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Educational inequalities in child mortality in low - and middle-income countries (LMICs)

Examining the international development of inequalities in under-five mortality based on maternal education in LMICs in recent decades

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ABSTRACT

Under-five mortality continues to be a major public health concern globally. Using data from the Demographic and Health Survey, this master thesis firstly investigates the relationship between maternal education and under-five mortality in low – and middle-income countries (LMICs). Secondly, the study examines the shape of the educational gradient in under-five mortality in LMICs. Third, the study examines how inequalities relating to under-five mortality based on maternal education have evolved between the two time-periods 1985-2000 and 2001-2017. Fourth, the study examines if maternal education has an independent, negative effect in four separate LMICs with different shapes of the educational gradient in under-five mortality. The study finds a negative relationship between maternal education and under-five mortality in descriptive graphs for 62 and 67 countries for the two time-periods respectively. Also, estimated with logistic regression, maternal education level is found to have a statistically significant negative effect in Angola, Dominican Republic, Pakistan and Niger, who all have a different shape of the educational gradient in under-five mortality. Furthermore, the thesis demonstrates that there is an educational gradient in 60 out of 86 LMICs disfavoring the lower educated. Most countries reveal decreasing under-five mortality rates for all maternal education levels, and most for children born by mothers with no education. Lastly, absolute inequality between maternal education levels' under-five mortality rates seem to be decreasing in 25 out of 37 LMICs. Reducing educational inequalities in LMICs must be the focus if further decrease in child mortality is to be accomplished.

Sammendrag

Under-fem dødelighet fortsetter å være en global folkehelsebekymring. Ved å bruke data fra Demographic and Health Survey vil denne masteroppgaven I) Studere forholdet mellom mors utdanningsnivå og under-fem dødelighet i lav – og mellominntektsland.
II) Undersøke formen på utdanningsgradienten i under-fem dødelighet i lav – og mellominntektsland. III) Overvåke hvordan ulikheter i under-fem dødelighet basert på mors utdanning har utviklet seg fra perioden 1985-2000 til 2001-2017. IV) Estimere hvorvidt mors utdanning har en selvstendig, negativ effekt på under-fem dødelighet i fire forskjellige lav – og mellominntektsland som viser ulik form på utdanningsgradienten i under-5 dødelighet. Studien finner en negativ sammenheng mellom mors utdanning og under-5 dødelighet i deskriptive grafer for 62 og 67 land fra de to respektive tidsperiodene. Videre viser studien at mors utdanning har en statistisk signifikant negativ effekt på under-5 dødelighet i Angola, Dominikanske Republikk, Pakistan og Niger, som alle har ulik form på utdanningsgradienten i under-fem dødelighet. Studien viser videre at 60 av 86 lav – og mellominntektsland har en utdanningsgradient i under-5 dødelighet, hvor de lavt utdannede mødrene kommer verst ut. De fleste lav – og mellominntektsland har synkende under-fem dødelighet og barn født av mødre med de laveste utdanningsnivåene har størst reduksjon i under-fem dødelighet. Til slutt viser studien en tendens til at absolutte ulikheter mellom mors utdanningsnivå og under-fem dødelighet synker i 25 av 37 lav – og mellominntektsland. Redusering av utdanningsforskjeller i lav – og mellominntektsland må være fokuset dersom under-fem dødeligheten skal fortsette å synke.

Preface

The idea of this master thesis in Political Science came about after meeting my supervisor Terje Andreas Eikemo in January. He introduced me to CHAIN (Centre for Global Health Inequalities Research) which he is the leader of. Their work and field of research intrigued me, and it did not take long until we agreed to work together. I want to express my sincere gratitude for how Terje Andreas Eikemo has facilitated and helped me during this process. I was invited to participate in CHAIN's kick-off conference in Trondheim in April, where scholars on health inequality from all over the world participated. This experience gave me valuable insight into this field of research and the magnitude of topics related to it. Furthermore, I want to mention The Demographic and Health survey, funded by USAID, who gave me full access to their survey-data on child health. I also want to thank my fellow students for long lunch breaks, constructive discussions and encouragement along the way. Lastly, I want to give a special regard to my girlfriend Lise Stokkeland for her love and support during these last months.

Helge Almås
Trondheim, 25.05.2019

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1.0 Introduction

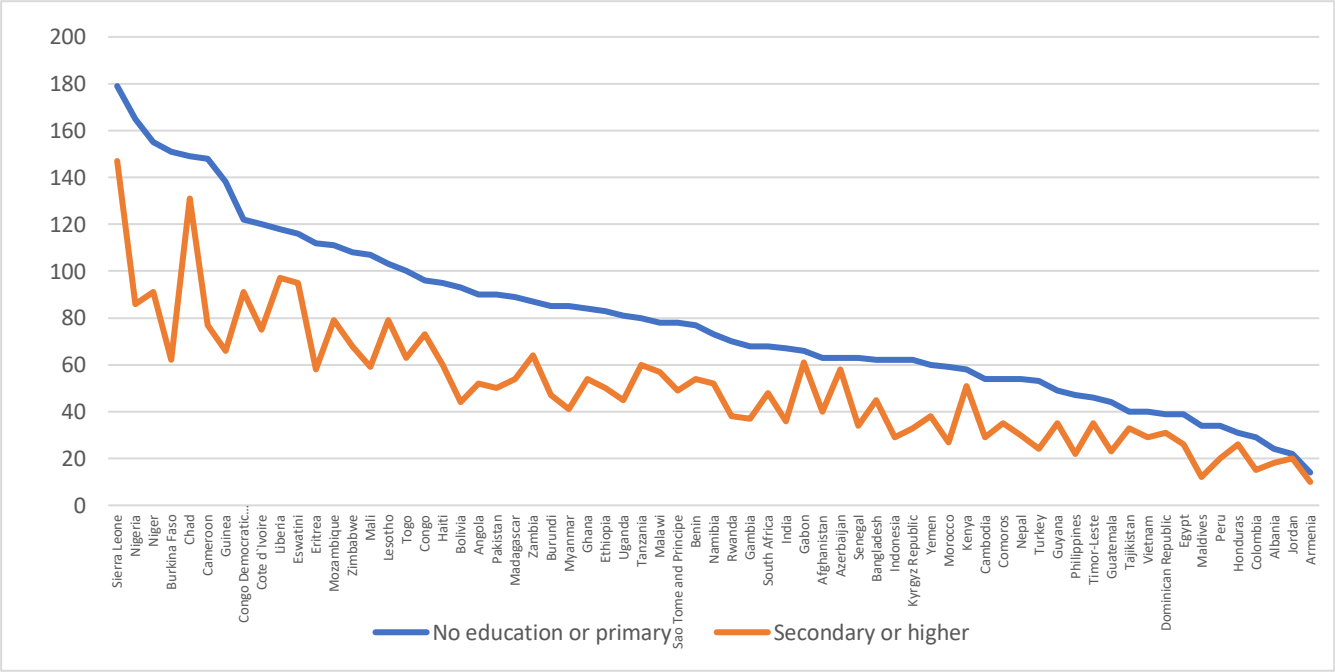
In 2017, 5.4 million children died before their fifth birthday. About half of those children died in Sub-Saharan Africa (UNIGME, 2018). Most of these deaths occur in low – and middle-income countries (LMICs). In 2016, the most common reasons for under-five mortality were both curable and preventable diseases. These diseases are complications during birth (18 %), pneumonia (16 %), intra-partum related events (12 %), congenital anomalies (9%), diarrhea (8 %), neonatal sepsis (7 %) and malaria (5 %) (Hug, Sharrow, & You, 2017).

Despite these dreading figures, progress have been made in reducing under-five mortality across the globe. Dicker et al. (2018) studied mortality and life expectancy all over the world from 1950-2017. One of their main findings was that the most significant improvement across all age-groups were for children under five years old (Dicker et al., 2018). Since 1990, under-five mortality has decreased by over 50 per cent (WHO, 2019). The pace of this reduction is accelerating, with a decrease of 1.9 per cent per year in the 1990s to 4 per cent in the 2000s (Hug, Sharrow, & You, 2017). One of the World Health Organization's (WHO) Millennium Development Goals was to reduce under-five mortality by two-thirds between 1990 and 2015 (WHO, 2015). As mentioned, the decrease between 1990 and 2017 has been over 50 per cent, coming close – but not reaching - the goal of a two-third reduction.

Socio-economic inequalities relating to under-five mortality in LMICs have received increased attention in the field of health research in recent years. Children born by less educated mothers and/or in poorer households have substantially lower chances of surviving to the age of five than children born by higher educated mothers and/or in wealthier households (Houweling & Kunst, 2009). Monitoring and laying the groundwork for decreasing inequalities in child health has both moral - and political dimensions: As a moral dimension, health is one of the main mechanisms human beings can enjoy other freedoms through (Alleyne et al., 2000; Wagstaff, 2001). As a political dimension, monitoring the different distributions and significance of different determinants relating to child health helps policymakers to have an evidence-based approach when trying to diminish these inequalities. This applies both to policymakers within international organizations like WHO and the UN, as much as the governments of each respective country. In addition, inequalities within countries can create social instability and unrest which have the potential to cause conflicts

between different classes of society (Alleyne et al., 2000).

No previous research have monitored the development of socio-economic inequalities in child mortality in LMICs, from recent decades till present time, which is what this master thesis will do. Under the umbrella of socio-economic inequalities relating to children's health in LMICs, several issues could be raised. This thesis will examine how inequalities in under-five mortality based on *maternal education levels* are distributed within LMICs, and how these inequalities have evolved over time in both absolute and relative measures (the distinction between absolute and relative measures of inequality will be discussed in detail in chapter 4). Maternal education is a particularly interesting determinant of child health as it often relates to both wealth and materialistic wellbeing - but also psychological traits such as changed behavior and attitudes, in addition to increased knowledge about health (Houweling & Kunst, 2009; Frost et al., 2005).



Gap in under-five mortality between two maternal education-levels; no education and primary and secondary and higher from 67 LMICs. Data from DHS (2001-2017). Y-axis represent under-five mortality rate per 1000 live births.

The thesis will examine the shape of the educational gradient in under-five mortality in LMICs, which is important in order to understand the scale of educational inequality in under-five mortality - and to give policymakers valuable evidence in order to implement targeted and universal policies aiming to reduce these inequalities. (Houweling & Kunst, 2009).

Lastly, the thesis will examine the effect of maternal education on under-five mortality in four LMICs revealing a different shape of the educational gradient in under-five mortality. This will give valuable insight into how maternal education (and other relevant variables) influence under-five mortality in LMICs with various educational inequalities revealed in the shape of their gradients.

The progress in improving child health presented by both Hug et al. (2019) and Dicker et al. (2018) is naturally very positive and encourages further decrease in under-five mortality in coming years. But, as mentioned, most of the under-five mortality today occur in low-and-middle income countries. In Nigeria, 100 out of 1000 children died before the age of five in 2017. In comparison, 2.6 out of every 1000 children died before the age of five in Norway (WHO, 2019). This striking contrast illustrates the enormous gap between low – and middle-income countries and the developed world. And more important, as this thesis will examine; there are huge inequality gaps *within* countries based on wealth and education levels, often shaped as a social gradient between the different levels of education and wealth (Houweling & Kunst, 2009).

1.1 Research question

How are under-five mortality rates based on maternal education distributed across low – and middle-income countries, and how have these inequalities developed in recent decades?

Implicit in the research question, this thesis has four main objectives:

I) To examine the relationship between maternal education and under-five mortality in LMICs.

II) To examine the shape of the educational gradient in under-five mortality in LMICs.

III) To examine how the magnitude of educational inequalities have developed in both absolute and relative terms from the period 1985-2000 till the period 2001-2017.

IV) To estimate maternal education's effect in LMICs with different shapes of the educational gradient in under-five mortality.

The thesis will examine these objectives by using data from the Demographic and Health survey from the two time-periods 1985-2000 and 2001-2017. The under-five mortality rates by maternal education levels will be monitored over time for 67 and 62 LMICs respectively. The educational gradient in under-five mortality will be monitored in 86 LMICs and change in absolute and relative educational inequalities in under-five mortality for 37 LMICs.

1.2 Framework for the thesis

In chapter 2, theory and concepts of how inequalities in health manifest itself across the world - and are socially graded within countries, will be examined. The negative relationship between maternal education and child health will be explained by viewing previous literature on the topic. Continuing, previous research on causality between maternal education and child health will be reviewed, in addition to how inequalities in health have developed in recent time, both in developing and developed countries. Based on all this, four hypotheses will be presented and lay out what the thesis expect to find. Chapter 4 explains choice of data and methods and chapter 5 will present the results tested against the four hypotheses. The chapter of results will be dominated with graphical descriptions of the different inequality distributions – but also contains tables and logistic regression models. In chapter 6, the thesis' results will be summed up and viewed considering theory and previous research, before concluding the thesis in chapter 7.

2.0 Theory and concepts

2.1 Theory of fundamental causes

Link and Phelan (1995) developed the theory of fundamental causes of disease to explain why the relationship between socio-economic status and health has endured profound changes in both risk-factors and disease over the last centuries. Previous research on socio-economic status and health have predicted more equal health as basic health preventives such as improved sanitation and immunization would be more and more universal over time (Kadushin, 1964). Time has proven Kadushin (1964) very wrong in the developed world. Both disease and intermediate risk-factors leading to disease has radically changed since the

1960s, where communicable diseases leading to death in large part has been replaced by non-communicable diseases. Intermediate risk factors highlighted by Kadushin (1964), like sanitation and immunization, have in large part been replaced by smoking, diet and exercise (Link & Phelan, 1995).

One motivation for developing the theory was the trend in modern epidemiology to focus too much on individual behavior and proximate "causes" of disease, such as diet and exercise. This focus fits Western values and culture, where the will and determination of the individual to take care of itself is cherished. This trend in modern epidemiology has in large part neglected social factors, which are more distant causes of mortality (Link & Phelan, 1995).

