates used the United Nations Inter-agency Group for Child Mortality Estimation equation (UNIGME, 2020):

Given that: ${}_nq_x$ *Is the probability of dying between age x and age x+n,*

$M_0 = D_0/P_0$ *is death rate for age <1*

$M_1 = D_1/P_1$ *is death rate for age group 1-4*

Then: ${}_1q_0 = M_0/[1 + (1 - a) * M_0]$ *where a is the fraction of year lived by an infant,* a= *0.1 for low mortality country*

${}_5q_0 =$ $1 - (1 - {}_1q_0)(1 - {}_4q_1)$ where ${}_4q_1 = 4 * M_1/[1 + 4(1 - 0.4) * M_1]$

Finally the rate is: ${}_0M_5 = {}_0M_5 = {}_5q_0 * 1{,}000$ live births

Equation 9-1

Explanatory variables

The explanatory variables are conceptually framed as proxy indicators representing potential access barriers, including variables to adjust for four dimensions: accessibility, affordability, accommodation and availability (Penchansky and Thomas, 1981). The inclusion of these variables was limited to the data available for the same year of the population census, these variables are listed in Table 9-2 and described in the following paragraphs.

Table 9-2: Variables used to estimate potential access barriers influencing differences in under-five mortality rates in Guatemala

Access barrier	Variable	Description
Accessibility	Rurality	Proportion of households located in rural areas.
Accessibility	Travel time to second level facilities	Mean travel time from the populated settlements to the nearest public second level facility (nearest GP).
Availability	Second level facilities coverage	Number of second level public health facilities per 10,000 individuals.
Accommodation	Births at public hospitals	Proportion of births delivered at a public hospital.
Accommodation	Births at second level	Proportion of births delivered at public second level facility.
Accommodation	Births at private hospitals	Proportion of births delivered at private hospitals.
Accommodation	Births at the Social Security	Proportion of births delivered at Social Security health services.
Affordability	Highest socioeconomic group	Proportion of households categorised in the highest standards of living quintile.
Affordability	Lowest socioeconomic group	Proportion of households categorised in the lowest standards of living quintile.
Control variable	Population density	Number of individuals per Km^2
Control variable	Ethnicity	Proportion of the population self-identified as indigenous.

Source: Author's own table

Accessibility represents geographical barriers, this variable operationalised by rurality and the average travel time to the public second level facility, healthcare services provided by a GP. Travel times were estimated using raster data by a RNB analysis controlling for travel speed scenarios and topography (Delamater et al., 2012, Ray and Ebener, 2008). The travel times represent the least-coast path estimate for every populated settlement in the country toward the nearest second level facility using AccessMod software 5.6.0 (WHO, 2017). The summary measure for the ADM-2 travel time corresponds to the mean time of every populated settlement.

Availability adjusted for the presence of general practitioners to provide healthcare services for the overall population. This variable followed a container methodological approach to estimate the density of second level public healthcare facilities per 10,000 individuals at the ADM-2 unit was used as a proxy variable of the availability of this service. Accommodation barriers explore factors related to the organisation of healthcare service delivery and the characteristics of the providers (Penchansky and Thomas, 1981). This research used the place for birth delivery as a proxy variable of a differentiated use of healthcare providers across geographic areas. Vital registrations of births

provided nominal data used to identify the proportion of births attended by different providers, including public hospitals, the Guatemalan Social Security (IGSS) and private medical doctors.

Affordability barriers are included by adjusting for accessibility to standards of living at the ADM-2 level. Household asset data from the population census was used to estimate an index for the standards of living. Asset and household characteristics data were transformed into binary dummy variables to construct a summary index representative at the household level. Principal Component Analysis was used as a data reduction method (Filmer and Pritchett, 2001) and the index was independently estimated for urban and rural households due to expected differences. The index was estimated using the first component explaining 18% of the variability in urban households and 23% for rural households.

9.3.2 Analysis

This research explores variations in $_0M_5$ levels associated with potential access barriers following an ecological study approach (Morgenstern, 1995). Ecological studies are commonly used in epidemiological and population research exploring relationships and differences between health outcomes across geographic areas. The analysis starts with descriptive statistics for the estimated travel times and the distribution of living standards (ADM-2). Descriptive statistics estimate average mortality rates and bivariate analysis was conducted to identify mean differences while grouping for explanatory variables. The association between the outcome variable with the explanatory variables was tested using multivariate analysis.

Under five-mortality rates ($_0M_5$) at ADM-2 level were associated with the explanatory variables using Generalized Linear Models. A linear regression model was used to test for multicollinearity among the explanatory variables using a variance inflation factor less than 4. The model residuals were checked to test the linear regression assumptions, finding that this method is not an appropriate model fit. The mortality rates were adjusted using a Poisson regression identifying that the conditional variance exceeded the conditional mean, indicating over dispersion. Given the data dispersion, the negative binomial model is preferred over the Poisson model. The negative binomial distribution $\mathrm{p(y)}$ is given by the Poisson-gamma mixture distribution (Hilbe, 2011):

$$\mathrm{p(y)} = \mathrm{P}(Y = y_i) = \frac{\Gamma(y_i + 1/\alpha)}{\Gamma(y_i + 1)\Gamma(1/\alpha)}\left(\frac{1}{1 + \alpha\mu_i}\right)^{1/\alpha}\left(\frac{\alpha\mu_i}{1 + \alpha\mu_i}\right)^{y_i}, \qquad y_i = 0,1,2, \ldots n > 0$$

Equation 9-2

Where y_i is the dependent non-negative integer for the *ith* observation, Γ is the gamma function, $\mu_i > 0$ is the mean of y_i and $\alpha = \frac{1}{\theta}$ is the overdispersion parameter, when $\alpha = 0$, the model reduces to Poisson specification. The negative binomial regression model is:

$$\ln(\mu_i) = \beta_0 + \beta_1 x_1 + \beta_2 x_2 + \cdots + \beta_q x_q$$

Equation 9-3

Where $x_1, x_2, \ldots x_q$ are the predictor variables for q variables and $\beta_1, \beta_2, \ldots \beta_q$ are the estimated coefficients. The model selection was based on the lowest Akaike information criteria (AIC) since the parameters are maximum likelihood estimates.

The model strategy distinguishes two models, firstly a model including every ADM-2 unit (N=340) and the second model estimates mortality rates removing the municipality that serves as the main geo-political centre of the ADM-1 unit (n = 318). These two models where explored given the distinctive pattern of the explanatory variables for the rural areas. This research tested the presence of a spatial pattern in the distribution of child mortality across ADM-2 units. The spatial pattern was analysed applying rooks' spatial weights to adjust for the ADM-2 neighbour contiguity. Moran's I Global Index (Chi and Zhu, 2007) identified spatial dependence in order to assess the need for spatially weighted regression analysis for the outcome variable. Data processing and statistical analysis was conducted using R software (version 3.5.1).

9.4 Results

This research identified potential access barriers to second level public healthcare facilities across geographic areas of the country while exploring levels of under-five mortality rates, deaths highly amendable by healthcare services. The analysis estimated proxy variables to represent availability, affordability, and accommodation and accessibility barriers, variables described in the following

paragraphs. These explanatory variables were used to explore differences in child mortality levels, in order to identify factors that might influence potential access to healthcare.

The availability of second level public healthcare services was estimated based on population counts and the available number of healthcare facilities within the administrative unit. A, reduced number of facilities available for the overall population was identified. The available number of second level facilities is 0.35 [± 0.06, 95% CI] facilities per 10,000 individuals. The population coverage is lower than the values established by law: one second level facility per 10,000 individuals (Congreso de la República de Guatemala, 1999). Coverage of second level facilities varies across the administrative units (see Figure 9-2), however, the majority of the ADM-1 units having less than one facility per 10,000 individuals (see **Error! Reference source not found.**).

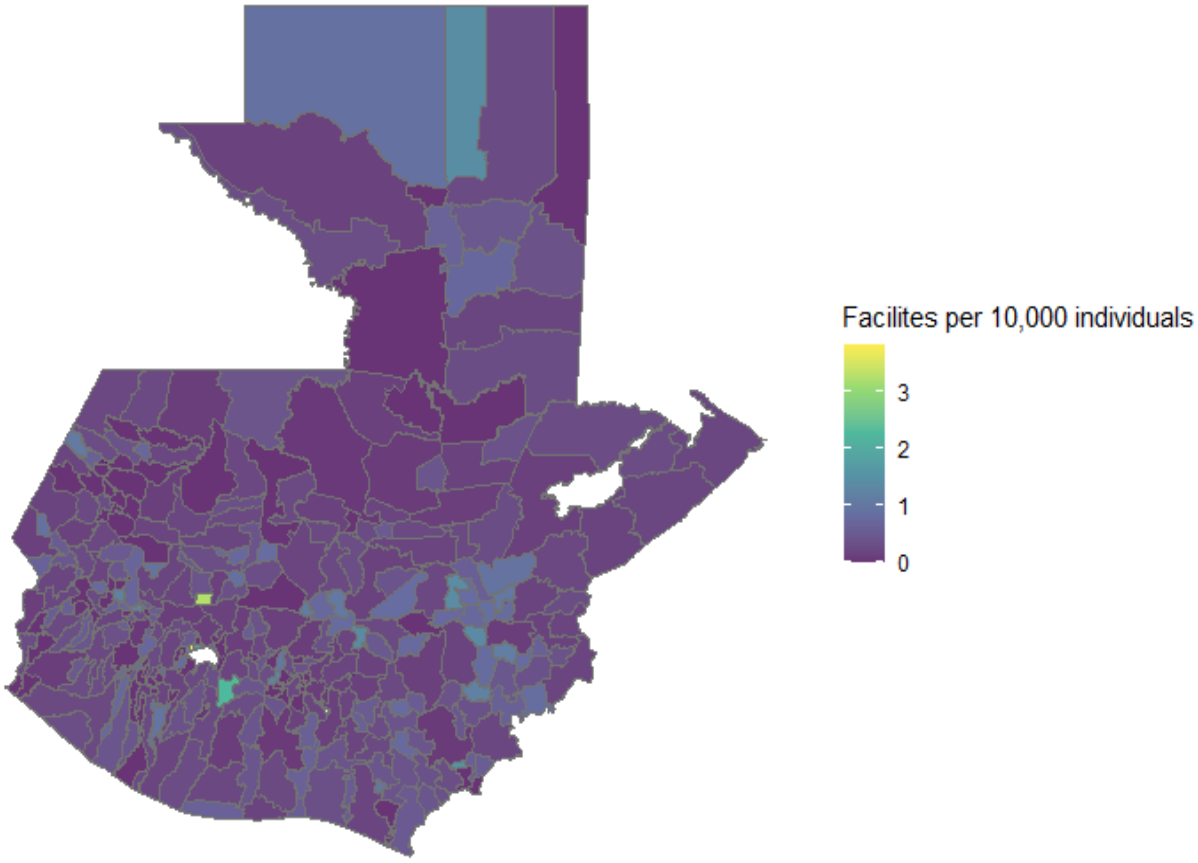

Figure 9-2: Number of second level public healthcare facilities per 10,000 individuals for each ADM-2 level, Guatemala 2018

Source: Author's own analysis using(INE, 2019, SEGEPLAN, 2018)

Table 9-3: Number of second level facilities per 10,000 individuals at the ADM-1 level, Guatemala 2018

ADM-1 name	Mean number of facilities per 10,000	Median number of facilities per 10,000	SD
National	0.35	0.24	0.22
Alta Verapaz	0.18	0.15	0.15
Baja Verapaz	0.40	0.27	0.32
Chimaltenango	0.49	0.31	0.58
Chiquimula	0.47	0.36	0.34
El Progreso	0.59	0.62	0.44
Escuintla	0.33	0.25	0.21
Guatemala	0.27	0.14	0.34
Huehuetenango	0.18	0.10	0.27
Izabal	0.19	0.20	0.05
Jalapa	0.49	0.37	0.39
Jutiapa	0.42	0.43	0.37
Petén	0.41	0.30	0.40
Quetzaltenango	0.41	0.39	0.35
Quiché	0.50	0.31	0.70
Retalhuleu	0.37	0.30	0.26
Sacatepéquez	0.08	0.00	0.14
San Marcos	0.25	0.21	0.23
Santa Rosa	0.45	0.40	0.23
Sololá¡	0.53	0.18	0.94
Suchitepéquez	0.23	0.13	0.32
Totonicapán	0.32	0.19	0.31
Zacapa	0.71	0.81	0.37

Source: Author's own analysis using(INE, 2019, SEGEPLAN, 2018)

Travel times to second level public healthcare facilities were measured as a proxy variable of accessibility, identifying relative shot travel times between populated settlements and the healthcare infrastructure. The mean travel time to reach the nearest second level facility was 50.7 [± 0.73, 95% CI] minutes, while the median travel time is 27.6 minutes, a value lower than the average. The third quintile indicates that 75% of the settlements of the country have a travel time lower than 66.7 minutes. Mean travel time varies across administrative units (see Table 9-4), mean travel times being high at northern geo-administrative regions, having a greater territorial extension, Figure 9-3 illustrates the travel time for each populated settlement.

