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Women´s Health in Ethiopia

A Regional Assessment of Diverse Health Outcomes Between 2000 and 2016

by

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Abstract: So far, broad-based assessments of health outcomes are scarce for Ethiopian women. Little is known about differences in overall health performance between regions. On that account, the present research scrutinizes a diversity of seven health indicators for women of their reproductive age. By this means, a deeper understanding of underlying mechanisms in female health performance over time and space is provided, crucial to mitigate unequal health outcomes. Aspects of preventive, curative as well as maternal health are taken into consideration in order to investigate both regional and rural-urban patterns in health outcomes between 2000 and 2016. Through a multilevel fixed effects analysis, composed of a first stage binary logistic regression and a second stage multinominal logistic regression, a series of postestimations is conducted. Odd ratios, predicted probabilities and marginal effects postestimation results are assessed. Over the years, marked improvements for the majority of health outcomes are recorded, linked to comprehensive governmental interventions since the 1990s onwards. However, substantial inter- and intraregional divergences in health performance is revealed. Comparatively good, regional performance in a single indicator is not a predictor for overall good performance in the totality of indicators considered. Similarly, health performance of women living in rural areas is remarkably poorer compared to their urban counterparts. Regional dynamics therefore represent a strong determinant of divergent health outcomes for women in the country. To continuously improve health outcomes and foster health equity in the future, regional adjustments in health interventions are consequently essential.

***Key Words**: Ethiopia, Health Outcomes, Regional Divergence, Fixed Effects Logistic Regression*

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List of Acronyms

AFDP – African Development Bank
BCG – Bacillus Calmette-Guérin
BMC – Biomedical Central
BMI – Body Mass Index
BMJ – British Medical Journal
CDC – Center for Disease Control and Prevention
CIA – Conditional Independence Assumption
DHS – Demographic and Health Surveys
DPT – Diphtheria, Pertussis, Tetanus
EFY – Ethiopian Fiscal Year
GIS – Geographic Information System Mapping
HEP – Health Extension Program
HEW – Health Extension Worker
HSDP – Health Sector Development Plan
HSTP – Health Sector Transformation Plan
ICF – Inner City Fund
IHME – Institute for Health Metrics and Evaluation
MMR – Maternal Mortality Rate
OECD – Organization for Economic Cooperation and Development
OOP – Out of Pocket Payment
ORT – Oral Rehydration Therapy
OVB – Omitted Variable Bias
PHCPI – Primary Health Care Performance Initiative
SEA – Strict Exogeneity Assumption
SNNPR – Southern Nations, Nationalities, and Peoples´ Region
SSA – Sub-Saharan Africa
UHC – Universal Health Coverage
UN - United Nations
UNDP – United Nations Development Programme
UNECA – United Nations Economic Commission for Africa
WHO – World Health Organization

1 Introduction

Ethiopia has recently experienced major improvements with respect to health outcomes. Coming from a detrimental health situation after a civil war ending in 1990 (Kloos, 2007), great deficiencies in service provision were overcome, and considerable improvements achieved ever since. Nowadays, the country ranks among the first developing countries to achieve the Millennium Development Goal Number 4 already before 2015, halving under five child mortality (UN, 2021). Likewise, maternal mortality dropped by three quarters between 1990 and 2015 (Tessema et al., 2017). Not only with regards to newborn and maternal health Ethiopia's health outcomes improved remarkably, but also concerning life expectancy, the transmission of communicable diseases as well as social determinants of health, such as access to save drinking water or sanitation facilities. Overall, the above-described developments point towards a strong and coherent governmental response towards health challenges emerging after the 1990s. Worldwide, Ethiopia ranks 173 out of 189 in terms of Human Development, placing the country in the low human development category (UNDP, 2020). However, the country has recently evolved into one of the fastest improving countries worldwide in terms of human development (UNDP, 2012). Likewise, it is classified as one of the strongest growing economies in Sub-Saharan Africa (SSA) (AFDB, 2011), standing out both in continental and global comparison. However, Ethiopia also counts with the third largest population in Africa with over 80% of its population living in rural areas, designating it as one of the least urbanized countries in the world (WHO, 2013). This poses serious challenges on the future provision of effective health services. Moreover, the country is characterized by a well-pronounced gender gap, with women facing substantial consequences due to their inferior socioeconomic status compared to men within Ethiopian society (Lailulo et al., 2015). Poor health outcomes and restricted access to essential health services are strongly linked with gender.

Consequently, human and economic development processes shaped past progress and will condition future outcomes, justifying the underlying research interest in the country. Particularly with regards to the health sector and resulting health outcomes, both challenges and opportunities are assumed to arise in the future, requiring comprehensive in-depth research in the field. According to the UNDP, health performance in Ethiopia is dominated by regional divergences, which is why substantial health inequalities apply throughout the country. Yet, for future, tailor-made health interventions to be successful, further investigation of regional dynamics and patterns is required, substantiating the research focus on a regional perspective of health outcomes. Importantly, it is a current lack in comparison of diverse health outcomes that limits precise regional health evaluation. Consequently, the underlying research will scrutinize a diversity of health outcomes over time and space and assess regional differences of health outcomes for women in their reproductive age. Emphasize on women is made due to their outlined disadvantageous position within society and the derived need for effective health

service provision for females. The elaboration of regional shortcomings will allow for an improved understanding of the Ethiopian health sector and contribute to obtain indications for outcome-oriented policy implications.

Research Problem

A considerable body of literature has recently emerged scrutinizing specific health outcomes in Ethiopia. However, most of contemporary research centers on single health outcomes, such as either maternal or newborn health indicators. Thus, overall assessments of health are so far neglected in the literature, characterized by a lack of comparison of diverse health indicators to evaluate overall performance. On that account, the underlying study identified an important area of contribution, taking into consideration several, diverse health indicators on the regional level. In this context, diverse health outcomes refer to a diversity of both maternal, preventive, and curative health indicators. In a similar manner, regional comparisons of health outcomes as yet do not include a time-related component in health performance (Lozano, 2020). Therefore, this study enables the assessment of a diversity of regional health outcomes over time. Besides, a focus is made on female health outcomes. Albeit substantial gender differences in health performance are stated in the literature (Lailulo et al., 2015), they are thus far not applied to specific health outcomes. In sum, the present research therefore amplifies existing knowledge through the consideration of diverse, gender-specific health indicators over space and time.

The importance of this investigation is justified by the necessity for adequate and tailor-made policy implications on the regional level in the future. Despite substantial improvements, the country still faces considerable inequalities regarding health service provision, which might impose serious limitations on future health performance and development. A crucial step in order to address the previously mentioned shortcomings is thus the time-sensitive mapping of gender-specific difference in health outcomes between regions.

1.1 Aim and Scope

The aim of this research is to better understand regional, female dynamics of health outcomes in Ethiopia to assess long-term trends within the health sector. Consequently, the paper is designed to detect regional divergences in health performance over time and estimate the impact of past governmental interventions into the health sector between 2000 and 2016 on females. By this means, regional inequalities in performance and outcome can be captured and quantified, enabling the evaluation of past trends and future outlooks regarding health performance. The research questions that will be scrutinized throughout the paper is the following:

Health as Economic Good - Have government interventions in the health sector in Ethiopia between 2000 and 2016 translated into regional divergent health outcomes for women?

The approach of the research is a quantitative one, scrutinizing health outcomes for nine geographic regions and two administrative areas of the Federal Democratic Republic of Ethiopia by means of Demographic and Health Survey data for the timespan indicated (DHS, 2021a).

Included health outcomes into the analysis are maternal health indicators, including prenatal and postnatal care as well as birth assistance, diarrhea treatment through oral rehydration therapies (ORTs), undernutrition by evaluating the Body Mass Index (BMI) and the prevalence of access barriers to seek health care. The totality of outcome indicators aims to represent diverse health aspects over the course of a women´s live.
Regarding the scope, the study is designed to investigate how region affected health outcomes for women over time as well as to validate the prevalence of substantial differences in outcomes between rural and urban areas. Methodically, the approach is inspired by foregone research in the field, applying both fixed effects binary and multinominal logistic regressions. Consequently, it is within the scope of this work to extend and deepen the understanding of previous knowledge and apply a diversity of different methods in order to validate obtained results.

1.2 Outline of the Thesis

The present research is organized as follows. In a first step, previous research with regards to the Ethiopian health care sector will be outlined, entailing overall health performance, past interventions into the sector as well as previous research on regional health outcomes. In a successive step, the theoretical framework will then be introduced, defining health as an economic good and elaborating about the efficient and equal allocation of health goods. Subsequently, data employed, and methods applied within the scope of the underlying study will be made intelligible. Section 5 consequently continues to present and analytically discuss empirical results obtained. In a last step, both the conclusion of results and an outlook on future research will be presented

2 Theory

The following section will thoroughly inquire into previous research and review relevant literature contributions in the field. Furthermore, the second part of the module will introduce the theoretical framework applied to the underling research and analyze health as a public good.

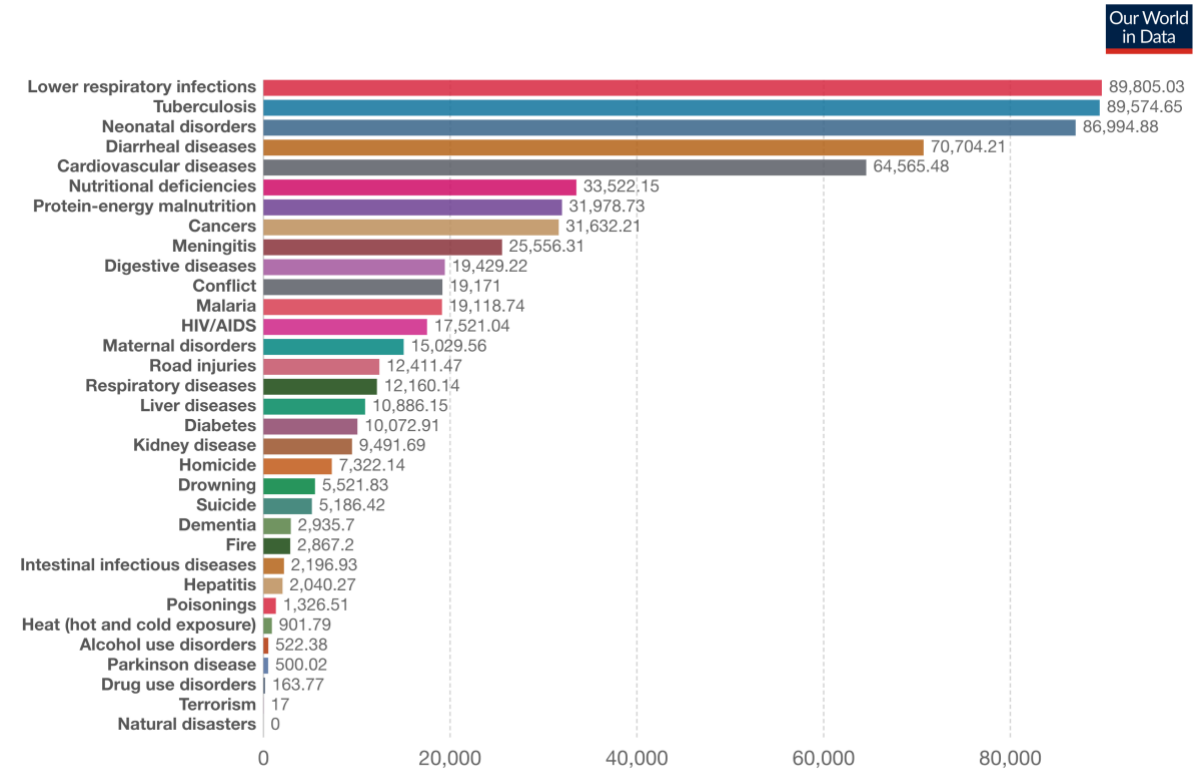
2.1 Previous Research

2.1.1 Health Background

Counting with a population of 51.4 million people in 1990, population growth in Ethiopia escalated ever since and doubled by 2017, resulting from a combination of both high fertility levels as well as reduced mortality rates (IHME, 2020). During the 1990, life expectancy was at 45.6 years for men and 48.8 years for women and effective Universal Health Coverage (UHC) stagnated at 10.1%, indicating that only a very limited share of the population did have access to relevant health services (IHME, 2020). Low figures of coverage also reflected in high child mortality, with 187.3 children out of 1,000 live births dying before the age of five (Census, 1991). In total, about 25% of total death in Ethiopia occurred under the age of one and more than 50% of total deaths under the age of five, with rural areas being affected more severely than urban ones (Census, 1991). Most deaths could be attributed to the spread of bacteria and viruses, such as tuberculosis, HIV or bronchitis, insufficient maternal and newborn health care as well as mal- and undernutrition (Murray & Lopez, 1996). On that account, it was predominantly communicable diseases and the lack of adequate health service provision that determined mortality rates in the country during the 1990s. Ethiopia´s health performance was opposed to a global trend of an increasing share of deaths due to non-communicable diseases by almost 58%, such as diabetes or cardiovascular diseases (Ritchie & Roser, 2019). The lack of ample health infrastructure in the country became thus apparent.

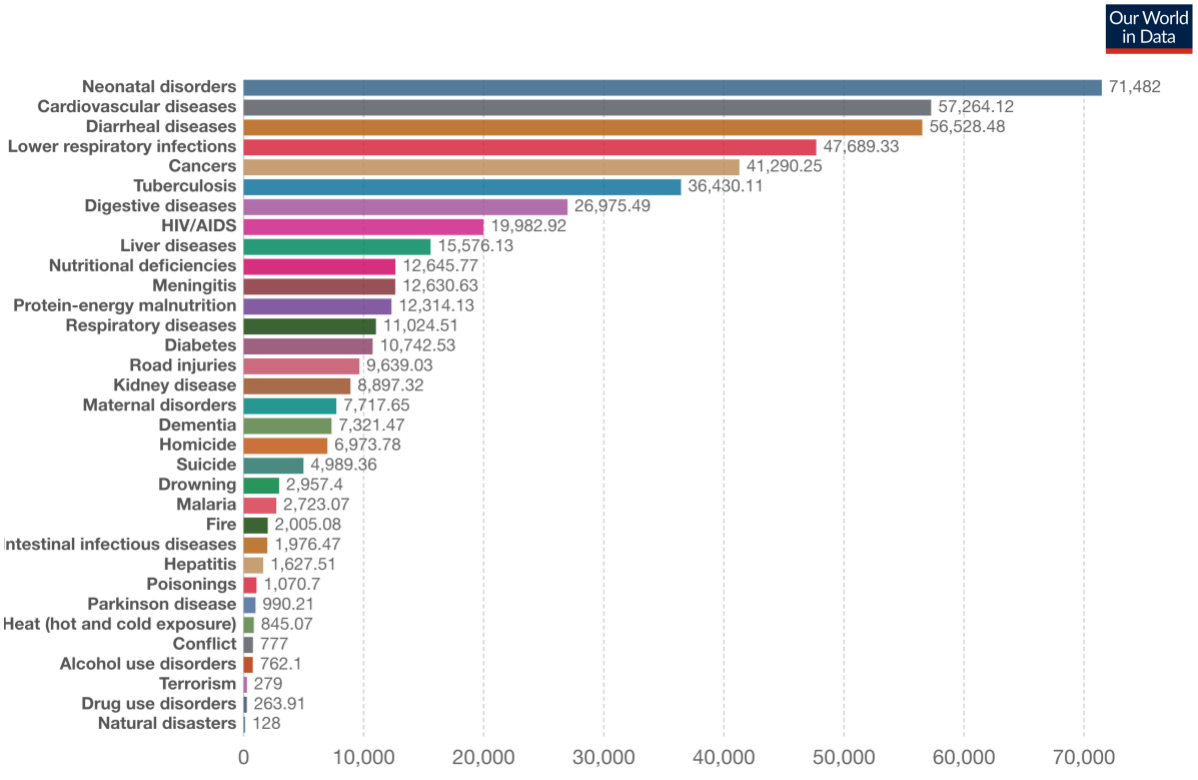
Coming from a detrimental health situation in the 1990s, considerable improvements were achieved ever since. Life expectancy increased noteworthily, averaging around 65 years in 2016 (WHO, 2021). Improvements can mainly be attributed to declining under five mortality rates, improvements in neonatal care as well as ameliorated maternal health services. Between 1990 and 2013, the maternal mortality rate (MMR) dropped by 69%, falling to 420 deaths per 100,000 live births (WHO, 2014).
Notwithstanding, the disease burden in Ethiopia is still over-proportionally high, stemming predominantly from preventable causes as for example insufficient hygiene practice, limited

access to sanitation facilities, the prevalence of mal-and undernutrition, the lack of knowledge as well as the spread of communicable disease due to missing treatment opportunities or scarce vaccination coverage (WHO, 2013).



Source: Our World in Data, 2021a

Graph 2: Number of Deaths by Cause, Ethiopia 1990



Source: Our World in Data, 2021b

Graph 1: Number of Deaths by Cause, Ethiopia 2016

GRAPH 1 and GRAPH 2 compare major causes of death between 1990 and 2016. The disease environment appears to have undergone fundamental changes, corroborated by the decline in lower respiratory diseases, such as pneumonia and bronchitis, as well as a reduced incidence of tuberculosis. Yet, although neonatal disorders are absolutely speaking falling, they represent the major cause of death in 2016. Similarly, diarrheal diseases are less common in absolute numbers, nevertheless, they are the third most common cause of death in 2016. Governmental interventions appear to have successfully altered the burden of diseases in the country since the 1990s. Despite progress, however, regional divergences in health performance exist, requiring a context-specific assessment of health outcomes.

2.1.2 Governmental Health Interventions

As has been demonstrated, Ethiopia has recently undergone significant improvements regarding key health outcomes. With the enactment of a Health Sector Development Plan (HSDP) in 1993, the government particularly aimed to tackle poverty-induced aspects of health (Ministry of Health Ethiopia, 2021). Realizing its implementation in 1997, the country for the first time in 50 years put into action an active health policy with the clear objective to develop a strong and effective health care sector (Wamai, 2009). Prior to the intervention, the Ethiopian health care system was characterized by the lack of funds, a weak and insufficient infrastructure system, and the long-term absence of a coherent national health policy (Wamai, 2009). The Ethiopian civil war, ending with the onset of the 1990s, contributed to the lowest health services coverage since the 1960s (Kloos, 1998). As a result, the majority of health facilities was either completely destroyed or malfunctioning, resulting in the rapid spread of epidemic, communicable diseases. With the implementation of the HSDP, the government therefore aimed to repair shortcomings. On that account, the issued 20-year health sector development strategy was subdivided into 5-year tailor-made sector development plans, each counting with specific targets and goals (Workie & Ramana, 2013).

Mohan (2007) outlines that the approach of the HSDP mainly intended to enlarge primary health care utilization and the prevention of the continuous spread of communicable diseases, entailing eight main goals. Major objectives of the development plan therefore comprised reduced access barrier to primary health care units, improvements in the quality of health service provision, a sufficiently large supply of medication and medical equipment throughout the country, the spread of health-related knowledge through campaigns and educational measures, organizational reforms as well as close monitoring of both progresses and funding (Mohan, 2007).

The first 5-year subdivision of the program lasted from 1997 until 2002 (Wamai, 2009). Substantial increases in life expectancy, a decline in infant and maternal mortality, the expansion of primary health care facilities, a higher usage rate of contraception methods and the extension of immunization coverage were achieved during the indicated period (Mohan, 2007). Yet, despite the mentioned achievements, substantial deficiencies within the health sector remained, such as the overall lack of adequate health infrastructure (Wamai, 2009). Three

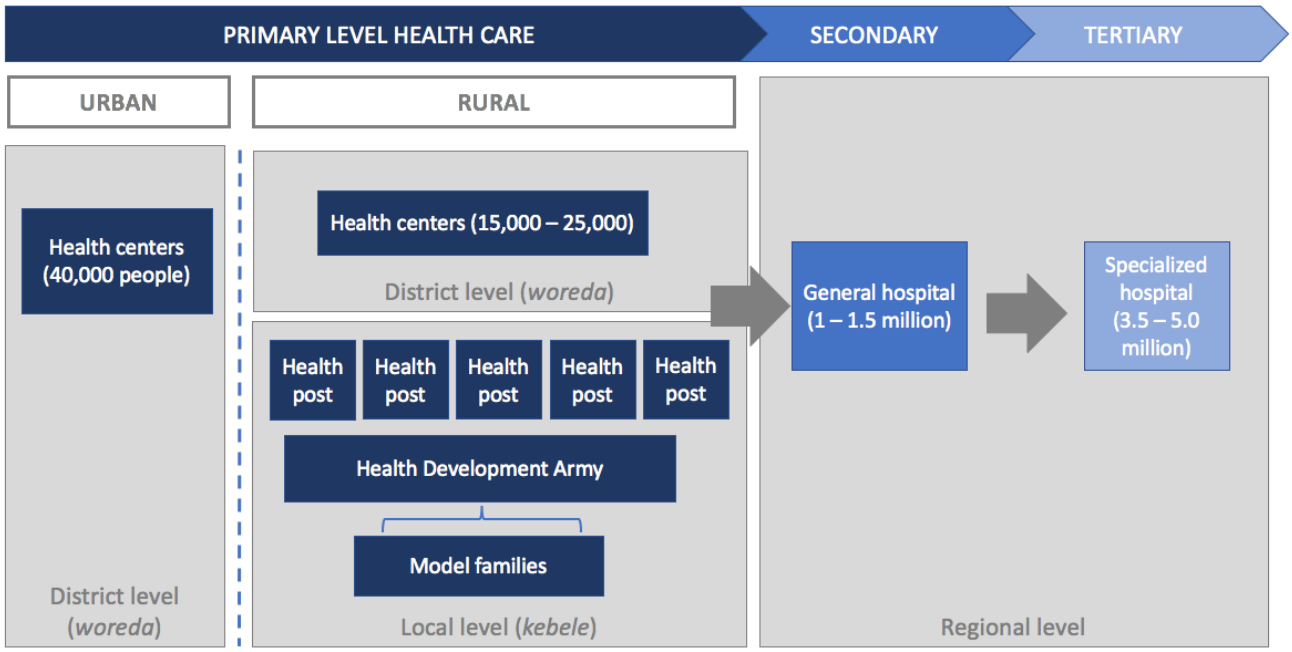
consecutives five-year sub-plans of the HSDP followed until 2015. Following the initial HSDP, a Health Sector Transformation Plan (HSTP) was implemented from 2015 until 2020, taking into consideration lessons learned from the HSDP as well as a changing socio-economic landscape within Ethiopia (Ministry of Health Ethiopia, 2015). Similarly, measurable goals and health outcomes were formalized within the context of the HSTP. Until 2020, the country intended to reduce MMR to 199 of 100,000 live births, decrease under-five year and neonatal mortality to 10 of 1,000 live births, limit the number of under-weight children under the age of 5 to 13% of all children, diminish the incidence of HIV by 60% compared to figures in 2010 including no new infections of children, lessen death from tuberculosis by 35% and the incidence by 20% compared to 2015 and lower the incidence and mortality of malaria by 40% respectively, also in relation to 2015 (Ministry of Health Ethiopia, 2015). Besides, strong emphasis was made on persistent social and economic inequalities as well as unsatisfactory quality achievements in service provision, which conditioned disparate access opportunities to health services within society.