The theory of fundamental causes emphasis socio-economic status as an enduring explanation of inequality in health. Socio-economic status effect health inequality through different mechanisms adaptable to new risk-factors and leaves the better-off more protected. This is done through increased I) wealth II) power III) knowledge IV) prestige and V) beneficial social connections (Link & Phelan, 1995, p. 29). These different resources applicable to the higher classes of society are adaptable to every changing disease and belonging risk-factors, making their importance for inequality in health last and sustain over time.

In fact, if diseases and their belonging risk-factors did not change over time, the fundamental causes of disease would not explain inequality in health the way they do now. When a new disease emerges, the better-off in terms of socio-economic status will have an advantage in both getting the new information on disease and interpreting it into changed behavior to protect themselves from risk – in addition to having the economic power and social connections to cure the disease ones affected. AIDS is one example of a disease that reinforced the link between socio-economic status and health when it emerged. One important explanation for this was that AIDS spread with high pace in locations dominated by worse-off groups in terms of socio-economic status (Link & Phelan, 1995).

Phelan et al. (2004) tested the theory of fundamental causes using survey data from the U.S. population between 1979-1981. They wanted to investigate if socio-economic status had a stronger effect in explaining socio-economic gradients in mortality caused by highly preventable diseases. With this reasoning, they also hypothesized that socio-economic status would have a weaker effect in explaining socio-economic gradients in mortality caused by

diseases which we know little or nothing about, neither how to prevent or cure. Their findings supported the hypothesis of socio-economic inequalities having a stronger effect on the social gradient in mortality caused by highly preventable diseases (Phelan, Link, Diez-Roux, Kawachi, & Levin, 2004). Most of the under-five mortality today is caused by diseases that are both curable and preventable, such as diarrhea and malaria, among others (Hug et al., 2017). In this notion, it is logical to assume that socio-economic status have a strong explanatory effect of the social gradient in under-five mortality in LMICs.

2.2 Social gradient in health

When investigating social inequalities in health, it is common to present results along wealth or educational levels, revealing a social gradient in health from low levels of wealth or education to higher levels. Social gradient in health is found across many countries, with different outlooks for different determinants for different countries (Houweling & Kunst, 2009; Marmot, 2006). Marmot (2006) has labelled this the "status syndrome" – the higher social status – the better health outcome.

The social gradient in health was first mentioned and published in the 1970s when there was found an inverse relationship between grade of employment among British civil servants and occurrence of coronary and heart disease (CHD). Messengers, the lowest grade of civil servant employees, had 3-6 times higher risk of CHD than the highest grade of employment, administrators. Furthermore, the second highest grade of employment within British civil servants had higher risk of CHD than the highest, the third had higher risk than the second and so on (Marmot, Rose, Shipley, & Hamilton, 1978).

The social gradient in mortality was not solely present for CHD, but for nearly all great causes of death – all over the world. Noncommunicable diseases such as CHD and diabetes were thought to hurt people who do not have access to health care and people living unhealthy lifestyles, but this only partly explain the social gradient in health and mortality. People in the lower social classes lack both autonomy in their health behavior and integration to the rest of society. In turn, when these basic human needs are absent, deep and enduring metabolic changes lead to higher risk of disease (Marmot, 2006). In countries where CHD-levels are low, communicable diseases are higher, revealing the same social gradient.

This social gradient is present in countries with both high and low social inequality. As two examples, Marmot (2006) highlights the United States, which have large and deep social inequalities, often within small geographic spaces. Here, life-expectancy can rise and fall with many years by travelling a few miles within the same city or state. At the same time, an equitable country like Sweden, with low social inequalities, also show a social gradient in health. Education in Sweden reveal a gradient in mortality where people with a PhD have lower mortality than people with a master's degree – who again have lower levels of mortality than people with a bachelor's degree. This gradient in mortality is shown all the way from PhD down the education levels to the non-educated (Erikson, 2001; Marmot, 2006).

So in what way does lack of autonomy and social participation and integration to society affect mortality levels? According to Marmot (2006), these two missing factors, as a result of low social position, increases stress-levels. Employees with low control at work, as in lack of autonomy at work, show a lower level of heart variability than those with higher levels of control at work. Low autonomy at work increases the risk for CHD, sick-leave and mental illness. The same difference can be viewed between higher and lower levels of employees, like the example with the messenger at the bottom of the hierarchy within British civil servants and the administrators at the top.

It is important to emphasis that it is not the social position itself that decides a person's health outcome - but rather what that social position means in form of autonomy and participation within *that society* for the person. In that notion, a person with a bachelor's degree in country A can have less autonomy and participate less in society than a person with only primary schooling in country B. Context matter in the health outcome from social position (Marmot, 2006).

2.2.1 Social gradient in under-five mortality

In order to understand the distributions of socio-economic inequality in child health it is important to examine the shape of the social gradient in child mortality for each country. This provides important information of how under-five mortality rates are shared between different classes of society, either by wealth or education levels. This information can then be used by policymakers to implement universal and evidence-based policies aimed at specific groups who are worse-off in terms of under-five mortality (Houweling & Kunst, 2009).

Within LMICs there is a social gradient present in under-five mortality. Also, proximate determinants of under-five mortality show a social gradient. But unlike mortality levels in the developed world, the social gradients in under five mortality in LMICs are not always linear. Some, though a minority of countries, are not "perfectly" socially graded, as in not showing declining under-five mortality for every increased level of wealth or education. In Sub-Saharan Africa, where under-five mortality rates are high, most countries show a clear gap between the elites (highest levels of education or wealth) and the rest of the population. In contrast to this; in LMICs where under-five mortality is low – the lower social classes stands out with higher levels of mortality than the rest of the population. The different gradients in all LMICs and for different time-periods prove that these inequalities are responsive to policy-intervention. Some LMICs need to lift the worst-off groups the most, while some need to lift the majority closer to the level of the elites (Houweling & Kunst, 2009).

As mentioned, the social gradient in under-five mortality found in most LMICs also include proximate determinants of under-five mortality. These proximate determinants all relate to the different aspects of child health which maternal education have an influence; socio-economic status, reproductive behavior, knowledge and attitudes towards health care and autonomy within and outside the family. Houweling & Kunst (2009) find in their study that most proximate determinants of under-five mortality are socially graded based on either household wealth or education in LMICs. Prevalence of stunting, which is a result of malnutrition, is graded from poor with the highest levels of stunting, to the rich who have the lowest levels. These gradients were based on world regions with many LMICs, such as Sub-Saharan Africa, South and Southeast Asia, Central Asia, North Africa and Latin America & Caribbean. Between the two extremities of wealth, the prevalence of stunting decreases for every step up the wealth latter. The same pattern is shown in the same study with respect to fertility rate (by maternal education), health-care use (household wealth) and professional assistance during birth-delivery (household wealth) (Houweling & Kunst, 2009).

Over half of the under-five deaths in LMICs are due to malnutrition. Malnutrition is a major mortality-risk for children under-five years, but it also contributes to worsen intestinal infections. Intestinal infections lead to malnutrition, and malnourished children get far worse intestinal infections which both increases mortality-risk and risk for lifelong disabilities (Guerrant, Oriá, Moore, Oriá, & Lima, 2008). These proximate determinants, like malnutrition, diarrhea, malaria etc. are influenced by socio-economic factors such as quality

of housing, electricity, quality of sanitation, access to clean water, handwashing with soap, breastfeeding and other nutritional feeding practices (Curtis & Cairncross, 2003; Wagstaff et al., 2004). Maternal aspects, such as reproductive behavior, also play a role in under-five mortality. The extent of social inequality and gradients in these proximate determinants – and their single and collective effect on the under-five mortality rate is what constitute the degree of social inequality in under-five mortality in LMICs (Houweling & Kunst, 2009).

2.3 Socio-economic inequality and under-five mortality

Viewing child mortality in low – and middle-income countries from a socio-economic point of view is relatively new in the field of health research (Houweling & Kunst, 2009). Yet, increasing attention has been brought to the link between socio-economic inequalities and health in LMICs in recent decades. This view on health research has been long-established in the developed world, though more often focusing on socio-economic inequalities and life-expectancy, living conditions and health etc., probably because the child-mortality rate is so low in these countries (Houweling & Kunst, 2009).

This new recognition of how socio-economic inequalities manifests itself in LMICs is shown clearly in the World Bank's strategy for "Health, Nutrition and Development" from 1997. Among its core "targeted approaches" are I) "Focus specifically on the poor individuals or households most vulnerable to illness, malnutrition, and high fertility…" II) "Focus on poor regions within a country or on population groups that are particularly vulnerable to poverty" III) "Greater gender equality in education and improvements in the status of women" (World Bank, 1997, p. 33). Furthermore, the general agenda both within global institutions and research has shifted towards more emphasis on how inequalities in maternal education and household wealth influence health, and more specifically child survival in LMICs (Evans, Whitehead, & Diderichsen, 2001; Jong-wook, 2005; Victora et al., 2003).

Evans et al. (2001) separates the two terms *inequalities* and *inequities*. "*Inequalities* in health describe the differences in health between groups independent of any assessment of their fairness. *Inequities* refer to a subset of inequalities that are deemed unfair" (Evans et al., 2001, p. 4). The unfairness comes in to play if the inequalities observed and described are unnecessary and avoidable, as much as it is a relative question of moral and justice.

Does socio-economic inequalities in health fall into the category of avoidable inequalities? Wagstaff (2001) and Alleyne et al. (2000) advocate for this perception. As a moral question, it is most common to think of inequalities in health as morally indefensible because good health is one the main mechanisms human beings can enjoy other freedoms through. As such, inequality in health is seen as something both avoidable and necessary to reduce. In addition, Alleyne et al. (2000) see inequality in health as a source of social instability both within and between countries. Within countries, different social interclasses form and make the problem of inequality in health into a potential conflict- and security issue. Finally, more equal health outcomes both within and between countries is seen as one the main mechanisms into reducing poverty (Alleyne et al., 2000).

Mosley (1984) proposed a conceptual framework for understanding how the socio-economic determinants of child mortality works. Socio-economic determinants were defined as social status, education and wealth. These determinants, working differently in different environmental contexts, result in different intermediate causes of death. These proximate causes of death are I) maternal factors relating to nutrition during pregnancy, birth intervals II) environmental contamination, referring to quality of air, water and sanitation facilities influencing the spread of infectious diseases such as diarrhea III) Nutrient deficiency, referring to the nutrition of the child – but also the mother as her nutrition infects the child during pregnancy IIII) Injury, referring to physical injuries, burns or poisoning and V) Personal illness control, referring to preventive actions to avoid disease and treatment of disease that has occurred. All socio-economic variables must work through these intermediate determinants to affect child death (Mosley & Chen, 1984).

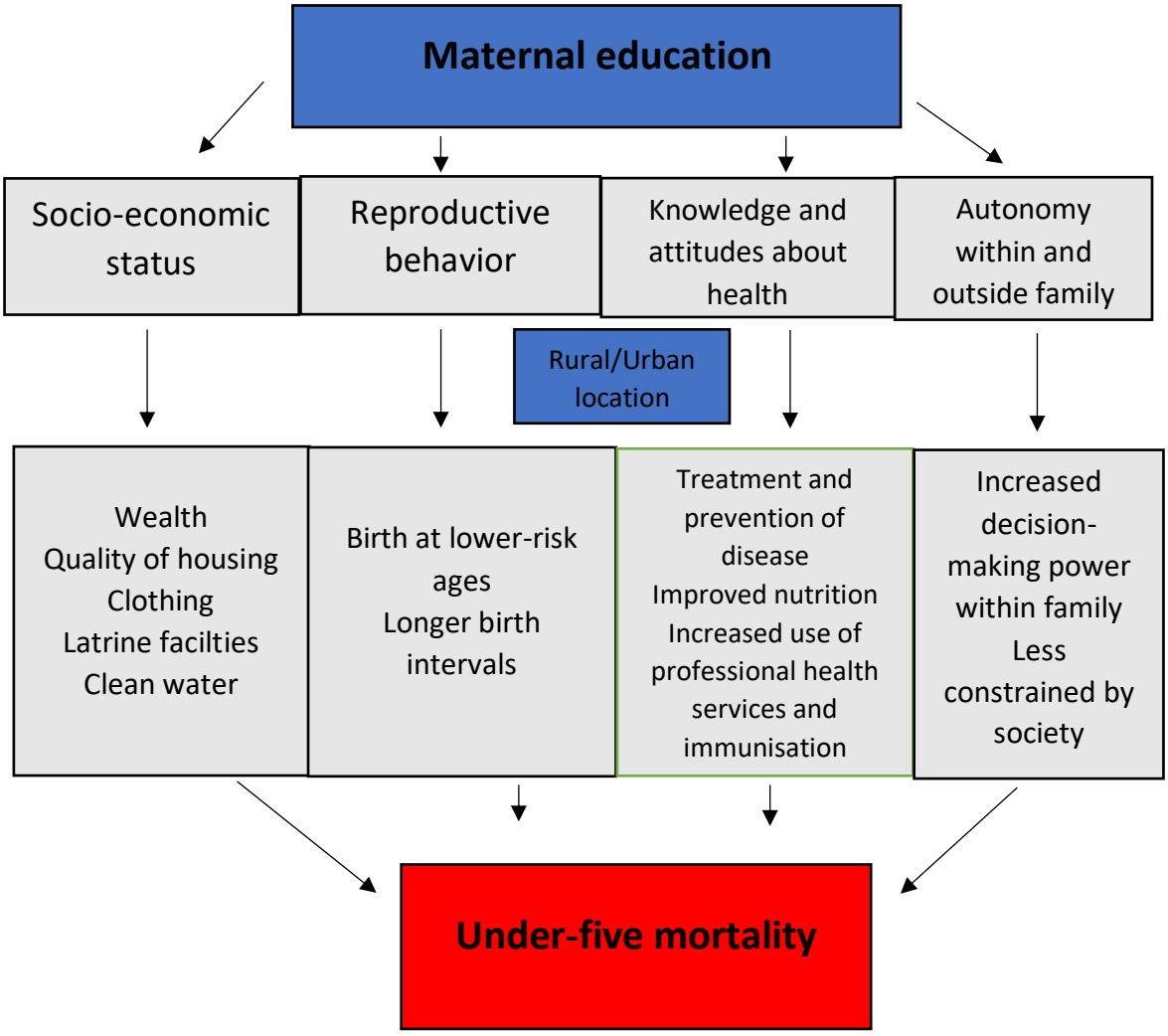
2.4 Educational inequality and its mechanisms affecting child health

Caldwell (1979) was a pioneer in examining the relationship between maternal education and child mortality in Nigeria. In this study maternal education was found to have a larger impact on child mortality than economic factors of the household. This research greatly stimulated further research into socio-economic inequalities and child mortality in LMICs (Houweling & Kunst, 2009).