Table 9-4: Summary statistics for travel time in minutes to reach the nearest second level public healthcare facility at ADM-1, Guatemala 2018

ADM-1 name	Mean time (minutes)	Median (minutes)	SD
National	50.7	27.6	32.3
Alta Verapaz	73.4	54.7	64.2
Baja Verapaz	75.3	47.6	72.5
Chimaltenango	27.2	16.2	29.5
Chiquimula	42.2	32.4	35.4
El Progreso	51.1	29.4	51.8
Escuintla	27.2	19.8	24.4
Guatemala	14.8	10.2	15.3
Huehuetenango	82.4	64.5	70.2
Izabal	99.7	70.4	90.3
Jalapa	37.7	27.5	33.0
Jutiapa	29.9	21.4	26.2
Petén	121.1	86.1	110.3
Quetzaltenango	25.5	15.0	28.7
Quiche	52.6	38.7	48.9
Retalhuleu	38.5	20.8	46.6
Sacatepéquez	11.4	8.3	9.8
San Marcos	46.0	27.4	48.7
Santa Rosa	37.4	26.1	34.2
Sololá	29.9	18.0	33.4
Suchitepéquez	23.8	16.8	21.7
Totonicapán	28.5	21.7	23.3
Zacapa	33.9	18.3	36.8

Source: Author's own table from AccessMod estimated travel times

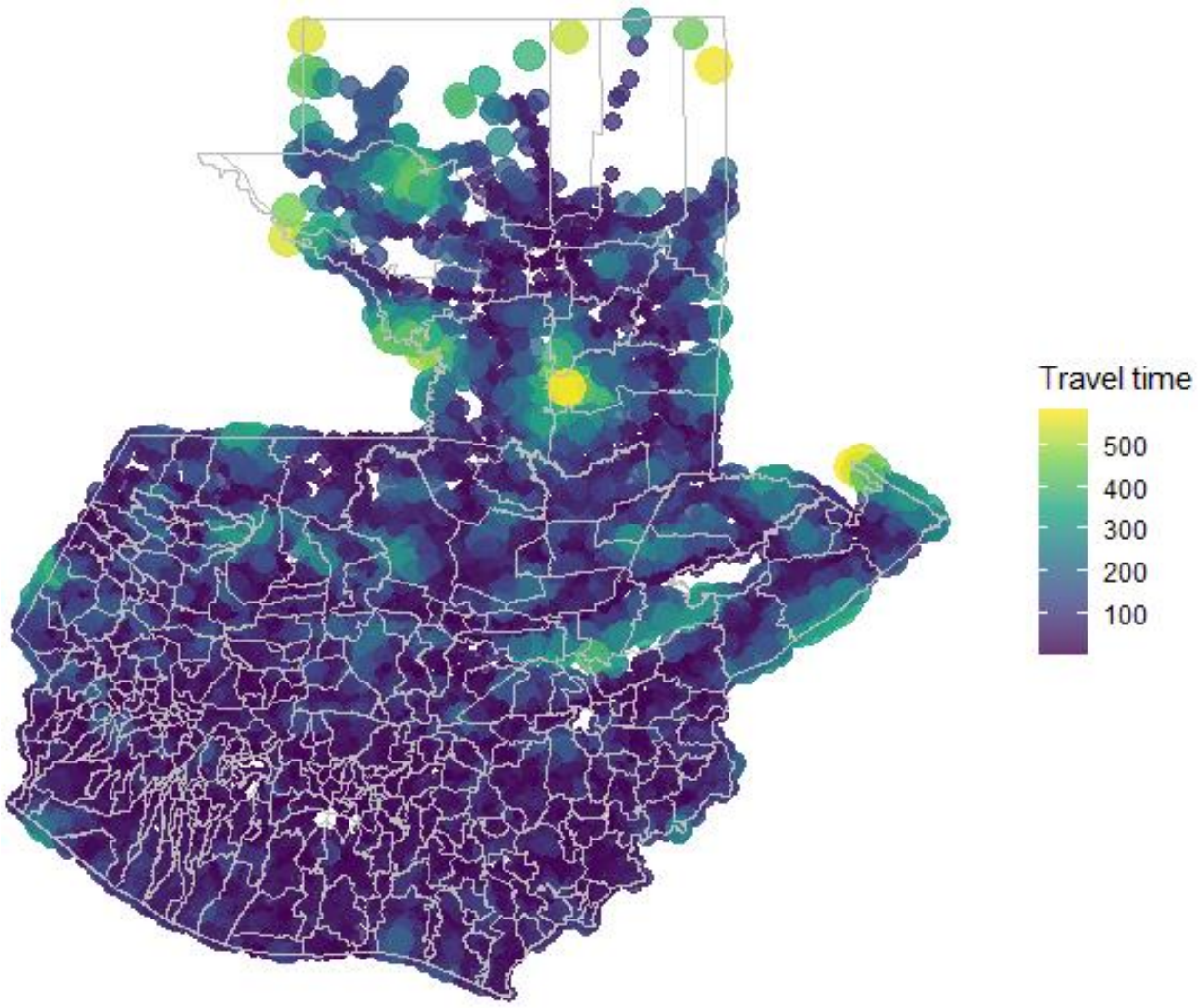

Figure 9-3: Travel time in minutes to reach the nearest second level public healthcare facility for every populated settlement, Guatemala 2002 cartography

Source: Author's own map with travel times estimates from AccessMod.

The geographic coverage of each second level facility was identified by deriving catchment areas adjusting for a maximum travel time and a population capacity. The maximum travel time was set to 60 minutes, based on the third quartile of the travel time to reach the nearest second level facility and 10,000 population capacity. The average travel time to reach the population capacity was 13.5[±1.9, 95% CI] minutes, with only 3% of the facilities not reaching the 10,000 individual capacity. The short travel time to reach the capacity and the residual population that might not be able to receive care despite being physically accessible indicates the reduced coverage of second level services, especially in highly densely populated areas. Figure 9-4 illustrates the travel time to reach the population coverage and the total population living in the travel time for each facility, while Figure 9-5 illustrates the catchments.

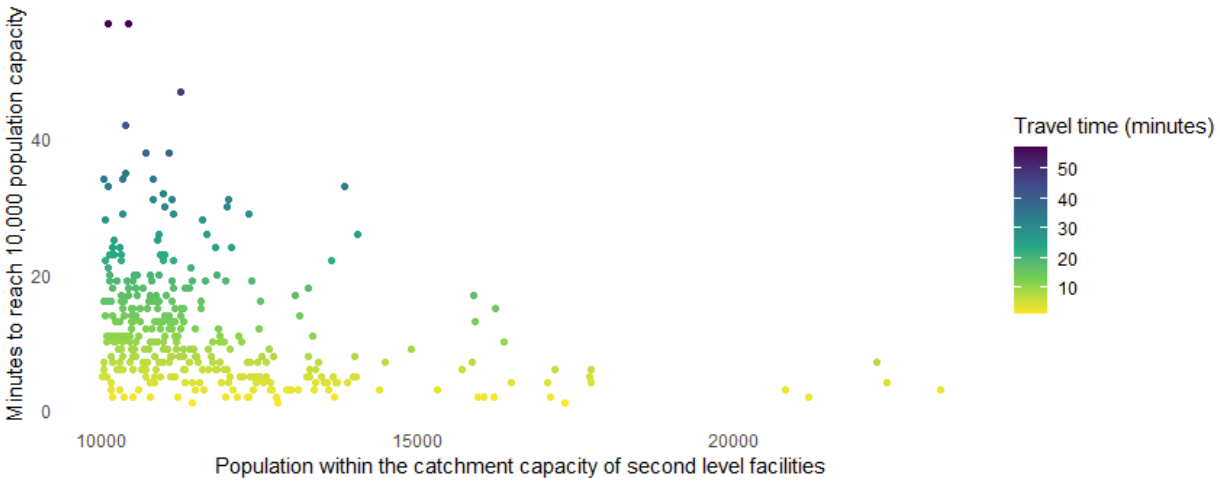

Figure 9-4: The geographic coverage of second level public healthcare facilities, Guatemala 2018

Source: Author's own table from AccessMod estimates

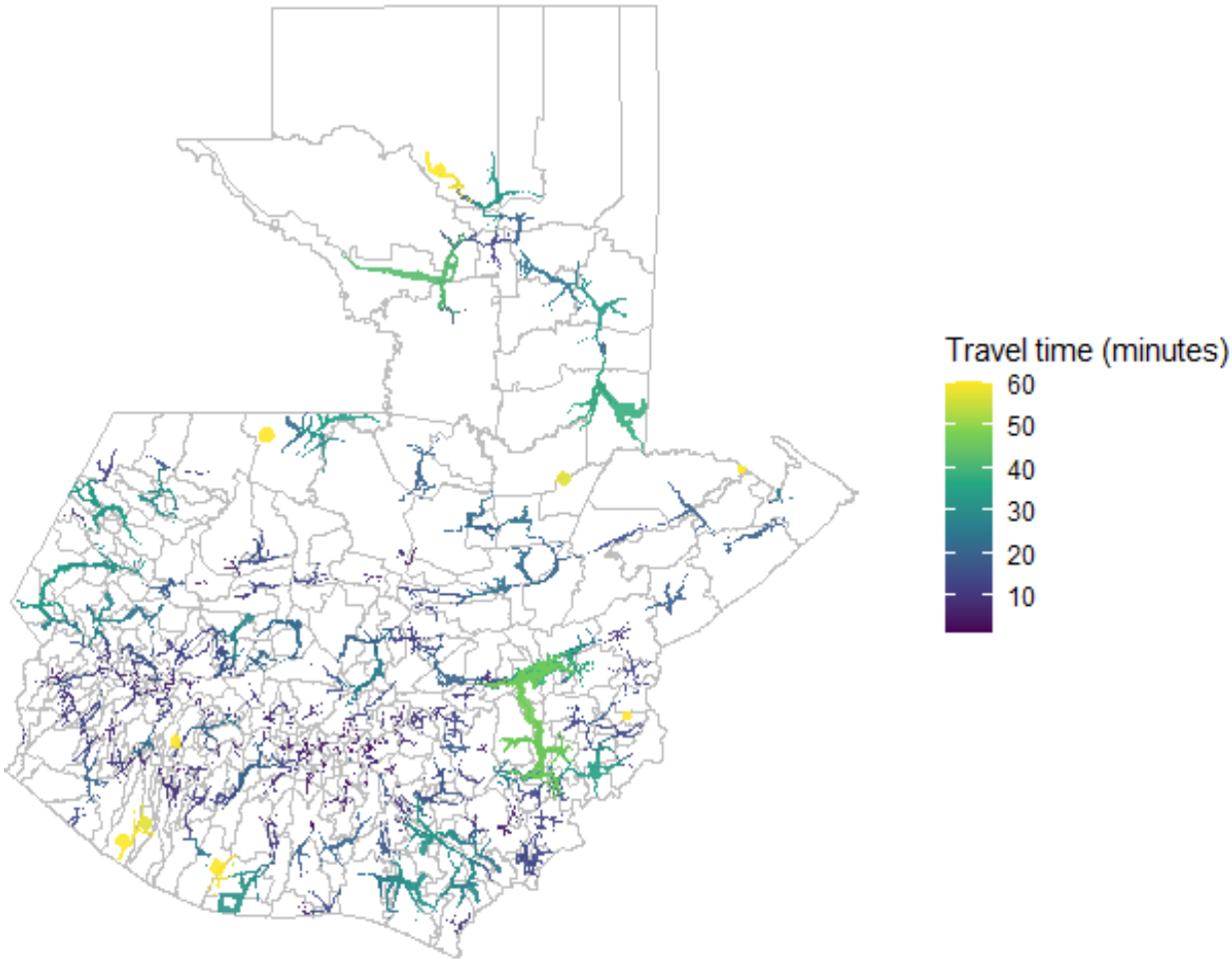

Figure 9-5: Geographic coverage (catchment areas) of second level public healthcare facilities, Guatemala 2018

Source: Author's own map with travel times estimates from AccessMod and using harmised data from (Lloyd et al., 2019)

This research used household asset data to estimate a proxy indicator of access to living standards. The analysis indicate negative scores for the variables likely to represent poor quality of housing materials or reduced wealth, including not having access to sanitation infrastructure (See appendix A Table 10-7 and appendix B Figure 10-6). The household score was classified in categorical variables using quantiles; identifying that on average 24.1% [± 0.98, CI 95%] households are classified at the lowest group. The average proportion of households at the ADM-2 level has the greatest access to living conditions is 13.7% [± 0.57, CI 95%]. There are differences in access to living standards across the country the metropolitan area having better access, Figure 9-6 illustrates the proportion of households having higher living standards at the ADM-2 level.

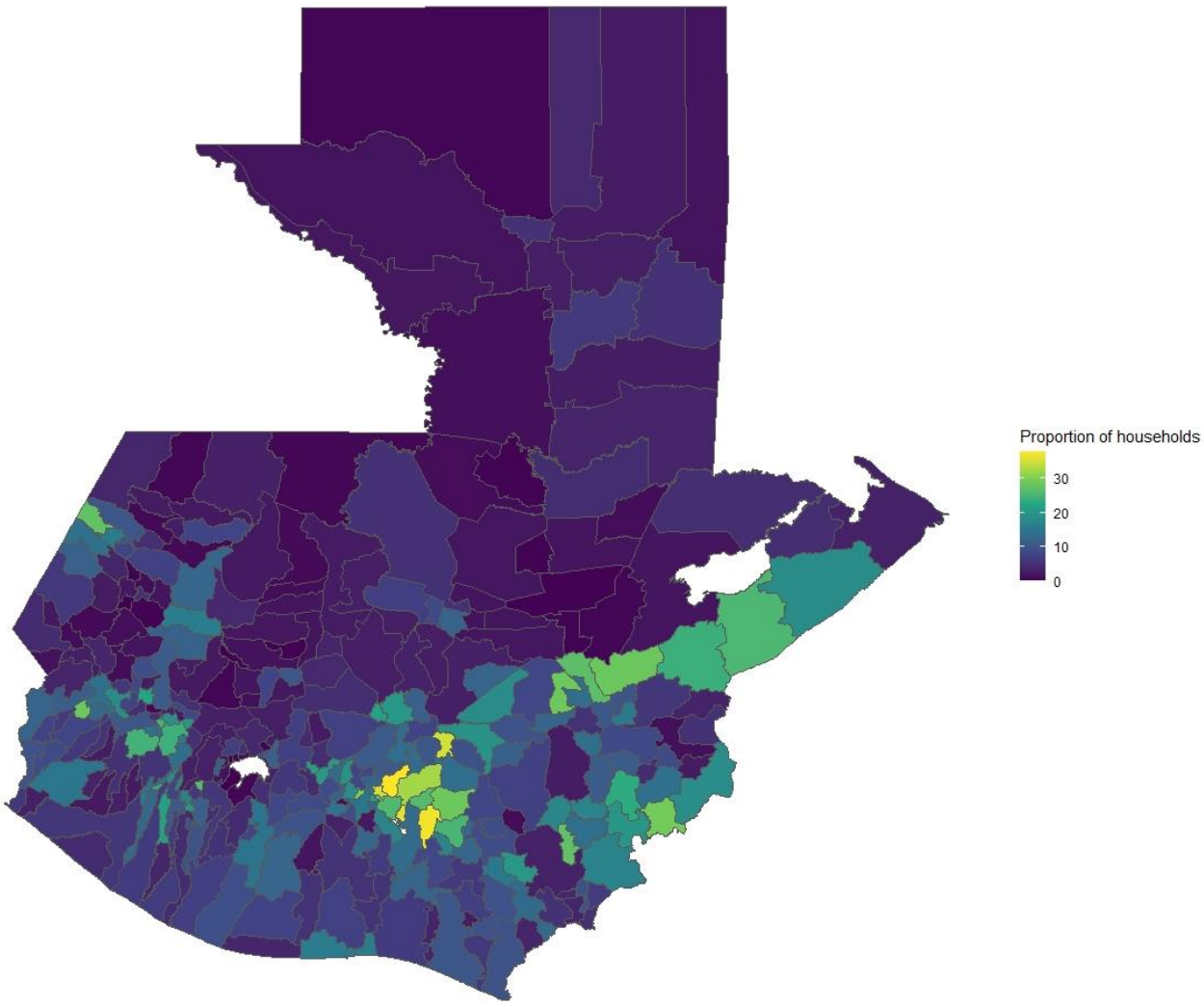

Figure 9-6: Proportion of households categorised at highest standards of living quintile for each municipality, Guatemala 2018

Source: Author's owns estimates using data from (INE, 2019, SEGEPLAN, 2018)

This research used under-five mortality rates (${}_5M_0$) as a health outcome to identify potential access barriers across geographic areas in Guatemala for 2018. The national under-five mortality rate was 20.6 deaths per 1,000 live births. The average mortality rate at the ADM-2 was 15.9 deaths per 1,000 live births [±1.4, 95% CI]. Under-five mortality rates vary across geo-administrative areas of the country, Figure 9-7 illustrates the estimated rates per each municipality in the country.