Apart from the described HSDP and the HSTP, the government implemented an additional program in 2003, supplementing already existing programs and interventions. The Community Health Extension Program (HEP) covered 16 packages addressing components of preventive, promotive and curative health services (Workie & Ramana, 2013), with a main emphasis on urban and rural discrepancies in health services. Rural and urban disparities still compose a major challenge concerning the availability and accessibility of health care services, therefore requiring specific attention. Consequently, the HEP exploits the inclusion and collaboration at the community level in response to insufficient coverage, poor service delivery and the lack of skilled health workers in rural areas (Assefa et al., 2019). The approach the HEP takes is based on community health extension workers (HEW), who need to fulfill certain requirements, namely the successful graduation from 10^{th} grade as well as the election by community members for the task, and who´s function is to deliver basic health services in rural areas (Assefa et al., 2019). After a one-year training, they are educated to provide essential curative health services to their community's members and are qualified to promote good hygiene practices and education on preventable communicable diseases.

Generally speaking, the Ethiopian health system is based on a three-tier-system, composed of a primary, secondary (general hospitals) and tertiary unit (specialized hospitals). On that account, the primary health care unit is composed of two different service delivery stages; namely health posts and health centers, both implemented during the HSDP (Workie & Romana, 2015). Health posts are run by two female HEWs recruited within the community and aimed to serve approximately 3,000 to 5,000 people, under the supervision and support of one health center. In rural areas, 25,000 individuals are covered under one primary health care unit, composed of five health posts and one health center (Assefa et al., 2019). Throughout the county, Ethiopia employs approximately 38,000 HEWs distributed in more than 16,000 health posts (Fetene et al., 2016). Through their proximity to the community, they have proven to be an effective tool for health care interventions in resource-scarce and rural environments (Fetene et al., 2016).

Urban primary health care services are delivered exclusively through health centers, serving approximately 40,000 people each.

The following graph depicts the organizational form of the Ethiopian health care sector. Model families and the Health Development Army represent additional components, which support the provision of health services at the individual level. However, their specific function is not of relevance within the scope of this research and will therefore not be discussed further.



Source: Annis & Ratcliffe (2018)

Graph 3: Organigram Ethiopian Health Care Sector

To conclude this section, it is important to stress that the present research will scrutinize alterations in diverse, regional health outcomes in connection to measure in the health sector induced by the government. Consequently, an overall assessment of interventions into the health sector will be realized rather than a measure-specific analysis that would distinguish between different interventions during the time period considered.

2.1.3 Previous Research on Regional Ethiopian Health Outcomes

Five years after the implementation of the HSDP, improvements concerning service utilization, health-related knowledge diffusion and hygiene practices were observed, with increasing community satisfaction over time (Assefa et al. 2019). However, deficiencies with regards to infrastructure in health posts, including running water and electricity as well as the lack of medical equipment and drugs, were mapped out. In a similar manner, the authors highlight the immense workload encountered by most of the HEWs, which was further exacerbated by

insufficient medical knowledge required for specific health needs, limiting the effectiveness of health interventions. Besides, substantial regional differences of compliance with the HSDP were considered decisive to result in unequal regional health outcomes. The concern is further elaborated upon by Workie & Ramana (2013), who reveal regional divergences in per capita health expenditures, leading to an uneven distribution of health facilities not only between regions but also within rural and urban areas of the same region. As a consequence, the supply of primary health care services in rural areas is limited in comparison to urbanized zones due to the restricted availability of health posts in some areas (Workie & Ramana, 2013). For the case of Mozambique, Anselmi et al. (2015) reveal a similar trend, disclosing an uneven distribution of health service provision between different regions and districts due to unbalanced governmental spending, favoring richer quintiles rather than need-assessed and poorer segments of society. Therefore, service utilization differs within Mozambique, hampering poorer quantile and indirectly limiting health care access (Anselmi et al., 2015).

The highlighted differences in Ethiopia are further assessed by Fetene et al. (2016), who distinguish between high-and low-performing administrative areas within regions of Ethiopia. As a result, they find evidence for differences in health outcomes across and within regions owed to deviations from the HSDP. Although not singling out particular health outcomes, the authors do elaborate upon the mechanisms driving divergences within and between regions. Better performing health posts rely to a large degree on data-driven service provision, count with a stronger relationship to the community and perceive greater support from regional health offices. Utilization of health services is therefore linked to the overall quality of service provision, explaining regional divergence. Consequently, Fetene et al. (2016) highlight the importance of comparative quality assessment coupled with fostered regional governance competences in order to successfully implement the HSDP and provide effective health services. In this context, Yitayal et al. (2014) analyzes health service utilization rates at the community level and extracts deterministic factors, that impact upon health post utilization rates. Accordingly, information and knowledge about the HEP or HSDP/ HSTP, high-quality health services and good reputation, visibility, and presence of HEW in the community as well as the income level of the household are all determinants that impact upon the likelihood of service utilization. Likewise, literacy, family size, educational attainment, distance to the closest health facility as well as transportation availability and treatment costs are other deterministic factors of health service utilization (Yitayal et al., 2014; Medhanyie et al., 2012).

Focusing exclusively on child health, Skaftun et al. (2014) uncover sizable regional inequalities regarding health care access. Accordingly, both geographic and socioeconomic barriers impede equal access to health care across the country. In other words, children of wealthier families, living in urban areas, are more prone to maintain or obtain good health than their poorer and rural counterparts. In this context, Lakew et al. (2015) further reveal differences in vaccination coverage. Children living in rural areas are less likely to receive full vaccination coverage than children of families located in an urban environment. Contextually, the regions of Afar, Amhara, Oromia, Somali and SNNPR (Southern Nations, Nationalities, and Peoples´ Region) display the lowest child immunization rates (Lakew et al., 2015). As major determinants for dissimilar coverage rates, the authors list restricted accessibility as well as lack of knowledge

and information in the mentioned regions. Therefore, sustainable long-term improvement in children´s health can only be achieved if frequent contact with the health care system for both mother and child is established in all regions (Lakew et al., 2015). Assessing the effects of HEWs on maternal health services for the region of Tigray, Medhanyie et al. (2012) stress the importance of health posts for reproductive health and family planning, antenatal care, and HIV testing. However, women tend not to deliver their newborns in health posts but rather at home, limiting the impact of HEWs on the increased prevalence of skilled birth attendance (Medhanyie et al., 2012).

Summarizing the above, Ethiopia experienced remarkable changes in health outcomes ever since governmental interventions were undertaken. Nevertheless, the health sector is still characterized by great deficiencies, particularly between regions. Contributing to preexisting knowledge, the underlying study hence scrutinizes a diversity of health outcomes for females on the regional level. By this means, a deeper understanding of underlying mechanisms in regional health inequalities is provided, tailored for Ethiopian women, and building the basis for future target-specific interventions into the health sector.

On that account, the following section will give theoretical insights into the provision of health as an economic good in order to assess regional health inequalities within Ethiopia. The applied theoretical framework allows to evaluate the economic value individuals are assumed to attribute to health. Also, it provides theoretical foundation for the demand and supply of adequate health services. Based on that, an improved understanding of mechanisms driving regionally diverse health outcomes can be derived.

2.2 Theoretical Approach

2.2.1 Health as Economic Good

The good “health” is defined by its rather abstract characteristics, acting as a necessary precondition for individuals’ successful participation in economic activities and determined both by input factors as well as individual attributes, such as genetic disposition and surrounding environment (Zweifel & Breyer, 1997, p. 52). Further, Cullis & West (1979) define health as an economic good that renders monetary and physical utility to the individual in the present and in the future (p.25). In line, health and health-related investments are therefore considered part of the human capital, having a pronounced impact on quality of life and productivity levels. Health is also considered a capital good with considerable investment gains (Cullis & West, 1979, p. 26).

In a similar manner, the Grossman Model of Health Demand (1972) defines health as both an investment and capital good. Accordingly, individuals dispose of an initial health stock, which is assumed to deteriorate with age; yet deterioration can be mitigated or even reversed through

adequate health investments. For that reason, individuals face opportunity costs between investments either in health or alternative goods and services. Grossman (1972) predicts rising health investments with increasing age as well as a positive relationship between income and monetary allocation on health services. Income and time, though, are negatively correlated. With increasing income, individuals tend to dedicate less time to health services but count instead with a higher willingness to pay. Therefore, rising income does not necessarily translate in improved health outcomes. Besides, education is positively associated with efficiency gains in the production of health. An expanding educational level decreases the price of health capital and thus stimulates an increase in the amount of health goods demanded (Grossman, 1972). Ergo, individuals' health outcomes are not the sole result of exogenous factors, but hinge on the quality and quantity of resources allocated to the production of health. A positive, yet time-delayed, association is assumed between health outcomes and the consumption of health services. However, a sudden deterioration in health status is projected to increase the demand for health services immediately (Zweifel & Breyer, 1997, p.12).

Although individuals demand health per se, contingent inter alia on their income and educational level, demand is de facto derived towards health care services, legitimized by the fact that health is a non-tangible good (Zweifel & Breyer, 1997, p.118). On that account, the optimum amount of health services provided in society is determined both by health supply and demand. In other words, the sum of individual's health production functions, representing "health supply", and the societal demand for health-related services condition the nature of the public health sector (Zweifel & Breyer, 1997, p. 11).

To sum up the above, health is a non-tradable good that counts with public good characteristics and is part of an individual´s invisible capital stock (Zweifel & Breyer, 1997, p.54; Cullis & West, 1979, p.33). On that account, outcomes in health are intangible but yet highly linked to the provision of adequate health services. Health in turn conditions labor productivity as well as future health-associated costs and determines individual´s human capital composition (Zweifel & Breyer, 1997, p.7).

Based on the presented characteristics of health as economic good, inquiries regarding the optimal allocation of health services arise. Good health is linked to individuals' investments into health as well as ample public service provision. Allocation decisions are, however, subject to both efficiency and equity requirements. In a subsequent step, the lack of efficiency in the allocation of health goods as well as potential adverse effects on health equity will hence be discussed, applying both principles of Pareto and equity on health goods.

2.2.2 The Optimal Allocation of Health Goods

In a perfectly competitive and free market at equilibrium, the Pareto theorem is assumed to apply. In other words, goods and services traded at the market are expected to be allocated in a state of efficiency. In a market at equilibrium, individual's welfare can only be increased on the condition that no one's welfare is decreased (Rice, 1998, p.20). Thus, the principle of scarcity

is the major driver of efficiency, simultaneously incurring opportunity costs and therefore requiring a tradeoff between different resource allocations alternatives (Vogel, 2000). On that account, the allocation of health resources is, according to the Pareto principle, conditioned by a consideration of diverse but likewise efficient alternatives. Aspects of social equity, notwithstanding, are not taken into consideration under Pareto.

Health goods, however, count with particular characteristics and are subject to the interdependence of economic and medical criteria. Therefore, failures in health markets arise. Although counting with some characteristics of a public good, such as the existence of positive and negative externalities and an asymmetric information distribution, health goods generate utility already through their sheer existence. Besides, health yields positive returns through its option-good character but does not incur economies of scale (Rice, 1998, p. 129). Furthermore, health goods differ from public goods by causing rivalry and excludability in consumption (Rice, 1998, p. 129). Likewise, independent decision-taking is restricted for health goods, since the demand side faces serious limitations of rationality, considering the impossibility of quality evaluation and the lack of sampling opportunities for medical services at the individual level (Rice, 1998, p.132). As a result, Arrow (1963) stresses the high level of uncertainty regarding health markets, conditioned by unpredictable demand patterns, health outcomes and asymmetric information. Consequently, the optimal allocation of health goods is restricted by the outlined characteristics of health.

Resource allocation oscillates between an equilibrium of costs and benefits and the maximization of benefits for patients without cost considerations (Vogel, 2000). In other words, the allocation of health goods is contingent on a tradeoff between efficiency and equity. As a consequence, the optimal allocation of health goods and services is not determined by demand and supply mechanisms based on pareto-efficient economic decision making (Zweifel & Breyer, 1997, p.127). As outlined, health markets are rather characterized by multiple market failures. Thus, health markets require interventions in order to generate pareto improvements and hence social equity and efficiency (Stiglitz, 1991). Consequently, both the *First Theorem of Welfare Economics*, assuming the efficient allocation of goods in competitive markets, and the *Second Theorem of Welfare Economics*, deducing the attainment of pareto-efficient allocation exclusively through price mechanisms based on initial lump sum redistributions, do not hold for health goods (Stiglitz, 1991). Unrestricted health markets are thus expected to result in the inefficient and unequal allocation of health goods, and thus require market adjustments (Arrow, 1963). For that reason, active governmental interventions into health markets are justified, emphasizing the need for social equity rather than efficiency.

2.2.3 Horizontal and Vertical Equity of Health Goods

As has been demonstrated, the Pareto theorem neglects aspects of social equity, possibly allowing for unequal distribution patterns regarding health goods. Thus, a pareto-optimal distribution of resources might be efficient but not necessarily socially desirable (Rice, 1998, p.22). Consequently, redistributive policies for health markets, supplying accessible health-related services, require governmental market intervention (Rice, 1998, p. 159).

In general, health inequality refers to the unmet need of health care due to unequal access towards health services within society (Olsen, 2011). Based on that, inequalities are the result of three determinants of health; namely genetic disposition, health-related lifestyle as well as physical and social environment of individuals (Olsen, 2011), whereby a major focus will be made on the latter within the scope of this research. Health inequalities are assumed to be mitigated through adequate policies that intent to distribute health care equally throughout society.

In this context, social equity can be distinguished between horizontal and vertical equity. The former concept takes the form of equal treatment of equal individuals, implying equal access to health services for similar diseases. The latter, however, adopts a more need-specific approach and suggests unequal but equitable and fair treatment for individuals with different needs based on procedural rather than distributive justice (Mooney & Jan, 1997). In other words, health needs are weighted according to socio-economic status, gender, or age in order to account for different requirements and states of urgency. Vertical equity further takes into consideration individuals health prioritization, displaying in divergent health investments between individuals (Wonderling et al., 2005). Accordingly, vertical equity is subject to ongoing political debate and thus shaped by societal values and norms, which might vary substantially between countries (Musgrave, 1990). The resulting equity-efficiency tradeoff is thus conditioned by specific cultural, financial, or geographical factors of influence (Wonderling et al., 2005).

Concerning vertical equity, rural populations are assumed to face considerably higher restrictions towards health markets compared to their urban counterparts (Sibley & Weiner, 2011). As a result, the place of residence, associated with an either urban or rural environment, has proven to significantly impact upon outcomes in health status, demand, access, and utilization patterns for health goods (Sibley & Weiner, 2011). The optimal amount of health consumed is determined by the interplay between biological, environmental, and behavioral factors. Yet, the environmental component of rurality is considered to impact adversely upon health outcomes, owed to both reduced availability of public health services and a higher burden of diseases (Humphreys & Solarsh, 2017). Structural and socioeconomic circumstances further correspond adversely to rurality, such as overall living standard, sanitation, educational attainment, income level, poverty, and employment opportunities (Humphreys & Solarsh, 2017). Based on the efficiency-equity tradeoff, health services are hence not only subject to social equity but further need to take into account spatial accessibility and availability of health goods and services.

Taking into consideration both peculiarities of health, determinants of allocation and vertical equity, this paper focuses on the case of Ethiopia and assess - within the scope of the theoretical framework - particular health outcomes in a context of regional divergences and urban-rural differences. Resource allocation of health in Ethiopia is administered by the government, complying with principal economic assumptions of health goods. Yet, vertical equity is so far hardly achieved, and health services differs widely across regions. Through several government interventions over the past decades, health outcomes altered, yet unevenly within the country. This paper thus focuses on disparities of health outcomes in Ethiopia and assesses health achievements over time and space. Did women of certain regions experience adverse health outcomes over time owed to their geographical location?

3 Data

To conduct the outlined research, the following section will give insights into the applied data material. An overview of the origin of the data, its quality and reliability will be given. In a subsequent step, descriptive statistics covering dependent and independent variables will be presented in detail.

3.1 Source Material

The quantitative data used for the underlying research has been collected by the Demographic and Health Survey between 2000 and 2016 (DHS, 2021a). The principal aim of the survey is the assessment of time-relevant key demographic and health measures in order to improve long-term health outcomes of the Ethiopian population (World Bank, 2017). On that account, the database is considered suitable for the present study. A longitudinal panel-dataset was created by adding up individual waves from 2000, 2005, 2011 and 2016 (DHS, 2021b).
Importantly, the first wave considered covers the year 2000. Although first governmental interventions have been realized already during the 1990s, an assessment from 1990 onwards is not possible due to the unavailability of data (DHS, 2021b). Yet, effects on health outcomes are expected to materialize with a certain time delay, which is why the start of the study from 2000 onwards still appears reasonable.
Each wave contains only female members of households aged between 15 and 49, representative for the reproductive age (DHS, 2021a). Since waves vary in sample size over the years, only women followed throughout the whole period of observation were considered, resulting in a balanced panel dataset, and supporting the validity and representativity of the study. In general, panel data is regarded beneficial concerning the analysis of intra-individual alterations, the estimation of variations over time as well as the minimization of unobserved heterogeneity (Brüderl, 2010).

According to the ICF (2018), the sample is considered to be representative at both national, regional and residence (urban-rural) level. Households nominated into the sample through the selection into enumeration areas based on census data conducted by the Ethiopian Central Statistical Agency. The setup of the census entailed approximately 85,000 enumeration areas, with each including about 180 households dispersed over all geographical regions of Ethiopia (World Bank, 2017). Based on enumeration areas, eligible women within the mentioned households were included into the final DHS sample (ICF, 2018). In total, more than 18,000 households were taken into account during the first sampling round, whereby only 17,000 were

classified as occupied and hence eligible for the questionnaires (World Bank, 2017). Interviews were conducted with approximately 16,650 households, representing a response rate of 98%. Depending on the specific wave, between 15,000 and 16,000 interviews per wave were realized (DHS 2021b), displaying in a general response rate of 95%. Interviews were conducted over a period of several months. In total, the final sample size is of 14,070 women per wave, resulting in a multi-stage stratified survey dataset of 56.280 observation points (ICF, 2018).
Non-sampling errors, such as data coding mistakes or wrongly located households, cannot be controlled for but are assumed to be neglectable due to the high-quality assessment of data collection (World Bank, 2017). It can consequently be assumed, that the sample fulfills necessary criteria of randomization.

The questionnaires from which the data was deducted contain information on reproductive health and sexual activity, fertility, circumcision, disease treatment, drug availability and domestic violence, inter alia. However, only variables conducive for the underlying analysis were considered within the scope of this research and will be discussed in the following subsection.

3.2 Descriptive Statistics

3.2.1 Outcome Variables

As previously outlined, the analysis of this research is composed of several outcome variables, which aim to measure diverse health outcomes for women. Thus, aspects of preventive, curative and maternal health are taken into account. The selection of outcome variables is based on Lozano (2020) as well as relevant indicators assessed in previous literature contributions. The inclusion of measures of maternal health is motivated by the mentioned improvements in MMR and substantial alterations in the major causes of death (GRAPH 1 & GRAPH 2). Potential drivers of the development, such as ante-and postpartum service provision, are consequently scrutinized. In a similar manner, the selected indicators of curative health – ORT and the high prevalence of underweight - represent a widespread difficulty in Ethiopia, justifying the inclusion in the study. The expansion of preventive care, such as increased vaccination cover, has been prioritized as one of the main goals of the HSDP in combination with reduced access barriers to health care. Generally speaking, the selection of relevant health outcomes has been made on aspects of comprehensiveness, meaningfulness, robustness in terms of sample and measurement as well as data availability (Institute of Medicine, 2001, p. 76).

For that reason, the main outcome variables are vaccination coverage, the Body Mass Index, oral rehydration therapy, prenatal and postnatal care, birth assistance and access barriers to health. Each outcome variable will be estimated in a separate model, entailing a first (binary coding) and second stage (multi-categorical coding). On that account, Section 4 will explicitly indicate the methodical approach of the conducted first and second stage analysis.

The following subdivisions and tables provide detailed information on each variable included. An additional overview of outcome and explanatory variables as well as their specific categories can be found in APPENDIX A.

Vaccination Coverage

For the first stage of the analysis, the variable is binary coded, attributing the value of 0 to lacking immunization and 1 to partial or full vaccination coverage. In a second step, the categorical variable of vaccination coverage differentiates between full, partial or no vaccination coverage. Lakew et al. (2015) reveal substantial regional differences in coverage rates, supporting the underlying reasoning to consider vaccination coverage a relevant outcome variable. Full vaccination coverage hence refers to individuals who received all of the vaccines listed below, whereas partially covered individuals only obtained at least one of them.
According to the CDC (2016), vaccination coverage includes fundamental vaccines that are aimed to protect against contagious diseases. Immunization counts with life-long positive effects, protecting newborns, children, and adults alike against infections. Based on recommendations of the CDC (2016), the present study thus includes the following vaccinations into the evaluation: Polio, Measles, Diphtheria-Pertussis-Tetanus (DPT) and Bacillus Calmette-Guérin (BCG [Tuberculosis]). Apart from BCG and Measles, three doses of each vaccine are required in order to achieve permanent immunization.