“A large number of studies have shown, almost as convincingly as anything can in the social

sciences, that a mother's education has an independent, strong and positive impact on the survival of her children" (Caldwell, 1994, p. 224). There are numerous ways in which maternal education can influence child mortality, both direct and indirect. Multiple studies have reported on the negative relationship between education and child mortality. We begin by viewing the more indirect ways maternal education may have an influence. Below I will present a conceptual framework showing how maternal education exerts its influence on under-five mortality, based on theories from previous research. Each step and part of the model will be thoroughly presented and explained in the pages following. The grey boxes consist of intermediate causes thought and proven to influence child mortality.

Figure 1: Conceptual framework of maternal educations' different routes influencing child mortality:



2.5 Education and socio-economic status

The negative correlation between maternal education and child mortality has often been closely linked to socio-economic status and higher living standards (Cleland & Van Ginneken, 1988; Defo, 1997). Socio-economic status can relate to, among other factors, household wealth or husband's occupation. One would assume that educated women more often marry educated men. Also, with higher educational background for both mother and father, this often implies higher wealth and living standards for those households. This again will give these families economic muscles to pay for different health services – both for themselves and their children (Barrett & Browne, 1996; Cleland & Van Ginneken, 1988).

Different studies have used regression models where maternal education's effect on child mortality is estimated, controlled for variables such as household wealth, husband's occupation and other socio-economic factors (Hobcraft, McDonald, & Rutstein, 1984; Mensch, Lentzner, & Preston, 1985). The general agreement between them is that about half of the effect maternal education has on child mortality comes from factors relating to wealth and socio-economic status (Houweling & Kunst, 2009). These factors are for example wealth, housing quality, clothing, water supply and latrine facilities (Cleland & Van Ginneken, 1988). Frost, Forste & Haas (2005) found in their study, using data from the Demographic and Health-survey from Bolivia in 1998, that education had the strongest pathway through socio-economic factors when it came to nutrition of children (Frost, Forste, & Haas, 2005)

Education as a proxy, or at least a part of a socio-economic status having effect on child health, may also be a result of selection bias. Socio-economic status can be hereditary from one generation to the next inside wealthy, educated families. Women coming from such families may have psychological traits in their character making them perform better as mothers. They may also be more encouraged by their family to get themselves an education. But this selection bias is of most concern in countries where girls have not been attending school until very recently. Also, according to Cleland and Ginniken (1988), the link between maternal education and child mortality in countries where education levels are widespread are so persistent that selection bias is not considered a big problem.

2.6 Education and reproductive behavior

Educated women tend to marry at an older age, thereby giving birth at lower-risk ages and have longer birth intervals. One would assume that this reproductive behavior of educated women would have a strong impact on child health and survival (Cleland and Ginniken, 1988). Two comparative studies by Hobcraft, McDonald and Rutstein (1984) and Hobcraft, McDonald and Rutstein (1985) deny this claim and say that educated mothers' reproductive behavior to be of little importance.

Having children at low risk-ages and having long birth intervals also have the greatest impact on an infant's health, not on older children, which maternal education is proved to have the most effect (Cleland and Van Ginniken, 1988). Also, as Ware (1984) points out, educated mothers may be more considered in their behavior during pregnancy – as in not drink alcohol or smoke. They will more often be healthier and more nurtured, which will have a positive influence on the expecting infant. But, again, this relates to infants' health, not so much to older children. This excludes many of the children up to five years old, which this thesis is concerned about.

2.7 Knowledge, autonomy and attitudes towards health

«Maternal education is thought to exert its influence through increased status and decision making power of mothers within the household, increased willingness and ability to travel outside the community, more timely use of health care, greater negotiating power with health care providers, increased knowledge, skills and identification with modern health systems and responsiveness to new ideas» (Houweling & Kunst, 2009, p. 14)

2.7.1 Knowledge

Increased knowledge about health, cause and prevention of diseases, hygiene and nutrition can be an effect of formal education. Educated mothers have a better chance of gathering and applying knowledge that can change and improve their health behavior, both for themselves and their children. They are more open to outside information, either through the health system or through media and literature (Cleland and Ginniken, 1988; Defo, 1997).

Educated women in Indonesia were found to have greater knowledge about immunization than uneducated women, especially women with at least secondary schooling. One can reasonably expect that increased knowledge about immunization will lead to increased use of immunization for their children – and improved health as a result (Streatfield, Singarimbun, & Diamond, 1990). A similar empirical study from Kenya concluded that formal maternal education influenced both child immunization and stunting. Stunting refers to height-for-age, which is a measurement used for child health in developing countries. Stunted children are normally a result of malnutrition over a longer time-period. Formal education increased their knowledge about immunization and nutrition, both from the health apparatus and through mass media such as newspapers and TV (Abuya, Onsomu, Kimani, & Moore, 2011). Christiansen & Alderman (2004) estimated in their study from Ethiopia that prevalence of stunted children could decrease with as much as 31 % if income growth, increased female education and nutritional knowledge improved (Christiaensen & Alderman, 2004).

The empirical evidence of the link between maternal education, increased health knowledge and child health are still very limited (Frost et al., 2005). There are also examples of studies not finding a vital connection between maternal education and knowledge of health (Cleland & Van Ginneken, 1988).

2.7.2 Autonomy

Educated women get stronger autonomy in their health behavior. This works, according to Caldwell (1990), in two ways: I) Increased decision-making power and confidence in their ability to perform adequate health management for their children and II) less constraints from family and society (Caldwell, 1990). Educated women take more responsibility for their children's health, both in preventing disease and ill-health through proper hygiene and nutrition - and detecting disease and acting in form of treatment at home or through health services. A study conducted in northern India showed that autonomous women, measured as whether they had freedom of movement, more often used antenatal health care and were more likely to use safe delivery care when giving birth (Bloom, Wypij, & Gupta, 2001).

A woman's autonomy within the household depends not only on her educational background. The context of her environment, both within and outside the family, can sometimes play a larger part. Cultural and religious traditions, beliefs and habits influence the autonomy of the

mother (Caldwell, 1990; Niraula & Morgan, 1996). As an example, in Sub-Saharan Africa, children are mostly dependent of their mother's economic resources and care. This family arrangement gives the mothers significant autonomy in their children's health care. The same maternal autonomy can be found in South Asia, where the nuclear-family structure – instead of an extended family, gives the mothers greater control and impact on their children's health. In India, even in an extended family-structure, educated women will also gain increased control of their children's health care (Caldwell & Caldwell, 1987). Niraula & Morgan (1987) studied two different families in Nepal; one living in the *hills* of Nepal and one living in the *tarai* (near the border of India). Although there were different practices of marriage and levels of autonomy for women in the family, they concluded in their study that external factors of the community play a more vital part in women's autonomy, discrediting the within family as a sole predictor of autonomous mothers (Niraula & Morgan, 1996).

In cultures where women's autonomy is suppressed, for example by fully or partly excluding them from attaining education, their influence and control over their children's health is limited. When religion also comes into play and reinforce different suppressions of women, their autonomy within the family is further decreased. Even if women get an education in such cultures, the effect of that education is severely reduced relating to their role and power within the family (Caldwell & Caldwell, 1987). Therefore, according to Caldwell (1990) Arab-countries perform so poorly relatively to their wealth and education when it comes to child mortality. Their autonomy is weakened by cultural factors like religion and traditions.

2.7.3 Attitudes

Besides increased autonomy and knowledge, education can also change mother's attitudes towards the modern health system. Education make them more open and alert to new ideas, shifting them away from traditional beliefs and customs towards more rationale explanations of disease and health (Frost et al., 2005). This change of attitudes makes mothers use health services to a greater degree, both for themselves and their children. It is also likely that the mothers seek health services with greater timing, listen and follow advice more precisely and get better quality in the help they receive (Cleland & Van Ginneken, 1988). Frost et al. (2005) conclude in their study, using 1998 DHS-data from Bolivia, that attitudes towards the modern health service is one of the pathways explaining education's effect and impact on child nutrition. This is similar to previous findings linking education and child nutritional status

(Abuya et al., 2011; Zeitlin et al., 1990).

It is common to measure mothers' attitudes towards modern health services with the frequency of use of health services as a proxy (Frost et al., 2005). Several studies have found evidence for the link between maternal education and use of health services (Addai, 2000; Babalola & Fatusi, 2009; Desai & Alva, 1998; Fernandez, 1984). Bobalola & Fatusi (2009) found that education was the only individual-level determinant that was consistently a significant predictor of health service utilization. Uneducated and lower-class people can feel alienated, overwhelmed and anxious when meeting with different health services. This notion is probably more significant in developing countries where the social differences run larger and deeper, and there has been evidence of literate and better-off citizens receiving better treatment from government officials than illiterate citizens (Cleland & Van Ginneken, 1988).

One would expect that living in an area with nearby health services would have a strong impact on the citizens' utilization of them, making education a stronger predictor and advantage in such areas (Cleland & Van Ginneken, 1988). Caldwell (1979) found that gaps between education levels had a greater effect on child mortality in villages where health services where available. This rural/urban divide in access to and use of health services is confirmed in a study of 17 developing countries by Bicego & Boerma (1993). Their hypothesis said that close physical access to health services was an important determinant of its uses, implying that higher levels of education had a greater impact in rural areas where access to health services were more difficult, because changed attitudes from formal education would overcome these hurdles. The results revealed the opposite, the effect of formal education and utilization of health services were stronger in urban areas where the physical access to health services was short.

A possible explanation for this is that urban mothers have less family and other network to rely on in their childcare, making economic and educational factors more important in explaining their use of child health services. In rural areas, educated mothers may still be influenced and pressured by their family and surroundings to maintain the use of traditional methods in their health care – both for themselves and their children (Bicego & Ahmad, 1996).

2.8 Rural and urban inequalities

There is a wide recognition in the literature that urban children are better-off in terms of health than its rural counterparts in LMICs (Cai & Chongsuvivatwong, 2006; Gould, 1998; Heaton & Forste, 2003). Children growing up in urban areas gain better health, among other factors, through improved nutrition and sanitation facilities and easier access to professional health care (Dye, 2008). Although the urban/rural divide may partly explain child health and mortality, socio-economic factors and status still have an independent effect (Van de Poel, O'Donnell, & Van Doorslaer, 2007). Van de Poel et al. (2007) found that the effect of urbanization on the risk of stunting and under-five mortality was reduced by, respectively, 53 and 59 per cent when controlling for household wealth. The effect of urban living was again reduced by 22 and 25 per cent for risk of stunting and under-five mortality when controlling for other socio-demographic factors. Moreover, and important to emphasis in this paper's context, a study of rural-urban differences in 15 developing countries in Sub-Saharan Africa revealed greater socio-economic differences within urban areas than rural. Socio-economic inequalities are undoubtably larger in urban areas when it comes to stunting, and the within-urban differences in child malnutrition are larger than urban/rural differences in child malnutrition (Fotso, 2006).

2.9 Review of the existing literature

On the topic of maternal education and child mortality, Caldwell (1979) was a pioneer with his study of child mortality in Nigeria. The study was a pioneer in the sense that maternal education was found to have an independent negative effect on child mortality. Controlling for socio-economic factors known to have an impact, the study still found significant negative effects of maternal education on child mortality. The effect was also graded; mothers with primary schooling had lower child mortality than mothers with no formal education, and mothers with secondary schooling had lower child mortality than mothers with primary schooling. Mother's education was also found to have greater influence than father's education. Even when controlling for five other variables relating to child mortality – mothers with secondary schooling had about half as many child mortalities as mothers with no formal education. The study concludes with maternal education to be the most significant differential explaining inequality in child mortality in Nigeria – and further notes that education cannot be

understood simply as a proxy for general socio-economic status. The study emphasis that maternal education exert its influence through changed dynamic within the family, and improved reactions to illness and skills for treatment (Caldwell, 1979).

Since Caldwell (1979), a large number of studies have found evidence for the negative correlation between maternal education and child mortality in developing countries (Caldwell & McDonald, 1982; Cleland & Van Ginneken, 1988; Desai & Alva, 1998; Frost et al., 2005; Grépin & Bharadwaj, 2015; Mosley & Chen, 1984; Ware, 1984).

There is a broad consensus about the negative correlation between maternal education and child mortality, but there has been a debate on whether the relationship is a causal one or not. A few studies have raised doubts of the former view; maternal education has no clear evident causal effect on child mortality – or maternal education works as a proxy for socio-economic status (Desai & Alva, 1998; Hobcraft, 1993). Hobcraft (1993) studied developing countries in South America, North-Africa and Asia. He found significant effects of maternal education on child survival in all regions, but the relationship was weaker in Sub-Saharan Africa. Even where strong significant relationships between maternal education and child health were observed, Hobcraft (1993) highlights the importance of caution in interpreting the results: "As has been stressed throughout this paper, we can still not be sure that the associations of all of these key factors in child health with maternal education is a causal one" (Hobcraft, 1993, p. 171).

Desai & Alva (1998) have been the most critical when it comes to accepting maternal education as a causal component of child mortality. The study directly criticizes Caldwell (1994) for viewing maternal education's causal effect on child mortality to be "…almost as convincingly as it can be in the social sciences…"(Caldwell, 1994, p. 224). Furthermore, they argue that studies doubting the causal link have largely been ignored – and studies concluding with a strong causal relationship between maternal education and child mortality do so without applying the correct statistical models or including appropriate control variables (Desai & Alva, 1998).