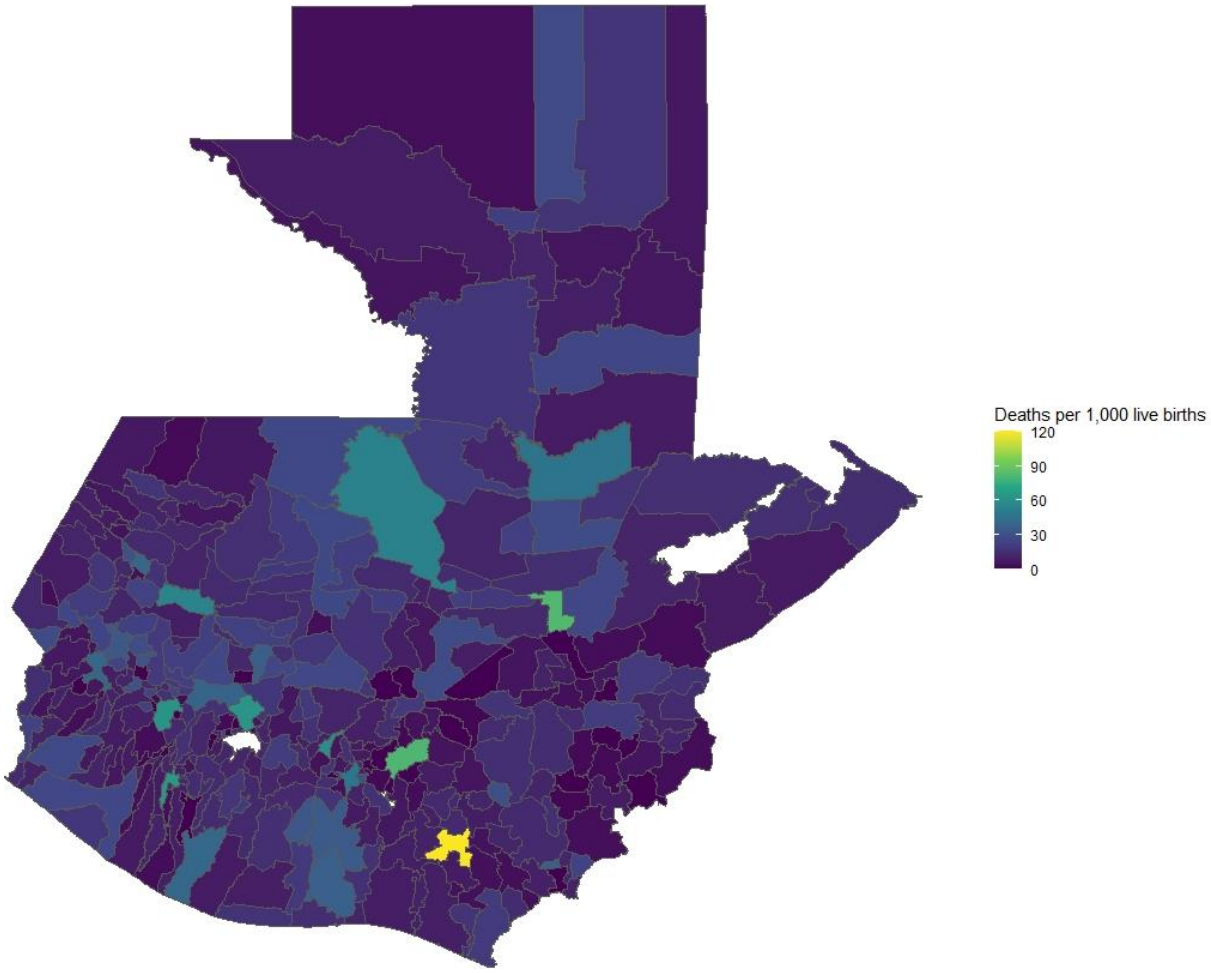

Figure 9-7: Under-five mortality rates (number of deaths per 1,000 live births) at ADM-2, Guatemala 2018

Source: Author's own analysis using data from (INE, 2019, INE, 2020, SEGEPLAN, 2018)

This research identified potential access barriers associated with variations in under-five mortality rates, the model coefficients are described in Table 9-5. The model estimates indicate that the average rate was 21.38 deaths per 1,000 live births [±12.7, 95% CI]. Differences in under-five mortality levels are explained by proxy variables adjusting for availability, affordability and

accommodation barriers, while geographic accessibility to second level facilities is not statistically significant.

Table 9-5: Negative binomial model estimates for potential access barriers associated with under-five mortality, Guatemala 2018

	Incidence rate ratio	**95% CI**		**p value**
(Intercept)	21.376	9.110	50.597	<0.0001
Proportion of households at the lowest wealth group	1.018	1.004	1.033	<0.01
Proportion of households at the highest wealth group	0.983	0.967	0.998	<0.01
Proportion of indigenous population	0.999	0.996	1.003	0.532
Travel time to nearest second level facility	0.999	0.998	1.002	0.832
Second level facilities per 10,000 individuals	0.745	0.617	0.978	<0.01
Proportion of births at public hospitals	1.000	0.992	1.009	0.660
Proportion of births at social security	0.981	0.966	0.998	<0.05
Proportion of births at private hospitals	0.959	0.955	0.981	<0.01
Proportion of births at public second level services	1.008	0.990	1.026	0.375
Population per Km^2	1.007	1.002	1.010	<0.05
Tetha	1.959			
Standard error	0.181			
2 x log-likelihood	-2393.433			
AIC	2419.400			
Moran I statistic	-0.02839			

Source: Author's own analysis

Higher under-five mortality rates are observed in areas with limited access to living standards, conversely, declining in municipalities having greater conditions. Other sociocultural factors, such as a higher proportion of Mayan indigenous population were not significantly associated with differences in child deaths. Increased availability of second level facilities has a significant association. Highly densely populated areas, which are also areas likely to have a reduced population coverage of second level facilities are associated with higher mortality rates. Lower rates are observed in association with a higher proportion of births at the Social Security services and an increased frequency of births attended at private hospitals.

The child mortality analysis controlled for potential barriers related to geographic accessibility. This research used the average travel time to reach the nearest professional healthcare workers free of charge, the second level public health facilities, finding no significant association between travel times and mortality rates. Additionally from adjusting for travel times, the spatial correlation test identified the Moran I statistic as being close to zero, highlighting the random distribution of the mortality rates or the absence of a spatial pattern. The model residuals diagnostics where conducted for the fitted models, see appendix B Figure 10-7: Negative Binomial model residuals diagnostics for under-five mortality rates, Guatemala 2018Figure 10-7.

The analysis conducted for 318 rural municipalities found similar potential access barriers associated with under-five mortality rates. Lower mortality rates are associated with increased access to standards of living, increased availability of second level facilities and births at private hospitals. Different from the previous analysis, under-five mortality rates in rural municipalities are likely to be higher at administrative units having a greater proportion of indigenous population and births delivered at public hospitals, the model regression coefficients are described in Table 9-6.

Table 9-6: Negative binomial model estimates for potential access barriers associated with under-five mortality for rural ADM-2 units, Guatemala 2018

	Incidence rate ratio	**95% CI**		**p value**
(Intercept)	7.959	3.471	18.342	<0.0001
Proportion of households at the lowest wealth group	1.019	1.005	1.034	<0.01
Proportion of households at the highest wealth group	0.977	0.963	0.991	<0.01
Proportion of indigenous population	1.003	1.000	1.006	<0.05
Travel time to nearest second level facility	0.999	0.997	1.001	0.369
Second level facilities per 10,000 individuals	0.788	0.645	0.967	<0.05
Proportion of births at public hospitals	1.009	1.001	1.016	<0.05
Proportion of births at social security	0.991	0.976	1.007	0.275
Proportion of births at private hospitals	0.959	0.938	0.985	<0.05
Proportion of births at public second level services	1.004	0.988	1.020	0.632
Population per Km^2	1.000	1.000	1.000	0.439
Tetha	2.648			
Standard error	0.284			
2 x log-likelihood	-2114.780			
AIC	2140.8			
Moran I statistic	0.0499			

Source: Author's own analysis

9.5 Discussion

Multiple barriers are likely to be encountered to gain access to healthcare. This research explored potential access barriers associated with under–five mortality rates across geographic areas in Guatemala. Using vital registration data and raster data was possible to identify affordability, availability and accommodation barriers, relevant factors that might influence child survival. These findings provide a unique contribution to the Guatemalan access to healthcare literature by exploring the spatial distribution of public healthcare facilities and the effect of potential barriers over a population health outcome highly amendable by access to healthcare services.

This research used travel times to the nearest second level facility to estimate the geographic accessibility barriers to public healthcare services, identifying considerably short travel times between populated settlements and the facilities. The estimated travel times were used as an explanatory variable to explore different child mortality levels, highlighting that geographic accessibility alone is likely to represent a lesser influence on access to healthcare services compared to other factors, such as the availability of second level facilities. This finding is aligned with previous research, identifying a marginal effect in the relationship between distance and child mortality in other Global South country settings (Sarrassat et al., 2019, Kelly et al., 2016). However, previous research exploring access barriers at the individual level has identified geographic accessibility as a relevant barrier to enter and using healthcare services across population groups (Chapters 5 and 6), as well as for children seeking surgical services (Weiss et al., 2018).

The availability of public services identifies the population that should be covered by the available second level facilities available at the municipalities, indicating a very limited number of healthcare facilities providing services for the overall population. On average, there are 0.27 second level facilities per 10,000 individuals, these values being lower than the population coverage parameters stablished by the national policy framework (Congreso de la República de Guatemala, 1999). The potential geographic coverage of the facilities is reduced and the facilities are likely reach the population coverage or carrying capacity at considerably short travel times.

Differences in under-five mortality rates are associated with the availability of healthcare services. Mortality rates are lower in administrative areas having a higher number of second facilities available for the population, also being areas less densely populated. These findings are aligned with previous research in other Global South countries studying the effect of increased service provision, such as professional healthcare workers over infant and child mortality (Fernandes et al., 2014). Increased capacity in these facilities, either by the range of services provided or due to the available resources, might be relevant to treat morbidities and can potentially child mortality.

Accommodation barriers related to the organisation of healthcare service delivery are relevant factors explaining differences in mortality rates. An increased proportion of births attended by Social Security services and at private hospitals is associated with lower under-five mortality rates. This relationship can potentially be explained by greater access and utilisation of healthcare services provided by specialised care workers, as well as a greater financial capacity to afford healthcare services. Previous research conducted in other Global South countries has identified that access to health insurance has a positive effect in increasing utilisation of healthcare and reducing child mortality (Schoeps et al., 2015, Dow and Schmeer, 2003).

Higher mortality rates in Guatemala are associated with lower access to living standards. Research exploring other health outcomes in the country, such as malnutrition and infectious diseases in childhood has identified that the increase in the prevalence is associated with lower socioeconomic status (Schoeps et al., 2015, Dow and Schmeer, 2003). Poor living standards such as reduced access to piped water, sewage systems, the use of firewood and household overcrowding are relevant factors influencing child health outcomes (Tomczyk et al., 2019, Poder and He, 2011, Headey and Palloni, 2019). This relationship is expected, these environmental factors are associated with an increased likelihood of infectious diseases, malnutrition and reduced child survival (Ortigoza et al., 2021).

Differences in under-five mortality rates explored in rural areas are associated with limited conditions to access other services, including social security. Child mortality is higher in municipalities where births at public hospitals are more frequent, a finding that requires cautious interpretation. Previous research conducted in the Western Highlands of the country has found that higher use of services provided by skilled professionals has improved neonatal and prenatal health outcomes (Garces et al., 2015). This association might represent a lower access to physicians

and EmOC at lower levels of the healthcare system, observed by the proportion of births delivered at hospitals, while delayed care might increase child mortality. Lower use of public hospitals for childbirth is observed in areas having a higher proportion of the Mayan indigenous population, likely preferring to be attended by traditional midwives (Berry, 2006a).

This analysis provided evidence about potential access barriers in access to healthcare services across geographic areas of the country. Like most ecological studies there are relevant limitations. Ecological studies are subjected to different limitations, including the misinterpretation of the explanatory variables due to a cofounder effect, cross-level bias and collinearity (Morgenstern, 1995). This research used the smallest spatial unit for data aggregation available, the ADM-2. However, the precision of the areal unit estimates, such as mortality and explanatory variables, are subjected to spatial limitations related to the modifiable unit areal problem (Openshaw, 1984). This place-based methodology assumes null mobility between administrative units, a limitation that applies to the outcome and the explanatory variables.

The outcome variable, under-five mortality rates is estimated following an indirect method and the accuracy of the estimates is restricted by the quality of the data. Vital registration data is likely to miss the registration of child deaths; particularly in rural areas, future research should use direct methods to estimate child mortality. Other limitations are related to the travel times, including the lack of updated geo-located data for public healthcare facilities and methodological considerations. Despite these limitations, this research provided evidence about geographic accessibility and potential access barriers, including the available healthcare services, to explain different child mortality rates.