Body Mass Index (BMI)

The outcome variable of BMI operates as a proxy for under-or malnourishment. As previously stated, the variable in the first stage is coded as dichotomous outcome, distinguishing between underweighted and normal-weighted individuals. Yet, for the second stage analysis, the variable differentiates between underweight, normal weight and obesity, based on individual BMI scores. The classification is inspired by the WHO (2021), considering individuals below a BMI of 18,5 points as underweighted, persons with a BMI between 18,5 and 24,9 points as normal weighted and individuals with a BMI above 25 as overweighted.
In a recent study, Kassie et al. (2020) affirm that gender-based evidence regarding undernourishment in Ethiopia is rare, particularly on a regional level. Nevertheless, undernourishment is significantly associated with child mortality and socio-economic achievements, implying major implications for the health of women. Consequently, by including BMI scores into the analysis, the present research accounts for the impact of underweight on overall female health performance.

Oral Rehydration Therapies (ORTs)

The first stage of this variable draws a distinction between the use and non-use of ORTs in the wake of diarrhea, taking into consideration home-made treatments including diluted water with salt and sugar, zinc supplements or even antibiotics and drugs in severe cases. The second stage categorical variable goes more into detail and further distinguishes between awareness and knowledge concerning rehydration therapy options. Therefore, the variable differentiates between three different categories, controlling for non-users of oral rehydration, non-users but aware of different available options as well as applicants of ORTs for the treatment of diarrhea. In South-Western Ethiopia women are assumed to lack basic education and knowledge regarding severe or dangerous forms of dehydration (Abera & Assefa, 2018). Likewise, Misgna et al. (2019) conclude that the potential of oral rehydration is not yet fully exploited, displaying in an under-proportional rate of application throughout Ethiopia. Therefore, the inclusion of ORT into the analysis accounts for regional alterations over time. By this means, persistent shortcomings are assessed, and the need for regional, governmental interventions highlighted.

Prenatal Care

As outlined, prenatal care is a fundamental component in the fight against newborn and maternal mortality. Including three different components, namely blood and urine samples as well as blood pressure, it is a strong predictor for both mother and child survival. Yet, Tegene et al. (2019) find persistent regional differences both with regards to availability and utilization rates of prenatal care visits. To account for the observed trend, the first stage binary outcome variable scrutinizes whether mothers of the sample had at least one visit at a health facility with a trained health worker during pregnancy or whether they did not. In a subsequent step, a categorical outcome variable thus distinguishes between the number of visits, precisely between no visit, one to two visits, three to four visits or more than five visits.

Birth Assistance

High-quality birth assistance substantially contributes to a successful birth process. Nevertheless, within an African context, Ethiopia ranks amongst the lowest countries in qualified birth attendance rates between 1990 and 2011, conditioning maternal and newborn mortality (Skaftun et al., 2014). To account for the persistent shortcomings, the first stage variable distinguishes between Ethiopian women who were assisted and those who weren't during birth. In more detail, the second-stage categorical variable then scrutinizes the form of assistance women received. A distinction was made between health professionals, trained traditional birth attendance and untrained traditional birth attendance. The latter concept refers to friends and neighbors or other household members whereas trained traditional birth attendance includes voluntary health workers or NGO members. Doctors, nurses, midwives and HEWs were classified as health professionals.

Postnatal Care

In a similar manner as prenatal care, postnatal care contributes to improved child and mother's health. However, Sisay et al. (2016) assess the 2016 DHS survey wave and find remarkable regional divergences in the accessibility and usage of postnatal health care services. Particularly in the regions of Somali, Oromia, Gambela and SNNPR, application rates were low. As a consequence, the dichotomous variable of the first stage controls for attendance and non-attendance of health checkups after delivery in order to assess usage rates over time and space. The second stage categorical variable is coded analogously as birth assistance, distinguishing between the attendance of post-partum health checkups with health professionals, non-attendance and trained or untrained traditional birth attendants.

Access Barriers

An additional outcome variable included is access barriers to health services. This variable aims to capture difficulties in seeking health care and represents a core element in order to match supply and demand of health goods. Thus, access barriers represent a relevant determinant of overall health performance, motivating the consideration in this research. The binary first stage variable divides between individuals who face access barriers and those who encounter no barriers. Thus, the second stage singles out particular barriers of Ethiopian women when intending to seek health care. Associated barriers are the lack of permission by the husband or partner to seek health care, concerns regarding the sex of the health provider, missing transportation infrastructure to the closest health facility, the distance to the next health establishment or the lack of money for out-of-pocket (OOP) treatments (Yitayal et al., 2014).

The subsequent tables report relevant summary statistics for the outcome variables, both for the first and second stage of analysis.

Table 1: First Stage Summary Statistics

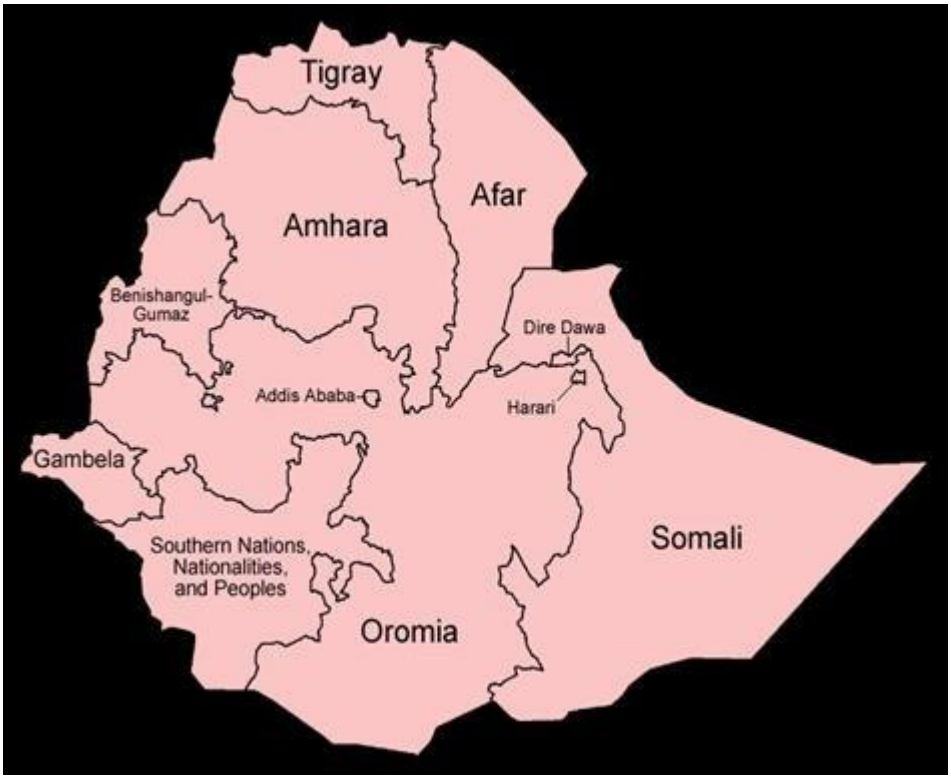
Variable	Obs.	Mean	Std. Dev.	Min	Max
Binary Vaccination	56280	0.571	0.872	0	1
Binary BMI	47389	0.27	0.444	0	1
Binary Oral Rehydration	56280	0.689	0.463	0	1
Binary Prenatal Care	26465	0.422	0.494	0	1
Binary Birth Assistance	56280	0.499	0.557	0	1
Binary Postnatal Care	56280	0.128	0.965	0	1
Binary Access Barriers	56280	0.724	0.447	0	1

Table 2: Second Stage Summary Statistics

Variable	Obs.	Mean	Std. Dev.	Min	Max
Vaccination Coverage	1778	2.871	0.47	1	3
BMI Classification	7522	20.442	3.253	12.03	58.8
Oral Rehydration	6280	1.354	0.922	0	2
Prenatal Care	6280	4.43	3.047	0	3
Birth Assistance	6280	3.194	1.071	0	3
Postnatal Care	6280	1.128	0.965	0	2
Access Barriers	6269	3.221	2.144	0	5

3.2.2 Explanatory Variables

The subsequent section will motivate the inclusion of specific explanatory and control variables into the models.



Source: Mekonnen et al. (2014)

Graph 4: Regions and Administrative Areas of Etnıopıa

In order to scrutinize the causal impact on the outcome variables, the explanatory variables *region* and *rurality* have been included in the analysis. Woldemichael et al. (2019) consider *region* as strong predictor for health outcomes due to the high dispersion of healthcare resources between different regions. According to the authors, inter-regional inequalities are subject to discrepancies in governmental health expenditures. On that account, regions differ strongly in compliance concerning the HSDP and HSTP as well as the prioritization of health on their policy agenda. Therefore, regional effects on health outcomes are assumed, further supported by Luo et al. (2015). They likewise stress the importance of geography on key health outcomes.

GRAPH 4 displays all nine geographic regions as well as the two administrative areas, Addis Ababa and Dire Dawa. As displayed, regions differ greatly in size, possibly distorting results. An association between the provision of health services and regional size might be assumed, since smaller regions might require less administrative complexity than larger regions. Yet, the emphasis of the present research is on regional health outcomes with the sample being evenly distributed throughout the country. In other words, each region includes a similar number of women, which enables a regional comparison of health outcomes independent of regional size.

Nevertheless, a further assessment of regional size will be addressed in the section covering the discussion of results.

The dichotomous variable *rurality* distinguishes between women living in households located in either urban or rural zones in order to account for location-specific divergences within regions. Tegenu (2010) testifies an uneven urbanization process in Ethiopia, with no regional pattern becoming apparent. Although Addis Ababa is the most urbanized area in the country, other regions are characterized by an unbalanced spatial dispersion of urban centers with great differences in health service provision. Considerable efforts have been made to close the detected rural-urban gap in health care access, quality, and utilization, yet regional differences persist (Brandley et al., 2012). Major emphasis is thus made on within-region urban-rural differentiations on the household level within the scope of this study. On that account, urbanity summarizes regional capital cities as well as cities and towns between 20.000 and 50.000 inhabitants whereas *rurality* accounts for countryside, long travel times to urban environments and low population density (ICF, 2018).

Control variables included in the analysis are women´s literacy level controlling for their ability of reading as well as the highest educational level attained of both women and their partners. By this means, both completed and uncompleted primary and secondary education are considered in the estimations.
In a systematic literature review, DeWalt et al. (2004) testify a significant relationship between reading skills and poor health outcomes. Similarly, Berkman et al. (2004) assess the harmful effect of low literacy levels on overall health outcomes, linked to a reduced understanding and knowledge of health-specific advice. Their findings are in line with Cutler & Llera – Muney (2006), who argue that with increasing education, health outcomes improve. In turn, health inequalities are associate with divergent educational levels, resulting in differences of knowledge, recognition, and health practices.
Importantly, it needs to be mentioned that the reasoning for including both a control for the highest educational level achieved and a literacy variable is rooted in the fact that literacy is not necessarily a product of formal education. Literacy therefore requires to be captured by a sperate variable. Furthermore, concerns regarding multicollinearity were tested for but did not yield relevant results.
Clustered under *Formation Control*, the variables education, partners education and literacy are thus reported in the respective regression output tables (TABLE 4 & TABLE 10 – 16), albeit for clarity reasons not stating their individual coefficients.

The cluster *Household Composition* entails a series of diverse household characteristics. Based on relevant literature contributions, it is the household size and the age of the women that are assumed to correlated with the outcome, legitimizing the inclusion into the analysis. In this context, Wu & Li (2012) argue for the case of China. A decreasing number of children is linked to a reduced likelihood of mothers being underweight. Likewise, Anyanwu (2014) established a relationship between household size and poor health outcomes in Nigeria. Accordingly, an increasing number of children is associated with reduced investments in human capital, both for the mother and the children and thus results in adverse health effects. Besides, age is

associated in the literature with a number of diverse health outcomes, such as for example knowledge of ORT as well as the prevalence of pre-and postnatal care. Leppert et al. (1986) find evidence for a negative impact of youth pregnancy on maternal and newborn health. Moreover, Kassie et al. (2020) affirm an increased likelihood of underweight for younger women. Consequently, youth appears to be negatively associated with health outcomes.

In order to control for health-related factors of influence, both the source of drinking water and the type of toilet facility used in the household were added as controls in some models, clustered under *Sanitation Infrastructure*. An impact on underweight and the use of ORT is assumed. The reasoning is supported by Gundry et al. (2004), demonstrating a strong relationship between health outcomes and the source and quality of water. Likewise, Prüss-Üstün et al. (2008) point out that contaminated water as well as insufficiently developed sanitation facilities contribute strongly to the overall burden of disease and hence condition the incidence of morbidity and mortality.

Additional information on explanatory and control variables can be found in APPENDIX A.

4 Methods

Based on the variables specified previously, a multilevel analysis, composed of two stages for each outcome variable, will be conducted. In a first step, fixed effects binary logistic regression models will be estimated and postestimation results reported. Thereupon, fixed effects multinominal logistic regression will scrutinize the regional impact on health outcomes. The approach is inspired by the guide of health-related data analysis of O´Donnell et al. (2008). Specifications of the models will be discussed hereafter.

4.1 The Approach

The quantitative approach of the underlying study is based on an individual fixed effects research design, subdivided into two analytical stages. Applying longitudinal data gathered by the DHS Ethiopia between 2000 and 2016, a timespan of 17 years with four points of measurement (2000, 2005, 2011, 2016) is investigated, covering a totality of approximately 15.000 Ethiopian women (DHS, 2021a). The panel structure of the data acknowledges both time-invariant as well as time-variant effects of unobserved characteristics that affect all women of interest. Thus, changes in health outcomes of individuals will be tracked over time, estimated by a within-unit change in health.
The main assumption regarding the research design is that time-invariant factors of influence are correlated with the explanatory variables but are controlled for by individual fixed effects (Allison, 2009, chapter 2, p. 2). As a consequence, the conditional independence assumption (CIA) between the explanatory variables and time-invariant factors of influence can be relaxed.

Formally, this is expressed as:

$$E\left[\eta_i \mid X_{i2000}, \ldots, X_{i2016}\right] \neq 0$$

However, the Strict Exogeneity Assumption (SEA) for unbiased estimates in fixed effects regressions reasons that the selection into treatment does not occur based on time-variant unobserved characteristics, such as shocks that affect both the outcome and explanatory variables. Consequently, under the assumption that the CIA can be relaxed and strict exogeneity is given, the particular models are specified emanating from the following base:

$$\Upsilon_{it} = \alpha + \mathrm{X}_{it}\beta + \eta_i + \varepsilon_{it}$$

whereas the components are connoted as:

Υ_{it} = outcome variable, contingent on time and individual

α = intercept

X_{it} = vector for explanatory and control variables, contingent on time and individual

β = coefficient

η_i = individual fixed effect, constant over time and individual

ε_{it} = error term, varies over time and individual

4.2 The Models

To control for diverse health outcomes, the underlying research distinguishes between seven different models. Thus, for each of the outcome variable, the particular model measures the regional effect for each woman *i* in year *t.*

(1) $Vaccination\ Coverage = \alpha + \beta_1\ Region_{it} + \beta_2\ Rurality_{it} + \beta_3\ C_i + \beta_4 D_{it} + \varepsilon_{it}$

(2) $Body\ Mass\ Index = \alpha + \beta_1\ Region_{it} + \beta_2\ Rurality_{it} + \beta_3\ C_i + \beta_4 D_{it} + \beta_5 Q_i + \varepsilon_{it}$

(3) $Oral\ Ryhadration = \alpha + \beta_1\ Region_{it} + \beta_2\ Rurality_{it} + \beta_3\ C_i + \beta_4 D_{it} + \beta_5 Q_i + \varepsilon_{it}$

(4) $Prenatal\ Care = \alpha + \beta_1\ Region_{it} + \beta_2\ Rurality_{it} + \beta_3\ C_i + \beta_4 D_{it} + \varepsilon_{it}$

(5) $Birth\ Assistance = \alpha + \beta_1\ Region_{it} + \beta_2\ Rurality_{it} + \beta_3\ C_i + \beta_4 D_{it} + \varepsilon_{it}$

(6) $Postnatal\ Care = \alpha + \beta_1\ Region_{it} + \beta_2\ Rurality_{it} + \beta_3\ C_i + \beta_4 D_{it} + \varepsilon_{it}$

(7) $Access\ Barriers = \alpha + \beta_1\ Region_{it} + \beta_2\ Rurality_{it} + \beta_3\ C_i + \beta_4 D_{it} + \varepsilon_{it}$

The vector C_i takes into account a control-series of time-invariant individual characteristics, namely literacy, partners education and women's education, expected to significantly impact upon health outcomes. Likewise, the vector D_{it} accounts for age, household size and the year of each panel wave, clustered at the individual level but variant over time. Vector Q_i takes into consideration time-invariant sanitation infrastructure of women´s residence, namely the source of drinking water and the type of toilet facility. Importantly, the control cluster is only included in MODEL 2 and MODEL 3, as motivated in the previous section. Further, the time-variant, individual error term ε_{it} is assumed to be zero, whereas the time-invariant error term, due to the relaxed CIA assumption, is not assumed to be zero. Standard errors are clustered at the individual level, taking into consideration repeated observations over time.

Crucially, the examination of the models is subdivided into a multilevel analysis, comprising two different stages. The first stage of the analysis entails fixed effects binary logistic regressions. For each of the seven outcome variables, a separate binary logistic regression is run in the first stage. Besides, in this stage of the analysis, outcome variables are coded dichotomously. The interpretation of the first stage fixed effects binary logistic regression is organized in three different postestimations, which are the odd ratio, the predicted probability as well as the marginal effect of each outcome variable. Therefore, three different coefficients are reported and compared for each outcome variable and region in the first stage. Consequently, both the relative and absolute magnitude of a regional impact on health outcomes can be estimated.

Reporting the odd ratio gives indications about the estimated number of times an event or outcome is assumed to occur in relation to the estimated times it is assumed not to occur and hence express the odd of occurrence (Persoskie & Ferrer, 2017). Accordingly, odd ratios are a commonly applied measure in public health owed to their statistical characteristics, which allows for computation in the context of logistic regression models. Notwithstanding, in order to assess relative and absolute probabilities, the authors suggest complementary postestimations, such as predicted probabilities or marginal effects. They argue that odd ratios cannot give effective indications about the magnitude of the effect. Consequently, the underlying study estimates predicted probabilities in a subsequent step, hereby indicating the absolute probability of the binary outcome variable adopting the value of one (Torres-Reyna, 2014). Additionally, marginal effects for each outcome variable facilitate the comparison on the regional level (Perraillon, 2019). In line, Mood (2010) argues that marginal effects facilitate the differentiation and interpretation of results. She suggests that the consideration of both odd ratios, predicted probabilities and marginal effects is necessary for an in-depth interpretation of results.
In relation to the base category, which is Addis Ababa, marginal effects thus indicate the relative change in probability of the outcome variable adopting the value of one. In context of this research, the marginal effect thus enables the regional comparison in terms of relative change in probability regarding specific health outcomes. Formally, marginal effects can be expressed as the slope of the prediction line (Perraillon, 2019).

The second stage of the analysis aims to deepen the evaluation of information. Therefore, the coding of the outcome variables changes from binary into multiple categories. In other words, the second stage distinguishes not only between “Yes “and “No” but allows for an in-depth specification of the outcome variables. Fixed effects multinominal logistic regressions are run for each outcome variable and region. Due to the change in coding of the outcome variables, however, the second stage analysis exclusively reports odd ratio estimations, since both predicted probabilities and marginal effects cannot be specified for multinominal logistic regressions.

The reasoning for a subdivision into a fist and second stage analysis is rooted in the structure of the data. Ananth & Kleinbaum (1997) argue, that the nature of medical data is frequently categorical, which in turn complicates the measurement and comparison of effects on a regional level. In order to obtain regionally comparable, multilevel results and exploit the nature of the data, the analysis has thus been subdivided into two stages. First stage results only allow for binary outcome variables. Valuable information is thus lost. Second stage results, on the contrary, allow for categorical outcome variables but do not permit for postestimations apart from odd ratios. Regional comparison is consequently more difficult in the second stage. To prevent a trade-off between categorical outcome variables and regionally comparable postestimations, the analysis has consequently been divided into two stages, exploiting the benefits of both binary and multinominal logistic regressions.

5 Empirical Analysis

Outcomes of the analysis show that health outcomes have manifested to differ widely not only across and between regions, but also over time. As previously outlined by Workie & Ramana (2013), this research has therefore unveiled uneven health outcome patterns within the country, pointing towards regional differences in compliance with the HSDP (Woldemichael et al., 2019). In line with previous research undertaken in the field, evidence for discrepancies between urban and rural areas was further established (Brandley et al., 2012). However, not all health indicators reveal the same regional pattern, yielding new insights into the Ethiopian health sector.

The subsequent section focuses on the analytical interpretation and discussion of results, drawing an overall pattern of regional divergent health outcomes in Ethiopia.

Firstly, each of the scrutinized health outcome variables will thereby be discussed, indicating regional tendencies in performance. Within this first part, both first and second stage results for health outcomes will be outlined and compared. Thereupon, the subsection *Patterns and General Trends* will summarize findings on a meta-level and indicate overall trends in the country. Besides, results will be linked to the literature. Importantly, for matters of clarity, specific ratios and probabilities for each region will only be discussed in APPENDIX C. Section 5 is dedicated to the analytical interpretation of results in order to establish a regional comparison. Also, significance levels will not be addressed individually in this section, but can be found in APPENDIX B.

TABLE 4 illustrates first stage regression results and reports odd ratios for each health outcome and region. TABLE 5 shows the evolution over time. Output tables of predicted probability and marginal effect postestimation results are found in APPENDIX B. Similarly, second stage results, reporting the odd ratio for categorical health outcome variables, are located at the end of APPENDIX B.