Desai & Alva (1998) found in their study of 22 developing countries that maternal education had only statistically significant negative effect in a handful of countries when controlling for socio-economic and geographical variables. The study estimated maternal education's effect

on three child health indicators; infant mortality, children's height-for-age and immunization status. Their conclusions were that the notion of Caldwell (1994) and others claiming women's education to be a clear, independent cause affecting infant and child mortality to be exaggerated (Desai & Alva, 1998). They further concluded that maternal education in most cases works a proxy for socio-economic status and health service-characteristics of the community. Later studies with evidence of a causal link between maternal education and child mortality is scarce. Even still, studies with evidence of causal links exceeds the studies of the contrary notion of no or a weak causal relationship (Breierova & Duflo, 2004; Chou, Liu, Grossman, & Joyce, 2010; Grépin & Bharadwaj, 2015; Güneş, 2015).

Breierova & Duflo (2004) used data from an educational program in Indonesia between 1973 and 1978 to study and estimate the effect of parental education on fertility and child mortality. Using regression models with fixed effects, the study concludes with parental education having a significant, causal effect on both fertility and child mortality. The study further notes that education of the mother has a stronger, causal effect on child mortality than education of the father (Breierova & Duflo, 2004).

Chou et al. (2010) studied the effect of parental education on child health in Taiwan, using a natural experiment as the method. This was made possible because of an extensive education reform where primary schooling was extended from six to nine years and an 80 % increase in junior-high schools were built. The study could then use control groups to estimate the causal effect of parental education on child mortality from 1978 to 1999. The results indicate that parental, and especially maternal education, indeed has a causal effect on child health. The education reform, extending primary schooling from 6 to 9 years in 1968, resulted in a decrease of roughly 11 per cent in child mortality (Chou et al., 2010).

As an answer to Hocbraft (1993) and others who could not find strong causal evidence of maternal education's effect on child health in Sub-Saharan Africa where both fertility and child mortality rate is high, Grépin & Bharadwaj (2015) studied the effects of educational reform in Zimbabwe. In 1980, Zimbabwe greatly widened access to secondary schooling. Like Chou et al. (2010), this made the method of a natural experiment achievable in investigating maternal education's causal relationship with child mortality. Their findings included causal effects such as improved child survival, improved economic status and lowered fertility. The study estimates that the effect of one year added maternal education

decreases child mortality with 21 per cent. They did not find causal effects through increased female autonomy or changed health-seeking behavior, but notes that the quality of secondary education in the area studied is pretty poor – which can explain the lacking effects on these intermediate mechanisms effecting child health (Grépin & Bharadwaj, 2015).

Another natural experiment was conducted by Günes et al. (2015) in Turkey on the background of an educational reform from 1997. The reform extended the length of primary schooling from five to eight years. The natural experiment finds robust, causal effects of mother's completion of primary schooling to improve both infant and child health; the former by reducing low birthweights by 17 per cents and the latter by a decrease in prevalence of stunting and low weight-for-age. Furthermore, the study finds evidence for maternal education to reduce fertility and smoking, take earlier preventive care and have children at higher ages (Güneş, 2015).

The three last studies viewed are all conducted with the method of a natural experiment, which is a rare thing for the social sciences. This gives them great reliability in estimating a causal relationship between maternal education and child mortality (Moses & Knutsen, 2012).

The literature concerning changes in social inequalities relating to child mortality in developing countries is also limited, with a few noteworthy exceptions. Monteiro et al. (2010) studied changing socio-economic inequalities over a 30-year period in Brazil relating to child stunting, which is one of the mechanisms causing child mortality. The study found the gap between the richest and poorest quantile to decrease over the period, making child stunting more socially equal in terms of wealth in Brazil (Monteiro et al., 2010).

In Thailand, Vapattanawong et al. (2007) investigated under-five mortality rates between 1990 and 2000, and whether the declining under-five mortality rate was followed by a reduction in the gap between the poorest and richest quantile. Their results and findings suggest that the wealth inequalities relating to under-five mortality had declined. Also – the average wealth-status of households had improved during the ten-year period. The poorest part of the population had the highest decline in under-five mortality, and the gap in under-five mortality rate between the poorest and richest part of the population had been reduced with almost 55 per cent. This decline in social inequalities relating to child mortality was accomplished through different mechanisms; economic growth, different poverty-reducing

actions and establishing more accessible and equitable health care systems (Vapattanawong et al., 2007).

In the developed world, a majority of OECD countries have revealed widening wage-gaps and inequality relating to household wealth in the last three decades before the financial crisis shook the world in 2007 (Development, 2011). In the US, the worst-off group in terms of a socio-economic deprivation (education, income, wealth etc.), had significantly lower gains of life-expectancy than the better-off group between 1980-2000 – making inequalities in health increase both relative and absolute (Singh & Siahpush, 2006).

Ruger & Kim (2006) found that the worst-off countries, specifically Sub-Saharan Africa, are making less progress in terms of under-five mortality than countries with low levels of child death. Also, the gaps between both child and adult mortality are widening – making widening gaps in socio-economic factors the more likely cause (Ruger & Kim, 2006).

3.0 Hypotheses

Based on the theories and concepts presented and reviewing the empirical evidence from the literature, the following hypotheses will be tested in this master thesis:

H1: There is a negative relationship between maternal education and under-five mortality in LMICs.

H2: There is an educational gradient in under-five mortality in LMICs disfavoring the lower educated mothers.

H3: Absolute and relative inequalities in under-five mortality, based on maternal education, have declined in LMICs from the time-period 1985-2000 till 2001-2017.

H4: Maternal education has an independent negative effect on under-five mortality in LMICs with different shapes of the educational gradient in under-five mortality.

4.0 Data and methods

Lack of vital registration-systems in the developing world make it difficult to acquire first source-data relating to child mortality and its causes. The vital-registration systems required to collect first source-data are, with a few rare exceptions, only present in countries with low under-five mortality rates – as in most high-income countries. This make it difficult to know the accurate distributions of the different causes of child deaths in LMICs (Morris, Black, & Tomaskovic, 2003). In Cameroon for example, there was found a clear lack of registration of both birth and infant deaths. The people of Cameroon did not see any benefits by doing these registrations, and as a result their motivations were low for doing so (Ndong, Gloyd, & Gale, 1994).

Because of the missing registration-systems in most of the developing world, researchers must use different surveillance and survey-based data collections and sites. One of the more commonly used surveys in child health-research stem from the Demographic and Health Survey (DHS) (Houweling & Kunst, 2009). The following graphs and tables presented in this thesis are based on survey-data from the Demographic and Health Survey (DHS) program (DHS, 2019a) The DHS program has since 1984 collected data on population, health and nutrition. Within these three main features include, among others, child and maternal health, nutrition, HIV/ AIDS, fertility and malaria from developing countries. Funded by the U.S Agency for International Development (USAID) and other significant donors, the DHS-program is recognized as a reliable source of health and health-related data from LMICs. The DHS-program has conducted and contributed to over 400 surveys in 90 countries since it's founding in 1984 (DHS, 2019b).

The DHS-surveys, which are applied in this master thesis, are conducted roughly every five years for all LMICs. These surveys are concentrated on households and contain large sample sizes (between 5000-30 000 households), which make the surveys very representative and reliable. Between the main DHS-surveys, the DHS also do interim surveys with complementary and updated information on several indicators, but not mortality. The DHS-surveys have standardized questionnaires, making comparisons between countries and over time possible. The main DHS-surveys contain four categories of questionnaire; I) Household II) Woman's III) Man's and IIII) Biomarker. There are also consistent questionnaires for each

country. Biomarkers refer to questions regarding infectious and sexually transmitted diseases such as HIV/ AIDS, chronic illnesses, deficiencies relating to malnutrition and exposures to different toxins. Furthermore, the DHS-surveys gather geographical data from each country, making the data representative bot nationally and regionally through provinces. This can be used to distinguish between rural and urban areas of residence (DHS, 2019b).

This papers' focus is to review how socio-economic inequalities influence child mortality. More specifically; the aim is to review how maternal education levels influence under-five mortality rate in low and middle-income countries. The DHS-data reaches back from 1985 to 2017. To get a descriptive and graphical view of how the relationship between maternal education and under-five mortality rate is, the paper has split the DHS-data into two time periods. The first time period goes from 1985-2000, and the second goes from 2001-2017. This way one can easily compare graphs of under-five mortality rates from one time-period to the next, and for the same countries and regions. For details of the data-material used from DHS, see appendix.

Firstly, the indicator of interest is under-five mortality rate. This is defined as the probability of a child dying before its fifth birthday for a thousand live births. This indicator is measured retrospectively, meaning that the mortality rates represent the ten years *preceding* the survey. Under-five mortality rate is this thesis' dependent variable for descriptive graphs. Our characteristic of the mother – and independent variable affecting the under-five mortality rate – is maternal education level. Maternal education is for most of the graphs divided into four groups: No Education, Primary Education, Secondary Education and Higher Education. This way one can investigate the shape of the educational gradient in under-five mortality. For two overview graphs showing inequalities in maternal education and under-five mortality for LMICs over time, maternal education is split up into two categories: I) No education and primary and II) Secondary and Higher education.

To make comparisons over time, the two time periods 1985-2000 and 2001-2017 contain the latest survey for every available country. For a detailed view of the countries included, including mortality levels for each maternal education level, see appendix. Datasets for each of the four LMICs (Angola, Dominican Republic, Pakistan and Niger) with different shapes of their educational gradient in under-five mortality have been downloaded with permission from the DHS (ICF, 2012-2018).

4.1 Relative and absolute measures of inequality

Measures of inequality – and changes in inequality over time, have been the subject of debate within the literature (Eikemo, Skalická, & Avendano, 2009; Harper et al., 2010; Wilkinson, 1997).

Whether one chooses absolute or relative measures of inequality has implications for the interpretations of the results. If one assumes that children born by mothers with no education has an under-five mortality rate of 300, and children born by mothers with higher education has an under-five mortality rate of 100, the relative rate ratio between them is 3:1. Now, over time these assumed under-five mortality rates have decreased from 300 to 220 for children born by mothers with no education, and from 100 to 60 for children born by mothers with higher education. The relative inequality is now 11:3 which is more than 3:1, *even* when the decrease in under-five mortality for the non-educated mothers are twice as large as for the higher-educated ones. Scholars emphasizing the use of absolute measures will highlight that the absolute inequality in under-five mortality rate between the two education levels have fallen from 200 to 160. These two different interpretations is the focal point of the debate between the two methods of measuring inequality (Mackenbach, 2015).

There is also a mathematical ambiguity related to both relative and absolute measures of inequality. When the mortality rate ratio between lower and higher socio-economic groups rise, the survival rate ratio subsequently falls, making it difficult to interpret if the inequalities have increased or decreased. When the overall rate of mortality is reduced, so will the absolute inequalities between socio-economic groups – without necessarily making the distribution of risk and protection between them more equal. The absolute inequalities will fall as a consequence of the overall mortality-decline (Mackenbach, 2015).

Mackenbach (2015) calls for using absolute measures of inequality. He argues that in a time when mortality-levels are declining with high pace, the relative inequality is not likely to decrease. For this to happen, the lower socio-economic groups must reduce their mortality-rates with over 50 per cent in many cases. This requires a radical shift in policy-making, not only aiming to make equal playing fields for different socio-economic groups; one would have to make policies favoring and increasing the reach for the lower socio-economic groups. In this sense, it is most reasonable and realistic to be content with a decline in absolute

inequalities regarding mortality.

Houweling et al. (2007) calls for a compromise between the two measures of inequality, depending that one considers the overall mortality-rate and carefully interpret and compare the results considering this. The study examined both methods of measurement on under-five mortality, immunization, antenatal care and skilled delivery during delivery between the 40 % poorest and 40 % wealthiest within 43 LMICs. The extent of inequality is correlated with the overall level of mortality, and both relative and absolute measures of inequality are bound by mathematical ceilings.

Relative inequalities, measured by rate ratios, are generally higher within countries with lower overall levels. The correlation was thus not so big for under-five mortality as the other three indicators (the overall mortality-level explained 18 % of relative inequalities in under-five mortality). Furthermore, several exceptions to this tendency were found, where the RR were low also within countries with low overall levels of inequality. Regarding absolute inequalities, also called rate difference (RD), the results showed low RD's with low and high overall levels of the outcome – and high RD's with intermediate levels of the outcome. Even still, there were also found exceptions to this pattern in several countries. The overall levels of under-five mortality explained 18 % and 30 % respectively of the absolute and relative inequalities between poor and rich. The same patterns, for both RR and RD, were also found for maternal education (Houweling et al., 2007).

This thesis will use both absolute and relative measures of inequality to investigate whether inequalities between maternal education levels' under-five mortality rates have gone down in LMICs over time.

4.2 Logistic regression

In order to investigate the fourth hypothesis: Maternal education has an independent, negative effect on under-five mortality in LMICs with different shapes of the educational gradient, this thesis will use the latest DHS-surveys for Angola, Dominican Republic, Pakistan and Niger, as they all reveal a different shape in their educational gradient in under-five mortality. The effect of maternal education level on under-five mortality will be estimated using logistic regression in these four LMICs.

"The equation for a logistic model can be written as

$L_i = \beta_0 + \beta_1 X_{1i} + \beta_2 X_{2i} + \beta_3 X_{3i} + \ldots + \beta_{k-1} X_{k-1,i}$'

where the logit (the total logit) is a linear function of the X-variables. *K* is the number of parameters in the model (the constant and all X-variables)" (Mehmetoglu & Jakobsen, 2016, p. 163).

In logistic regression, the dependent variable (Y) are in most cases dichotomic and have the values 0 and 1. Logistic regression is also called maximum likelihood; the logit can be viewed as a measure of how often or how likely it is for something (Y=1) to occur. The logit estimates the change in in the natural logarithm of the odds for (Y=1) for every one-step change in the in the independent variable (Mehmetoglu & Jakobsen, 2016, p. 163). One can only interpret the direction of the effect, and whether the effect is statistically significant or not, by looking at the independent variables' coefficients and p-values. To say anything about the strength of the effects the independent variables have on the dependent variable, we can interpret it through the odds ratios. To calculate the odds each independent variable's have of getting into category 1, the formula is (OR-1) *100 (Mehmetoglu & Jakobsen, 2016, p. 186).