9.6 Conclusion

This research identified potential access barriers by exploring a population health outcome highly amendable by access to healthcare services. Differences in under-five mortality rates across administrative units are explained by affordability, accommodation and availability dimensions. The distribution of healthcare resources, measured by the availability of facilities having the presence of a General Practitioner and other healthcare resources, is a relevant factor associated with lower levels of child mortality in Guatemala.

The accommodation of healthcare service delivery and the characteristics of the providers have an influence on potential access to healthcare services. The most frequent place of birth explored this association, finding that administrative units having an increased use of private services and access to Social Security had lower under-five mortality rates. However, increased use of public healthcare hospitals during childbirth might represent increased difficulties to access quality healthcare services at the lower levels of the organisation of the public health sector. Despite the positive association between the use of private healthcare and the child health outcome, access to private services is likely to be limited by the affordability dimension.

Limited access to quality standards of living, including access to improved sanitation facilities and drinking-water sources is a relevant factor explaining higher under-five mortality rates. These families might face several barriers limiting access to multiple services, including transport, education and access to healthcare. However, finding that travel times to second level facilities are relatively short. Despite these barriers, the null association between travel times to second level facilities and child mortality levels highlights that geographic accessibility might represent a lesser barrier compared to other factors. The geographic coverage is rather limited by the population capacity and density. Increasing the availability and the capacity of second level facilities might be relevant to prevent child mortality and reduce potential access barriers.

Chapter 10 **Conclusion**

10.1 The context

Health is a fundamental human right and access to medical care is a matter of daily concern for many people. Healthcare services are essential to treat morbidities throughout the lifespan, preserve the wellbeing of individuals and prevent mortality. Social health protection is relevant for economic growth and social development of countries and societies. Conversely, the lack of accessible medical services carries significant social and economic implications, in many contexts pushing individuals into poverty. Despite the widespread relevance of medical care, many individuals encounter limitations to obtain appropriate healthcare services to preserve a healthy life and the active participation in society.

Access to diverse healthcare services is desired to preserve the wellbeing of every individual and this service might favour social development. Therefore, it is relevant to understand the capacity and the conditions to gain access to healthcare services. Understanding access to healthcare requires exploring factors beyond the individual choice, it implicates structural aspects of the health system. The performance of the health system depends on fundamental components to execute essential functions, these include health workforce, financing, governance and others (WHO, 2000, WHO, 2018b). Exploring access to healthcare is a complex endeavour and the multiple aspects of the service provision might pose difficulties to qualify the population capacity to access healthcare services.

Despite the complexity of qualifying a phenomenon that involves multiple dimensions, measuring access to healthcare services might be crucial in order to improve health outcomes across the population. The analysis of access to healthcare provides relevant evidence to evaluate healthcare

system and identify inequities. Access to healthcare measures can provide an assessment of the system's efficiency while understanding barriers or factors that can strengthen the service provision. Systematic evidence about the capacity to benefit from healthcare services can support decision-making and public policy, including the implantation of initiatives that can improve health outcomes, monitoring health equity and understand the potential barriers that might be encountered at public health emergencies.

The interest to understand access to healthcare has led to the development of multiple frameworks and methods to analyse this phenomena. Some access to healthcare analysis have focused on the distribution of resources, while others have assessed the service coverage. The analysis might change according to the research aim, the scope of the project and the data available. It is the case that in many Global South countries there is a poor empirical evidence about exploring access while incorporating aspects of the health system. Access to healthcare studies in these countries frequently analyse a selected group or a service, such as antennal care. These studies can provide relevant evidence, however in many occasions the analysis of these cost-effective services provide a limited overview about the functioning of the system.

10.2 Review about access to healthcare services

Multiple factors and processes are involved in the provision of medical care with the sole aim for individuals to obtain quality services. Access to healthcare is a relevant concept for study given the implications on the wellbeing of individuals and societies. Access to healthcare services is generally described as the probable outcome of dynamic processes that occur between the service provision and the capacity of the individuals to seek and use services at the time of need (Aday and Andersen, 1974, Frenk, 1985, Gulliford et al., 2002). Other authors have proposed to distinguish three dimensions: the structural characteristics, the processes and the outcomes of the delivery of quality healthcare services (Donabedian, 1966).

The outcomes of multiple processes and factors involved in healthcare services delivery are observed and measured among the individuals using the services. Therefore, exploring individual level outcomes are relevant to identify who can benefit from healthcare services and can gain access to quality services. Diverse outcomes that can be used to study access to healthcare services,

including contact coverage, utilisation, continuity of care, trust and other aspects. On the other hand, the attributes of the health systems explore structural characteristics in which healthcare provision occurs, including the resources and organisation of the services. The comprehensive understanding of the healthcare system attributes should include to explore external factors, these include aspects about education, transport and economic factors, these and others are necessary for a functional system.

The conceptual definition of access to healthcare is relevant for having a common understanding of the factors that should be explored when assessing access to healthcare. Exploring access to healthcare is relevant to assess the efficiency of the services provided to the population and for public policy. Therefore it becomes relevant to inquire about how access to healthcare services is measured. There are multiple factors and methods to measure access to healthcare services, some authors have explored access to healthcare services in terms of the distribution of resources (Wang and Luo, 2005, Anand and Bärnighausen, 2004), while many other studies have proposed to explore the coverage of certain attributes of the healthcare services (Tanahashi, 1978, Wagstaff et al., 2007).

The dichotomisation simplifies the measurement, however, the comprehensive analysis requires recognising the influence that structural factors have on individual outcomes. The detailed study of access to healthcare should ideally explore the interrelationship between outcomes, processes and service provision. This raises the question of how we can effectively measure access to healthcare outcomes while accounting for the characteristics of the healthcare system. A comprehensive study of access to healthcare might require to analyse of different outcomes across diverse groups and exploring a range of healthcare services provided at different types of facilities.

The data and methods selection depends on the research questions, for those studies interested in quantifying outcomes for different groups of the population, detailed individual-level data is required. Exploring access outcomes requires extensive data about the users of the services. Administrative records are valuable resources for exploring access to healthcare and are elemental for the operation of the system (Thygesen et al., 2011a). Data about healthcare users is a relevant resource to explore different research questions, including: what is the actual coverage of the services, how far the patients are willing to travel, how important and which factors can modify the

distance-decay effect and finally, whether it is possible to identify a relationship between the health system organisation and impact outcomes.

Exploring the relationship between outcomes, processes and the structural factors for the provision of services might be a challenge in many contexts. In many cases, impact assessments are conducted independently missing to identify factors that might explain the observations. This thesis explores access outcomes while adjusting for structural factors of the service provision, the regionalisation of healthcare services. Regionalisation serves to organise the demand by distinguishing distinctive levels for service provision while aiming for the efficient allocation of resources (Lewis, 1977, WHO, 2012). Within this thesis is argued that the differentiated provision might influence health seeking behaviour and the actual use of healthcare services. Using administrative records it is possible to explore access to healthcare outcomes for two levels of the service provision and the reasons to bypass while seeking services provided at a higher level.

Detailed information about the users is a relevant data source that can be used to identify the efficiency of the services and access inequalities (Beckman and Anell, 2013, Gerdtham, 1997, Sortso et al., 2017). However, these detailed data registers are mostly available in countries having a robust administrative data collection system. This constraint poses a significant challenge in many Global South countries, where access to detailed data is often scarce. The comprehensive study of access to healthcare across population groups and the analysis of the relationship between service organization and outcomes is limited in Global South countries. This context might explain the relevance and appeal of the UHC summary measure to qualify the effectiveness of health systems despite not being able to represent the majority of treatment episodes (Wagstaff and Neelsen, 2020, Wagstaff et al., 2007).

10.3 Access to healthcare services findings in Guatemala

This thesis contributes to the literature by exploring access to healthcare outcomes using a health system perspective analysing a Global South country. The analysis studied the relationship between access outcomes and structural factors of the public service provision by identifying who benefits from the services provided at two levels of the organisation. This research was possible to conduct by using administrative healthcare records of individuals located in selected rural areas of the country, providing nominal records for every visit to healthcare facilities.

A reduced proportion of the population in rural areas uses regularly the public healthcare services. The contact coverage and utilisation levels are further reduced for individuals seeking services at second level facilities compared to primary healthcare services. These findings provide evidence about the limited reach of public healthcare services in Guatemala. However, it is relevant to mention that the coverage varies according to the services level and the population group being analysed. Under-five-year-old children and women of reproductive age exhibit higher coverage and utilization levels of services at both levels of public services. The predominance of these two population groups highlights the main beneficiaries of public services correspond to the public policy and global health prioritised groups.

The analysis revealed significant inequalities in access to public health services. The inequalities are observed considering demographic and the social characteristics of the users. Teenagers, adult males' population and older age individuals are found to have less contact and utilisation of the public healthcare services for both levels of the organisation. Older individuals, who are likely to have increased healthcare needs, are also the least seeking and using these services. Additionally, differences among ethnic groups further highlight the presence of access to healthcare inequalities. Mayan indigenous population groups, facing higher social vulnerabilities and language barriers, tend to seek and use fewer public healthcare services compared to other groups.

This research found that there are both, spatial and non-spatial factors associated with access to public healthcare services in rural areas in Guatemala. Travel times to the nearest public healthcare facilities are considerably short for the majority of populated settlements in the study areas. Despite the geographic proximity this research indicates that the most frequent users of public healthcare services are the individuals located at a very short travel times from the healthcare facilities. The spatial dimension was further analysed by exploring the distance decay-effect. Increased travel times have a significant effect in the decline of utilisation of public healthcare services. This geographic accessibility barrier is more pronounced for second level services and those individuals located in remote areas who are likely to face greater socioeconomic disadvantages that might limit mobility.

The beneficiaries of the public healthcare services are greatly located at a very close proximity to the facilities. However, health-seeking behaviour is significantly influenced by the specific

healthcare needs of individuals. This research explored seeking behaviour among those users likely to require palliative care or services to prevent mortality. The findings show a higher demand for second level services located at further distances, resulting in lower demand for primary services. The willingness to travel extended distances when seeking healthcare services was further explored by analysing factors associated with bypassing behaviour.

Bypassing behaviour increases for individuals going to second level facilities while seeking services to treat injuries, acute conditions and non-communicable diseases. Bypassing healthcare services is associated with the service delivery at a given level of the service provision. These findings highlight that individuals follow a rational behaviour when seeking healthcare services, this behaviour is largely guided by the differentiated provision of healthcare services, the regionalisation of the demand, a characteristic considered a structural factor of the healthcare system. Furthermore, the capacity to bypass healthcare facilities in rural Guatemala might be associated with external factors of the healthcare system, including access to transport.

Access to healthcare services is relevant across geographies of the country and it is necessary for every individual of the population. Timely access to healthcare services is relevant to prevent mortality across population groups, including child deaths. Child deaths are highly preventable and amendable by quality healthcare services. Exploring access to healthcare outcomes across the geographic areas of the country is limited to the data available. Therefore, this research used the available information about child deaths to identify differences in child mortality explained by potential access to healthcare barriers.

The analysis indicates that the availability of resources (the presence of facilities with General Practitioners), is a relevant factor associated with lower levels of child mortality in Guatemala. However, it is relevant to mention that Guatemala healthcare system is fragmented and other healthcare providers have a relevant role in access to healthcare. This research found lower levels of child mortality associated with the increased coverage of Social Security and increased use of private healthcare services. Understanding access to healthcare in settings with a fragmented system with multiple healthcare providers might increase the difficulties to assess or estimate a UHC measure representative of the population.

10.4 Policy implications

Access to diverse and comprehensive healthcare services is essential for the wellbeing and social development of the population in Guatemala. Despite the relative economic progress observed in recent decades, issues that adversely affect the health status of its people, such as persistent poverty and limited access to public healthcare services remain present. Fundamental findings of this research highlights access inequalities, with certain demographic groups and rural areas facing significant barriers. This research not only provide valuable evidence but also serve to identify implications for public policy that can support efforts to improve access to healthcare.

1. Addressing poverty and social vulnerabilities:

Differences in population health outcomes in Guatemala have been associated with social determinants, poverty, reduced education and ethnic background being aspects that exacerbate vulnerabilities of the population. High poverty levels limit access to essential services, including access to public healthcare services funded by general taxation. This research indicates limited coverage of primary and second level public healthcare services across population groups. Poor access to public healthcare services might drive individuals to seek healthcare services at other providers, phenomenon that might increase the risks of poverty in a country due to catastrophic healthcare expenditures. The Guatemalan government should prioritize poverty alleviation strategies, particularly in settings of high poverty prevalence and with high governance challenges. The implementation diverse public health policies might be required, including to strengthening regulatory mechanisms, disease prevention, including to reduce labour health risks. Several of these public policies might be outside of the direct influence of the healthcare sector.

2. Targeting and prioritising groups:

Strengthening the public healthcare services to improve access to healthcare and increase UHC is relevant across population groups. However, healthcare equity can be fostered by vertical interventions to allocate scarce resources efficiently while targeting populations. This research shows that certain population groups, such as children under five and women of reproductive age, benefit more from public services. Despite the limitations, there has been progress in health outcomes among the prioritised groups and other vertical strategies could expand the services to other vulnerable groups, including older age individuals facing vulnerabilities and barriers accessing

healthcare services. Implementing targeted social protection programs can ensure that those who need healthcare the most have adequate access and financial protection.

3. Strengthening public healthcare service provision:

The poor capacity of the public healthcare sector limits the possibility to gain access to healthcare services. Despite the reduced coverage of publicly funded healthcare services, they remain a critical source of medical care, particularly for the underserved population and those in remote areas. This research indicates that the population follows a rational behaviour while seeking services provided at public facilities by choosing the nearest facility and likely having a conscious use of the services. Access to public healthcare services in Guatemala is mostly limited by the governmental capacity to provide services to the population. Strengthening the public healthcare service provision implies increasing the coverage, extend the range of healthcare services and enhance the technical capacity, these are fundamental aspects to favour access to healthcare. Nevertheless, this attempt might imply a significant increase in the allocation of resources; the public health expenditure should be increased, the accountability of budget allocation and expenditure should improve, alongside improving the capabilities of the health workforce, and many other aspects that required for administration and functioning of an institution.