Table 3: First Stage Results - Odd Ratios

	(1) Vaccination	(2) BMI	(3) Rehydration	(4) Prenatal Care	(5) Birth Assistance	(6) Postnatal Care	(7) Access Barriers
Base Category: Addis Ababa							
Tigray	1.926***	2.013***	3.290***	1.537***	2.865**	1.215	0.649***
	(0.149)	(0.224)	(0.414)	(0.243)	(1.312)	(0.298)	(0.0843)
Afar	0.709***	2.711***	1.488***	0.436***	22.39***	0.640*	0.838
	(0.0586)	(0.313)	(0.184)	(0.0721)	(14.45)	(0.171)	(0.124)
Amhara	1.268***	1.336***	0.541***	0.763*	2.245*	0.477***	0.582***
	(0.0945)	(0.148)	(0.0633)	(0.119)	(1.004)	(0.119)	(0.0745)
Oromia	1.207***	1.270**	0.757**	0.631***	0.854	0.530***	1.190
	(0.0877)	(0.138)	(0.0877)	(0.0967)	(0.370)	(0.127)	(0.147)
Somali	0.784***	1.891***	1.518***	0.310***	5.382***	0.842	1.549***
	(0.0659)	(0.223)	(0.192)	(0.0512)	(2.726)	(0.219)	(0.249)
Ben. Gum.	1.110	1.490***	0.624***	0.690**	0.236***	0.497**	1.049
	(0.0910)	(0.175)	(0.0768)	(0.113)	(0.102)	(0.138)	(0.156)
SNNPR	1.320***	1.154	0.626***	0.783	0.485*	0.612**	1.150
	(0.0988)	(0.129)	(0.0739)	(0.122)	(0.208)	(0.152)	(0.152)
Gambela	0.868*	2.955***	0.857	0.706**	0.456*	0.771	0.842
	(0.0713)	(0.340)	(0.107)	(0.118)	(0.201)	(0.197)	(0.121)
Harari	1.357***	1.337**	3.777***	0.848	2.818**	1.291	1.014
	(0.110)	(0.159)	(0.547)	(0.142)	(1.435)	(0.349)	(0.135)
Dire Dawa	1.302***	1.572***	1.950***	1.442**	1.130	0.767	0.765**
	(0.114)	(0.199)	(0.280)	(0.266)	(0.531)	(0.204)	(0.103)
Rurality	0.903**	0.736***	2.115***	3.242***	2.732***	3.693***	0.378***
	(0.0424)	(0.0513)	(0.152)	(0.268)	(0.614)	(0.527)	(0.0318)
Formation Control	YES	YES	YES	YES	YES	YES	YES
HH Composition Control	YES	YES	YES	YES	YES	YES	YES
Sanitation Infrastructure Control	NO	YES	YES	NO	NO	NO	NO
Observations	28,274	16,590	25,243	13,871	3,317	3,487	26,125
Number of z	9,060	5,862	8,070	5,326	1,260	1,260	8,410

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

Table 4: First Stage Results - Time Trends (Odd Ratios)

	(1) Vaccination	(2) BMI	(3) Rehydration	(4) Prenatal Care	(5) Birth Assistance	(6) Postnatal Care	(7) Access Barriers
Base Category: 2000							
Wave 2005	0.871***	0.914*	0.429***	0.964	1.093	0.973	65.24***
	(0.0288)	(0.0467)	(0.0178)	(0.0354)	(0.125)	(0.104)	(4.980)
Wave 2011	1.133***	1.023	0.898**	1.328***	1.200	1.448***	57.20***
	(0.0384)	(0.0498)	(0.0447)	(0.0504)	(0.149)	(0.164)	(4.497)
Wave 2016	0.823***	0.836***	1.036	2.641***	0.421***	1.831***	83.72***
	(0.0298)	(0.0422)	(0.0536)	(0.113)	(0.0491)	(0.221)	(6.947)
Observations	28,274	16,590	25,243	27,036	3,317	3,487	26,125
Number of z	9,060	5,862	8,070	8,688	1,260	1,260	8,410

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

Based on attained results, GRAPH 5 gives an overview of regional health performance. Ranging from one to eleven, the ranking displays individual regions´ health outcomes. For that reason, ranking number one indicates best performance whereas ranking number eleven analogously represents worst comparative outcome performance. Better performing outcomes are colored in lighter blue whereas the intensity of color increases with decreasing performance. As stated previously, health outcomes are shown to differ greatly between regions. Importantly, no region appears to perform well in all outcomes. Equivalently, no particular region can be mapped out underperforming in all health outcomes.

	Vacc. Coverage	BMI Class.	ORT	Prenatal Care	Birth Assistance	Postnatal Care	Access Barriers
Addis Ababa	8	1	6	3	7	1	7
Tigray	1	9	2	1	3	7	2
Afar	11	10	5	10	1	2	4
Amhara	5	4	11	6	5	6	1
Oromia	6	3	8	9	8	10	10
Somali	10	8	4	11	2	9	11
Ben.-Gum.	7	6	10	7	11	8	8
SNNPR	2	2	9	5	9	11	9
Gambela	9	11	7	8	10	4	5
Harari	3	5	1	4	4	3	6
Dire Dawa	4	7	3	2	6	5	3

1
2
3
4
5
6
7
8
9
10
11

Source: Authors own elaboration based on first stage regression results (predicted probabilities)

Graph 5: Health Performance Ranking - Clustered by Region and Outcome

5.1 Results and Discussion of Health Outcomes

First stage results reveal that the regions of Afar, Somali and Gambela display the lowest predicted probabilities of vaccination coverage, whereas the regions of Tigray and SNNP appear to outperform other regions (see TABLE 6, APPENDIX B), confirming previous results of Lakew et al. (2015) concerning child immunization. The odd of vaccination are significantly lower in the former than in other regions, as can be seen in TABLE 4. Compared to Addis Ababa, Afar, Somali and Gambela also report negative marginal effects, corroborating an overall low likelihood of vaccination coverage in these regions (see TABLE 8, APPENDIX B). A distinction between partial and full coverage of the second stage analysis discloses the following pattern (TABLE 10, APPENDIX B). Although partial coverage is lowest in Addis Ababa, the capital region

counts with the highest share of fully vaccinated women. That said, the prevalence of full vaccination coverage is positively associated with Addis Ababa, whereas women in other regions face a higher likelihood of partial coverage. In line, urbanity and full coverage are likewise associated whereupon women living in rural areas correlate negatively with the likelihood of full vaccination coverage. As a consequence, the results substantiate findings of Lakew et al. (2015) of a reduced likelihood of full vaccination coverage in rural areas. Regarding time trends, an ambiguous tendency was revealed, with the overall likelihood of full coverage increasing but partial coverage slightly decreasing. Improvements in vaccination coverage can thus mostly be attributed to the region of Addis Ababa.
Both with regards to partners and women's education, a positive effect on the likelihood of vaccination is disclosed. With increasing educational level, the likelihood of vaccination also rises. Literacy, however, is not significantly associated with vaccination coverage. Concerning household size, women of larger households appear to encounter an increased probability of vaccination. Age, on the contrary, is negatively associated with vaccination. Therefore, older women reveal a reduced likelihood concerning coverage.
Consequently, what appears to drive regional differences in vaccination coverage are education, household size and age. The findings are only partly in line with the literature. Confirming previous results by Cutler & Llera-Muney (2006), a link between increasing education and improving health outcomes was established. However, with regards to household size, a different mechanism appears to apply in the case of Ethiopia. Larger households seem to have a positive impact on the likelihood of vaccination coverage, which is why the underlying research supplements existing knowledge for other countries (see f.e Anyanwu, 2014). Likewise, adverse effects of youth on vaccination coverage are not revealed, as for example highlighted by Leppert et al. (1986), but rather a negative effect of increasing age on the likelihood of vaccination.

In general, Ethiopia is characterized by a high prevalence of underweight. However, it is the regions of Gambela and Afar that predict most women to be underweighted in the first stage. Addis Ababa, on the contrary, counts with the lowest predicted probability of underweight (see TABLE 6, APPENDIX B). The odd of being underweight are thus significantly higher in any other region, also indicated by positive marginal effects compared to the capital (TABLE 4 & TABLE 8, APPENDIX B). The findings are further confirmed by second stage odd ratio results (see TABLE 11, APPENDIX B), uncovering an elevated association with underweight compared to Addis Ababa. The incidence of obesity, however, appears to be of minor importance throughout Ethiopia, reflected in predominantly insignificant results. Also, it is mostly rural areas that exhibit an increased likelihood of undernourishment. Over time, a decreasing tendency was observed, indicating an overall reduction in the prevalence of underweight (see TABLE 5; TABLE 7 & 9, APPENDIX B).
Contextually, the results of the research contribute to the outlined lack of gender-based evidence regarding undernourishment by Kassie et al. (2020). Underweight appears to be influenced by women´s education. With increasing educational level, the likelihood of underweight decreases. Partner's education and literacy are however not associated with underweight. The importance of education for health outcomes, stated in previous literature contributions, is hence confirmed within the scope of this research, and applied to a regional level. Besides, the study adds to

existing knowledge by distinguishing female education as particularly decisive for nourishment outcomes. Household controls are not statistically significant, restricting the impact of household size and age on the incidence of underweight in the regions. Although drinking water appears to not significantly impact upon the incidence of underweight, it is the type of toilet facility that seems to have an effect. The absence of a toilet facility is positively associated with the incidence of underweight, therefore increasing the likelihood of women to be underweighted. Connecting the obtained results to findings by Prüss-Üstün et al. (2008), novel evidence is thus found for an increased likelihood of underweight due to inadequate sanitation facilities, resulting in outcome differences between regions.

Use and knowledge of ORTs expanded remarkably in Ethiopia over the observed time period (see TABLE 5; TABLE 7 & 9, APPENDIX B). However, regional differentiation shows an uneven patter of dispersion. First stage results disclose the following. Whereas Amhara and Benishangul-Gumuz represent those regions with the lowest predicted probability of use, they are contrasted by the regions of Tigray and Harari, expressing the highest comparative likelihood in use of ORT (see TABLE 6, APPENDIX B). The odd of ORT application are therefore significantly higher in the latter (TABLE 4). Marginal effects are negative for the regions of Amhara, Oromia, Benishangul-Gumuz, SNNPR and Gambela, indicating reduced likelihood of use and knowledge compared to other regions (see TABLE 8, APPENDIX B). The second stage analysis (TABLE 12, APPENDIX B) therefore discloses a link between the non-application of therapy forms and the lack of knowledge. In other words, regions with comparatively low probabilities of usage also present less knowledge of ORT. Yet, both use and knowledge are positively associated with urban areas. With reference to findings from Misgna et al. (2019), the present study therefore does not find evidence for an under-proportional use of diarrhea treatment but rather argues that application increased over time, albeit unevenly within the country. Nevertheless, the lack of knowledge and education found by Abera & Assefa (2018) for the South-Western part of the country continues to represent a major obstacle in the general uptake of therapy forms. Formation controls are hence positively associated with ORT. With increasing educational level, the odd of knowledge or use increases significantly. Similarly, literate women are more likely to use or know about ORT than illiterate women. On that account, present findings support the necessity for health-specific knowledge diffusion and education. Besides, larger households are more prone to apply ORT than smaller ones. Again, household size correlates positively with health, contrasting findings from Nigeria and China (Wu & Lo, 2012; Anyanwu, 2014). Furthermore, it is sanitation infrastructure controls that impact upon ORTs. Well and springs are negatively associated with the application of therapies, possibly attributable to a reduced incidence of diarrhea in this context. Contrarily, households with pit facilities display a higher probability of knowledge of ORTs. Ergo, both literacy, education, household size and sanitation infrastructure represent decisive factors that impacts upon regionally divergent health outcomes.

Concerning the realization of prenatal care visits, it is the regions of Addis Ababa, Tigray and Dire Dawa that appear to outperform other regions in terms of predicted probability. Contrarily, the regions of Somali and Afar display the greatest predicted deficiencies (see TABLE 6, APPENDIX B). First stage results therefore exhibit an increased odd of prenatal care visits in

Addis Ababa, Tigray and Dire Dawa (TABLE 4). Marginal effects, however, are slightly negative for both regions (TABLE 8, APPENDIX B). Based on first stage postestimations, it can hence be derived that Tigray, Dire Dawa and Addis Ababa are rather similar in health performance regarding prenatal care, whereas the rest of the country appears to comparatively underperform.
On that account, it is also the number of visits realized that varies greatly across regions, since an overall pattern of a reduced number of visits compared to Addis Ababa is uncovered in the second stage (see TABLE 13, APPENDIX B). Women in the capital are thus expected to realize five or more prenatal visits with a higher probability than in any other region of the country. Despite an increasing likelihood concerning prenatal care over time (see TABLE 5; TABLE 7 & 9, APPENDIX B), the maximum number of visits realized is therefore still limited to four in most regions. In this context, women in urban areas are more likely to realize prenatal care visits, also with regards to the number of visits realized, than their rural counterparts. The results point towards continued restricted regional availability and utilization of prenatal care, as outlined by Tegene et al. (2019). Yet, formation controls appear to be positively associated with prenatal care. Higher educational levels, both for women and their partners, appear to result in an increased likelihood of prenatal care visits. Differences in prenatal care visits between regions are thus expected to be subject to divergences in educational levels. The nexus between education and health outcomes, established by Cutler & LLera-Muney (2006), is hence confirmed in the present study and applied to prenatal care. Household controls are not significant in the context of prenatal care. Evidence for adverse effects of youth on maternal health, stressed by Leppert et al. (1986), is thus not corroborated.

Concerning qualified birth assistance, second stage results reveal an overall scarcity across the country (see TABLE 14, APPENDIX B). Important to mention, it is traditional trained and untrained birth assistance that is more common in most regions whereupon the prevalence of birth assistance by health professionals is low throughout the country. Furthermore, the likelihood of qualified birth assistance even decreased over time. The results consequently do confirm previous findings by Medhanyie et al. (2012), revealing strong limitations regarding skilled birth assistance in Ethiopia. Yet, women living in urban areas exhibit a higher propensity towards birth assistance than their rural counterparts, particular with regards to assistance by health professionals and traditional trained individuals. In a similar manner as for other health outcomes, first stage results demonstrate that the probability of birth assistance is spread unevenly throughout the country. In detail, the regions of Afar and Somali display higher probabilities of birth assistance as opposed to the regions of Benishangul-Gumuz, Gambela and SNNPR (see TABLE 6, APPENDIX B). Outstandingly, the odd of birth assistance in Afar is significantly higher than in Addis Ababa, particular with regards to magnitude (TABLE 4). Marginal effects disperse greatly in comparison to Addis Ababa, with some regions over- and others underperforming the capital in terms of birth assistance and therefore showing an uneven regional pattern (see TABLE 8). Formation controls appear not be of influence in the context of birth assistance, nor is household size. A relationship between literacy or education on health outcomes can therefore not be established in the context of birth assistance. Consequently, formation does not count with an overall positive impact on health throughout the country but needs to be assessed in the context of specific outcomes. Age, however, is negatively associated

with birth assistance. In other words, with increasing age, the likelihood of birth assistance decreases. Relating the findings to previous contributions by Kassie et al. (2020), youth in the context of birth assistance appears to have a positive impact. Therefore, an overall negative effect of youth on health outcomes cannot be established.

The capital Addis Ababa displays the highest probability of postnatal care in the first stage. The regions of SNNPR, Oromia and Somali, on the contrary, appear to underperform when compared to the rest of the country (see TABLE 6, APPENDIX B). Therefore, the odd of attending postnatal care is also highest in the capital (TABLE 4). Compared to Addis Ababa, marginal effects are negative for all regions (if significant), confirming an overall inferior regional health performance in terms of postnatal care (see TABLE 8, APPENDIX B). The results are thus in line with Sisay et al. (2016), who affirm regional divergences in both accessibility and usage of postnatal care services. Yet, an increasing trend in the realization of postnatal care visits can be observed over time (see TABLE 5; TABLE 7 & 9, APPENDIX B). This holds particularly true for women in urban areas, showing a higher likelihood of receiving postnatal care than women living in a rural environment. However, the majority of second-stage results are statistically insignificant, limiting the validity of results regarding this particular health outcome (see TABLE 15, APPENDIX B). Similarly, control variables are mostly insignificant concerning postnatal care. It is however partners education that is positively associated with the likelihood of postnatal care visits. Regional differences in this regard therefore appear to condition divergences in health outcomes, once again confirming the importance of education on health (Cutler & Llera-Muney, 2006).

Unexpectedly, the likelihood to face health access barriers increases remarkably over the period of observation (see TABLE 5; TABLE 7 & 9, APPENDIX B). Even though all regions display high probabilities concerning access barriers in the first stage, it it's the regions of Somali, SNNPR and Oromia that stand out by their high values (see TABLE 6, APPENDIX B). The odd of facing access barriers are significantly higher in those regions than in Addis Ababa (TABLE 4). Although most coefficients concerning marginal effects are statistically insignificant, their magnitude is in line with the described trend (see TABLE 8, APPENDIX B). Taking into consideration Skaftun et al. (2014), who find unequal health care access for children, the present research extends their results to Ethiopian women. Besides, a rural disadvantage, stemming from the lack of adequate transportation, an increased OOP burden and larger distances to health facilities was unveiled in the second stage. Second stage results thus disclose that restricted access to health care appears to be strongly driven by a lack in supporting infrastructure in terms of financial support for OOPs, distance, and transportation (see TABLE 16, APPENDIX B). Besides, it is the absence of husband's permission that has been stated most frequently by Ethiopian women, impeding access to health care and indicating a gender gap in health outcomes (Lailulo et al., 2015; Kassie et al., 2020). However, increasing partners education is assumed to reduce access barriers, whereas women´s education does not have a significant impact. The result might be linked to the observed lack of husband's permission in connection to restricted access. Also, literate women are expected to encounter reduced access barriers. Hence, supporting evidence is found for the link between literacy and health outcomes (DeWalt et al., 2004). Previous knowledge is thus deepened and applied on the regional level.

Household size does not have a significant impact on access barriers. Women´s age, on the contrary, is negatively associated with access to health care. For that reason, increasing age is associated with higher access barriers. The findings thus reaffirm the ambiguous relation between age and health outcomes, established in this study.

5.2 Patterns and General Trends

Concluding the above, it is not the region of Addis Ababa, capital of Ethiopia, that outperforms other respective regions of the country in overall health performance. Different health outcomes appear to perform divergently throughout the country, which is why no region appears to perform well concerning the totality of all outcomes considered. Yet, it is the region of Tigray in the North of Ethiopia, bordering with Eritrea, that shows evidence for over-proportional good health performance in comparison to other Ethiopian regions. Strikingly, Tigray´s neighboring regions Amhara and Afar do not share similar patterns, being characterized by a rather mediocre overall health performance. For that reason, a geographical pattern in health outcomes, disclosing a North-South divide, was not uncovered. Underlying reasons for the diversity in health outcomes between regions might be related to differences in compliance or success of the HSDP and HSTP but remain subject to future research.

Contextually, the region of Benishangul-Gumuz discloses a comparatively poor performance in health outcomes, particularly when compared to Tigray or Addis Ababa. A similar trend was revealed for Gambela, albeit not all coefficients showed statistically significant results for the region. Health performance in SNNPR appears to be equally impaired, even though to a lesser extend since partial vaccination coverage for example does indeed exceed performance in Addis Ababa. Geographically, a regional cluster in the West of the country including the regions of Benishangul-Gumuz, Gambela, and SNNPR was thus detected, manifesting in under-proportional health outcomes compared to other regions. Nevertheless, divergences in performance are not of a magnitude to establish an East-West divide in health outcomes.

In terms of geographical size, particularly small regions, such as Dire Dawa and Harari, have not revealed to benefit from a size-related advantage regarding health outcomes. Intuitively, assumptions might be made about a facilitated provision of health services in smaller administrative units, however, the present research could not find indications concerning the regard. The biggest regions by size, Oromia and Somali, underline the independence between geographical size of the regions and performance in health outcomes, displaying in uneven health indicators. Furthermore, the argument is supported when assessing particular access barriers regarding health care seeking. Oromia faces major obstacles regarding lacking permission and money, whereas in Somali it is the additional lack of transport that seems to inhibit adequate health care seeking. Having said that, the regions show divergences in access barriers although they are similar in size. As a consequence, regional size does not appear to impact upon health outcomes, confirming previous assumptions.

With regards to maternal health, entailing pre-and postnatal care as well as birth assistance, it is particularly the scarceness and shortage of qualified birth assistance that stands out in most regions, further showing a decreasing trend in probability over time. As previously outlined, the predominant form of birth assistance is untrained assistance in most regions, realized by neighbors and friends, revealing substantial shortcomings in the provision of adequate maternal health services in Ethiopia. Over the course of the underlying research, it became further apparent that receiving prenatal care services is not a predictor with respect to birth assistance or postnatal care. In other words, a high probability to receive prenatal care might still translate in comparatively low figures on the subject of birth assistance or postnatal care, as the regions of Oromia, SNNPR, Benishangul-Gumuz and Dire Dawa reveal. The tendency is, however, most pronounced with respect to birth assistance, revealing a great gap to prenatal and postnatal care in most regions. On that account, Addis Ababa and Gambela show high shares in pre-and postnatal care but low probabilities with respect to birth assistance. Nevertheless, some regions build an exception from the highlighted tendency, namely Tigray, Amhara, and Harari, showing similar probabilities concerning all three health indicators. An outstanding case, however, is represented by the region of Afar, owed to the fact that birth assistance counts with the highest probability in this region. Almost all women are predicted to receive some form of birth assistance, uncovering a unique case within the Ethiopian context. The probability of pre-and postnatal care is remarkably lower in Afar. The region of Somali displays an equivalent pattern, although lower in magnitude. As for other indicators, maternal health performance is thus regionally diverse. Yet, urban areas seem to be generally better equipped regarding maternal health than rural zones.

Elements of preventive health services, such as access barriers and vaccination coverage, disclose an opposing trend. Access barriers are regarded as measures of preventive health care due to their adverse impact on women seeking curative health care. In a similar manner, immunization preventively protects against future infections. Although all regions display high levels of access barriers and only distinguish themselves in magnitude to a limited extend, an overall pattern can be observed. Regions with relatively high levels of access barriers also display comparatively low figures in vaccination coverage. That being said, the region of Afar reports an overall probability of access barriers of 91% while vaccination coverage is 33.2%. Similar figures apply for the region of Somali and Gambela. The region of Tigray, on the contrary, presents the highest probability of vaccination coverage of 59.3%, coinciding with one of the lowest probabilities in access barriers of all regions. An analogous trend is observed in Amhara. Nevertheless, it needs to be mentioned that the association between access barriers and vaccination coverage is not an exclusive one, meaning that additional factors of influence are assumed to impact upon the rate of vaccination coverage, albeit not included within the scope of this research. Surprisingly, urban areas are expected to show a lower probability of vaccination than rural environments, requiring additional in-depth research in the future. Besides, it remains unclear which specific factors were driving varying vaccination rates over time. The same applies for an observed, time-related increase in access barriers. Despite outlined governmental interventions into the health sector, barriers increased rather than

decreased with time. The findings thus advocate for advanced investigation regarding preventive health indicators.