4.2.1 Dependent variable

For descriptive statistics of the dependent variable for each of the four countries, including coding, see appendix. The dependent variable for the logistic regression models is named "Child dead". It is coded with the values 0 and 1, where 0 means the child is alive and 1 means the child is dead. So, we measure each independent variable's likelihood of getting into category 1 "child dead". But to measure if the child is dead or not is not enough. We want to look at under-five mortality. So, in order to estimate child death under five years, the variable "child age" is used. This variable measure the age of every child in each country in months. 60 months is the same as five years, so I make a dummy-variable with the values 0 and 1; 1 if the child is less than 60 months old and 0 if not. In the STATA-command I type *"logit child_dead X-var X-var X-var* ***if child_age60==1".*** This way the model measures each independent variable's likelihood of getting into category 1 "child dead under five years".

4.2.2 Independent variables

For descriptive statistics of all independent variables and their coding, see appendix. The first independent variable is of course maternal education. The survey question goes like this: "What is the highest level of school you attended: primary, secondary, or higher?" In the survey-data, the variable is coded from the values 0-3. 0= "no education", 1= "primary", 2= "secondary" and 3= "higher". In the logistic regression models, maternal education is presented as a dummy set, with category 0 "no education" as the reference category. This makes it easy to interpret the effect of the other three education levels compared to the reference category.

Education levels for the respondent's husband or partner are also included in the models. This is categorized the same way as women's education levels, going from 0-3 where 0= "no education", 1= "primary", 2= "secondary", 3= "higher". It is important to control for the man in the household's education level, because educated women tend to marry educated men – and this can hide some of the effect maternal education have on child health (Barret & Browne, 1996).

The next independent variable is a wealth index coded from 1-5. 1= "poorest", 2= "poorer", 3= "middle", 4= "richer" and 5= "richest". Wealth is a vital part of socio-economic status. The main consensus in the literature says that socio-economic status accounts for about half of the effect maternal education has on under-five mortality (Hobcraft, McDonald, & Rutstein, 1984; United Nations, 1985; Houweling & Kunst, 2009; Cleland & Van Ginneken, 1988). This variable is also presented as a dummy set, with category 1 "poorest" as the reference category. Household wealth is measured as the aggregate of the overall living standard of the home. This includes factors such as TV, electricity, sanitation facilities, what quality of materials the house is built of and access to clean water. This wealth index is generated with a statistical method called principal component analysis – which places every household on a wealth-scale measuring its relative wealth inside its country (DHS, 2017).

Maternal age is also included as an independent variable. This is the age of the women responding in the surveys at the time they responded. The question is: "How old were you at your last birthday?". The age-variable goes from 15 to 49. Age is a very standard independent variable to include no matter what the subject is. This can reveal if the older or younger age-

groups are more likely to fall into category 1 “child dead under five years”. This also control for some part of reproductive behavior, saying that higher educated women give birth to children at more low risk-ages and engage in family planning (Cleland and Van Ginniken, 1988).

Moving on, whether the respondent has health insurance or not is the next independent variable in in the logistic regression models. The question is “Do you have any health insurance?”. Health insurance is coded as a dummy variable with the two values 0 and 1, where 0= “no health insurance” and 1= “have health insurance”. Different countries with different health systems makes it important to control for this and estimate its effect on under-five mortality. Most of the respondents from the four countries Angola, Dominican Republic, Pakistan and Niger *do not* have health insurance. In this sense, it will be interesting to see if the minority *with* health insurance, have a lower chance of getting into category 1: “child dead under five years”.

The next independent variable relates to women’s autonomy in health-related questions within the household. The question is “When you are sick and want to get medical advice or treatment, is each of the following a big problem or not a big problem: a) Getting permission to go to the doctor?”. The respondent can answer either “big problem” or “not a big problem”. I have named the variable “Woman making the health decisions”, and dummy coded it 0 if it is a big problem to get permission to go to the doctor and 1 if it is not a big problem to get permission to go to the doctor. We will expect that children having mothers who are independent in their health-seeking behavior will have lower chances of dying before their fifth birthday than children born by mothers who are not autonomous in these questions. This is because autonomous women more often seek professional health facilities for themselves and their children (Caldwell, 1990; Bloom et. al, 2001). Of course, the best variable to use would be the question “When your child is ill, you can choose whether medical treatment is sought”. But this question/variable did not have any observations in either of the four data sets. Still, I would say that the variable measuring a woman’s independence in seeking healthcare for herself works as a good proxy for also seeking health care for her children.

The last independent variable included in these four logistic regression models measures health behavior more directly. The question is: “In the last 12 months, have you visited a

health facility for care for yourself or your children?". I have dummy coded the variable to 0 and 1, where 0 stands for "not visited health facility last 12 months" and 1 stands for "have visited health facility last 12 months". We will expect that children born by mothers visiting a health facility at least once the last year will have lower chances of under-five mortality. The Dominican Republic did not have any response to this question in its dataset, but it will be included in the three other models for Colombia, Pakistan and Niger.

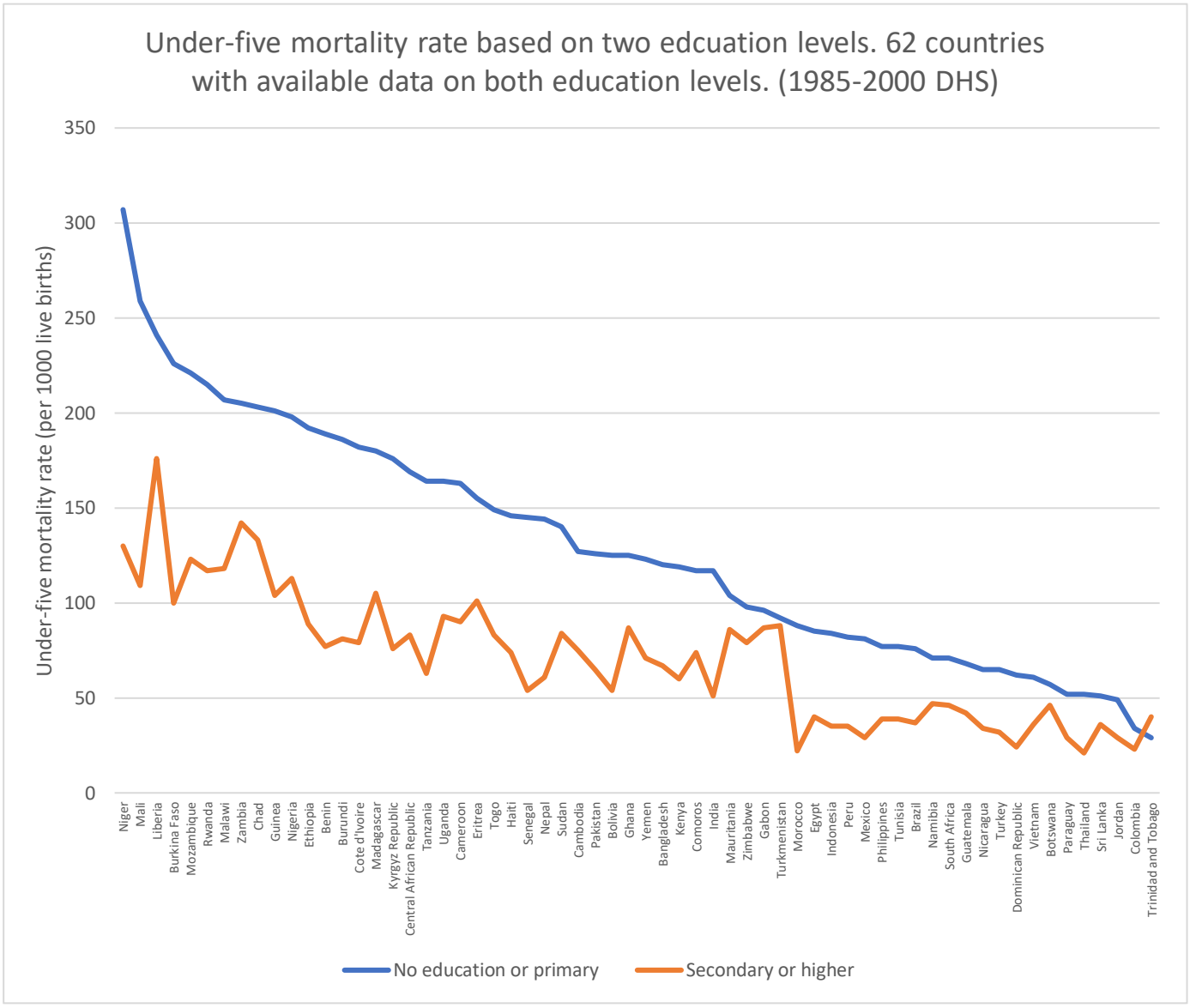
Woman's individual sample weights are included in every logistic regression model estimating maternal education's effect on under-five mortality in the four countries. According to the DHS-recode manual (2017), the sample weights should be included in all tabulations and regressions when extracting their data-file. The weight is normalized, so when using the full dataset with no selection, the weighted number of cases are identical to the unweighted number of cases.

With these seven independent variables I am confident of having a model reflecting the theory of under-five mortality – and at the same time not overexaggerating in the use of controlling for every plausible variables having an effect, as one can never control for everything (Achen, 2000).

5.0 Results

5.1 Overall view of under-five mortality based on maternal education in LMICs over time

Graph 1:

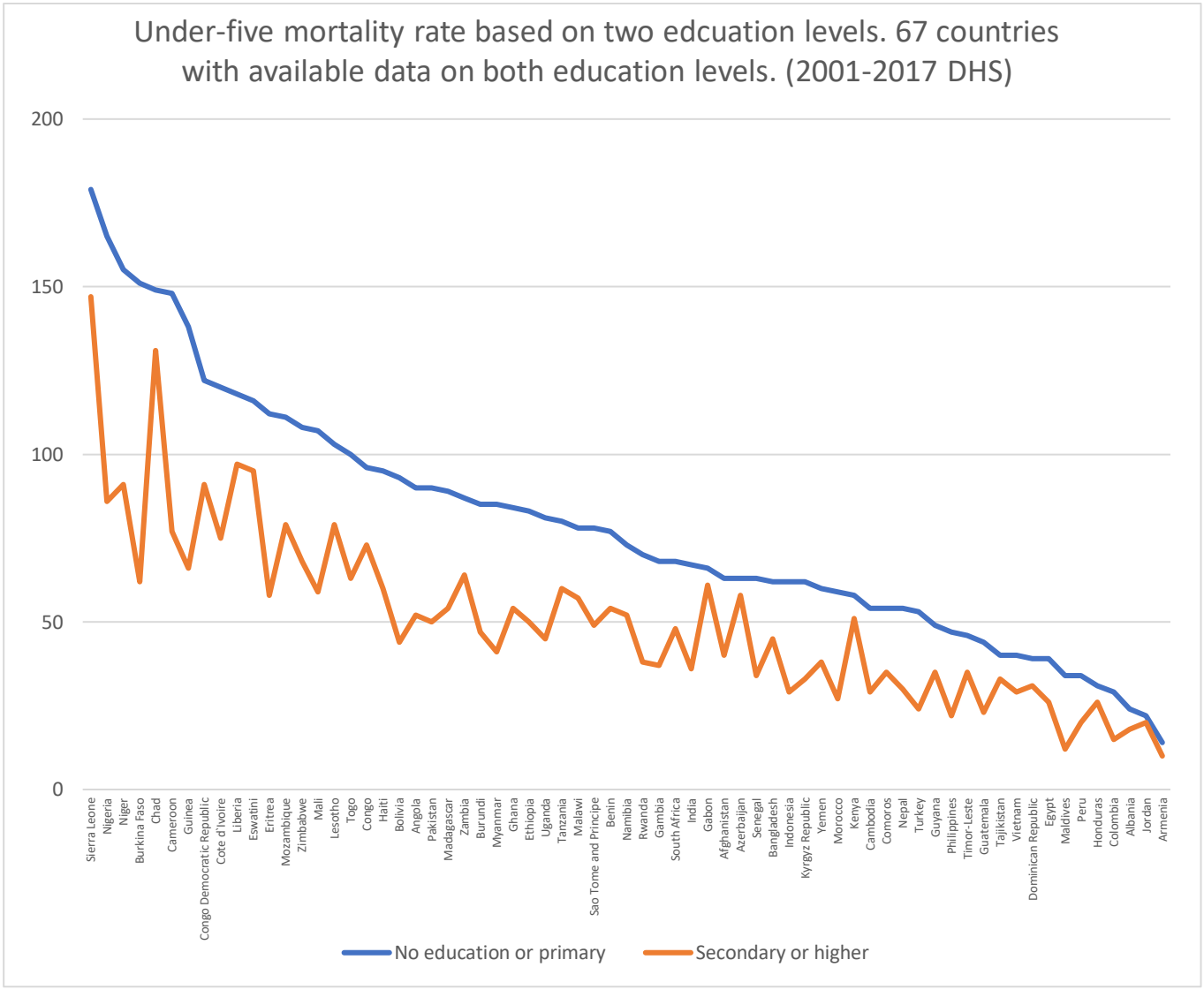


Provided with DHS-data for under-five mortality, based on maternal education level. 10 years preceding the survey. (1985-2000 DHS).

In this first graph, available data from 62 countries in the period 1985-2000 for under-five mortality rate is presented, based on two maternal education levels; no education and primary, secondary and higher. There is a striking contrast between the worst-off country, Niger, and

for example, Colombia, in terms of both under-five mortality rate and absolute inequality between the two education levels.

Graph 2:



Provided with DHS-data for under-five mortality, based on maternal education level. 10 years preceding the survey. (2001-2017 DHS).