4. Improve the service organisation and regionalisation:

Access to public healthcare services is highly influenced by the structural characteristics of the service provision, the available resources and the organisation of the services. This research provides evidence of access outcomes modified by the regionalisation of healthcare services. The regionalisation of healthcare services is an essential structural aspect organising the demand and the distribution of resources. However, it must be strengthen to achieve greater efficiency and equity in access to healthcare in Guatemala. The services provision at primary healthcare services are inefficient and provide a reduced range of treatments, modifying seeking behaviour at public services. The government should assess the current organisation and the procedures used to distribute resources and strategically plan service provision to ensure fair and effective coverage across the country.

5. Addressing access barriers:

Healthcare inequities are expected and addressing access barriers is crucial to promote equitable healthcare services. The findings of this research identified relevant barriers to access public healthcare services in Guatemala. This research indicate that geographic accessibility to public healthcare services might represent a lesser barrier compared to other factors, such as the availability of the services. However, geographic barriers might be more relevant in rural areas and among vulnerable populations likely experiencing greater mobility and affordability barriers. Public policy in this context should improve the transportation infrastructure and other strategies, such as mobile healthcare units. Likewise, other types of access barriers might challenge equal access to healthcare in the country.

10.5 Concluding remarks

Access to healthcare is the outcome of a complex phenomenon that involves many factors, including the structural characteristics of the healthcare system and processes for rendering the services. The comprehensive understanding of access to healthcare provides empirical evidence that can be used to evaluate the health system performance and for decision-making. Measuring access to healthcare outcomes requires exploring various indicators at the individual level while adjusting for the interrelationship between the healthcare system's characteristics and service provision.

Exploring the relationship between outcomes, processes and the structural factors for the provision of services might be a challenge in many contexts. Detailed data such as administrative healthcare records are a limited resource in many countries, and household surveys are the most predominant data source in Global South countries. However, the demographic scenario is transitioning in many countries and these surveys might miss to capture the needs across age groups and for a range of different treatments. Future research should explore how the available data sources in these countries can be enhanced to provide indicators that can depict the complexity of gaining access to diverse healthcare services.

This research provides a unique contribution in the literature by exploring access to healthcare services exploring structural attributes of the healthcare delivery in a Global South country. Guatemala was the scenario for the case study and the research provided empirical evidence that can be used for public policy. Strengthening the public healthcare service provision in Guatemala is

crucial but this aim will likely demand a substantial increase in resources, invest in a health information system and improve the diagnostics and human resources capacity. Furthermore, improving the public healthcare system requires improved access to higher education, strong regulatory mechanisms, improve governance and other aspects necessary for the operation of a health system. However, translating these policy recommendations into practice might not be simple in countries with a fragmented healthcare sector. Nonetheless, improving access to healthcare is fundamental and public policy efforts should focus on achieving equitable healthcare services for all to support the wellbeing and development of the population.

Access to healthcare concept might have been adjusted alongside with the transformation of healthcare services. Market-oriented health services have gained relevance in many Global South countries and fragmented healthcare service provision are commonly observed. This research indicate a rational behaviour while seeking services and gaining access to public healthcare services in rural areas. Future research should explore if reduced access to public healthcare services have an impact on demographic trends that are associated with economical decisions, such as such as fertility and migration.

Appendix A Tables

Table 10-1 Sociodemographic factors associated with the individual odds for seek services at least once per year at primary healthcare facilities for each study site, Guatemala between 2013 and 2017

	Site 1				Site 2				Site 3				Site 4			
	Odds	95% CI		P value	Odds	95% CI		P value	Odds	95% CI		P value	Odds	95% CI		P value
Age structure																
<5	1.000				1.000				1.000				1.000			
5-9	0.397	0.377	0.418	<0.0001	0.235	0.218	0.254	<0.0001	0.404	0.358	0.455	<0.0001	0.338	0.299	0.381	<0.0001
10-19	0.308	0.296	0.321	<0.0001	0.149	0.140	0.158	<0.0001	0.342	0.310	0.377	<0.0001	0.210	0.190	0.233	<0.0001
20-29	1.028	0.987	1.071	0.181	0.403	0.378	0.429	<0.0001	1.198	1.084	1.324	<0.0001	0.526	0.473	0.585	<0.0001
30-39	1.363	1.302	1.427	<0.0001	0.543	0.508	0.580	<0.0001	1.526	1.365	1.706	0.000	0.881	0.785	0.987	0.029
40-49	0.872	0.827	0.918	<0.0001	0.438	0.406	0.471	<0.0001	1.116	0.986	1.263	0.083	0.681	0.604	0.768	<0.0001
50-59	0.565	0.532	0.600	<0.0001	0.314	0.288	0.342	<0.0001	0.720	0.625	0.829	<0.0001	0.560	0.490	0.641	<0.0001
60-69	0.488	0.454	0.525	<0.0001	0.305	0.275	0.338	<0.0001	0.605	0.513	0.713	<0.0001	0.479	0.416	0.551	<0.0001
70-79	0.399	0.363	0.439	<0.0001	0.291	0.253	0.334	<0.0001	0.625	0.507	0.770	<0.0001	0.494	0.415	0.589	<0.0001
79>	0.223	0.193	0.258	<0.0001	0.221	0.180	0.270	<0.0001	0.521	0.393	0.692	<0.0001	0.287	0.223	0.370	<0.0001
Sex																
Female	1.000				1.000				1.000				1.000			
Male	1.053	1.008	1.099	0.021	1.038	0.969	1.111	<0.00001	1.033	0.928	1.149	0.555	0.976	0.870	1.096	0.683
Age * Sex																
5-9 * male	0.817	0.760	0.879	<0.0001	0.797	0.716	0.886	<0.0001	0.961	0.813	1.134	0.635	0.821	0.692	0.975	0.024
10-19 * male	0.339	0.318	0.361	<0.0001	0.392	0.358	0.430	<0.0001	0.403	0.351	0.464	<0.0001	0.541	0.468	0.626	<0.0001
20-29 * male	0.079	0.073	0.085	<0.0001	0.090	0.081	0.101	<0.0001	0.072	0.061	0.084	<0.0001	0.091	0.075	0.110	<0.0001
30-39 * male	0.113	0.105	0.123	<0.0001	0.104	0.093	0.117	<0.0001	0.107	0.090	0.127	<0.0001	0.093	0.077	0.113	<0.0001
40-49 * male	0.209	0.192	0.228	<0.0001	0.153	0.135	0.174	<0.0001	0.160	0.131	0.195	<0.0001	0.178	0.147	0.215	<0.0001
50-59 * male	0.307	0.278	0.340	<0.0001	0.263	0.228	0.304	<0.0001	0.367	0.297	0.454	<0.0001	0.252	0.204	0.311	<0.0001
60-69 * male	0.371	0.330	0.416	<0.0001	0.379	0.324	0.442	<0.0001	0.417	0.327	0.532	<0.0001	0.442	0.352	0.555	<0.0001
70-79 * male	0.498	0.432	0.574	<0.0001	0.510	0.417	0.623	<0.0001	0.528	0.390	0.716	<0.0001	0.600	0.462	0.780	<0.0001
79> * male	0.915	0.746	1.122	0.391	0.783	0.579	1.060	0.113	0.654	0.438	0.975	0.037	1.459	1.024	2.080	0.037
Death period																
No	1.000				1.000				1.000				1.000			
Yes	0.523	0.418	0.654	<0.0001	1.084	0.844	1.392	0.530	0.843	0.533	1.333	0.465	0.510	0.346	0.751	<0.0001
Wealth																
Lower	1.000				1.000				1.000				1.000			
Middle	0.908	0.886	0.930	<0.0001	0.925	0.893	0.958	0.291	0.848	0.795	0.904	<0.0001	0.805	0.764	0.848	<0.0001
Upper	0.768	0.747	0.789	<0.0001	0.728	0.702	0.754	<0.0001	0.682	0.626	0.744	<0.0001	0.661	0.621	0.704	<0.0001
Ethnicity																
Non-indigenous	1.000				1.000				1.000				1.000			
Indigenous	0.912	0.875	0.950	<0.0001	1.022	0.707	1.478	0.909	0.931	0.858	1.010	0.084	0.869	0.757	0.998	0.047
Unknown	0.914	0.815	1.024	0.122	0.998	0.680	1.464	0.992	0.904	0.809	1.010	0.075	0.617	0.460	0.827	0.001
Spoken language																
Spanish	1.000				1.000				1.000				1.000			
Indigenous-spanish	0.909	0.870	0.950	<0.0001	0.937	0.763	1.150	0.532	0.912	0.846	0.984	<0.0001	0.983	0.894	1.080	0.716
Indigenous	0.723	0.622	0.841	<0.0001	1.052	0.856	1.292	0.631	0.766	0.679	0.866	0.018	0.799	0.661	0.966	0.021
Time nearest																
<5	1.000				1.000				1.000				1.000			
5-9	1.381	0.695	2.744	0.357	0.752	0.114	4.947	0.767	0.107	0.001	18.350	0.395	0.064	0.027	0.152	0.002
10-14	1.132	0.623	2.058	0.684	0.747	0.113	4.921	0.762	0.117	0.001	11.253	0.357	0.075	0.002	0.034	0.000
15-29	1.296	0.739	2.271	0.366	2.670	0.523	13.632	0.238	0.124	0.003	5.605	0.283	0.060	0.031	1.178	0.064
30-59	1.272	0.623	2.595	0.509	0.262	0.014	4.846	0.368	0.164	0.004	6.856	0.342	0.038	0.004	0.326	0.014
>59	0.932	0.204	4.255	0.927	1.968	0.089	43.337	0.668	0.781	0.008	78.426	0.916	0.001	0.000	60.318	0.814
Year																
2013	1.000				1.000				1.000				1.000			
2014	0.712	0.690	0.734	<0.0001	0.993	0.949	1.040	0.773	0.942	0.881	1.007	0.080	0.753	0.704	0.804	<0.0001
2015	0.474	0.459	0.490	<0.0001	0.641	0.612	0.671	<0.0001	0.565	0.527	0.605	<0.0001	0.516	0.482	0.552	<0.0001
2016	0.454	0.440	0.468	<0.0001	0.613	0.585	0.641	<0.0001	0.404	0.377	0.434	<0.0001	0.437	0.408	0.468	<0.0001
2017	0.744	0.722	0.767	<0.0001	1.093	1.046	1.143	<0.0001	0.755	0.705	0.808	<0.0001	0.562	0.526	0.602	<0.0001

Source: Author's own analysis using data from the study sites

Appendix A

Table 10-2: Sociodemographic factors associated with the individual odds for seek services at least once per year at second level public healthcare facilities for each study site, Guatemala between 2013 and 2017

	Site 1				Site 2			
	Odds	**95% CI**		**P value**	**Odds**	**95% CI**		**P value**
Intercept	0.324	0.126	0.839	0.02018	1.587	0.495	5.080	0.43701
Age structure								
<5	1.000				1.000			
5-9	0.421	0.392	0.452	<0.0001	0.320	0.286	0.359	<0.0001
10-19	0.437	0.414	0.461	<0.0001	0.262	0.241	0.286	<0.0001
20-29	1.404	1.337	1.476	<0.0001	0.592	0.543	0.645	<0.0001
30-39	1.438	1.361	1.518	<0.0001	0.755	0.691	0.824	<0.0001
40-49	0.866	0.811	0.925	<0.0001	0.546	0.493	0.604	<0.0001
50-59	0.639	0.591	0.691	<0.0001	0.462	0.410	0.521	<0.0001
60-69	0.509	0.461	0.562	<0.0001	0.505	0.440	0.579	<0.0001
70-79	0.422	0.371	0.481	<0.0001	0.597	0.495	0.719	<0.0001
79>	0.276	0.227	0.336	<0.0001	0.395	0.302	0.517	<0.0001
Sex								
Female	1.000				1.000			
Male	1.081	1.023	1.141	0.005	1.168	1.069	1.275	0.001
Age * Sex								
5-9 * male	0.939	0.850	1.037	0.214	0.896	0.765	1.049	0.171
10-19 * male	0.380	0.348	0.414	<0.0001	0.490	0.432	0.555	<0.0001
20-29 * male	0.105	0.095	0.116	<0.0001	0.178	0.154	0.206	<0.0001
30-39 * male	0.147	0.133	0.164	<0.0001	0.185	0.159	0.215	<0.0001
40-49 * male	0.261	0.232	0.294	<0.0001	0.256	0.215	0.307	<0.0001
50-59 * male	0.380	0.333	0.434	<0.0001	0.391	0.323	0.473	<0.0001
60-69 * male	0.560	0.481	0.652	<0.0001	0.459	0.371	0.567	<0.0001
70-79 * male	0.820	0.681	0.987	0.036	0.441	0.333	0.585	<0.0001
79> * male	1.177	0.907	1.529	0.220	0.646	0.436	0.956	0.029
Death period								
No	1.000				1.000			
Yes	1.582	1.281	1.953	<0.0001	1.324	0.963	1.819	0.064
Wealth								
Lower	1.000				1.000			
Middle	1.240	1.199	1.283	<0.0001	0.954	0.904	1.007	0.089
Upper	1.302	1.256	1.349	<0.0001	0.799	0.759	0.840	<0.0001
Ethnicity								
Non-indigenous	1.000				1.000			
Indigenous	0.892	0.849	0.937	<0.0001	1.131	0.601	2.127	0.702
Unkown	1.066	0.930	1.223	0.357	0.519	0.237	1.138	0.101
Spoken lenguage								
Spanish	1.000				1.000			
Indigenous-spanish	0.839	0.796	0.883	<0.0001	0.477	0.346	0.657	<0.0001
Indigenous	0.550	0.449	0.674	<0.0001	0.506	0.367	0.697	<0.0001
Time nearest								
<5	1.000				1.000			
5 -9	0.645	0.204	2.043	0.456	0.705	0.143	3.481	0.667
10-14	0.534	0.178	1.603	0.264	0.194	0.029	1.297	0.091
15-29	0.366	0.125	1.070	0.066	0.184	0.052	0.647	0.008
30-59	0.211	0.075	0.591	0.00308	0.011	0.003	0.039	<0.0001
>60	0.034	0.012	0.094	<0.0001	0.045	0.010	0.212	<0.0001
Year								
2013	1.000				1.000			
2014	1.073	1.026	1.121	0.002	1.039	0.976	1.106	0.229
2015	1.362	1.304	1.421	<0.0001	0.656	0.615	0.699	<0.0001
2016	1.696	1.628	1.767	<0.0001	0.612	0.574	0.653	<0.0001
2017	1.883	1.808	1.962	<0.0001	1.019	0.958	1.083	0.554