Two different measures on the subject of curative health, namely oral rehydration therapy and undernourishment, have been further included into the present research. Acute malnutrition is a medical condition requiring curative treatment measures just like severe diarrhea. However, a particular structure was not revealed. Outlined in the previous section, the prevalence of undernourishment is high throughout Ethiopia. Correspondingly, the probability of knowledge or application of ORTs reaches at least almost 50% in most regions. Assumptions with respect to the prevalence of diarrhea and persistently low levels in terms of BMI might be made but are not explicitly tested for within the scope of this research. What can, however, be deduced from the present results is that future health interventions, targeted towards curative health, are required in order to improve regional outcomes of ORT and undernourishment. On that account, the two indicators of curative health included in the study reveal a strong need for action in the future. Substantial improvements were achieved since the 1990s, translating in decreasing undernourishment over time as well as in an uptake of ORTs. Notwithstanding, it is particularly rural areas that still reveal an over-proportional burden of diseases with respect to the included indicators of curative health.

5.3 Limitations

Despite comprehensive assessment and considerations, the present research displays limitations worth of mention, therefore discussed within the context of this subsection. Methodically, the study applies individual fixed effect, associated with context-specific weaknesses. On the one hand, the method exclusively takes into consideration those individuals that change treatment over the period of observation. In other words, regional effects on health outcomes are only estimated for women who experience alterations in status between 2000 and 2016. Hence, previously underweight, or vaccinated women for example, are not included into the models, restricting the external validity of results. On the other hand, it is further difficult to control for changes in health outcomes owed to unnoticed external shocks that are variant over time. Mentioned shocks might refer to regionally variant health interventions by non-governmental or donor agencies, which are not applicable for all regions of the country or are limited to a certain period of time but do indeed have an impact on regional health outcomes. As a consequence, concerns regarding an omitted variables bias (OVB) might arise.

With regards to variables included, apprehensions regarding the categorization of variables might occur. In order to gain supplemental insights, a distinction on the district level could shed additional light onto regional divergences in health outcomes. Due to substantial differences in regional size, a district level analysis would further imply more nuanced results independent from the specific size of the region. However, owed to data limitations, district-level results cannot be obtained from the dataset applied. Similarly, the differentiation between urban and

rural areas does not take into consideration gradual divergences between rurality or urbanity. A non-rural area is not necessarily an urban one by definition. As outlined previously, different types of urbanity and rurality are yet clustered under the same dichotomous variable. The lack of adequate data restricts further differentiation in this regard. Hence, the inclusion of additional, location-specific GIS (Geographic Information System Mapping) data would be beneficial, yet exceeds the scope of the present study.

Another limitation of the present study is the restricted inclusion of females only in the analysis. To expand the scope of the research and contribute to a comprehensive understanding of regional dynamics of health outcomes, both the elderly, children and men are recommended to be additionally incorporated into future research.

6 Conclusion

The present study has scrutinized regional health outcomes and established a relevant nexus between performance and region. Contributing to the field of research through the inclusion of preventive, curative, and maternal health measures, substantial health inequalities both between and within regions were revealed. On that account, the results obtained supplement previous literature contributions by complementing existing knowledge through an in-depth regional assessment of overall health performance and including a diversity of comprehensive health indicators. Regional dynamics represent a crucial predictor for health outcomes and therefore are of major importance concerning the future evolution of the Ethiopian health sector.
Consequently, the last chapter of this research will give an analytical synopsis of the main findings - embedded into the applied theoretical framework - and draw practical implications from the results. Moreover, an outlook over future, supplemental research extensions will be given.

6.1 Research Aim and Findings

Within the scope of this study, long-term trends concerning the Ethiopian health sector have been scrutinized, emphasizing a regional impact on performance over time. As a result, the majority of health indicators underwent marked improvements, linked to comprehensive governmental interventions. The incidence of underweight, the use and knowledge of ORTs as well as pre-and postnatal care showed positive tendencies over time and space. Contrarily, however, performance of measurements considering birth assistance, vaccination coverage and access barriers revealed a deteriorating or uneven time trend, testifying in mediocre and time-varying outcomes. In particular, regional outcomes concerning access barriers to health care show an increasingly high prevalence. Likewise, the birth assistance indicator demonstrates great regional dispersion, with some regions performing comparatively well while others are considerably underperforming. Consequently, birth assistance is the health indicator where between-regional-divergence is greatest.
Overall, regional tendencies in health performance are disperse. Over the course of the present study, it thus became apparent, that a singular, well-performing region, taking into account all health indicators included, cannot be mapped out. In other words, comparatively good performance in a single indicator is not a predictor for an equally well assessed performance in the totality of regional health outcomes.

That being the case, undertaken governmental interventions appear to have had a positive impact on health outcomes, albeit to an uneven degree. Although the majority of outcomes

show improvements over time, within-and between regional divergences still continue to adversely impact upon the overall assessment of the Ethiopian health sector. The discussion is thus dominated by overall mediocre performance of the sector, exacerbating the judgement of potential, future interventions. Particularly in connection to rural and urban environments, differences in health performance are well-pronounced. Significant negative effects on overall health outcomes are found, amplified by the majority of the Ethiopian population living in rural areas. Strong regional divergences might also be circumstantial evidence for inconsistent, fluctuating, or differing compliance with ratified development and transformation programs.

The impact of governmental interventions on health outcomes are thus assumed to differ, displaying in regionally diverse effects. The argument is further supported by the lack of evidence for an upward bias in health performance in Addis Ababa, despite its capital status. For that reason, resources regarding health interventions appear not to discriminate between regions, favoring the capital region, but rather seem to spread evenly throughout the country. Nevertheless, it needs to be taken into consideration that regional health outcomes might as well have differed already before the interventions. On that account, no assumptions can be made about the effectiveness of particular interventions. Health policies in Ethiopia might have been effective, yet additional determinants might drive regional diversity in health. As a result, the underlying reasons for outlined regional differences appear to be more subtle. Additional in-depths analysis scrutinizing specific interventions on the regional level is required, which remains subject to future research. In this context, the inclusion of relevant control variables has not yielded a straightforward pattern. Diverse factors of influence appear to drive regional discrepancies in health outcomes.

6.2 Research Objectives

Based on the foregone synopsis of results and with reference to the research question, the principal objective of the underlying study was met, enabling the adequate evaluation of the subsequent key research question:

Health as Economic Good - Have government interventions in the health sector in Ethiopia between 2000 and 2016 translated into regional divergent health outcomes for women?

Defining health as an economic good - provided by the Ethiopian government - strong evidence for divergent health outcomes between geographical regions of the country was found. However, it is not only between geographical regions that particular health indicators differ, but also within regions. For that reason, outcomes are assumed to interact with additional factors of influence within each region, such as education, literacy, and household size. Similarly, the impact of geographical location, either urban or rural, projects an adverse effect on health performance for rural populations of Ethiopia. Further, good performance in single indicators

does not establish a link to overall high-standard performance in all indicators, obstructing the assessment of past and future governmental interventions with regards to effectiveness and health equity. Additional in-depth analysis is required in the future.

From a theoretical perspective, the obtained results further testify major economic implications. The economic good health is predicted to yield positive returns, yet it requires adequate investments and supporting infrastructure. On that account, labor productivity and health performance are strongly linked, which is why deduction about the effect on Ethiopia's future economic development are reasonable. So far, the optimal allocation of health goods seems not to be reached, especially with regards to maternal care, and major access barriers continue to apply. As shown, women in most regions do experienced positive health returns only to a limited degree, since the prevalence of underweight and lack of health-related knowledge still prevail. The potential of the female labor force, conditioned by impaired health outcomes, is hence not exploited fully.

In case health outcomes continue to diverge within and between regions, characterized by a generally mediocre health performance throughout the country, further adverse effects both on female labor productivity, human capital accumulation and hence on overall economic development might be expected in the future. The highlighted gender gap is expected to withdraw valuable human resources from the economy if persistent. So far, the Ethiopian government reacted to market failures in the health sector through comprehensive interventions, including the HSDP and HSTP, since principles of Pareto-efficiency do not apply for health markets and aspects of health equality are otherwise neglected. However, the optimum amount of health services provided, determined by health supply and demand, has not been met yet, as considerable discrepancies between and within regions reveal. Particularly access barriers have shown to hinder the provision of an optimal amount of health supply. Likewise, vertical health inequalities, characterized by unmet health needs on the regional level, persist. This is especially the case for qualified birth assistance. Both in terms of efficiency and vertical health equity, shortcomings in the Ethiopian health sector do consequently apply. As yet, governmental interventions are denoted by lacking success in the equal distribution of health services in order to mitigate adverse effects concerning health inequalities. The place of residence, either from a regional or rural/urban perspective, is highly decisive on health outcomes, driven by spatial availability and accessibility. To achieve pareto improvements in the future, particularly in reference to vertical health equity, tailor-made and region-adjusted interventions are thus needed.

6.3 Practical Implications and Future Research

Practical implications, which can be derived from the present study, comprise the following. Owed to inter-and intraregional differences in health outcomes, tailor-made governmental interventions are required, taking into consideration current regional shortcomings and strengths. A one-size-fits-it-all approach has not proven to be of sufficient effectiveness or equity in the past. Contextually, regional exchange, showcasing best-practices and learning outcomes regarding specific health indicators, represents another feasible opportunity to sustainably mitigate health inequalities and deficiencies within the Ethiopian health sector. On that account, regions are thus enabled to engage and learn from one another.
Further practical implications which can be deduced from the findings entail the immanent need for a surge in awareness and education regarding health-related outcomes. Per se, health infrastructure in most regions is provided by the Ethiopian government, manifesting in the presence of health posts and HEWs throughout all regions. Nevertheless, the lack in uptake and acceptance still appears to be a major constrained to achieve improved health outcomes. This also manifests in high and increasing access barriers for health care seeking.
Driving forces behind distinctively high access barriers consequently remain subject to future research. In doing so, special emphasis needs to be made on mapping out singular reasons accountable for the substantial increase over time and revealed within the scope of this research. In addition, the impact of gender on health outcomes requires further investigation. The present study exclusively focused on women, neglecting male health outcomes. However, differentiations between gender will strengthen the understanding of regional health performance and hence contribute to the effective adjustment of health interventions.

This research has established evidence for a regional impact on overall health outcomes, supplemental studies should consequently go beyond and focus on underlying mechanisms driving within and between regional divergencies in health outcomes.

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Appendix A

Table 5: Overview of Outcome and Control Variables

Variable	Categories	Binary
Outcome Variables		
Vaccination Coverage	1=Fully covered 2=Partially covered 3=Not covered	0=No coverage 1=Vaccinated
BMI Classification	0= Normal Weight 1=Underweight 2=Pre-Obesity 3=Obesity	0=Normal weight 1=Underweight
Oral Rehydration	0= Never heard of 1=Used 2=Heard of but not used	0=Never used 1=Used/knows
Prenatal Care	0=No visits 1=One visit 2=Two visits 3=Three visits 4=Four visits 5=between 5 and 10 visits	0=No visits 1=At least one visit
Birth Assistance	0=No assistance 1=Health Professional 2=Trained trad. birth attendant 3=untrained trad. birth attendant	0=No assistance 1=Assisted Birth
Postnatal Care	0=No assistance 1=Health Professional 2=Trained trad. birth attendant 3=untrained trad. birth attendant	0=No checkup 1=Checkup after delivery
Access Barriers	0= no access barriers 1=no permission 2=no female health provider 3=no transportation 4=distance to health facility 5=no money	0=No access barriers 1=Access barriers
Explanatory Variables		
Regions	Tigray, Afar, Amhara, Oromia, Somali, Ben. -Gum., SNNPR, Gambela, Harari, Addia Ababa, Dire Dawa	
Rurality	0=Rural areas / 1=Urban areas	
Literacy	0=Not literate/ 1=Able to read part of a sentence/ 2= Literate	
Educational Level	0=No education/ 1=Incomplete primary/ 2=Complete primary/ 3=Incomplete secondary/ 4= Complete secondary/ 5=Higher	
Partners Education	0=No education/ 1=Incomplete primary/ 2=Complete primary/ 3=Incomplete secondary/ 4= Complete secondary/ 5=Higher	
Household Size	1= 1 to 2 members/ 2= 3 to 5 members/ 3= 6 to 10 members/ 4= 11 or more members	
Age	Continuous, ranging from 15 to 49	
Source of Drinking Water	1=Piped Water/ 2=Well/ 3=Spring, river, rainwater/ 4=Other	
Type of Toilet Facility	1=Flush toilet/ 2=Pit toilet/ 3=No facility/ 4= Other	

Appendix B

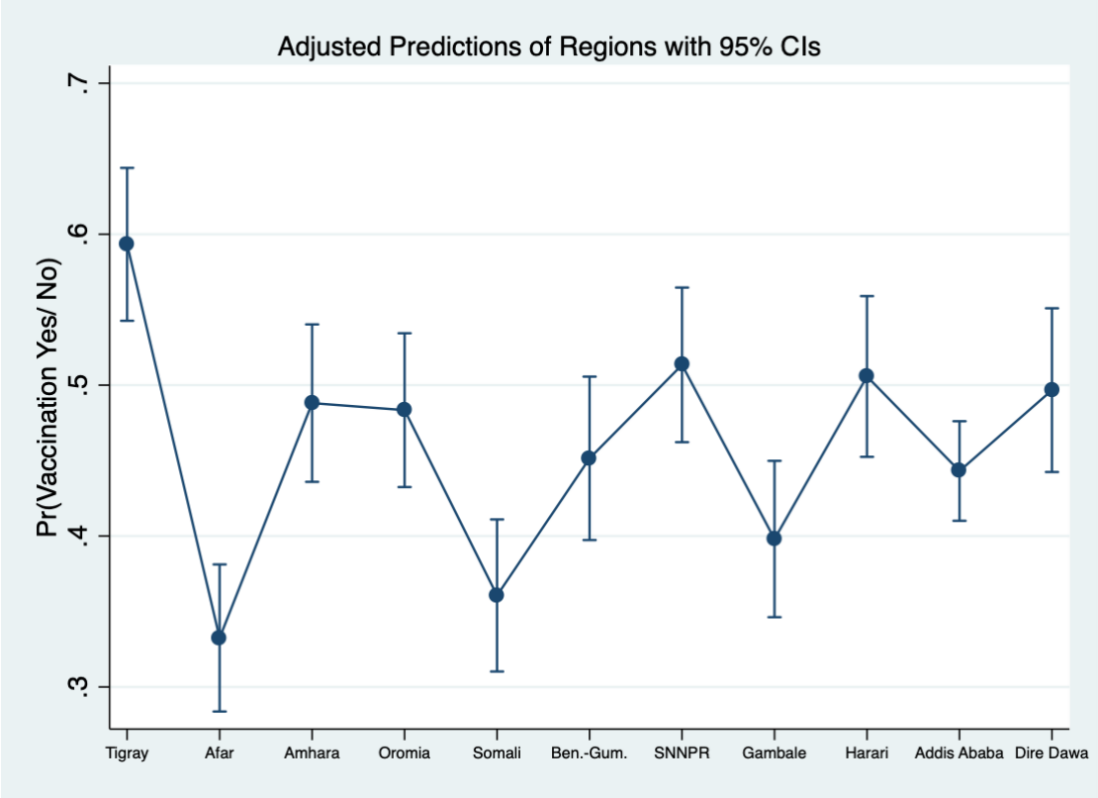
Regression Results

This section is organized as follows. In a first step, first stage postestimation results of fixed effects binary logistic regression models are reported for the specified health outcome variables. Therefore, regression results showing predicted probabilities and marginal effects are displayed for all regions, rurality and over time. In a second step, second stage results, presenting odd ratios, are illustrated. Likewise, results are exhibited for all regions, rurality as well as over time.

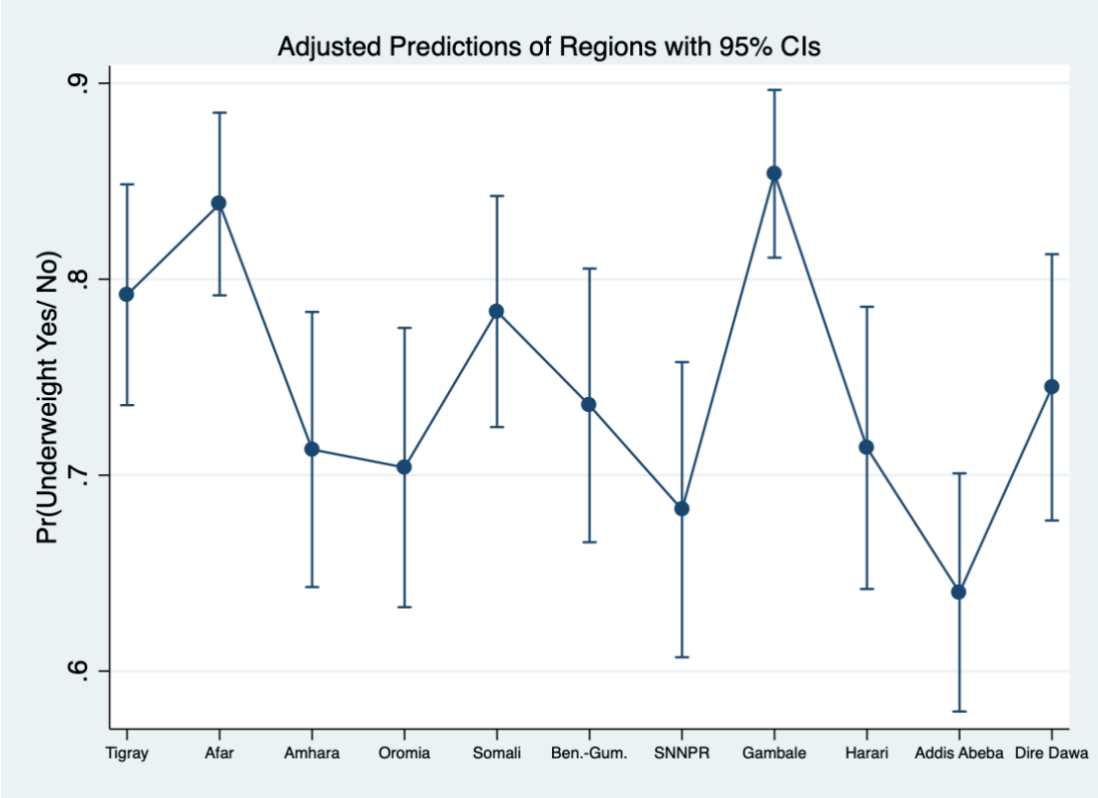
Table 6: First Stage Results - Predicted Probabilities

Regions	(1) Vaccination	(2) BMI	(3) Rehydration	(4) Prenatal Care	(5) Birth Assistance	(6) Postnatal Care	(7) Access Barriers
Tigray	0.593***	0.792***	0.819***	0.787***	0.621***	0.550***	0.883***
	(0.0258)	(0.0287)	(0.0267)	(0.0344)	(0.126)	(0.0316)	(0.0202)
Afar	0.332***	0.838***	0.658***	0.491***	0.927***	0.611***	0.910***
	(0.0249)	(0.0238)	(0.0395)	(0.0529)	(0.0480)	(0.0314)	(0.0175)
Amhara	0.488***	0.713***	0.433***	0.643***	0.571***	0.560***	0.873***
	(0.0266)	(0.0358)	(0.0429)	(0.0471)	(0.129)	(0.0314)	(0.0218)
Oromia	0.483***	0.704***	0.517***	0.613***	0.336***	0.493***	0.933***
	(0.0260)	(0.0364)	(0.0435)	(0.0477)	(0.115)	(0.0311)	(0.0122)
Somali	0.361***	0.784***	0.665***	0.403***	0.741***	0.537***	0.950***
	(0.0257)	(0.0301)	(0.0398)	(0.0501)	(0.109)	(0.0328)	(0.0104)
Ben.-Gum.	0.451***	0.736***	0.468***	0.619***	0.123**	0.540***	0.925***
	(0.0276)	(0.0356)	(0.0451)	(0.0497)	(0.0558)	(0.0332)	(0.0148)
SNNPR	0.513***	0.682***	0.475***	0.670***	0.226**	0.465***	0.930***
	(0.0261)	(0.0384)	(0.0442)	(0.0446)	(0.0889)	(0.0312)	(0.0130)
Gambela	0.398***	0.854***	0.532***	0.617***	0.204**	0.607***	0.912***
	(0.0264)	(0.0218)	(0.0442)	(0.0493)	(0.0831)	(0.0313)	(0.0165)
Harari	0.506***	0.714***	0.841***	0.675***	0.620***	0.610***	0.921***
	(0.0272)	(0.0368)	(0.0260)	(0.0466)	(0.136)	(0.0316)	(0.0146)
Addis Ababa	0.443***	0.640***	0.587***	0.709***	0.367***	0.706***	0.919***
	(0.0168)	(0.0310)	(0.0309)	(0.0251)	(0.0602)	(0.0162)	(0.0100)
Dire Dawa	0.497***	0.745***	0.731***	0.768***	0.380***	0.572***	0.901***
	(0.0277)	(0.0347)	(0.0375)	(0.0396)	(0.126)	(0.0331)	(0.0171)