In the second graph, available data from 67 countries in the period 2001-2017 for under-five mortality rate is presented, based on two maternal education levels; no education and primary, secondary and higher. The first noticeable change visible in graph 2 is that no countries have under-five mortality rates over 200 for no maternal education or primary per 1000 live births. Again, as in graph 1, countries from Sub-Saharan Africa make up the worst-off levels of under-five mortality rate. Both levels of maternal education seem to have decreased rates of

under-five mortality, with the level of no education or primary having the largest reductions of under-five mortality of the two. The overall impression is also that inequalities have decreased between the two groups of maternal education from the period 1985-2000 (graph 1) to the second period 2001-2017 (graph 2).

These graphs are presented to give a first impression of how maternal education influence under-five mortality rates in LMICs across the world, and how seemingly both under-five mortality rates and inequalities between education levels are decreasing in most of them. It reveals an optimistic view of the progress being made in terms of reducing under-five mortality. It also gives a clear-cut support for this thesis' first hypothesis: There is a negative relationship between maternal education and under-five mortality in LMIC.

5.2 Social gradient in under-five mortality based on maternal education

To investigate whether there exists an educational gradient in under-five mortality in LMICs, disfavoring the lower educated, I have used the latest available DHS-surveys from 86 LMICs (see appendix). The under-five mortality rate, based on 1000 live births, are now measured based on four maternal education levels; No education, primary education, secondary education and higher education. Based on this I get a graphical view of the distribution of under-five mortality rate among the four education levels.

I have chosen to categorize the different shapes of the educational gradient in under-five mortality into four categories, like Houweling & Kunst (2009): I) LMICs where there exists a linear, maternal educational gradient in under-five mortality. This means that for every step up on the educational latter, under-five mortality rates decrease II) LMICs which do not have an educational gradient for every educational level. For example, in a LMIC where primary education has *higher* under-five mortality rates than children born by mothers with no education. III) LMICs where children born by mothers with no education have significantly higher under-five mortality rates than the three other education levels and IV) LMICs where children born by mothers with higher education have significantly lower under-five mortality rates than the three other education levels.

Out of the 86 LMICs where the shape of the educational gradient in under-five mortality have been investigated, 60 LMICs revealed an educational gradient in under-five mortality

disfavoring the lower educated. For each increasing level of maternal education, under-five mortality rates decreased in these countries. Out of the 60 LMICs, four of them revealed significantly higher under-five mortality rates for children born by mothers with no education. Three LMICs showed significantly lower under-five mortality levels for children born by mothers with higher education. 26 LMICs did not have a negative, educational gradient for *every* level of maternal education, but most of them had for three out of four maternal education levels. In sum, this gives support for this thesis' second hypothesis that there is an educational gradient in under-five mortality in LMICs, disfavoring the lower educated. In the following table, the distribution of countries into the four categories are presented:

Table 1: Four categories of the shape of the educational gradient in under-five mortality

53	26	4	3
Educational gradient for every education level	***No gradient for every education level***	***No edu. w/high levels of U5MR***	***Higher edu. w/ low levels of U5MR***
Afghanistan	Angola	Colombia	Namibia
Albania	Armenia	Dominican Republic	Sierra Leone
Bangladesh	Azerbaijan	Tajikistan	Niger
Benin	Bolivia	Turkey	
Burkina Faso	Bottswana		
Cambodia	Brazil		
Cameroon	Burundi		
CAF	Chad		
Congo	Cameroon		
Cote d'Ivoire	Congo Democratic Republic		
Ecuador	Honduras		
Egypt	Jordan		
El Salvador	Kazakhstan		
Eritrea	Kenya		
Ethiopia	Lesotho		
Gabon	Mali		
Gambia	Mauritania		
Ghana	Moldova		
Guatemala	Morocco		
Guinea	Mozambique		
Guyana	South Africa		
Haiti	Thailand		
India	Trinidad and Tobago		
Indonesia	Turkmenistan		
Kyrgyz Republic	Ukraine		
Liberia	Uzbekistan		

Table 1 (continued)

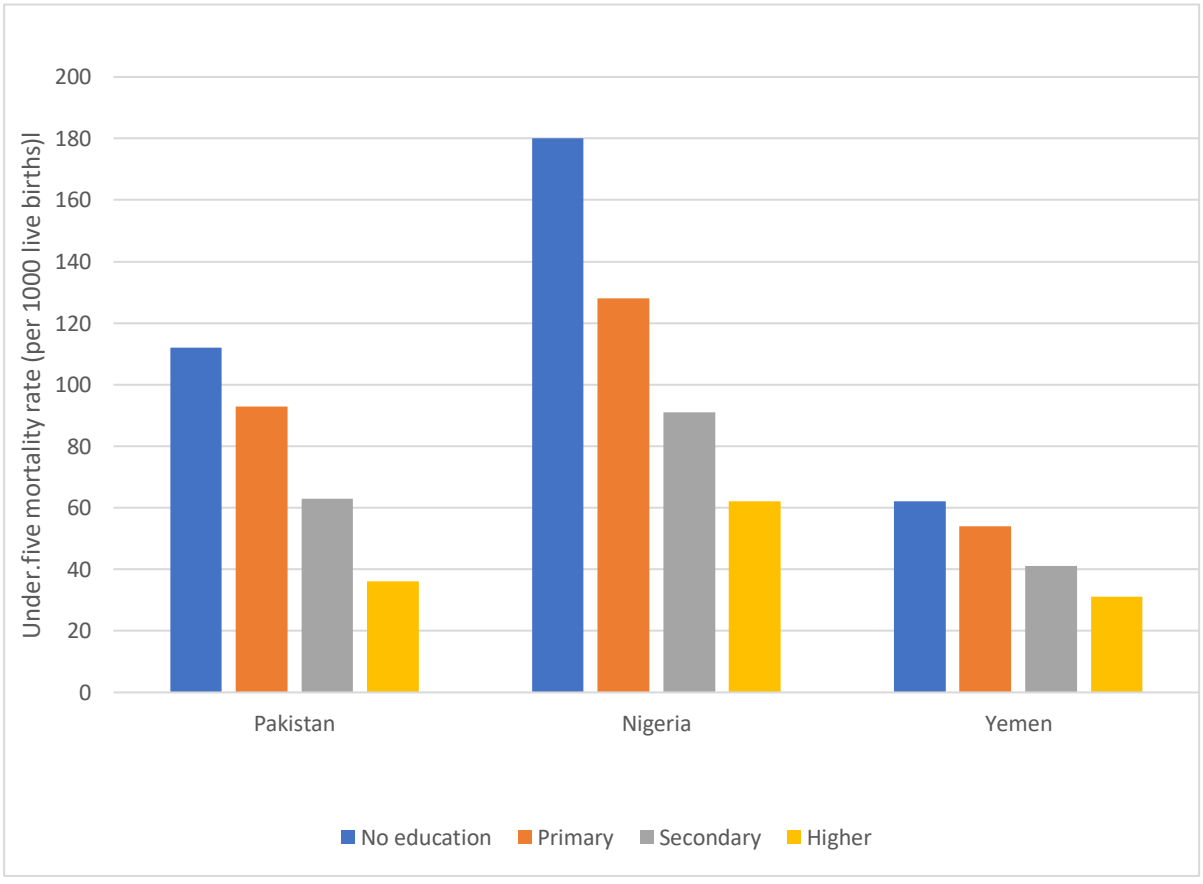
Educational gradient for every education level	*No gradient for every education level*	*No edu. w/high levels of U5MR*	*Higher edu. w/ high levels of U5MR*
Madagascar			
Malawi			
Maldives			
Myanmar			
Nepal			
Nicaaragua			
Niger			
Nigeria			
Pakistan			
Paraguay			
Peru			
Philippines			
Rwanda			
Sao Tome and Principe			
Senegal			
Sri Lanka			
Sudan			
Swaziland			
Tanzania			
Timor Leste			
Togo			
Tunisia			
Uganda			
Vietnam			
Yemen			
Zambia			
Zimbabwe			

On the following pages, graphical results will show how these four categories of maternal educational gradient of under-five mortality unfolds in different low – and middle-income countries.

5.2.1 Educational gradient in under-five mortality rate

These are examples of countries (see graph 3) showing decreasing under-five mortality rates for every step up the maternal education latter. The three countries presented graphicly are perfect examples of how maternal education have a negative relationship with under-five mortality rate. This graph also highlights that under-five mortality does not only differ between high and low education, but also between every of the four levels of maternal education – revealing a linear, educational gradient in under-five mortality rate in Pakistan, Nigeria and Yemen.

Graph 3:



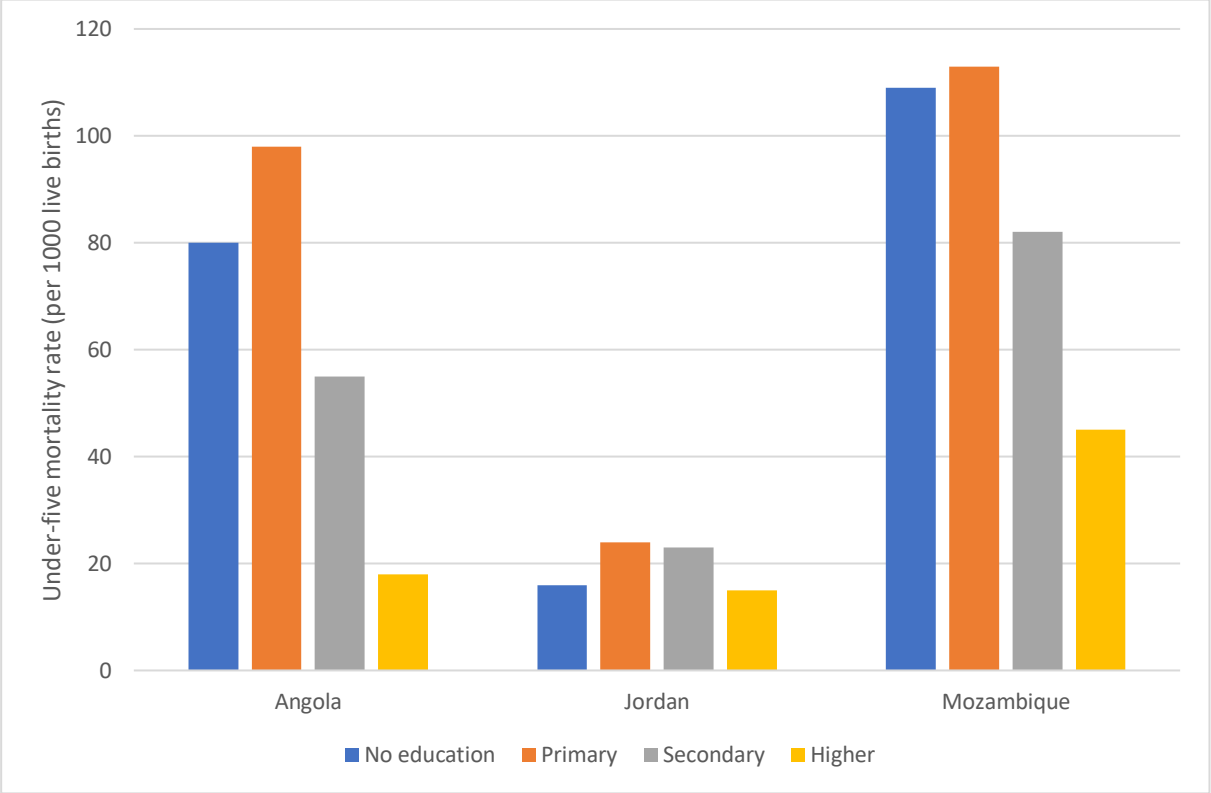
Provided with DHS-data for under-five mortality, based on maternal education level. 10 years preceding the survey. Pakistan (2017-2018), Nigeria (2013) and Yemen (2013).

The "gap" between each maternal education level in term of under-five mortality rate is close to equal in most of the three countries presented in graph 3. The relative position in the educational hierarchy is thus proven to be of importance in these three out of 60 LMICs also having an educational gradient in under-five mortality rate.

5.2.2 No negative educational gradient in under-five mortality for every level of maternal education

These countries (see graph 4), does not reveal a negative educational gradient in under-five mortality for every maternal education level, as graph 3 does. 26 LMICs out of the 86 LMICs included have a similar pattern where maternal education does not have a negative relationship with under-five mortality for every level of maternal education.

Graph 4:



Provided with DHS-data for under-five mortality, based on maternal education level. 10 years preceding the survey. Angola (2016-2017), Jordan (2012) and Mozambique (2011).