Source: Author's own analysis using data from the study sites

Table 10-3: Factors associated with utilisation levels of public healthcare services at primary care facilities for each study site, Guatemala between 2013 and 2017

	Site 1				Site 2				Site 3				Site 4			
	Rate ratio	95% CI		P value	Rate ratio	95% CI		P value	Rate ratio	95% CI		P value	Rate ratio	95% CI		P value
Intercept	2.289	2.142	2.446	<0.0001	2.996	2.400	3.738	<0.0001	2.554	2.298	2.838	<0.0001	3.341	3.050	3.659	<0.0001
Age structure																
<5	1.000				1.000				1.000				1.000			
5-9	0.674	0.652	0.696	<0.0001	0.520	0.498	0.543	<0.0001	0.722	0.674	0.772	<0.0001	0.625	0.584	0.669	<0.0001
10-19	0.783	0.764	0.803	<0.0001	0.643	0.622	0.664	<0.0001	0.879	0.835	0.924	<0.0001	0.690	0.654	0.727	<0.0001
20-29	1.216	1.191	1.242	<0.0001	1.024	0.995	1.054	0.103	1.459	1.396	1.525	<0.0001	1.261	1.203	1.322	<0.0001
30-39	1.225	1.198	1.253	<0.0001	1.043	1.013	1.074	0.004	1.455	1.388	1.525	<0.0001	1.309	1.247	1.373	<0.0001
40-49	1.046	1.017	1.075	0.001	0.886	0.856	0.917	<0.0001	1.308	1.240	1.381	<0.0001	1.084	1.027	1.144	0.003
50-59	0.869	0.839	0.900	<0.0001	0.754	0.720	0.789	<0.0001	1.107	1.033	1.186	0.004	0.994	0.933	1.060	0.865
60-69	0.910	0.872	0.950	<0.0001	0.779	0.737	0.822	<0.0001	0.986	0.903	1.076	0.753	0.955	0.891	1.024	0.199
70-79	0.852	0.804	0.904	<0.0001	0.858	0.797	0.923	<0.0001	0.971	0.869	1.085	0.600	1.009	0.924	1.102	0.842
79>	0.740	0.666	0.822	<0.0001	0.894	0.800	0.999	0.048	1.074	0.924	1.250	0.353	0.995	0.861	1.149	0.942
Sex																
Female	1.000				1.000				1.000				1.000			
Male	1.037	1.014	1.061	0.001	1.059	1.031	1.088	<0.0001	1.030	0.981	1.082	0.237	1.032	0.983	1.084	0.206
Age * Sex																
5-9 * male	0.929	0.886	0.973	0.002	0.941	0.883	1.001	0.055	0.946	0.859	1.041	0.255	0.902	0.817	0.995	0.039
10-19 * male	0.665	0.636	0.695	<0.0001	0.582	0.550	0.616	<0.0001	0.643	0.591	0.698	<0.0001	0.693	0.637	0.754	<0.0001
20-29 * male	0.444	0.419	0.470	<0.0001	0.377	0.349	0.407	<0.0001	0.412	0.372	0.457	<0.0001	0.400	0.352	0.455	<0.0001
30-39 * male	0.498	0.472	0.524	<0.0001	0.396	0.366	0.427	<0.0001	0.444	0.401	0.492	<0.0001	0.419	0.372	0.473	<0.0001
40-49 * male	0.591	0.558	0.626	<0.0001	0.492	0.452	0.536	<0.0001	0.529	0.469	0.597	<0.0001	0.546	0.488	0.612	<0.0001
50-59 * male	0.718	0.670	0.770	<0.0001	0.593	0.539	0.653	<0.0001	0.710	0.631	0.800	<0.0001	0.608	0.535	0.691	<0.0001
60-69 * male	0.727	0.671	0.786	<0.0001	0.714	0.649	0.786	<0.0001	0.815	0.706	0.942	0.006	0.955	0.842	1.082	0.467
70-79 * male	0.857	0.779	0.942	0.001	0.795	0.708	0.893	<0.0001	0.754	0.628	0.906	0.003	0.966	0.839	1.111	0.624
79> * male	0.970	0.837	1.125	0.689	0.937	0.791	1.109	0.449	0.792	0.628	0.999	0.049	0.969	0.797	1.179	0.756
Death period																
No	1.000				1.000				1.000				1.000			
Yes	0.845	0.719	0.993	0.041	1.079	0.942	1.235	0.272	0.814	0.616	1.075	0.147	0.752	0.583	0.971	0.029
Wealth																
Lower	1.000				1.000				1.000				1.000			
Middle	0.979	0.966	0.993	<0.0001	0.964	0.945	0.982	<0.0001	0.958	0.926	0.991	0.014	0.949	0.923	0.976	<0.0001
Upper	0.952	0.936	0.967	<0.0001	0.910	0.893	0.928	<0.0001	0.975	0.932	1.019	0.260	0.911	0.880	0.942	<0.0001
Ethnicity																
Non-indigenous	1.000				1.000				1.000				1.000			
Indigenous	0.996	0.971	1.022	0.756	1.028	0.859	1.231	0.759	0.972	0.932	1.013	0.180	0.899	0.833	0.971	0.007
Unknown	0.984	0.919	1.054	0.648	1.101	0.912	1.329	0.318	0.979	0.925	1.036	0.458	0.878	0.748	1.030	0.111
Spoken language																
Spanish	1.000				1.000				1.000				1.000			
Indigenous-spanis	0.962	0.936	0.988	0.004	0.937	0.831	1.056	0.286	0.985	0.947	1.025	0.453	1.014	0.959	1.071	0.625
Indigenous	0.916	0.825	1.018	0.102	0.945	0.838	1.065	0.353	0.949	0.890	1.011	0.106	1.005	0.904	1.117	0.926
Time to nearest																
<10	1.000				1.000				1.000				1.000			
10-14	0.986	0.888	1.096	0.797	0.920	0.746	1.13426	0.434	0.884	0.738	1.058	0.179	0.872	0.550	1.380	0.558
15-29	0.954	0.869	1.048	0.330	0.946	0.807	1.1097	0.498	0.858	0.735	1.000	0.051	0.961	0.851	1.085	0.518
30-59	0.905	0.798	1.027	0.122	0.779	0.575	1.05512	0.107	0.871	0.757	1.002	0.053	1.002	0.778	1.292	0.987
>59	0.784	0.587	1.049	0.101	0.835	0.592	1.17712	0.303	0.810	0.670	0.980	0.030				
Year																
2013	1.000				1.000				1.000				1.000			
2014	0.884	0.869	0.899	<0.0001	1.066	1.041	1.091	<0.0001	1.020	0.989	1.053	0.210	0.947	0.916	0.979	0.001
2015	0.856	0.840	0.872	<0.0001	1.016	0.992	1.041	0.195	0.853	0.823	0.884	<0.0001	0.827	0.798	0.857	<0.0001
2016	0.911	0.895	0.928	<0.0001	0.960	0.936	0.984	0.001	0.725	0.698	0.754	<0.0001	0.773	0.745	0.803	<0.0001
2017	0.999	0.982	1.016	0.869	0.957	0.934	0.982	0.001	0.960	0.928	0.992	0.015	0.867	0.836	0.898	<0.0001

Source: Author's own analysis using data from the study sites

Table 10-4: Factors associated with utilisation levels of public healthcare services at second level facilities for each study site, Guatemala between 2013 and 2017

	Site 1				Site 2			
	Rate ratio	95% CI		P value	Rate ratio	95% CI		P value
Intercept	1.543	1.445	1.648	<0.0001	3.468	2.314	5.195	<0.0001
Age structure								
<5	1.000				1.000			
5-9	0.736	0.697	0.777	<0.0001	0.542	0.500	0.588	<0.0001
10-19	0.952	0.917	0.988	0.009	0.692	0.655	0.731	<0.0001
20-29	1.273	1.234	1.313	<0.0001	1.035	0.985	1.088	0.176
30-39	1.152	1.113	1.192	<0.0001	1.087	1.034	1.142	0.001
40-49	0.924	0.884	0.966	<0.0001	0.953	0.898	1.011	0.108
50-59	0.832	0.787	0.880	<0.0001	0.720	0.666	0.777	<0.0001
60-69	0.789	0.733	0.850	<0.0001	0.758	0.694	0.828	<0.0001
70-79	0.816	0.739	0.901	<0.0001	0.932	0.835	1.039	0.204
79>	0.722	0.616	0.847	<0.0001	0.868	0.731	1.031	0.106
Sex								
Female	1.000				1.000			
Male	1.022	0.987	1.059	0.226	1.020	0.973	1.070	0.404
Age * Sex								
5-9 * male	1.010	0.937	1.089	0.793	1.060	0.949	1.185	0.302
10-19 * male	0.663	0.621	0.708	<0.0001	0.654	0.598	0.714	<0.0001
20-29 * male	0.493	0.456	0.533	<0.0001	0.445	0.399	0.497	<0.0001
30-39 * male	0.581	0.536	0.629	<0.0001	0.452	0.404	0.505	<0.0001
40-49 * male	0.746	0.681	0.818	<0.0001	0.498	0.433	0.571	<0.0001
50-59 * male	0.839	0.756	0.933	0.001	0.720	0.627	0.828	<0.0001
60-69 * male	0.843	0.747	0.952	0.006	0.793	0.683	0.921	0.002
70-79 * male	0.871	0.753	1.007	0.062	0.678	0.560	0.822	<0.0001
79> * male	0.926	0.747	1.147	0.480	1.001	0.776	1.291	0.992
Death period								
No	1.000				1.000			
Yes	0.895	0.763	1.051	0.177	1.144	0.941	1.392	0.178
Wealth								
First	1.000				1.000			
Second	1.068	1.043	1.093	<0.0001	1.053	1.017	1.090	0.004
Third	1.105	1.079	1.132	<0.0001	1.002	0.970	1.036	0.897
Ethnicity								
Non-indigenous	1.000				1.000			
Indigenous	0.955	0.923	0.988	0.007	0.981	0.674	0.880	0.920
Unknown	1.070	0.984	1.164	0.115	0.775	0.456	1.317	0.346
Spoken language								
Spanish	1.000				1.000			
Indigenous-spanish	0.972	0.938	1.006	0.106	0.756	0.640	0.893	0.001
Indigenous	0.855	0.731	1.000	0.050	0.745	0.631	1.427	0.001
Time nearest								
<10	1.000				1.000			
10-14	0.939	0.866	1.018	0.127	0.709	0.508	0.989	0.043
15-29	0.855	0.792	0.923	<0.0001	0.715	0.583	0.877	0.001
30-59	0.805	0.751	0.863	<0.0001	0.658	0.522	0.831	<0.0001
>59	0.754	0.687	0.828	<0.0001	0.542	0.392	0.750	<0.0001
Year								
2013	1.000				1.000			
2014	1.050	1.016	1.086	0.003	1.052	1.013	1.093	0.008
2015	1.213	1.176	1.251	<0.0001	0.963	0.925	1.003	0.067
2016	1.292	1.255	1.330	<0.0001	0.906	0.869	0.945	<0.0001
2017	1.285	1.248	1.323	<0.0001	0.960	0.921	1.001	0.053

Source: Author's own analysis using data from the study sites

Table 10-5: Binary logistic regression coefficients for females and males bypassing the nearest public healthcare facility for selected rural areas, Guatemala between 2013 and 2017

	Female				Male			
	Odds ratio	95% CI		P value	Odds ratio	95% CI		P value
Intercept	1.310	1.300	1.321	<0.0001	1.292	1.278	1.306	<0.0001
Age								
<5	1.000				1.000			
5-9	0.994	0.984	1.003	0.198	0.989	0.979	0.998	0.022
10-19	1.032	1.024	1.040	<0.0001	0.996	0.986	1.007	0.504
20-29	1.032	1.024	1.040	<0.0001	1.058	1.041	1.074	<0.0001
30-39	1.026	1.019	1.034	<0.0001	1.057	1.041	1.073	<0.0001
40-49	1.020	1.012	1.029	<0.0001	1.080	1.063	1.098	<0.0001
50-59	1.039	1.028	1.051	<0.0001	1.018	1.000	1.037	0.052
60-69	1.057	1.043	1.072	<0.0001	1.077	1.057	1.097	<0.0001
70-79	0.974	0.957	0.992	<0.01	1.016	0.994	1.038	0.165
79>	0.981	0.952	1.011	0.2104	1.015	0.986	1.045	0.321
Wealth								
Lower	1.000				1.000			
Middle	0.977	0.972	0.981	<0.0001	0.969	0.962	0.976	<0.0001
Upper	0.955	0.950	0.959	<0.0001	0.951	0.944	0.958	<0.0001
Language								
Spanish	1.000				1.000			
Spanish and Mayan	0.991	0.980	1.003	0.155	1.013	0.993	1.034	<0.0001
Mayan	0.931	0.921	0.940	<0.0001	0.939	0.923	0.956	0.21
Ethnicity								
Non-indigenous	1.000				1.000			
Indigenous	1.027	1.016	1.037	<0.0001	1.071	1.054	1.089	<0.0001
Diagnostic category								
Respiratory diseases and TB	1.000				1.000			
Child monitoring	0.995	0.980	1.010	0.487	1.001	0.986	1.016	0.919
Communicable diseases	1.007	1.000	1.015	0.065	1.016	1.007	1.025	<0.001
Contraceptive services	0.989	0.981	0.997	<0.01	0.964	0.928	1.000	0.051
General symptoms	0.993	0.980	1.006	0.292	0.991	0.968	1.015	0.474
Injuries	0.964	0.943	0.986	<0.01	0.972	0.954	0.991	<0.01
Maternal, neonatal and nutritional disorders	1.028	1.005	1.052	0.017	1.004	0.975	1.034	0.776
Non-communicable diseases	1.005	0.998	1.013	0.179	1.004	0.992	1.015	0.521
Antenatal care services	1.038	1.030	1.046	<0.0001				
Interaction* level 2								
Child monitoring	0.946	0.916	0.978	<0.0001	0.955	0.924	0.987	<0.01
Communicable diseases	1.058	1.043	1.072	0.052	1.013	0.995	1.031	0.152
Contraceptive services	0.923	0.910	0.936	<0.0001	1.070	0.993	1.154	0.076
General symptoms	0.997	0.973	1.022	0.834	1.032	0.990	1.075	0.134
Injuries	1.083	1.041	1.126	<0.0001	1.168	1.133	1.205	<0.0001
Maternal, neonatal and nutritional disorders	1.121	1.069	1.176	<0.0001	1.104	1.003	1.214	0.042
Non-communicable diseases	1.058	1.043	1.072	<0.0001	1.044	1.023	1.066	<0.0001
Antenatal care services	1.096	1.082	1.110	<0.0001				
Weekday								
Monday	1.000				1.000			
Tuesday	0.992	0.986	0.998	0.171	1.003	0.994	1.012	0.53