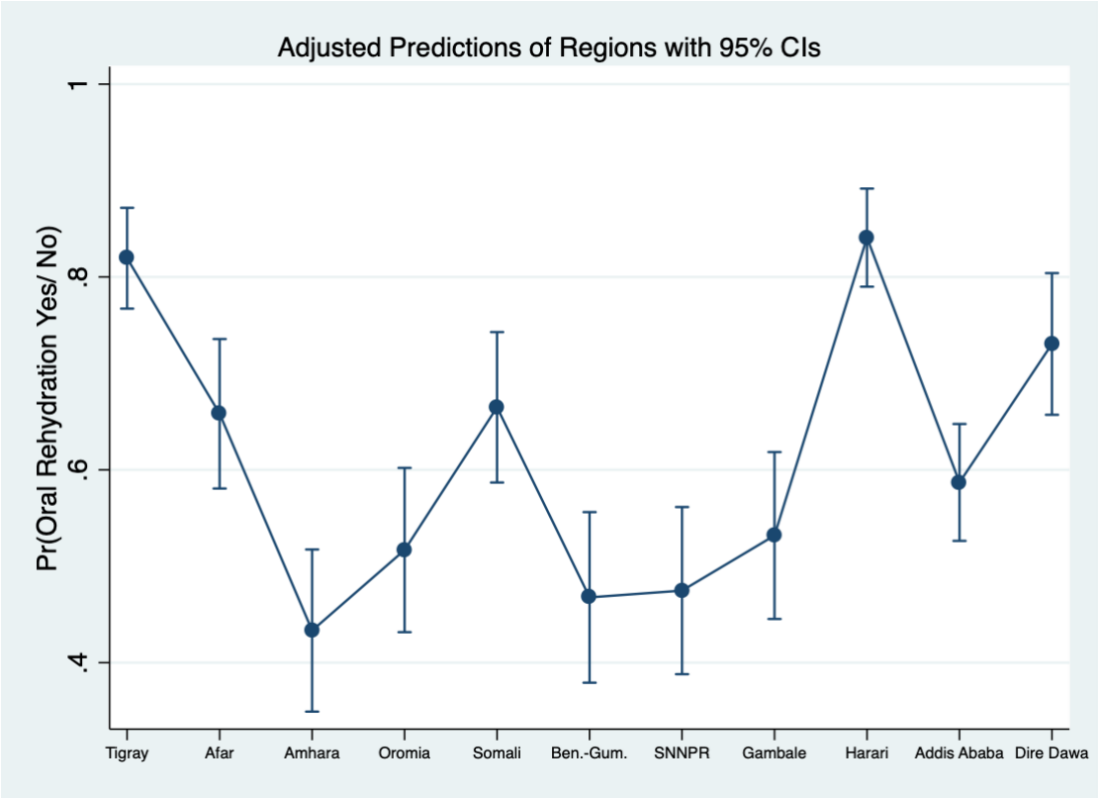
Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1



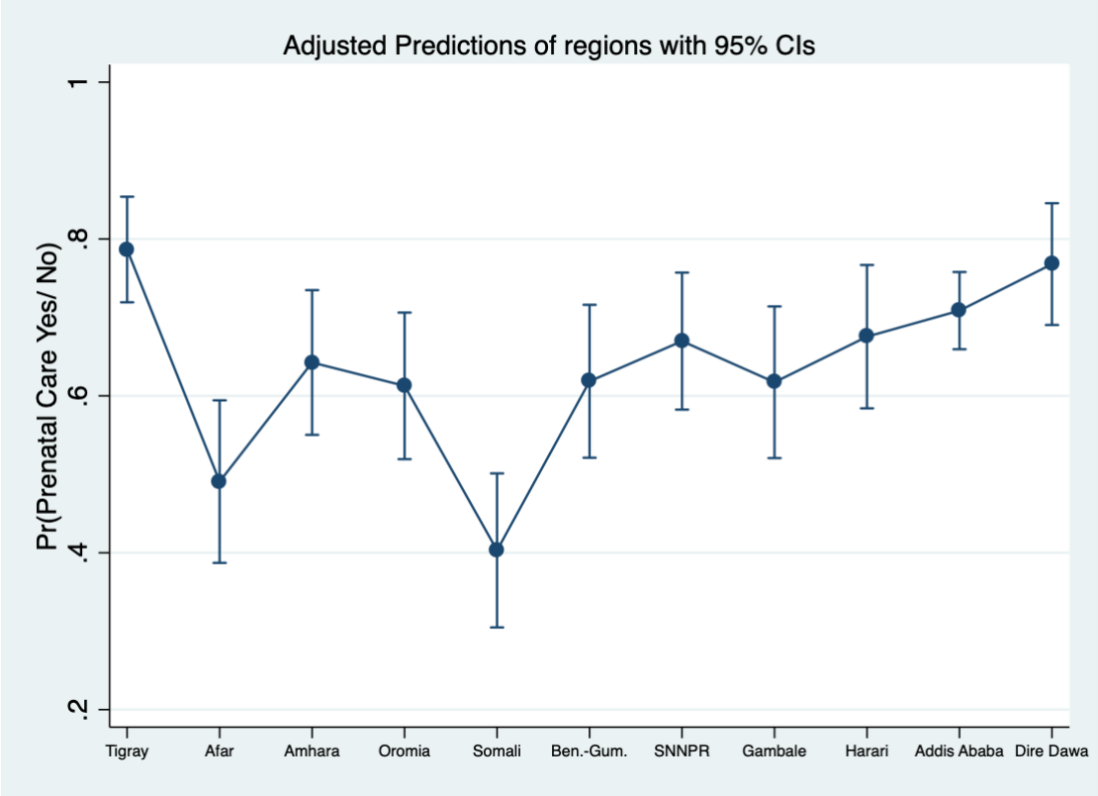
Graph 6: Vaccination Coverage (Predicted Probability)



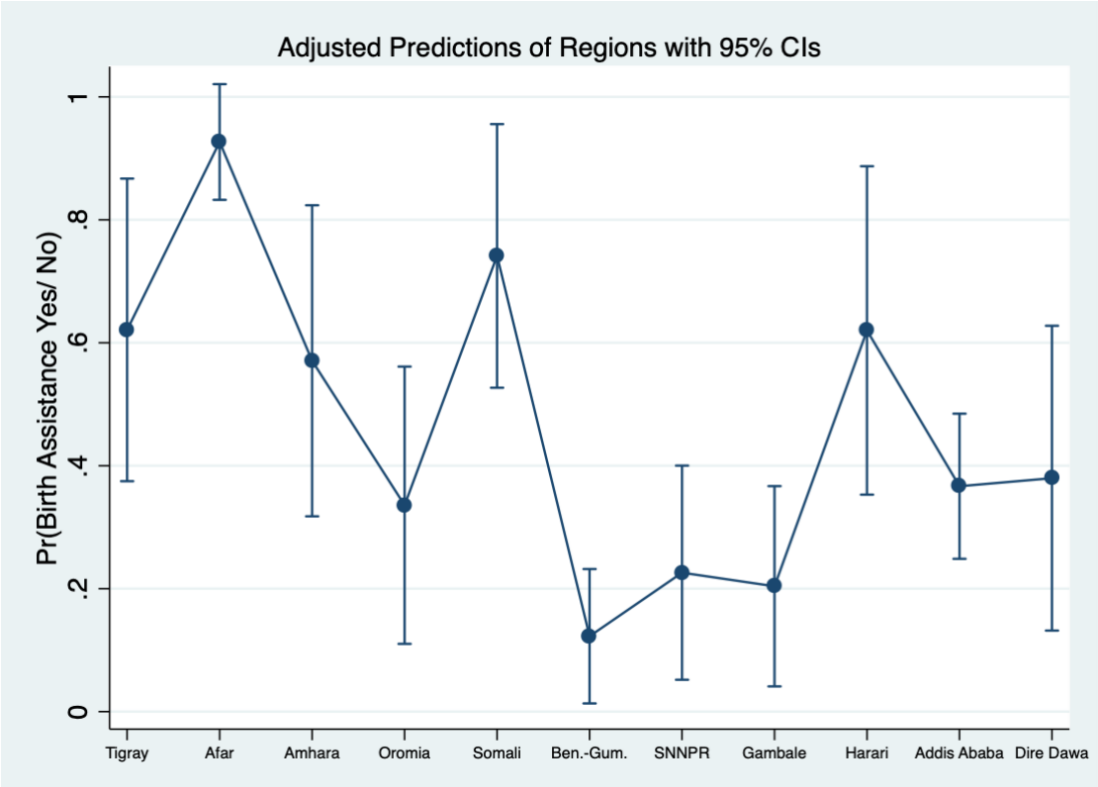
Graph 7: Underweight (Predicted Probability)



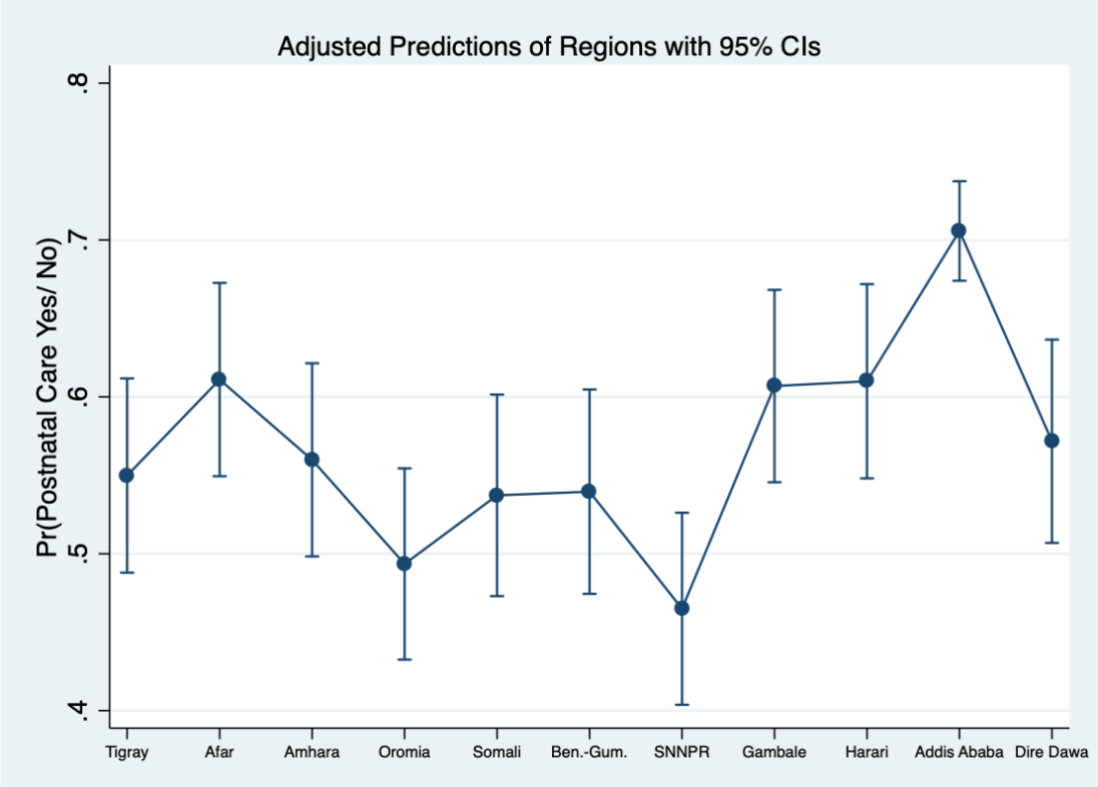
Graph 8: Oral Rehydration (Predicted Probability)



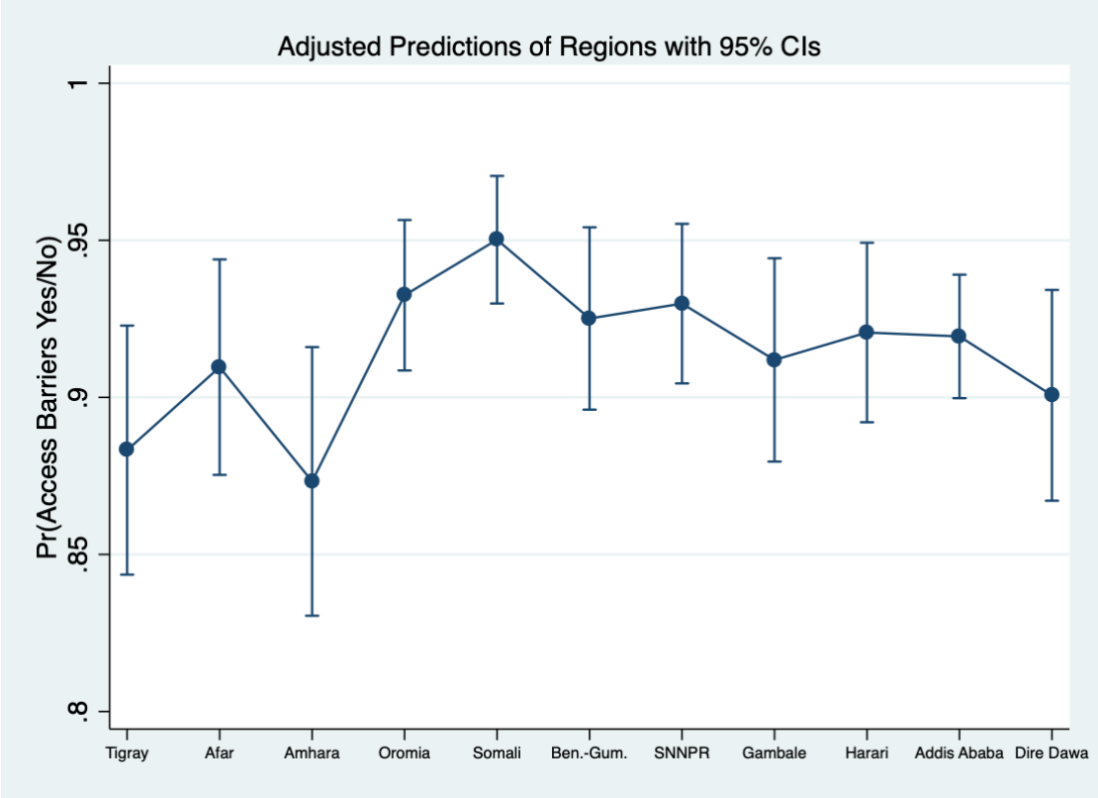
Graph 9: Prenatal Care (Predicted Probability)



Graph 10: Birth Assistance (Predicted Probability)



Graph 11: Postnatal Care (Predicted Probability)



Graph 12: Access Barriers (Predicted Probability)

Table 7: First Stage Results - Time Trends (Predicted Probabilities)

VARIABLES	(1) Vaccination	(2) BMI	(3) Rehydration	(4) Prenatal Care	(5) Birth Assistance	(6) Postnatal Care	(7) Access Barriers
Wave 2000	0.444***	0.658***	0.652***	0.606***	0.164***	0.713***	0.432***
	(0.0167)	(0.0297)	(0.0277)	(0.0286)	(0.0330)	(0.0160)	(0.0328)
Wave 2005	0.421***	0.639***	0.470***	0.616***	0.179***	0.664***	0.978***
	(0.0181)	(0.0328)	(0.0321)	(0.0308)	(0.0376)	(0.0189)	(0.00319)
Wave 2011	0.480***	0.668***	0.656***	0.741***	0.209***	0.710***	0.975***
	(0.0185)	(0.0309)	(0.0292)	(0.0248)	(0.0425)	(0.0177)	(0.00367)
Wave 2016	0.398***	0.634***	0.692***	0.870***	0.0924***	0.807***	0.984***
	(0.0180)	(0.0333)	(0.0284)	(0.0148)	(0.0215)	(0.0135)	(0.00246)

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

Table 8: First Stage Results - Marginal Effects

	(1) Vaccination	(2) BMI	(3) Rehydration	(4) Prenatal Care	(5) Birth Assistance	(6) Postnatal Care	(7) Access Barriers
Base Category: Addis Ababa							
Tigray	0.150***	0.152***	0.226***	-0.129***	0.203**	0.0443	-0.0362**
	(0.0181)	(0.0200)	(0.0215)	(0.0330)	(0.0843)	(0.0453)	(0.0143)
Afar	-0.111***	0.198***	0.0728***	-0.298***	0.470***	-0.0957	-0.00978
	(0.0177)	(0.0200)	(0.0267)	(0.0355)	(0.0506)	(0.0641)	(0.0123)
Amhara	0.0450**	0.0729***	-0.153***	-0.228***	0.169**	-0.167***	-0.0462***
	(0.0181)	(0.0225)	(0.0287)	(0.0348)	(0.0853)	(0.0631)	(0.0155)
Oromia	0.0403**	0.0637***	-0.0689**	-0.308***	-0.0899	-0.139**	0.0131*
	(0.0176)	(0.0224)	(0.0285)	(0.0340)	(0.0836)	(0.0603)	(0.00768)
Somali	-0.0824***	0.143***	0.0779***	-0.395***	0.312***	-0.0517	0.0308***
	(0.0186)	(0.0212)	(0.0271)	(0.0328)	(0.0747)	(0.0586)	(0.00798)
Ben.Gum.	0.00840	0.0954***	-0.117***	-0.242***	-0.318***	-0.157**	0.00572
	(0.0197)	(0.0227)	(0.0304)	(0.0359)	(0.0502)	(0.0701)	(0.0102)
SNNPR	0.0704***	0.0422*	-0.112***	-0.287***	-0.224***	-0.109*	0.0104
	(0.0182)	(0.0239)	(0.0292)	(0.0347)	(0.0659)	(0.0603)	(0.00852)
Gambela	-0.0450**	0.214***	-0.0526*	-0.245***	-0.192***	-0.0598	-0.00748
	(0.0189)	(0.0200)	(0.0302)	(0.0363)	(0.0728)	(0.0580)	(0.0114)
Harari	0.0627***	0.0738***	0.247***	-0.234***	0.212**	0.0545	0.00124
	(0.0196)	(0.0242)	(0.0232)	(0.0369)	(0.0931)	(0.0484)	(0.00972)
DireDawa	0.0536**	0.105***	0.140***	-0.141***	-0.0318	-0.0582	-0.0188
	(0.0213)	(0.0246)	(0.0280)	(0.0370)	(0.0972)	(0.0607)	(0.0122)
Rurality	-0.0340***	-0.0794***	0.201***	0.289***	0.305***	0.312***	-0.0761***
	(0.0112)	(0.0157)	(0.0147)	(0.0150)	(0.0588)	(0.0366)	(0.0138)

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

Table 9: First Stage Results - Time Trends (Marginal Effects)

	(1) Vaccination	(2) BMI	(3) Rehydration	(4) Prenatal Care	(5) Birth Assistance	(6) Postnatal Care	(7) Access Barriers
Base Category: 2000							
Wave 2005	-0.0233***	-0.0188*	-0.182***	0.0105	0.0150	-0.0489***	0.546***
	(0.00777)	(0.0111)	(0.00959)	(0.0125)	(0.0147)	(0.00793)	(0.0301)
Wave 2011	0.0359***	0.00971	0.00340	0.135***	0.0447**	-0.00354	0.543***
	(0.00788)	(0.00851)	(0.00878)	(0.0114)	(0.0187)	(0.00765)	(0.0297)
Wave 2016	-0.0463***	-0.0244**	0.0401***	0.265***	-0.0717***	0.0935***	0.552***
	(0.00811)	(0.00998)	(0.00901)	(0.0165)	(0.0155)	(0.00713)	(0.0307)

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

Table 10: Second Stage Results - Vaccination Coverage (Odd Ratios)
Reference Category No Coverage

	(1) Full Coverage	(2) Partial Coverage
Base Category: Addis Ababa		
Tigray	0.906	3.921**
	(0.160)	(2.729)
Afar	0.0728***	5.222**
	(0.0220)	(3.565)
Amhara	0.371***	10.55***
	(0.0692)	(7.014)
Oromia	0.285***	9.084***
	(0.0533)	(6.000)
Somali	0.247***	9.235***
	(0.0548)	(6.390)
Ben.Gum.	0.633**	6.134***
	(0.128)	(4.181)
SNNPR	0.468***	4.775**
	(0.0877)	(3.222)
Gambela	0.399***	12.78***
	(0.0799)	(8.751)
Harari	0.503***	10.67***
	(0.0885)	(7.495)
Dire Dawa	0.763	7.694***
	(0.145)	(5.662)
Rurality	2.112***	0.352***
	(0.265)	(0.0880)
Base Category: 2000		
Wave 2005	0.842*	0.470***
	(0.0874)	(0.0648)
Wave 2011	1.368***	0.396***
	(0.137)	(0.0590)
Wave 2016	1.685***	0.316***
	(0.169)	(0.0520)
Formation Control	YES	YES
HH Composition Control	YES	YES
Sanitation Infrastructure Control	NO	NO
Observations	5,669	5,669

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

Table 11: Second Stage Results - BMI Classification (Odd Ratios)
Reference Category Normal Weight

	(1) Underweight	(3) Obesity
Base Category: Addis Ababa		
Tigray	1.775***	0.124***
	(0.204)	(0.0692)
Afar	2.504***	0.911
	(0.298)	(0.429)
Amhara	1.185	0.464
	(0.135)	(0.220)
Oromia	1.153	0.768
	(0.129)	(0.283)
Somali	1.976***	3.741***
	(0.242)	(1.595)
Ben.Gum.	1.361**	0.363*
	(0.165)	(0.206)
SNNPR	1.036	0.394**
	(0.120)	(0.184)
Gambela	2.565***	0.397*
	(0.306)	(0.207)
Harari	1.283**	1.282
	(0.158)	(0.500)
Dire Dawa	1.674***	1.224
	(0.223)	(0.440)
Rurality	0.347***	0.923
	(0.0478)	(0.297)
Base Category: 2000		
wave_2005	0.933	1.765*
	(0.0484)	(0.538)
wave_2011	1.061	3.010***
	(0.0522)	(0.795)
wave_2016	0.893**	3.326***
	(0.0455)	(0.863)
Formation Control	YES	YES
HH Composition Control	YES	YES
Sanitation Infrastructure Control	YES	YES
Observations	19,593	19,593

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

Table 12: Second Stage Results - ORT (Odd Ratios)
Reference Category Never Heard of ORT