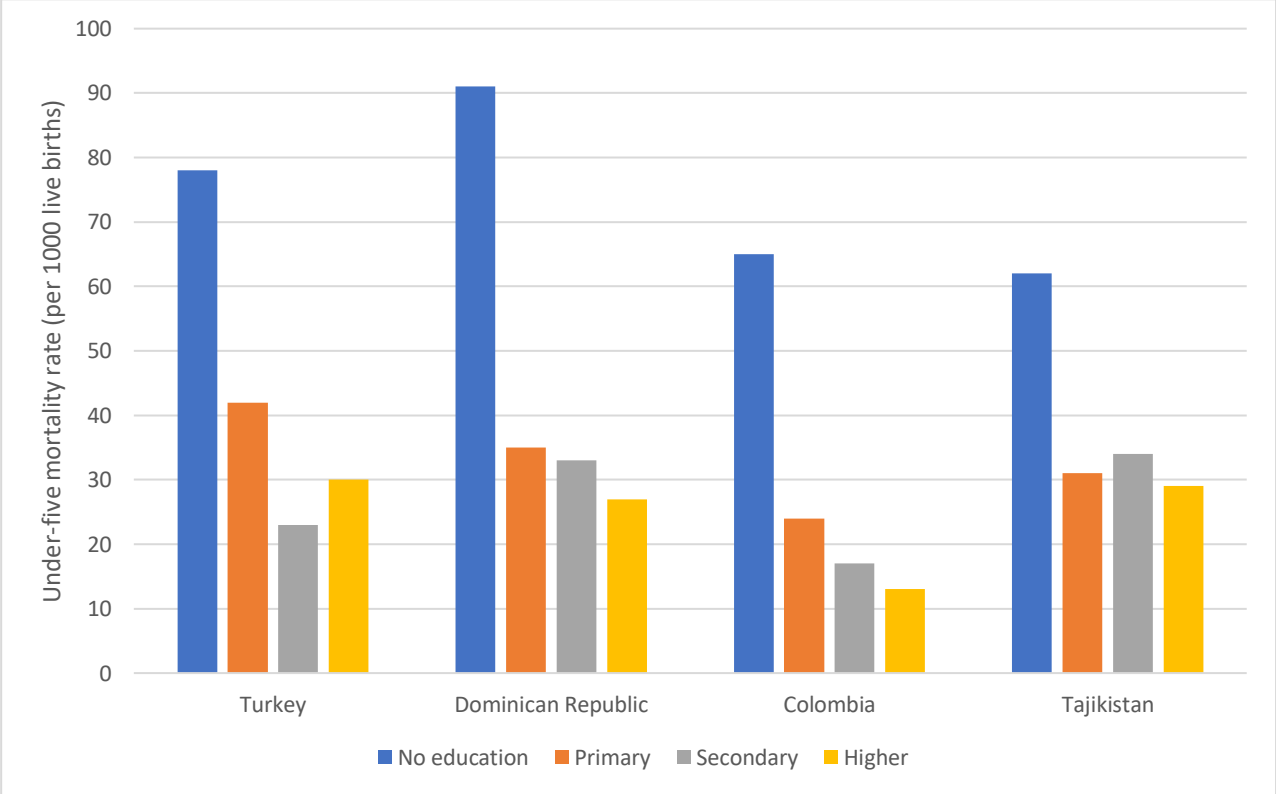
The three LMICs presented in graph 3, Angola, Jordan and Mozambique all reveal different patterns in their under-five mortality distributions based on maternal education. In Angola, children born by mother's with secondary education have considerably lower under-five mortality rate than children born by mothers with primary education. One can also see that children born by mothers with higher education clearly stand out with low under-five mortality rate. In Jordan, children born by both mothers with primary and secondary education have higher under-five mortality rates than children born by mothers with no

education. In Mozambique, children born by mothers with primary education have slightly higher rates of under-five mortality than children born by mothers with no education. The elites, children born by mothers with higher education, also have clearly lower levels of under-five mortality in Mozambique.

5.2.3 Great divide between children born by mothers with no education and the rest

In these countries (see graph 5), the worst-off, in this case children born by mothers with *no education*, have a significantly higher under-five mortality rate than children born by mothers with either primary, secondary or higher education.

Graph 5:



Provided with DHS-data for under-five mortality, based on maternal education level. 10 years preceding the survey. Turkey (2003), Dominican Republic (2013), Colombia (2015) and Tajikistan (2017).

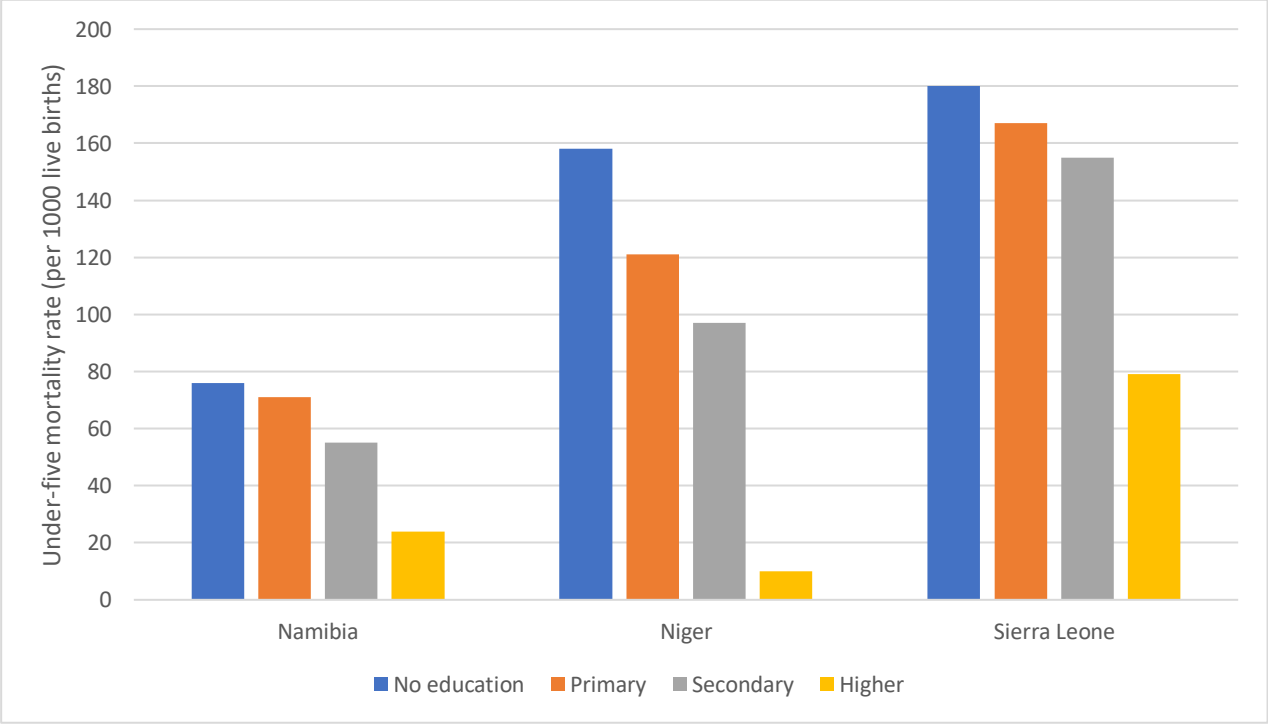
The four LMICs presented in graph 5 all reveal somewhat of an even distribution of under-five mortality for the three education levels primary, secondary and higher. Furthermore, Turkey, Dominican Republic, Colombia and Tajikistan all have in common is the fact that

children born by mothers with *no education* all have very high under-five mortality rates compared to the three other maternal education levels. In Turkey, children born by mothers with no education have almost double the under-five mortality rate as the closest education level, primary education. Dominican Republic is the worst example here, where children of mothers with no education have around three times higher under-five mortality rate than the three other levels of maternal education. Colombia and Tajikistan also reveal an extensive gap between the children born by mothers with no education and the rest.

5.2.4 Great divide between children born by mothers with higher education and the rest

The LMICs presented in graph 6 reveal the gap between the elites, children born by mothers with higher education, and the rest in terms of under-five mortality rates.

Graph 6:



Provided with DHS-data for under-five mortality, based on maternal education level. 10 years preceding the survey. Namibia (2013) Niger (2012) and Sierra Leone (2013).

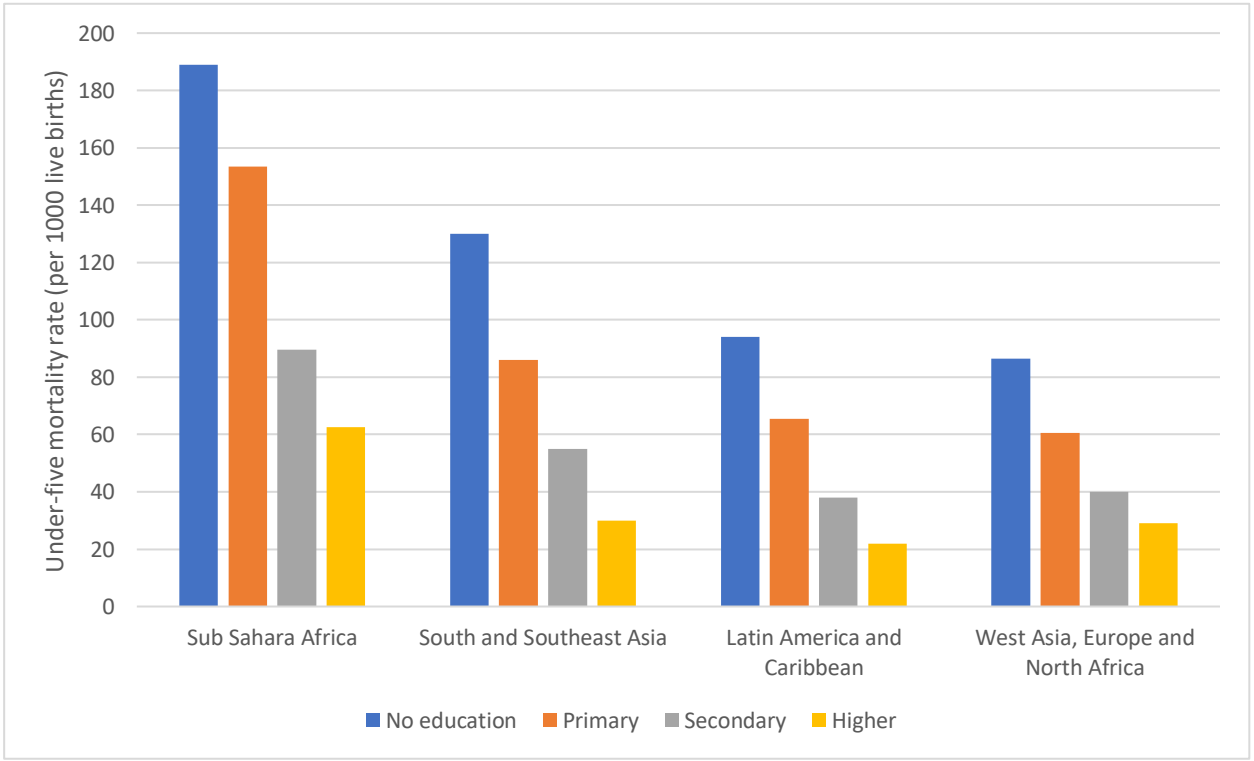
With the small exception of Niger, the two other countries Namibia and Sierra Leone both show close to even levels of under-five mortality for the three lowest levels of maternal education. In these three countries, the best-off; children born by mothers with higher

education, all have significantly higher chances of survival than children born by mothers with secondary or lower levels of education. This is an opposite trend of the what graph 5 revealed, where the worst-offs are "forgotten" compared to rest. In this case, graph 6 shows clearly how the elites are the only ones benefitting in terms of relatively low under-five mortality rates. The differences are striking in Niger, where children born by mother with higher education have 10 times lower under-five mortality than the closest group, secondary education, and almost 16 (!) times lower than children born by mothers with no education. In Namibia and Sierra Leone both groups of children born by mothers with higher education have about half, or over half the under-five mortality rate of the rest.

5.2.5 Educational gradient in under-five mortality at the regional level

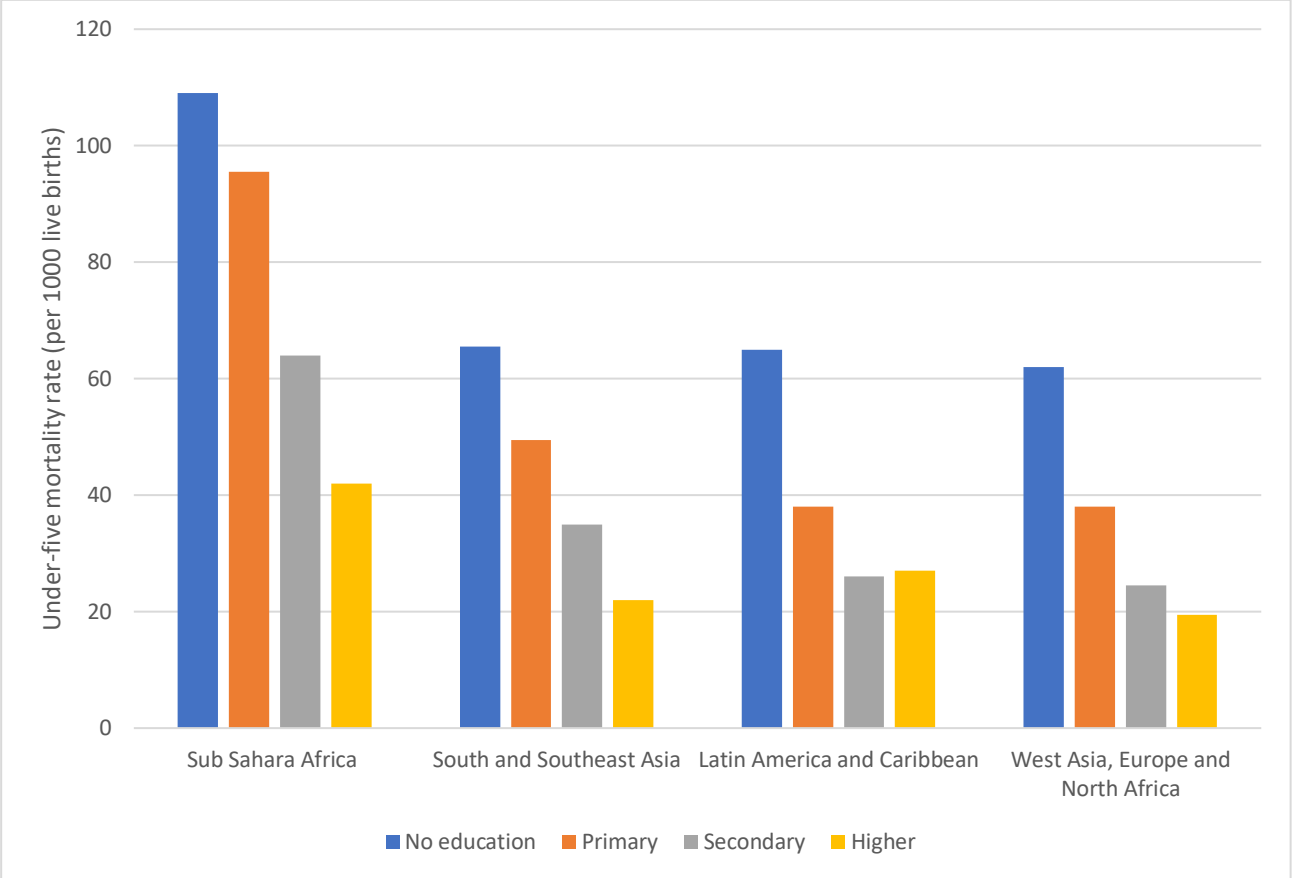
The four categories explained and presented graphically gives a glimpse of the different shapes of the educational gradient in under-five mortality in LMICs. Now, to close the segment of educational gradient in under-five mortality, let us see how the distributions between maternal education levels' under-five mortality rates unfolds at the regional level in graph 7 and 8.