Appendix A

	Female				Male			
	Odds ratio	**95% CI**		**P value**	**Odds ratio**	**95% CI**		**P value**
Wednesday	0.992	0.987	0.998	<0.01	1.002	0.992	1.011	0.734
Thursday	1.006	1.000	1.013	<0.01	1.013	1.003	1.022	<0.01
Friday	1.000	0.993	1.006	0.938	1.009	0.999	1.020	0.082
Saturday	1.015	0.994	1.036	<0.01	1.045	1.017	1.074	<0.01
Sunday	0.983	0.961	1.006	0.147	1.005	0.977	1.034	0.712
Level of health care service								
Primary level	1.000				1.000			
Second level	1.424	1.411	1.438	<0.0001	1.442	1.426	1.458	<0.0001
Site								
Site 1	1.000				1.000			
Site 2	0.844	0.836	0.852	<0.0001	0.800	0.786	0.814	<0.0001
Year								
2013	1.000				1.000			
2014	0.996	0.990	1.003	0.249	1.005	0.995	1.014	0.333
2015	0.997	0.991	1.003	0.361	1.002	0.992	1.012	0.743
2016	1.009	1.003	1.015	<0.01	1.020	1.010	1.030	<0.0001
2017	1.031	1.025	1.037	<0.0001	1.023	1.014	1.033	<0.0001

Source: Author's own analysis using data from the study sites

Table 10-6: Model fit parameters for Poisson and Negative binomial models for utilisation of primary and second level public healthcare services in rural Guatemala

	Primary services		Second level services	
	Poisson	**Negative binomial**	**Poisson**	**Negative binomial**
Level 2 variance	0.039	0.036	0.042	0.041
AIC	480073.5	473295.6	147929.4	147271
BIC	480455.4	473687.3	148252.2	147602.6
LogLik	-239998	-236607.8	-73927.7	-73597.5
ICC	0.074	0.061	0.073	0.062
Log likelihood test		6779.89		473215.6
Theta		5.3523		7.822
Standard error		0.06		0.21

Source: Author's own analysis using data from the study sites

Table 10-7: Summary statistics and PCA score for urban and rural household wealth index, Guatemala 2018

	Urban households			Rural households		
Factor	Mean	SD	Factor score	Mean	SD	Factor score
Stove	0.993	1.363	0.003	0.995	1.119	0.000
Television	0.847	0.788	0.145	0.513	0.672	0.315
T.V. cable	0.699	0.687	0.196	0.337	0.631	0.291
Refrigerator	0.627	0.626	0.237	0.290	0.627	0.275
Water tank	0.304	0.606	0.148	0.148	0.616	0.100
Washing machine	0.304	0.573	0.218	0.058	0.564	0.083
Personal computer	0.319	0.544	0.216	0.069	0.517	0.089
Internet	0.274	0.518	0.206	0.035	0.505	0.050
Boiling water system	0.216	0.479	0.160	0.037	0.496	0.043
Car	0.318	0.446	0.197	0.130	0.489	0.134
Rain water source	0.009	0.437	-0.010	0.042	0.456	-0.030
Water tank truck	0.015	0.430	-0.003	0.006	0.450	0.002
Municipality piped water	0.024	0.424	-0.015	0.042	0.434	-0.010
Lake water source	0.000	0.400	0.000	0.000	0.408	0.000
Spring water source	0.016	0.389	-0.016	0.095	0.404	-0.056
Other water source	0.009	0.375	-0.007	0.018	0.366	-0.008
Well water source	0.077	0.356	-0.026	0.183	0.335	0.002
River water source	0.004	0.337	-0.005	0.022	0.325	-0.016
Pipes within the household infrastructure	0.752	0.327	0.145	0.369	0.317	0.175
Exposed pipes	0.095	0.321	-0.062	0.221	0.313	-0.058
Toilet	0.054	0.311	-0.021	0.101	0.293	0.058
Toilet connected to septic tank	0.093	0.300	-0.028	0.125	0.285	0.088
Toilet connected to pipes	0.674	0.291	0.227	0.143	0.281	0.149
Pit latrine	0.158	0.285	-0.153	0.547	0.277	-0.247
No toilet	0.021	0.264	-0.023	0.084	0.263	-0.048
No separate room for kitchen	0.277	0.253	-0.083	0.314	0.263	-0.106
Separate room for kitchen	0.723	0.251	0.083	0.686	0.251	0.106
Charcoal cooking fuel	0.000	0.237	0.000	0.000	0.243	0.000
Electricity cooking fuel	0.017	0.229	0.012	0.003	0.235	0.001
Gas cooking fuel	0.000	0.225	0.000	0.001	0.231	0.000
Propane gas cooking fuel	0.648	0.219	0.237	0.151	0.222	0.186
Firewood cooking fuel	0.326	0.218	-0.245	0.840	0.219	-0.187
Do not have a kitchen	0.008	0.215	-0.004	0.005	0.215	0.000
Other cooking fuel	0.000	0.195	0.000	0.000	0.198	0.000
Connected to sewage	0.714	0.185	0.223	0.188	0.193	0.183
Without sewage draining system	0.286	0.181	-0.223	0.812	0.188	-0.183
Waste recycling	0.039	0.164	-0.024	0.107	0.184	-0.018
Buried waste	0.020	0.160	-0.013	0.055	0.169	-0.009
Burn waste	0.247	0.150	-0.187	0.674	0.166	-0.084
Leave the waste in the street	0.017	0.146	-0.008	0.044	0.160	-0.016
Leave the waste in a valley	0.017	0.138	-0.004	0.011	0.156	0.003
Other waste disposal	0.010	0.134	-0.002	0.004	0.142	0.002
Municipality waste collector	0.243	0.128	0.046	0.060	0.137	0.070
Private waste collector	0.407	0.121	0.192	0.043	0.132	0.051
Flat	0.028	0.119	0.020	0.000	0.118	0.001

House	0.942	0.118	-0.009	0.949	0.116	0.040
Rent a room	0.022	0.104	-0.002	0.003	0.112	0.001
Other type of housing	0.000	0.103	0.000	0.000	0.111	0.000
Ranch	0.004	0.101	-0.005	0.036	0.084	-0.030
Improvised housing	0.004	0.092	-0.005	0.012	0.081	-0.011
Tiled walls	0.091	0.090	-0.067	0.215	0.080	-0.080
Mud walls	0.005	0.086	-0.005	0.024	0.069	-0.013
Cement bricks walls	0.677	0.076	0.110	0.430	0.065	0.285
Cement walls	0.071	0.068	0.034	0.038	0.062	0.016
Brick walls	0.038	0.067	0.023	0.006	0.060	0.003
Galvanised corrugated walls	0.049	0.065	-0.030	0.037	0.060	-0.017
Sticks walls	0.008	0.065	-0.009	0.030	0.045	-0.027
Wood walls	0.058	0.057	-0.054	0.216	0.040	-0.164
Recycled materials walls	0.000	0.050	0.000	0.001	0.036	-0.001
Other type of walls	0.002	0.045	-0.001	0.004	0.033	-0.002
Asbestos roof	0.010	0.029	0.004	0.005	0.026	0.004
Cement roof	0.346	0.026	0.226	0.067	0.025	0.071
Galvanised corrugated roof	0.603	0.020	-0.208	0.822	0.021	-0.034
Recycled materials roof	0.000	0.018	0.000	0.000	0.021	0.000
Leaf roof	0.004	0.012	-0.005	0.036	0.017	-0.031
Tiled roof	0.034	0.010	-0.018	0.068	0.011	-0.010
Ceramic tiles floor	0.315	0.007	0.189	0.106	0.009	0.112
Clay tiles	0.005	0.000	0.000	0.003	0.000	0.001
Cement tiles floor	0.156	0.000	0.047	0.057	0.000	0.039
Wood floor	0.005	0.000	-0.002	0.012	0.000	-0.005
Other type of floor	0.004	0.000	0.002	0.002	0.000	0.000
Vinyl floor	0.003	0.000	0.001	0.002	0.000	0.001
Dirt floor	0.140	0.000	-0.136	0.429	0.000	-0.325
Cement floor	0.373	0.000	-0.101	0.390	0.000	0.178
<3 rooms	0.470	0.000	-0.195	0.668	0.000	-0.229
Between 3 to 5 rooms	0.493	0.000	0.171	0.322	0.000	0.219
>6 rooms	0.037	0.000	0.025	0.010	0.000	0.009
<4 individuals	0.392	0.000	0.017	0.305	0.000	0.030
4 to 6 individuals	0.484	0.000	0.021	0.467	0.000	0.028
>6 individuals	0.124	0.000	-0.038	0.228	0.000	-0.058

Source: Author's own analysis

Table 10-8: Descriptive statistics of the explanatory variables associated with under-five mortality rates at ADM-2 level, Guatemala 2018

	Mean	± 95% CI		Median	SD
Proportion of households lowest wealth quintile	7.09	6.18	8.00	4.37	8.52
Proportion of households highest wealth quintile	8.86	8.02	9.71	6.44	7.93
Travel time nearest second facility (75% settlements)	57.64	56.79	58.49	41.36	48.49
Number of health professionals per 1,000 individuals	1.71	0.87	2.56	1.11	1.73
Proportion of households in rural areas	57.01	53.82	60.20	64.84	29.90
Proportion of indigenous population	44.74	40.36	49.12	30.01	41.03
Proportion of births at public hospitals	46.10	44.29	47.90	48.31	16.89
Proportion of births at second level facilities	9.85	9.23	10.47	8.80	5.80

Source: Author's own analysis

Source: Author's own analysis

Appendix B Figures

Figure 10-1: Google API travel time for a selected community to the chosen primary healthcare facility in rural Guatemala

Source: Google Maps

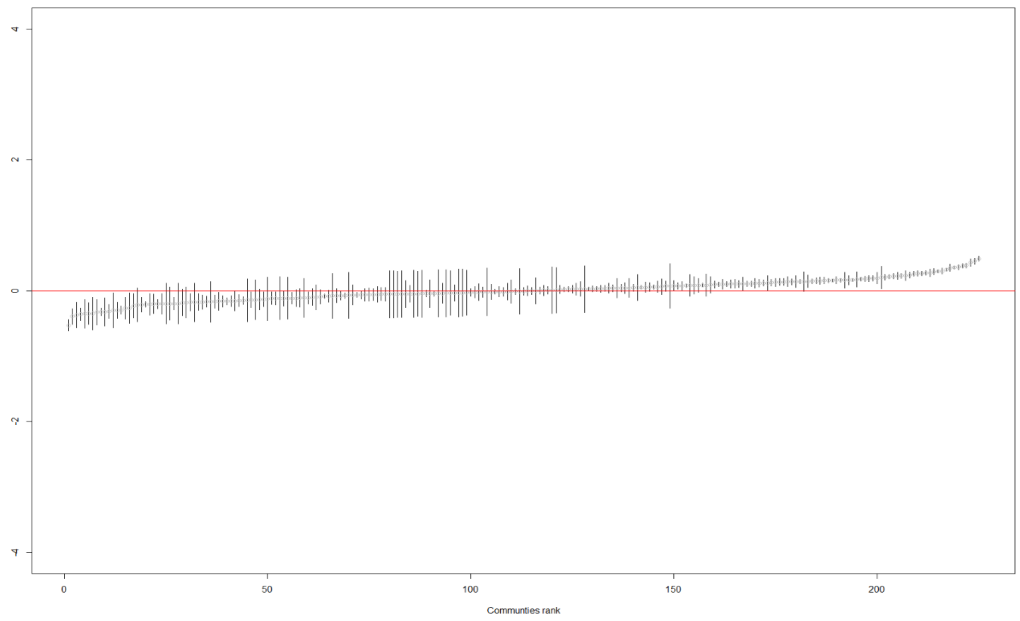

Figure 10-2: Second level residuals and 95% CI negative binomial model for utilisation of primary healthcare services in selected rural areas, Guatemala 2013- 2017

Source: Author's own analysis using data from the study sites

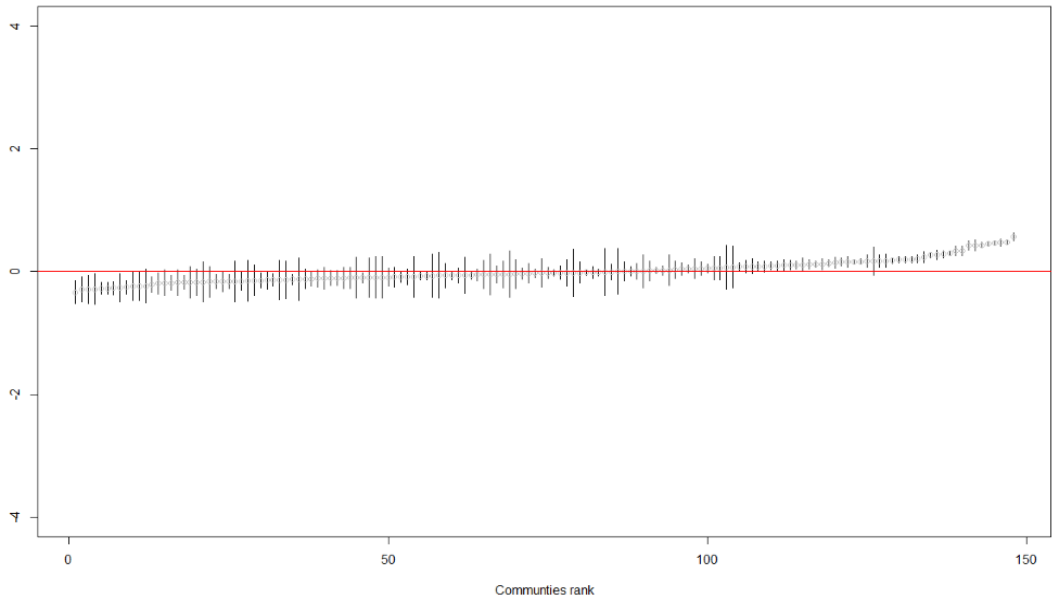

Figure 10-3: Second level residuals and 95% CI negative binomial model for the utilisation levels of second level public health services in selected rural areas, Guatemala 2013- 2017