	(1) Used Rehydration	(2) Heard of Rehydration
Base Category: Addis Ababa		
Tigray	2.624***	3.291***
	(0.662)	(0.419)
Afar	1.049	1.461***
	(0.274)	(0.182)
Amhara	0.664*	0.526***
	(0.161)	(0.0621)
Oromia	0.989	0.752**
	(0.230)	(0.0880)
Somali	2.028***	1.436***
	(0.510)	(0.184)
Ben.Gum.	1.260	0.585***
	(0.322)	(0.0729)
SNNPR	1.021	0.616***
	(0.242)	(0.0735)
Gambela	1.552*	0.810*
	(0.393)	(0.102)
Harari	4.423***	3.736***
	(1.161)	(0.547)
Dire Dawa	1.715*	1.969***
	(0.486)	(0.288)
Rurality	1.934***	2.155***
	(0.287)	(0.157)
Base Category: 2000		
Wave 2005	0.584***	0.423***
	(0.0624)	(0.0178)
Wave 2011	1.104	0.881**
	(0.131)	(0.0442)
Wave 2016	1.186	1.044
	(0.144)	(0.0543)
Formation Control	YES	YES
HH Composition Control	YES	YES
Sanitation Infrastructure Control	YES	YES
Observations	26,223	26,223

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

Table 13: Second Stage Results - Prenatal Care (Odd Ratios)
Reference Category No Prenatal Visits

	(1) One to two visits	(2) Three to four visits	(3) Five or more visits
Base Category: Addis Ababa			
Tigray	1.372	1.749**	0.428***
	(0.470)	(0.467)	(0.123)
Afar	0.677	0.325***	0.0609***
	(0.235)	(0.0909)	(0.0191)
Amhara	0.881	0.705	0.150***
	(0.299)	(0.187)	(0.0430)
Oromia	0.625	0.741	0.131***
	(0.211)	(0.193)	(0.0364)
Somali	0.425**	0.321***	0.0299***
	(0.149)	(0.0891)	(0.00968)
Ben.Gum.	0.566	0.810	0.160***
	(0.199)	(0.221)	(0.0487)
SNNPR	0.864	0.904	0.203***
	(0.295)	(0.238)	(0.0577)
Gambela	0.428**	0.868	0.262***
	(0.152)	(0.240)	(0.0774)
Harari	1.080	0.637	0.183***
	(0.383)	(0.181)	(0.0553)
Dire Dawa	1.066	1.193	0.535**
	(0.408)	(0.360)	(0.168)
Rurality	1.779***	3.829***	6.920***
	(0.230)	(0.432)	(0.924)
Base Category: 2000			
Wave 2005	0.713***	1.356***	1.208*
	(0.0586)	(0.112)	(0.129)
Wave 2011	1.284***	2.921***	2.087***
	(0.101)	(0.236)	(0.216)
Wave 2016	2.414***	9.119***	6.685***
	(0.210)	(0.786)	(0.731)
Formation Control	YES	YES	YES
HH Composition Control	YES	YES	YES
Sanitation Infrastructure Control	NO	NO	NO
Observations	14,912	14,912	14,912

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

Table 14: Second Stage Results - Birth Assistance (Odd Ratios)
Reference Category No Birth Assistance

	(1) Health Professional	(2) Trained Assistance	(3) Untrained Assistance
Base Category: Addis Ababa			
Tigray	0.884	2.512	3.952**
	(0.533)	(1.495)	(2.222)
Afar	1.978	51.18***	18.07***
	(1.532)	(38.64)	(13.21)
Amhara	0.458	2.366	3.078**
	(0.271)	(1.385)	(1.703)
Oromia	0.187***	1.282	1.273
	(0.108)	(0.732)	(0.686)
Somali	1.220	16.18***	4.808**
	(0.817)	(10.61)	(3.014)
Ben.Gum.	0.0514***	0.287**	0.298**
	(0.0305)	(0.166)	(0.162)
SNNPR	0.124***	0.436	0.703
	(0.0721)	(0.249)	(0.378)
Gambela	0.211***	0.578	0.572
	(0.126)	(0.340)	(0.316)
Harari	1.819	6.826***	3.765**
	(1.202)	(4.433)	(2.340)
Dire Dawa	1.168	3.352*	1.821
	(0.754)	(2.147)	(1.108)
Rurality	10.09***	1.919**	1.348
	(2.690)	(0.487)	(0.327)
Base Category: 2000			
Wave 2005	1.102	0.808	1.212
	(0.183)	(0.105)	(0.148)
Wave 2011	1.697***	0.306***	1.249
	(0.301)	(0.0463)	(0.171)
Wave 2016	3.326***	0.844	0.395***
	(0.543)	(0.113)	(0.0515)
Formation Control	YES	YES	YES
HH Composition Control	YES	YES	YES
Sanitation Infrastructure Control	NO	NO	NO
Observations	14,144	14,144	14,144

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

Table 15: Second Stage Results - Postnatal Care (Odd Ratios)
Reference Category No Postnatal Care

	(1) Health Professional	(2) Trained Assistance	(3) Untrained Assistance
Base Category: Addis Ababa			
Tigray	1.246	3.409e+35	5.610
	(0.216)	(2.060e+39)	(49.84)
Afar	0.889	6.432e+19	113.7
	(0.169)	(4.398e+23)	(1,241)
Amhara	0.953	3.804e+12	109.3
	(0.167)	(4.316e+16)	(1,239)
Oromia	0.912	1.921e+29	0.0470
	(0.153)	(1.077e+33)	(0.294)
Somali	1.032	1.202e+30	3,891
	(0.206)	(9.216e+33)	(37,155)
Ben.Gum.	0.795	4.895	4.43e-06
	(0.158)	(215,687)	(6.862)
SNNPR	0.966	5.246e+32	114.4
	(0.171)	(2.316e+36)	(1,199)
Gambela	1.225	7.187e+28	6,527
	(0.225)	(3.283e+32)	(78,043)
Harari	1.191	1.774e+38	6.799e+07
	(0.209)	(1.307e+42)	(1.329e+09)
Dire Dawa	0.931	7.742	429.1
	(0.171)	(2.820e+07)	(5,926)
Rurality	2.737***	4.913e+07	0.144
	(0.302)	(1.602e+11)	(0.629)
Base Category: 2000			
Wave 2005	2.972***	0	4.811e+07
	(0.299)	(0)	(7.617e+08)
Wave 2011	4.081***	0	28.84
	(0.423)	(0)	(135.4)
Wave 2016	4.225***	0	1.086e+06
	(0.452)	(0)	(1.771e+07)
Formation Control	YES	YES	YES
HH Composition Control	YES	YES	YES
Sanitation Infrastructure Control	NO	NO	NO
Observations	5,262	5,262	5,262

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

Table 16: Second Stage Results - Access Barriers (Odd Ratios)
Reference Category No Access Barriers

	(1) No Permission	(2) No Female Provider	(3) No Transportation	(4) Distance to Facility	(5) No Money
Base Category: Addis Ababa					
Tigray	1.982	1.183	1.720**	0.645**	0.570***
	(1.339)	(0.351)	(0.466)	(0.125)	(0.0807)
Afar	1.789	0.772	1.146	1.049	0.837
	(1.455)	(0.239)	(0.325)	(0.216)	(0.133)
Amhara	3.647**	1.389	1.563*	0.676**	0.519***
	(2.385)	(0.361)	(0.407)	(0.128)	(0.0722)
Oromia	8.304***	0.925	0.972	0.766	1.315**
	(5.193)	(0.249)	(0.249)	(0.142)	(0.176)
Somali	6.184**	1.646	2.041**	1.164	1.665***
	(5.129)	(0.544)	(0.611)	(0.260)	(0.285)
Ben.Gum.	6.951***	1.185	1.275	1.201	1.000
	(5.144)	(0.350)	(0.368)	(0.247)	(0.157)
SNNPR	3.046*	1.061	0.780	0.871	1.261
	(2.063)	(0.299)	(0.211)	(0.168)	(0.179)
Gambela	3.945*	1.453	0.737	0.725	0.958
	(3.023)	(0.436)	(0.211)	(0.151)	(0.150)
Harari	3.677*	2.951***	1.730**	0.477***	1.023
	(2.854)	(0.845)	(0.476)	(0.105)	(0.152)
Dire Dawa	4.673*	0.828	0.543**	0.440***	0.962
	(3.766)	(0.253)	(0.161)	(0.0977)	(0.138)
Rurality	0.883	0.827	0.550***	0.172***	0.355***
	(0.355)	(0.141)	(0.0878)	(0.0214)	(0.0322)
Base Category: 2000					
Wave 2005	4.290***	450.2***	51.79***	36.11***	73.75***
	(1.335)	(157.7)	(10.30)	(3.667)	(5.926)
Wave 2011	4.270***	454.3***	72.48***	49.58***	56.27***
	(1.369)	(159.0)	(13.93)	(4.930)	(4.507)
Wave 2016	3.569***	417.2***	858.4***	51.62***	63.32***
	(1.305)	(147.9)	(165.4)	(5.484)	(5.424)
Formation Control	YES	YES	YES	YES	YES
HH Composition Control	YES	YES	YES	YES	YES
Sanitation Infrastructure Control	NO	NO	NO	NO	NO
Observations	32,613	32,613	32,613	32,613	32,613

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

Appendix C

The subsequent section will present results of the specified models in detail, distinguishing between regions, rurality, and time trends. All regions are compared to the base category of Addis Ababa. Odds Ratios (reported as ratios), Predicted Probabilities (reported in %) and Marginal Effects (reported in percentage points pp) will be outlined in this section. Predicted Probabilities are reported with all other predictors at their mean values. The effects of Odd Ratios <1 are computed as 1-OR. Specific significance levels can be found in the specific regression table.

First Stage Results: Fixed Effects Binary Logistic Regressions

Addis Ababa

The capital region of Ethiopia displays the following results concerning predicted probabilities. With regards to vaccination coverage, 44.3% of the women are predicted to be at least partially covered. However, an estimation of 64.0% of the women in Addis Ababa are further considered to be undernourished. Yet only a share of 58.7% is predicted to use ORTs. With regards to maternal health care, a share of 70.9% of the women in Addis Ababa is estimated to receive prenatal care. However, the predicted probability of an assisted birth lies only at 36.7%. With regards to postnatal care, a 70. 6% share of all women in Addis Ababa are estimated to receive the adequate services, which is the highest amount of all regions. Despite this, the region of Addis Ababa is also associated with a predicted probability regarding access barriers of 91.9%, clearly indicating that the large majority of women is indeed facing challenges in seeking adequate health care. All results are significant at the 1% confidence level. Since Addis Ababa acts as the reference category with regards to odd ratios and marginal effects, no estimates are reported for this particular region.

Tigray

In general terms, the probability of being vaccinated in the region of Tigray is 59.3% (1% significance level). Women of this particular region are having 1.93 the odds of being vaccinated than individuals of the region of Addis Ababa, statistically significant at the 1% level. Comparatively speaking, this means that the probability of being vaccinated in Tigray is 15 pp higher than in Addis Ababa. Yet, in terms of nourishment, the odds of being underweight is 2.01 time higher than in the capital. This translates into a general probability of being underweighted of 79.2% in Tigray. Further, a marginal effect of 15.2 pp indicates that individuals in Tigray are substantially more likely to be underweighted than individuals in Addis Ababa. A remarkable trend can also be observed with regards to ORTs, counting with a statistically significant 3.30 odd when compared to Addis Ababa. Hence, the predicted probability of the use of ORTs in Tigray is 81.9%, representing the highest value of all regions and therefore outperforming the capital region in terms of oral rehydration. On that account, women in this region show an increased probability towards the use of ORTs by 22.6 pp. The

odd of prenatal care is 1.54 times higher than in the capital region, likewise, showing in a probability of prenatal care of 78.7%. Comparatively, women in Tigray are thus having an increased probability to receive prenatal care by 7.8 pp than women in the capital. However, the odd ratio for postnatal care does not display statistically significant results and therefore reveal ambiguous results with regards to maternal health care. Likewise, the marginal effect for postnatal care is statistically insignificant. The predicted probability, however, reveals a value of 62.1% for birth assistance and 55.0% for postnatal care. Also, the odd of birth assistance displays in an increased factor of 2.87. Women in Tigray are assumed to receive birth assistance with a 20.3 pp higher probability than in Addis Ababa. Access barriers towards health care services are significantly less pronounced in Tigray than in Addis Ababa, with an odds ratio of 0.35. This also reflects in a predicted probability value of 88.3%, which is lower than in Addis Ababa. Individuals in Tigray are thus 3.6 pp less likely to face access barriers towards health services than individuals in Addis Ababa.

Afar

Overall, the probability of vaccination in Afar is 33.2% at a 1% significance level. Therefore, individuals of this region are having a 0.29 lower odd to be vaccinated than individuals residing in Addis Ababa. Consequently, the probability of vaccination is 11.1 pp smaller in Afar than in Addis Ababa. Likewise, the odd of undernourishment is 2.71 times higher in this region than in the capital, statistically significant at the 1% level. Therefore, a predicted probability of undernourishment in Afar of 83.8% is not surprising. Compared to Addis Ababa, women in Afar are exposed to an increased probability of undernourishment by 19.8 pp. The use of ORTs appears to be increased compared to Addis Ababa, with an odd of 1.49. On that account, statistically significant at the 1% level, the probability of the application of oral rehydration in Afar is 65.8%. Thus, individuals are 7.3 pp more likely to use ORTs than in Addis Ababa. Prenatal care, birth assistance and postnatal care reveal an uneven pattern. Having received prenatal care is less likely in Afar by a ratio of 0.56, also displaying in a negative marginal effect of 29.9 pp. Women are therefore less likely to receive prenatal care than in Addis Ababa with an overall probability of 49.1%. The likelihood of the service of birth assistance however is 22.39 times higher than in the capital region, the ratio being significant at the 10% level. This also displays in the probability of having received birth assistance, which is at 92.7%, the highest value for all regions. On that account, the probability of receiving birth assistance is 47.0 pp higher in Afar than in Addis Ababa. On the contrary, postnatal care does not count with a significant marginal effect. The odd ratio reveals a decreased likelihood of postnatal care by a factor of 0.36, significant at the 10% level. The probability of receiving postnatal care in the region of Afar is estimated to be 61.1%, significant at the 1% level. Both the odd ratio and the marginal effect for Afar regarding access barriers are statistically insignificant. However, with regards to predicted probability, women in the region of Afar are predicted to experience barriers to seek health care with a probability of 91,0%, significant at the 1% significance level.

Amhara

In Amhara, the predicted probability of being vaccinated is 48.8% (1% significance level). Also, the region of Amhara displays a positive odds ratio for vaccination coverage of 1.27 compared to Addis Ababa. In other words, women are on average 4.5 pp more likely to be vaccinated in Amhara than in Addis Ababa. Normal weight, however, is negatively associated with this region, showing in a 1.34 increased likelihood of being underweight than individuals from Addis Ababa. Thus, the region of Amhara counts with a predicted probability of underweight of 71.3%. Compared to the capital, this means that women are 7.3 pp more likely to be underweight. Similarly, the use of ORTs is less likely by a ratio of 0.46 in Amhara. As a result, the predicted probability of having used ORTs is only 43.3%, the lowest value of all regions. Women in Amhara are therefore 15.3 pp less likely to use oral rehydration than women in Addis Ababa. Ratios concerning maternal health care indicate a lack of adequate service provision with regards to prenatal and postnatal care, displaying in a reduced odd of 0.24 and 0.52 respectively. The odd of birth assistance, however, is increased by a ratio of 2.24 in this region. Also, predicted probabilities further show significant results at the 1% level for maternal health. The probability of having received prenatal care is at 64.3%. Yet, the probability for women having received prenatal care is 22.8 pp lower than in Addis Ababa. Similarly, an assisted birth process is likely to occur with a probability of 57.1% in the region of Amhara. This is still an increased probability of 16.9 pp compared to the capital. Also, receiving postnatal care is predicted with a probability of 56.0%. This is, however, a 16.7 pp reduced probability of receiving postnatal care than in Addis Ababa. Furthermore, less severe access barriers to health care services appear to apply, revealed by an odd ratio of 0.42. This is also confirmed by a predicted probability value of 87.3% with regards to access barriers. Consequently, women experience a reduced probability of access barriers by 4.6 pp compared to women in Addis Ababa.

Oromia

With a probability of 48.3%, residents of Oromia are at least partially vaccinated. Compared to Addis Ababa, the likelihood of individuals being vaccinated is thus increased by a ratio of 1.21. The marginal effect of vaccination shows a significant impact, indicating an increased probability of vaccination by 4 pp compared to Addis Ababa. Being underweight is positively associated with the region of Oromia, individuals show a 1.27 higher likelihood of being underweight in Oromia than in Addis Ababa, which is why the predicted probability for underweight is as high as 70.4%. A marginal effect of 6.4 pp supports the argument of an increased probability of underweight in this region. Similarly, the odd of application of ORTs is 0.24 times lesser than in Addis Ababa. This also reflects in a probability of the use of ORTs of 51.7%. A negative marginal effect of 6.9 pp is hence in line with the findings. Predicted probabilities reveal that having received prenatal care is associated with a likelihood of 61.3%, that is a reduced odd of 0.37 compared to Addis Ababa. Hence, the probability of antenatal care is reduced by 30.8 pp, indicating a worse availability of prenatal care in Oromia. With regards to assisted delivery, women from Oromia count with a probability of assistance of only 33.6%. Both the marginal effect coefficient and odd ratio are not statistically significant. Furthermore,

the estimated probability for postnatal care is predicted to be 49.3%. A reduced odd of 0.47 was further found. In other words, women in Oromia are facing a decreased probability of 13.9 pp for postnatal care than women in Addis Ababa. Women of this region, however, appear to face higher access barriers to health services, although the odd ratio is not statistically significant. Yet, the predicted probability to encounter access barriers to health care is 93.3%. In other words, the probability to encounter access barriers compared to the capital is 1.3 pp higher.

Somali

In general terms, Somali displays the lowest probability of vaccination with a value of 36.1%. On that account, the Somali region also counts with a reduced likelihood of being vaccinated by a ratio of 0.22 in comparison to the capital, statistically significant at the 1% level. Thus, women in this region face a decreased probability of vaccination by 8.2 pp compared to women residing in Addis Ababa. Similarly, the odd of being underweight is increased by a significant ratio of 1.90 in the Somali region and the predicted probability reports a value of 78.4%. Thus, Somali women encounter an increased probability of underweight by 14.3 pp, compared to Addis Ababa. The odd ratio of ORTs shows an increased likelihood of 1.52. In line, the predicted probability of the use of ORTs reports a value of 66.5% (significant at the 1% level). This also reflects in a marginal effect of 7.8 pp, indicating an elevated use of ORTs compared to the capital. Having received prenatal care before delivery appears to be less likely by a ratio of 0.70, significant at the 1% level. Therefore, the predicted probability of prenatal care is only 40.3%, the lowest value of all regions. This trend is further underlined by a highly reduced probability of prenatal care of 39.5 pp compared to Addis Ababa. Contrarily, the likelihood of being assisted at birth by either a professional or non-professional assistant is increased by an odd ratio of 5.38 when compared to Addis Ababa. Consequently, the probability of an assisted birth is predicted to be 74.1%. Hence, Somali women are 31.2 pp more likely for assisted birth delivery than women in Addis Ababa. Both the odd ratio and marginal effect for postnatal care display a negative value, albeit statistically insignificant. Still, the predicted probability for postnatal care is 53.7%, statistically significant at the 1% level. Access barriers are statistically significantly predicted to impede health care seeking with a probability of 95.0% in the region of Somali, representing one of the highest values for all regions. Therefore, the odd is 1.55 times higher. This means, that the probability of facing access barriers is 3.1 pp higher in Somali than in Addis Ababa.

Benishangul-Gumuz

The probability of vaccination in this region is 45.1%. Yet, neither the odds ratio nor the marginal effect for this region are statistically significant. However, the odd of being underweight appears to be increased by a factor of 1.49 in Benishangul-Gumuz, statistically significant at the 1% level. This also reflects in a predicted probability of underweight of 73.6%. Women in this region are 9.5 pp more likely to be unweight than in Addis Ababa. The likelihood of application of ORTs is reduced by a significant ratio of 0.38, compared to Addis Ababa. Consequently, the predicted probability of the use of ORTs is only 46.8%. On that account, the

probability of use is decreased by a factor of 11.7 pp. Further, both prenatal and postnatal care as well as birth assistance appear be restricted when it comes to odd ratios, as ratios of 0.31; 0,76 and 0.50 respectively indicate. A statistically significant predicted probability for prenatal care of 61.9% is estimated for the region of Benishangul-Gumuz. Women of this region face a lower probability of prenatal care by 24.2 pp than women from Addis Ababa. Besides, the predicted probability of an assisted birth is 12.3% in this region, significant at the 5% level. This is the lowest value compared to other regions and in line with a decreased odd ratio mentioned previously. Compared to Addis Ababa, women in this region are 31.8 pp less likely to receive birth assistance. Postnatal care is predicted to be at 54%. However, compared to Addis Ababa, the region is 15.7 pp less likely to deliver postnatal care. Access barriers to health care services are not statistically significant with regards to both odds ratios and marginal effects but do indeed yield significant results concerning predicted probabilities. 92.5% of all women in this region are predicted to encounter barriers regarding access to health care, the highest share of all regions.

SNNPR (Southern Nations, Nationalities, and People´s Region)

More than half women of this region are predicted to be vaccinated, precisely 51.3%. The likelihood of being vaccinated is therefore 1.32 higher than in Addis Ababa, statistically significant at the 1% level. This means, women in SNNPR tend to be vaccinated with an increased probability of 7.0 pp when compared to women in Addis Ababa. The odds ratio for being underweighted is not statistically significant for this particular region. Nevertheless, a statistically significant predicated probability of underweight of 68.2% is reported. Thus, the probability of women being underweighted tends to be 4.2 pp greater than in Addis Ababa. Yet, a reduced likelihood of the use of ORTs can be mapped out with a significant odd ratio of 0.34. Only 47.5% of the women of this region are assumed to use ORTs for the treatment of diarrhea. Therefore, the probability of use is decreased by a factor of 11.2 pp compared to Addis Ababa. Prenatal care ratios are not statistically significant. Yet, the predicted probability of prenatal care reports a value of 67.0%, significant at the 1% level. A reduced likelihood of 28.7 pp is thus found concerning the marginal effect. For birth assistance, a predicted probability value of 22.6% is reported. Consequently, the probability of birth assistance compared to Addis Ababa is reduced by 22.4 pp, equivalent to a reduced odd of 0.51. Postnatal care seems to be negatively associated with the region of SNNPR by a ratio of 0.39. This also displays in a relatively low predicted probability value for postnatal care of 46.5%, the lowest value of all regions. In relation to Addis Ababa, women in SNNPR therefore experience a decreased probability for postnatal care by 10.9 pp. Albeit statistically insignificant for the odds ratio and marginal effects, access barriers appear to be slightly higher in SNNPR than in Addis Ababa. An estimated, significant share of 93% of women is predicted to face access barriers.

Gambela

The predicted probability of vaccination in this region is 39.8% (1% significance level). Yet, in the region of Gambela, the likelihood of being vaccinated is relatively decreased compared to the region of Addis Ababa by a factor of 0.13, statistically significant at the 10% level.

Therefore, residents face a decreased probability of vaccination of 4.5 pp. Besides, the odd of being underweight is increased by a ratio of 2.96 in Gambela, further displaying in a predicted probability of undernourishment of 85.4%. This is the highest value of all regions. As a consequence, the region also shows the highest comparative value with regards to Addis Ababa; women tend to be 21.4 pp more likely to be underweight in Gambela. The use of ORTs is negatively associated with the region, which is why the probability of use is only at 53.2%. Hence, a negative marginal effect of 5.3 pp indicates a reduced probability of use compared to the capital. The odd ratio is not significant. Predicted probabilities for maternal health care, on the contrary, yield statistically significant results at the 1% level. The predicted probability of having received prenatal care in Gambela is 61.7%. However, women in Gambela are 24.5 pp less likely of having received prenatal care than women in Addis Ababa. Therefore, an odd of 0.29 applies. Likewise, the probability of having received birth assistance is estimated to be 20.4% at a 5% significance level. Comparatively, women in Gambela are thus facing a reduced probability of 19.2 pp with regards to birth assistance than women in Addis Ababa. This also displays in a reduced odd of 0.54. Concerning postnatal care, women in the region are predicted to receive postnatal care with a probability of 60.7%. Both the marginal effect and the odd ratio with regards to postnatal care for this region are not statistically significant. Correspondingly, the access barriers odd ratio and the marginal effect also yield insignificant results. Yet, the predicted probability of access barriers is significant at the 1% level and reveals a value of 91.2%.

Harari

Generally, the probability of vaccination in the region of Harari is 50.6%. Therefore, the odd of vaccination is increased by a factor of 1.36. Besides, the marginal effect indicates an increased probability of vaccination by 6.3 pp compared to the capital. Furthermore, women in this region do display an increased odd of being underweight by a factor of 1.34, significant at the 1% level. Thus, the predicted probability of underweight in this region is 71.4%. This also translates in an increased comparative probability of underweight by 7.4 pp. Likewise, the likelihood of using ORTs is increased by a ratio of 3.78 compared to the region of Addis Ababa. Therefore, 84.1% of all women are predicted to use ORTs in Harari. The use is more likely by a factor of 24.7 pp. The likelihood of future mothers receiving prenatal care is reduced by a marginal effect of 23.4 pp. In line, the probability of having received prenatal care is thus 67.5%. The odd ratio for this region is not statistically significant. We further observe a predicted probability of receiving birth assistance of 62.00%, significant at the 1% level. Women in Hararia are 21.2 pp more likely to receive birth assistance than women in Addis Ababa. This also displays in an increased odd of 2.81. Likewise, almost 61% of all women in Harari are predicted to receive postnatal care. The marginal effect and odd ratio are statistically insignificant. Further, access barriers do not count with a statistically significant odds ratio or marginal effect whereas the predicted probability of facing access barriers to health care is 92.1%, significant at the 1% level.

Dire Dawa

The probability of vaccination in Dire Dawa is 49.7%, with an increased odd of 1.30 compared to Addis Ababa. The marginal effect regarding vaccination likewise denotes an increased probability of 5.4 pp in comparison to Addis Ababa. Besides, women of the region have a 1.57 higher odd of undernutrition, displaying in a probability of undernourishment of 74.5%. Comparatively, they face a higher probability of undernourishment of 10.5 pp compared to Addis Ababa. The odd ratio for use of ORTs is increased by a factor of 1.95 compared to the capital. In line, the predicted probability displays a statistically significant value of 73.1% for the use of oral rehydration. Women in Dire Dawa are comparatively more likely to apply oral rehydration than women in Addis Ababa by 14.0 pp. Likewise, prenatal care appears to be applicable with a probability of 76.8%. Consequently, women are 14.1 pp less likely to receive prenatal care than women in the capital. Controversy, the odd ratio of prenatal care is increased by a factor of 1.44. Birth assistance is estimated to take place with a probability of 38%. Yet, no statistically significant result are obtained with regards to marginal effects and odd ratio. When it comes to postnatal care, women from Dire Dawa are predicted to receive adequate health care with a probability of 57.2%. However, the marginal effect is insignificant. Concerning access barriers, individuals from Dire Dawa are facing slightly less access barriers to seek health care, indicated by a predicted probability of access barriers of 90.1%. A slightly reduced odd of 0.24 confirms the finding. However, the marginal effect regarding access barriers is statistically insignificant.

Rurality

Controlling for urbanity and rurality reveals a reduced odd of vaccination in urban areas by a factor of 0.10. Thus, the marginal effect regarding vaccination shows a decreased probability of vaccination coverage in urban areas of 3.4 pp. The odd of undernourishment, however, is reduced in urban areas by an odd of 0.26. Therefore, individuals in urban areas are less likely to be underweight by 7.9 pp than individuals living in rural areas. Contrarily, the odd of using oral rehydration increases for urban areas by a factor of 2.11 with a significance of 1%. Therefore, urban areas display an increased probability for the application of ORTs of 20.1 pp. Likewise, the likelihood of receiving prenatal and postnatal care is elevated in urban areas by an odd of 3.24 and 3.70 respectively. The marginal effect for prenatal care shows a value of 28.9 pp, demonstrating an increased probability for urban than rural areas. The odd ratio for birth assistance is increased by a factor of 2.73 in urban environments. Consequently, urban areas are associated with an increased probability of birth assistance by 30.5 pp when marginal effects are scrutinized. Postnatal care is calculated to be 31.2 pp more likely in urban areas than in rural ones. Urban areas display a decreased odd of access barriers by a factor of 0.62, significant at the 1% level. Comparatively, this further displays in a reduced likelihood of access barriers in urban areas by 7.6 pp.

Time Trends

Considering the above-described interventions by the Ethiopian government into the health sector, it is further of interest to assess the evolution of health outcomes over the period of observation.

Overall, vaccination coverage in Ethiopia appears to have improved since 2000, indicated by an overall increasing trend in the odd ratios from a slightly negative relationship of 0.13 in 2005 towards a positive trend in 2011 with a ratio of 1.13. By 2016, however, coverage rates seem to have deteriorated again, as the odd ratio once again decreased. This also reflects in a predicted probability of vaccination of 44.4% in 2000, which then increases to 48.0% in 2011 to decrease to 39.80% in 2016. In other words, the likelihood of vaccination coverage decreased by 4.63 pp between 2000 and 2016. The likelihood of underweight, however, appears to have slightly decreased over the period of observation, as both the odd ratio for 2005 and 2016 show a statistically significant decreasing trend with a off of 0.09 and 0.16 respectively and therefore indicate that women are less likely to be underweight in 2016 than in 2000. In 2000, 65.8% of all women were predicted to be underweight whereas in 2016, the percentage turned down to 63.4%. This is a decrease in likelihood by 2.44 pp. Likewise, with regards to ORTs, we observe that the likelihood of use increases with time, as the odd ratios for 2005 and 2011 show. Yet, odd ratio results for 2016 are not statistically significant. Nevertheless, the predicted probability regarding the use of ORTs rises, with an application rate of 65.2% in 2000 rising to 69.2% in 2016, hence representing a 4.01 pp increase over time. Ethiopia also made significant progress with regards to prenatal and postnatal care. Since 2000, the likelihood of receiving prenatal care increased by an odd factor of 2.64 until 2016, that is an overall predicted probability for prenatal care of 87.0% and therefor a rise in service provision by 26.5 pp. Likewise, the probability of postnatal care displays a ratio of 1.83 in 2016. Whereas in 2000, only 71.3% of all women were predicted to received postnatal care, it was already more than 80% by 2016, accounting for a 9.4 pp surge in service provision regarding the outcome. Nevertheless, the likelihood of birth assistance of any kind shows a negative relationship by a significant odd ratio of 0.58 in 2016; women are hence less likely of receiving birth assistance in 2016 than in 2000. This also reflects in a decreasing predicted probability from 16.4% in 2000 to 9.2% in 2016, gauged as a 7.2 pp decline. A similar trend can be observed regarding access barriers. They appear to have increased over time, as a significant odd ratio of 83.72 in 2016 connotes. In 2016, up to 98.4% of all women in Ethiopia face some kind of access barriers towards health services, which is 55.2 pp more than in 2000.

Second Stage Analysis: Fixed Effects Multinominal Logistic Regressions

The second part of the analysis will scrutinize different categorical outcomes of the dependent variables in order to gain additional and in-depth insights into the regional performance of specific health outcomes. This step is considered important owed to the need for a relevant distinction between health outcomes, which can only partially be represented by binary outcome variables. In the following, the respective odd ratios will be reported. Predicted probabilities and marginal effects are not applicable for this type of analysis. The reference

category is Addis Ababa. The categorical variable of postnatal care does not report significant results, which is why it has not been included into this section of analysis. With regards to access barriers, only those regional barriers will be reported, that count with significant results.

Tigray

Distinguishing between no vaccination coverage, partial and full coverage, we observe that individuals are having a 3.92 higher odd in Tigray of being partially vaccinated than individuals in Addis Ababa. With regards to full coverage, the odd ratio is not significant. Concerning weight classifications, a 1.76 higher odd of underweight is reported in this region. The risk of obesity is, however, is decreased by a factor of 0.88. The application of ORTs is increased by an odd of 2.62, compared to the capital. Likewise, women are more likely to have heard of several therapy options for diarrhea by a factor of 3.29. Besides, women in Tigray are also facing a higher likelihood of receiving three to four prenatal visits by an odds ratio of 1.75. However, the likelihood of receiving five visits or more is reduced by a ratio of 0.57, compared to Addis Ababa. Ratios for assisted birth by either a health professional or a traditional trained birth assistant are statistically insignificant. Yet, birth assistance by an untrained assistant is 3.95 times more likely in Tigray than in the capital. Dominant access barriers towards health care seeking in the region of Tigray are the lack of transportation, the distance to health facilities as well as the lack of money for treatment. Women are facing an increased likelihood to experience barriers due to transportation by a ratio of 1.72 compared to women in Addis Ababa. Yet, in relation to the capital, the distance to the nearest facility as well as money for treatment are comparatively less severe access barriers, as reflected by their odd ratios of 0.36 and 0.43.

Afar

Women in Afar face an increased likelihood of partial vaccination coverage by a ratio of 5.22, compared to Addis Ababa. However, the odd of being fully vaccinated is slightly decreased when compared to the capital by a ratio of 0.93, significant at the 1% level. Weight classifications report an increased likelihood of underweight by a factor of 2.50. The odd ratio concerning obesity does not yield statistically significant results. Besides, women in Afar are more likely to have heard of ORTs by a ratio of 1.46. With regards to prenatal visits, individuals encounter a reduced likelihood for both three to four visits or five or more visits in relation to women in Addis Ababa, with a ratio of 0.68 and 0.94 respectively. Birth assistance by both traditional trained and untrained helpers are more likely by a ratio of 51.18 and 18.07 respectively. The ratio with respect to assistance by a health professional is statistically insignificant for the region of Afar. Besides, all ratios regarding access barriers are likewise statistically insignificant.

Amhara

The odd of being partially vaccinated is 10.55 higher in Amhara than in Addis Ababa. Yet, with a value of 0.63, individuals in this region also experience a lower odd of being fully vaccinated. Both the odd ratio for obesity and underweight are statistically not significant. With regards to

knowledge of ORTs, women in this region are less likely to have heard about therapy options by a ratio of 0.47. The ratio for three to four prenatal visits is statistically insignificant for the region of Amhara. Yet, women of the region are significantly less likely to realize five or more visits by an odd ratio of 0.85. Both the ratio considering birth assistance by a health professional or traditional trained assistant are statistically insignificant. Yet, deliveries in Amhara tend to be accompanied by untrained assistance 3.08 times more likely than in Addis Ababa. Considering access barriers, we see that the access to health services is affected by the lack of permission by the husband, 3.66 times more than in Addis Ababa. However, women face reduced distances to health facilities by a ratio of 0.32 when compared to the capital. The same applies for the lack of money for treatment, which seems to impede women in the capital more than in Amhara to seek health care by a ratio of 0.48. The lack of transportation is associated with an odd ratio of 1.56, indicating higher barriers compared to the capital.

Oromia

In Oromia, women encounter an increased odd of 9.08 of being partially vaccinated when compared to women in Addis Ababa. Besides, the odd of being fully vaccinated is decreased by a factor of 0.71. Ratios with regards to underweight as well as obesity are not statistically significant for this region. Besides, women are less likely to be knowledgeable about ORTs than in Addis Ababa by a ratio of 0.25. Considering the number of prenatal visits, women in Oromia are less likely to receive five or more prenatal visits by a ratio of 0.87, compared to women in the capital. The ratio regarding three to four visits is statistically insignificant. Further, in Oromia, the likelihood of birth assistance by a health professional is slightly decreased by a ratio of 0.81, compared to Addis Ababa. Birth assistance by both traditional trained and untrained persons are statistically insignificant. Access barriers to health care are most pronounced regarding the permission to seek care by the husband; women in this region are 8.31 times more likely to not receive a permission than women in Addis Ababa. Further, the lack of money for treatment is an additional impediment to seek health care, increasing the odds of a barrier by a factor of 1.31.

Somali

Partial vaccination coverage in Somali is associate with an 9.24 higher odd than in Addis Ababa. Women are however less likely to be fully vaccinated by an odd of 0.75, significant at the 1% level. Concerning normal weight, women of this region encounter a decreased odd compared to Addis Ababa. Ratios with regards to underweight and obesity both display an increased odd by 1.98 and 3.74 respectively. In other words, women tend to be either more prone towards underweight or obesity than in the capital. Concerning ORTs, women are more likely to have at least heard about therapy options by a factor of 1.44 compared to the capital region. Further, in Somali the likelihood of women having between three and four prenatal visits is reduced by a ratio of 0.68. The ratio regarding five or more visits is 0.97, slightly less likely than in Addis Ababa. When it comes to birth assistance, women in the region of Somali are 16.18 times more likely to receive traditional trained birth assistance than in Addis Ababa. Likewise, they are also more likely to receive untrained assistance by a ratio of 4.81. The ratio

considering health professionals is statistically insignificant for this region. Access barriers in the Somali region predominantly compromise the lack of permission, transportation, and money for treatment. Women are exposed to a 6.18 higher odd of not obtaining permission, a 2.04 higher odd of not having access to the required transport infrastructure and a 1.67 higher odd of lacking the required money for treatment than women in Addis Ababa.

Benishangul-Gumuz

In this region, the odd of being partially vaccinated is higher by a factor of 6.13 compared to the capital. Yet, the odd of being fully vaccinated is decreased, albeit only by a factor of 0.37. Women are considered to be underweight by an increased ratio of 1.36, compared to Addis Ababa. The obesity ratio is decreased compared to Addis Ababa, indicated by a factor of 0.64. Furthermore, women in this region are less likely to are knowledgeable about ORTs than in the capital as an odd ratio of 0.42 indicates. Realizing three to four prenatal visits displays an insignificant ration, yet the likelihood of receiving five or more prenatal visits is reduced compared to the capital, reflected by an odds ratio of 0.84. Birth assistance is significantly less likely in the region of Benishangul-Gumuz than in the capital, both with respect to assistance by health professionals, traditional trained and untrained support. The respective ratios are 0.95, 0.71 and 0.70. The major access barrier women face in this region is the lack of permission to seek health care by the husband, which is 6.95 times higher than in Addis Ababa.

SNNPR

The region of SNNPR displays an increased odd ratio of 4.76 for partial vaccination coverage. Nevertheless, full vaccination coverage is decreased by a factor of 0.53 in this region. The ratio regarding underweight is not statistically significant. Besides, the likelihood of obesity is reduced by a factor of 0.61 compared to the capital. With regards to ORTs, women in this region are less likely to be knowledgeable about the topic by a ratio of 0.38. Similarly, women are also less likely of receiving five or more prenatal visits by a ratio of 0.80. Additional ratios concerning the number of realized prenatal visits are statistically insignificant. Compared to Addis Ababa, women are facing a reduced probability of birth assistance by a health professional by a factor of 0.88. Ratios regarding birth assistance by traditional trained and trained birth assistants are statistically insignificant for the SNNPR region. The region is further associated with an increased odd of lacking permission to seek health care by a factor of 3.05.

Gambela

In Gambela, the odd of partial vaccination coverage in increased by a factor of 12.78. Nevertheless, concerning full vaccination coverage, women in this region are less likely to be fully covered by a ratio of 0.60 in comparison to Addis Ababa. Furthermore, the likelihood of underweight appears to be increased by a factor of 2.66. The ratio for obesity indicates a reduced likelihood by a factor of 0.60. The ratio concerning knowledge about ORTs displays a reduced odd by a factor of 0.19. With regards to prenatal care visits, the ratio concerning five or more

visits displays a significant result, indicating a reduced likelihood of 0.74 for women of the region. Birth assistance by a health professional is less likely by a factor of 0.79. Ratios for both traditional trained and untrained health assistants are statistically insignificant. Furthermore, ratios concerning access barriers reveal an increased odd of lacking permission by a factor of 3.95.

Harari

Women are more likely to be partially covered in Harari than in Addis Ababa by a ratio of 10.67. Yet, when it comes to full coverage, the odd is negative by a factor of 0.45, indicating a reduced odd of full coverage for this region. Besides, the likelihood of underweight displays a ratio of 1.28, indicating an increased prevalence of undernourishment than in Addis Ababa. Obesity is not statistically significant for this region. Yet, women in Harari are remarkably more likely to be knowledgeable about ORTs than in the capital as indicated by an odd ratio of 3.74 for the region. Realizing three to four prenatal visits displays an insignificant ratio for the region. Yet, the likelihood of five or more prenatal care visits is slightly less than in Addis Ababa, as reflected by an odd ratio of 0.82. Concerning birth assistance, women in Harari are however significantly more likely to receive birth assistance either by a traditional trained or untrained assistant, respectively with a ratio of 6.83 and 3.77. The ratio regarding birth assistance by a health professional is statistically insignificant. A predominant access barrier woman face in the Harari region is the concern of non-female health workers. Women of this region are more likely by a ratio of 2.95 to not seek health care due to this concern compared to women in Addis Ababa. Also, women in this region face a higher odd of lack of permission by a factor of 3.68 as well as the lack of transportation by an odd factor of 1.73. Distance to health facility, however, appears to be reduced as an odd of 0.52 indicates.

Dire Dawa

The region of Dire Dawa shows an increased odd ratio by 7.65 for partial coverage when compared to Addis Ababa. The ratio for full coverage does not yield a statistically significant result. The likelihood of underweight is increased by a ratio of 1.67 in the region and obesity being statistically insignificant. Women are however estimated to be more likely to have heard of ORTs by a factor of 1.97 than women in the capital. Five or more prenatal care visits are remarkably less likely in Dire Dawa than in Addis Ababa by a ratio of 0.47. Odd ratios regarding birth assistance are statistically insignificant concerning untrained assistance and assistance by a health professional for the region of Dire Dawa. The odd of trained birth assistance is increased by a factor of 3.35. Women in Dire Dawa further experience less access barriers than women in Addis Ababa when it comes to the availability of transportation and distance to the nearest health facility. Reduced barriers regarding transportation are reported by a ratio of 0.46 whereas reduced distance to health facility is reflected by a ratio of 0.56. The lack of permission is increased by an odd of 4.67, compared to Addis Ababa.

Rurality

Individuals living in rural areas are less likely to be partially vaccinated by a factor of 0.65 when compared to individuals of urban areas. Yet, urbanity is positively related to full vaccination coverage by a factor of 2.12. A similar trend can be observed with regards to weight classifications. Underweight appears to be negatively related to urbanity as an odd ratio of 0.65 shows. Obesity is not significantly associated with urbanity. Knowledge about ORTs is positively associated with urbanity; women in urban areas are more likely to have heard of therapy options by a ratio of 2.16. With regards to prenatal visits, women in urban areas are also 3.83 times more likely to receive between three and four visits. In a similar manner, they are also 6.92 times more likely to receive even five or more visits than in rural areas. Considering birth assistance, we observe a positive effect of urbanity on birth assistance by a health professional by a factor of 10.09. Likewise, traditional trained birth assistance is slightly more likely to occur in urban areas than in rural ones by a factor of 1.91. Untrained birth assistance is insignificant for the variable of rurality. Additionally, rurality is negatively associated with the availability of transport infrastructure, distance to health facilities and money requirements for treatment. With a ratio of 0.45, 0.83 and 0.65 respectively, all these barriers represent improved access to health care services in urban areas than in rural ones.

Time Trends

Over the period of observation, we observe an increasing likelihood of full vaccination coverage, indicated by an odd ratio of 1.69 in 2016 as compared to 1.37 in 2011. The odd of being partially vaccinated, however, decreases slightly. With regards to weight classifications, no clear time trend can be mapped out. The finding can be attributed to divergent evolutions in different regions. Concerning the use and knowledge of ORTs, most ratios are statistically insignificant but indicate an uptake in use and knowledge. Generally, the likelihood of prenatal care visits increases over time and women are more prone to receive prenatal health services. For example, women are 9.12 time more likely to attend three to four prenatal visits in 2016 than in 2000. On that account, in increase in the number of visits is observed over time, albeit in most cases not exceeding the number of four. Similarly, the odd of five or more visits increases by a factor of 6.69 in 2016. Particular forms of birth assistance and postnatal care show a positive trend over time. Especially with regards to birth attendance by health professionals, the odds increased significantly since 2000, as demonstrated by an odd ratio of 3.34 in 2016. Likewise, the odd of receiving postnatal care by a heath professional is 4.22 times more likely in 2016 than in 2000. Yet, the likelihood of access barriers towards health services appears to have increased remarkably since 2000. Particularly the lack of transportation appears to rise with time as an elevated odd ratio indicates, putting serious restrictions on the adequate provision of health services.