Source: Author's own analysis using data from the study sites

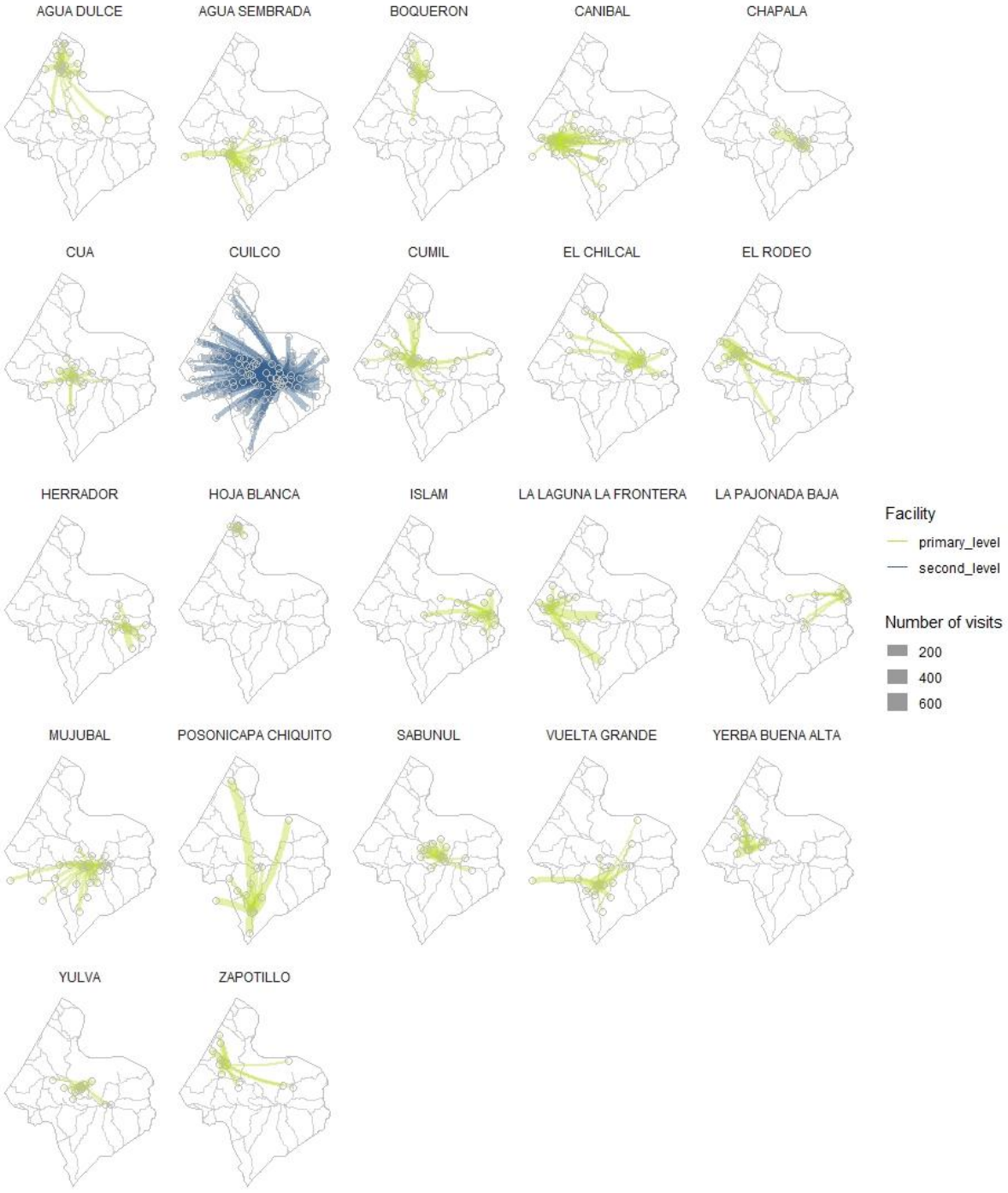

Figure 10-4: O-D flows for every visit to primary and second level facilities at study site 1, Guatemala 2017

Source: Author's own analysis

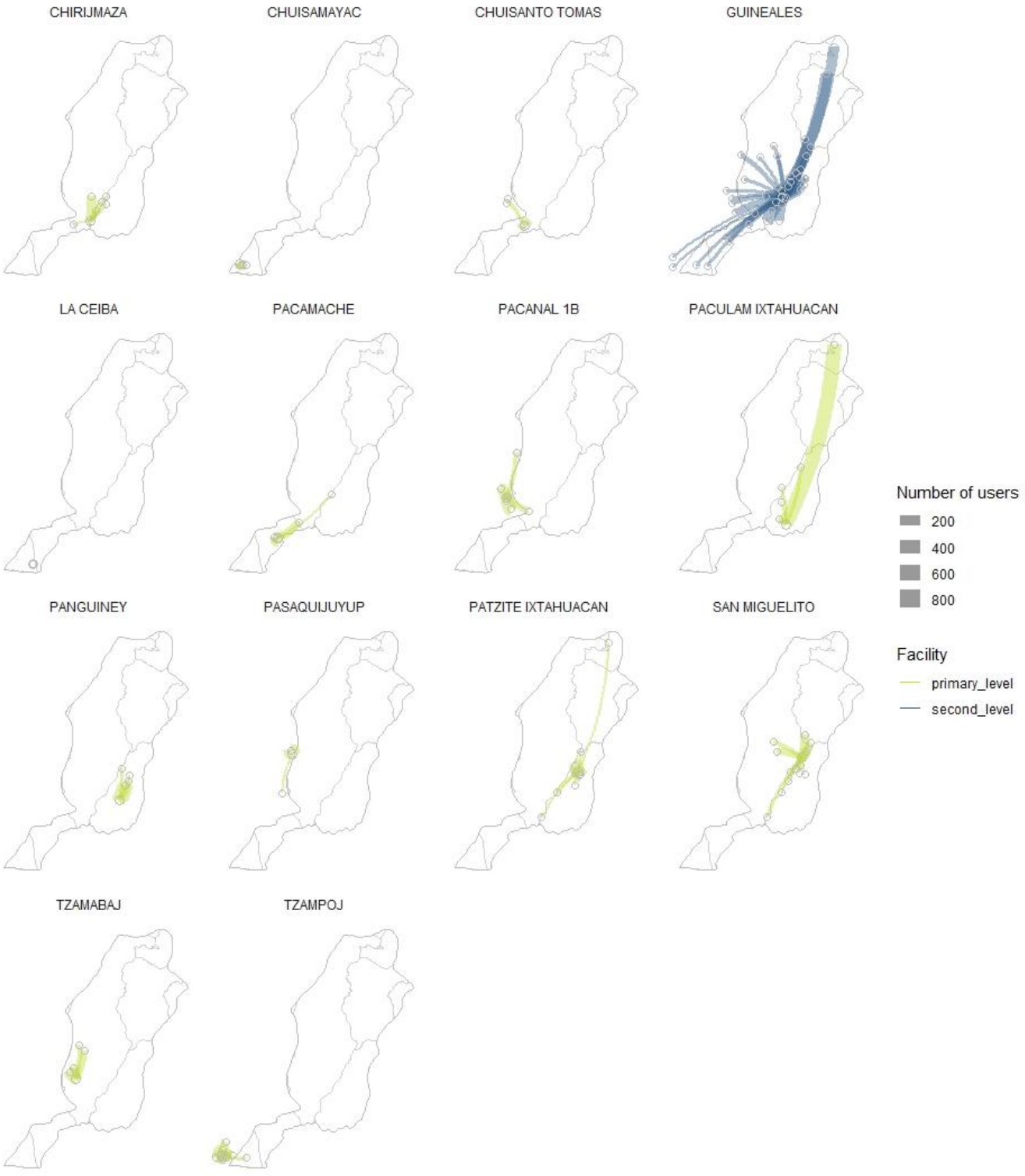

Figure 10-5: O-D flows for every visit to primary and second level facilities at study site 2, Guatemala 2017

Source: Author's own analysis

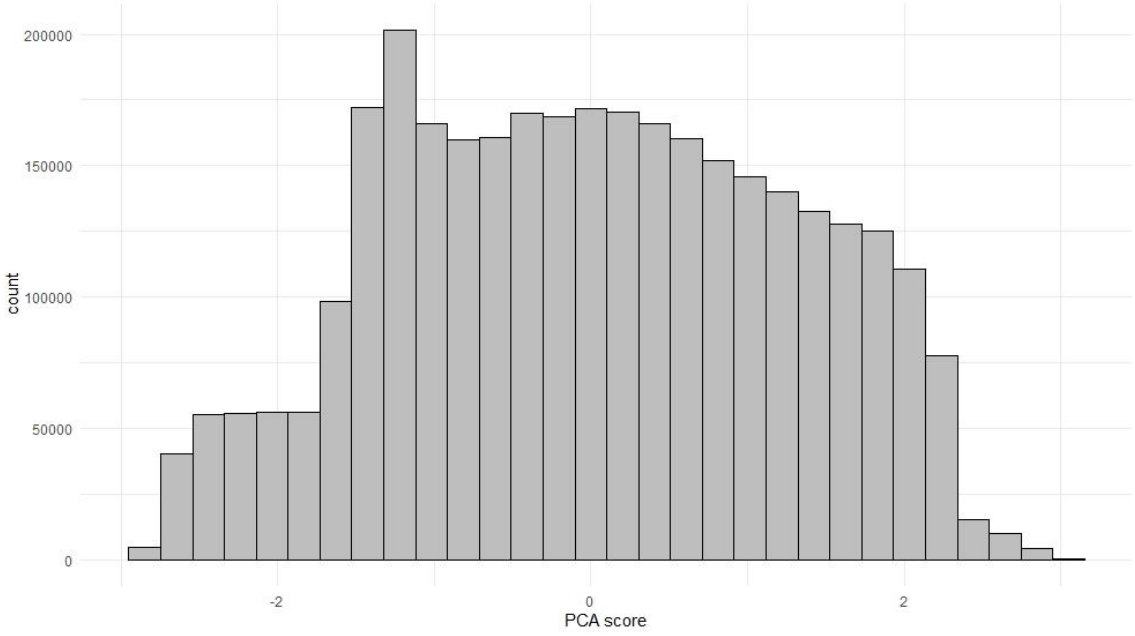

Figure 10-6: PCA score distribution for Census 2018 households at National level and ADM-1

Source: Author's own analysis

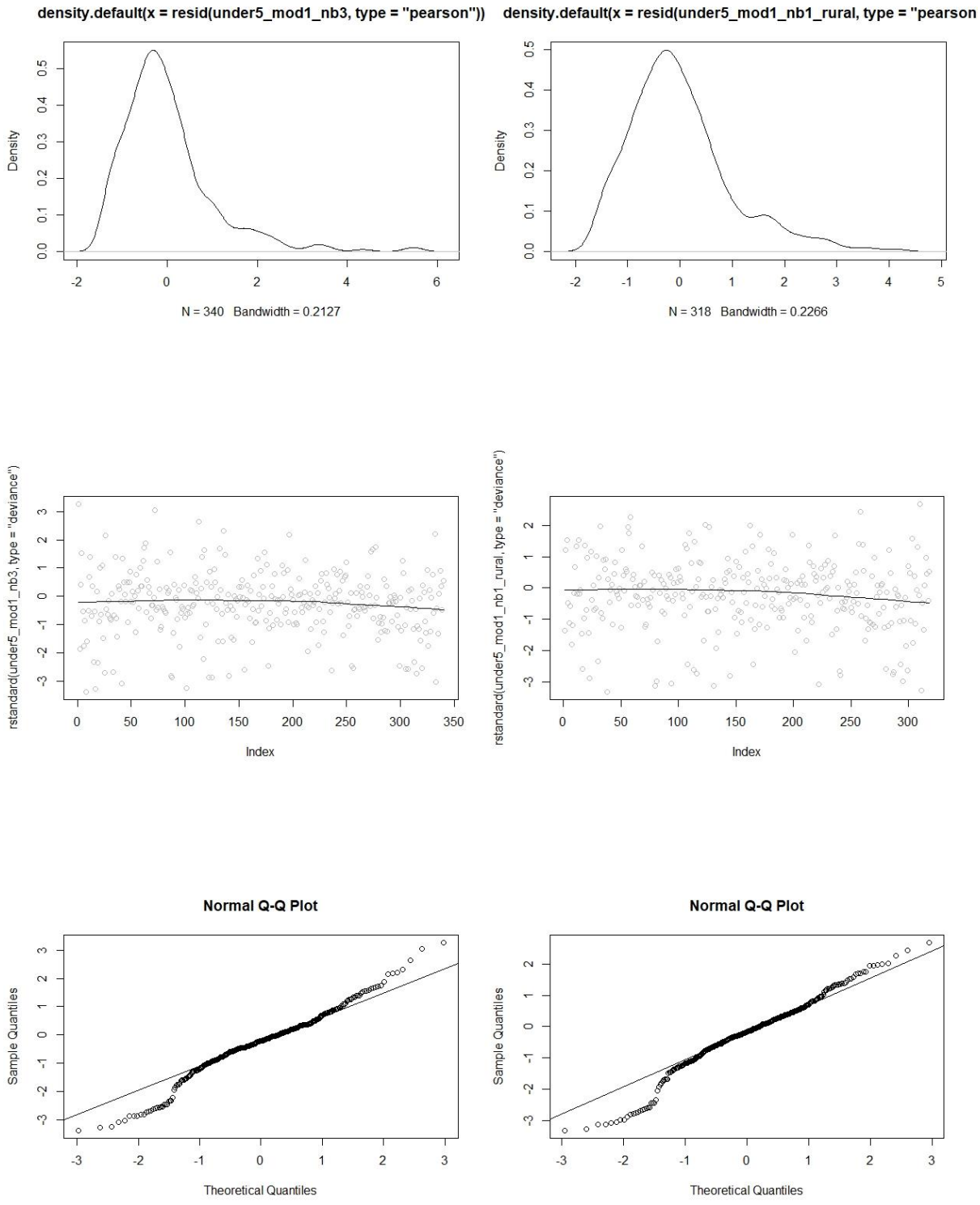

Figure 10-7: Negative Binomial model residuals diagnostics for under-five mortality rates, Guatemala 2018

Source: Author's own analysis

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