Graph 7:



Median level of under-five mortality rate by region, by maternal education level. 1985-2000 DHS.

Graph 8:



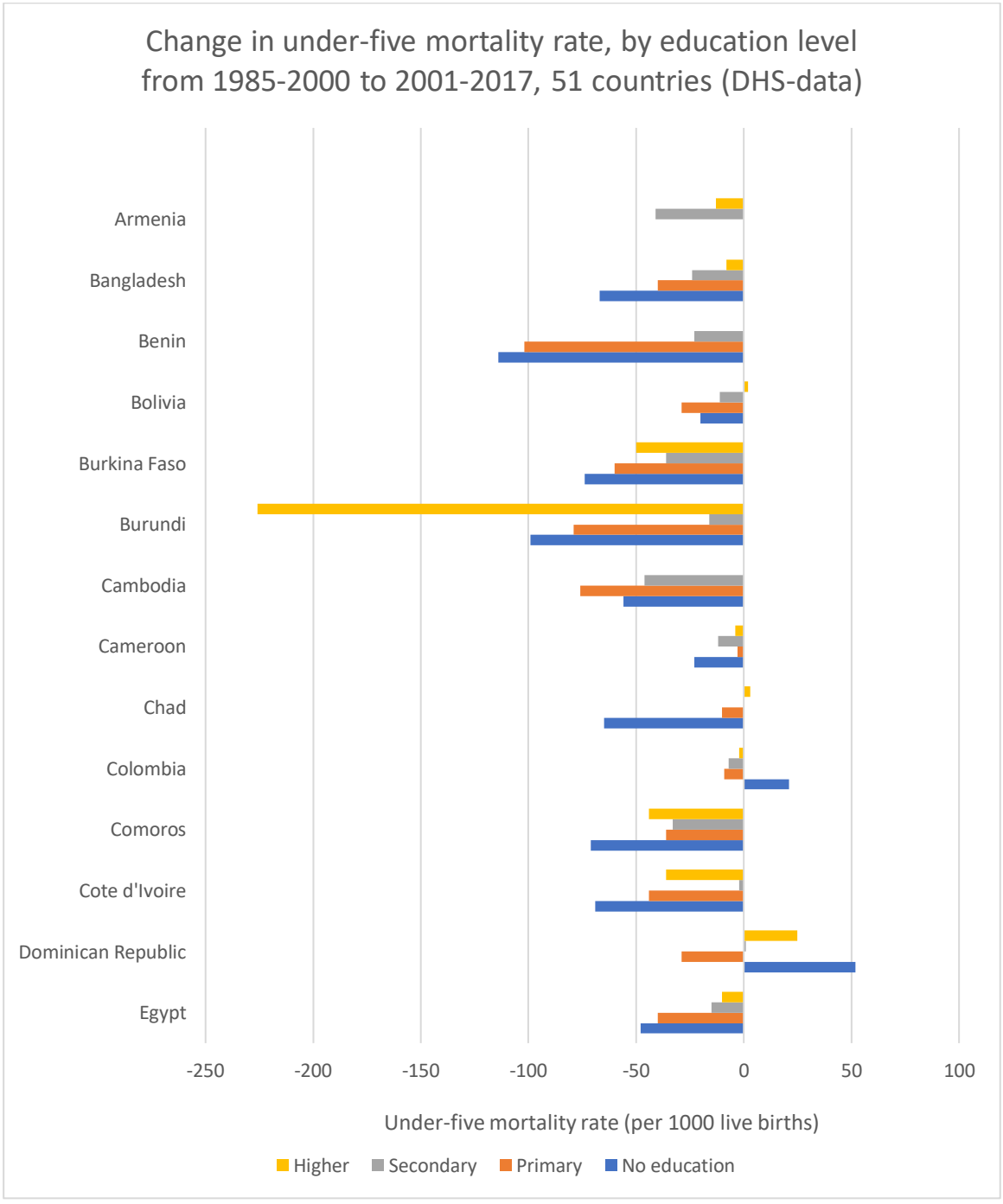
Median level of under-five mortality rate by region, by maternal education level. 2001-2017 DHS.

Median levels of every maternal education level's under-five mortality rate for each region is used to produce these two graphs. As both graphs clearly declare, all regions with LMICs and for both time-periods show a linear, educational gradient in under-five mortality rate, disfavoring the lower educated. The only small exception to this rule is the region of Latin America and Caribbean which show a slightly higher under-five mortality rate for children born by mothers with higher education than secondary in the time-period 2001-2017. Away from this exception, the results clearly state that for each climb up the education-latter, the lower under-five mortality rate. There can be countries with different profiles in their distribution of under-five mortality based on maternal education – but the regional graphs demonstrate that the distributions of under-five mortality are educationally graded. The two graphs also reveal the change in under-five mortality for each region between the two time-periods 1985-2000 and 2001-2017. All regions show a decrease overall, with Sub-Saharan Africa having the largest.

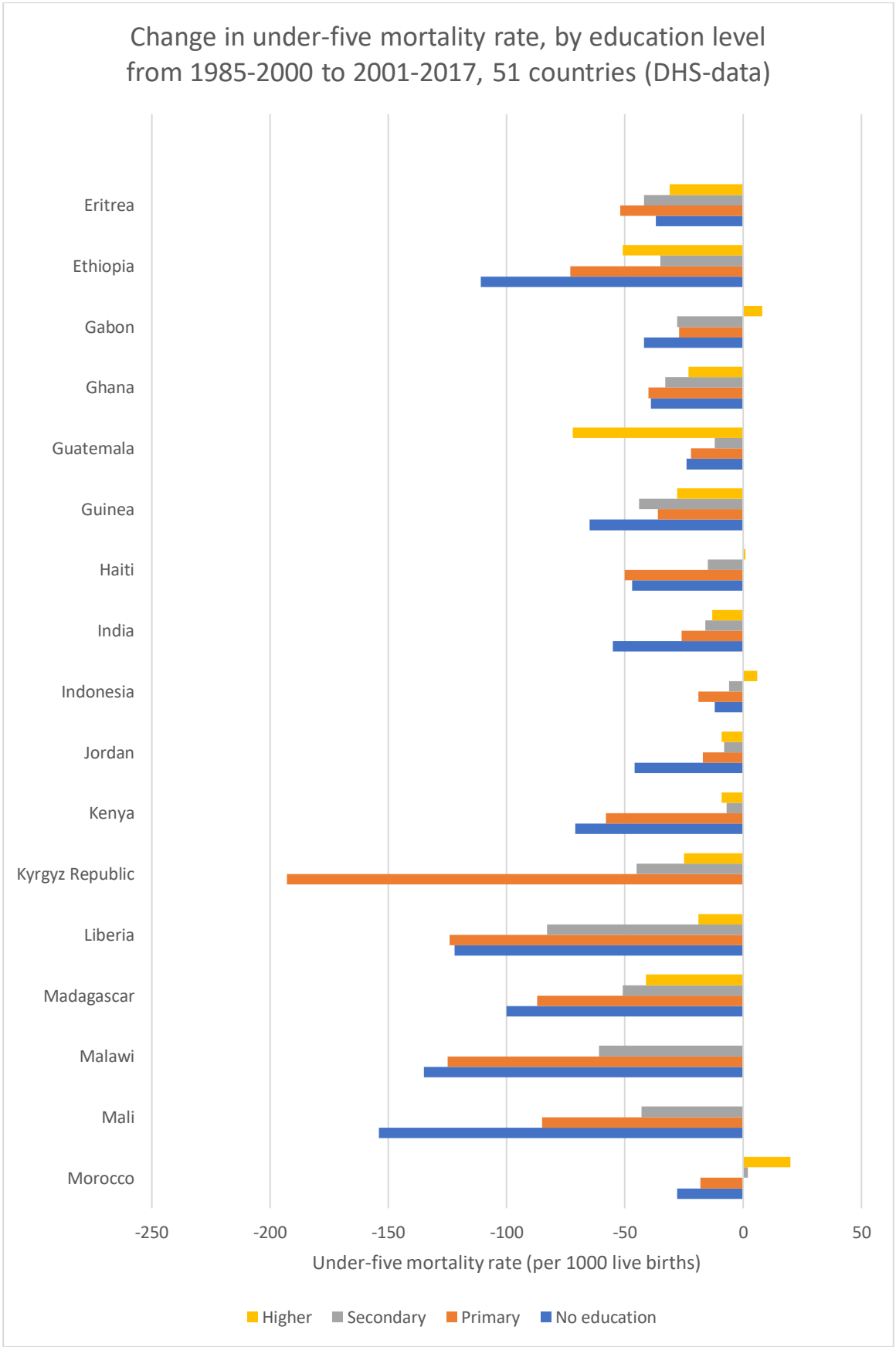
5.3 Decrease in under-five mortality between the two time-periods for each country

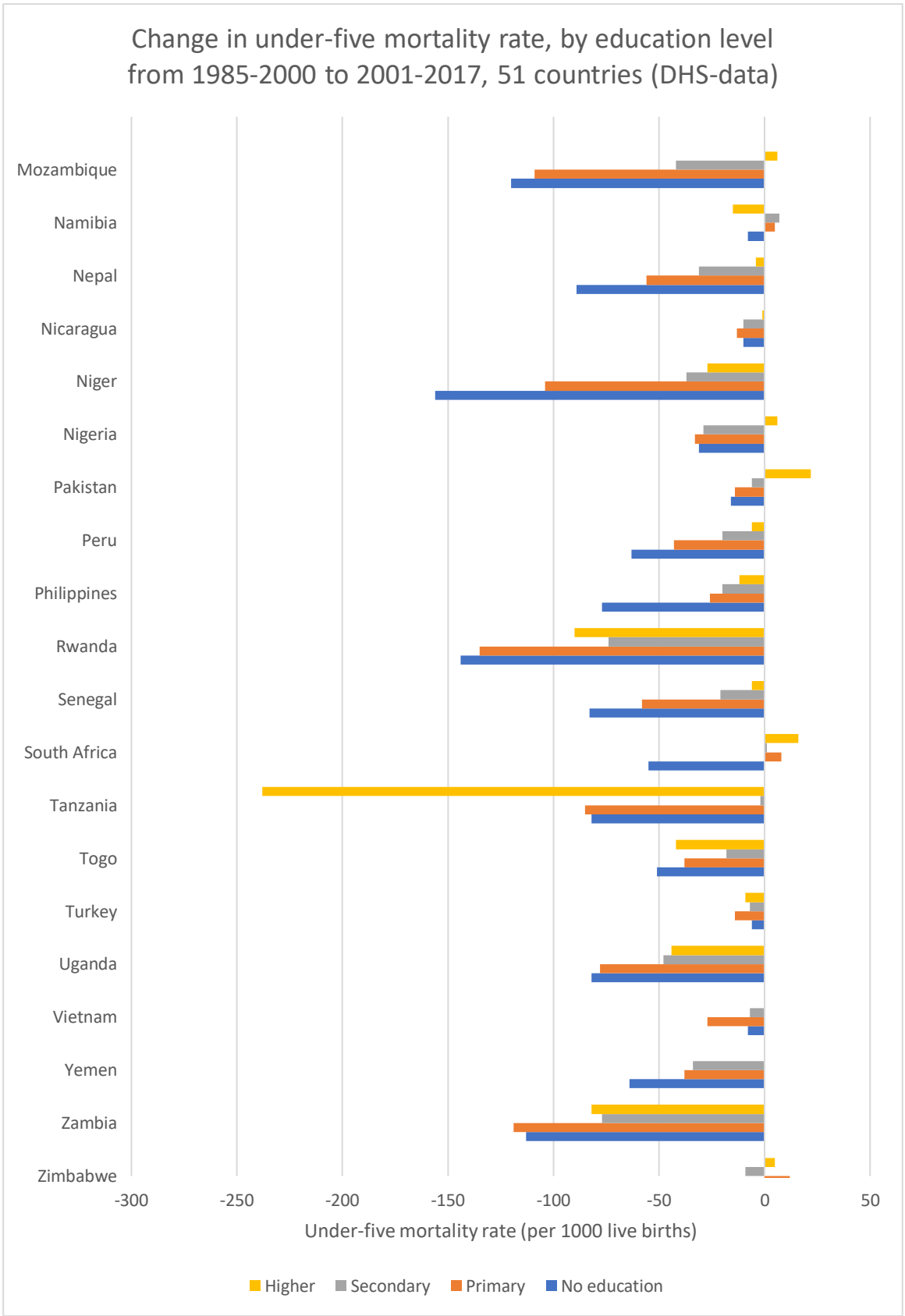
In the following graphs I will present the decrease in under-five mortality for each country, based on maternal education levels, from the first time-period (1985-2000) to the second (2001-2017).

Graph 9:



Graph 9 (continued)





Change in under-five mortality rate (based on 1000 live births). Based on the latest available DHS-data for each country for the two time-periods 1985-2000 and 2001-2017. For details on each country's values on under-five mortality for the different education levels for both time-periods, see appendix.

The first thing to point out is the significant decrease in under-five mortality for children born by mothers with higher education in Burundi. This decrease in under-five mortality rate is enormous, and highly doubtful, giving its under-five mortality rate for higher education in 1987 is 283, with a confidence interval of -52-619. The under-five mortality rate measured in the next DHS-survey done in 2016-17 is 92, with a confidence interval of 85-100. This figure is much more trustworthy, and therefore the giant decrease should not be given any considerable weight here. The same can be said for the Kyrgyz Republic and Tanzania.

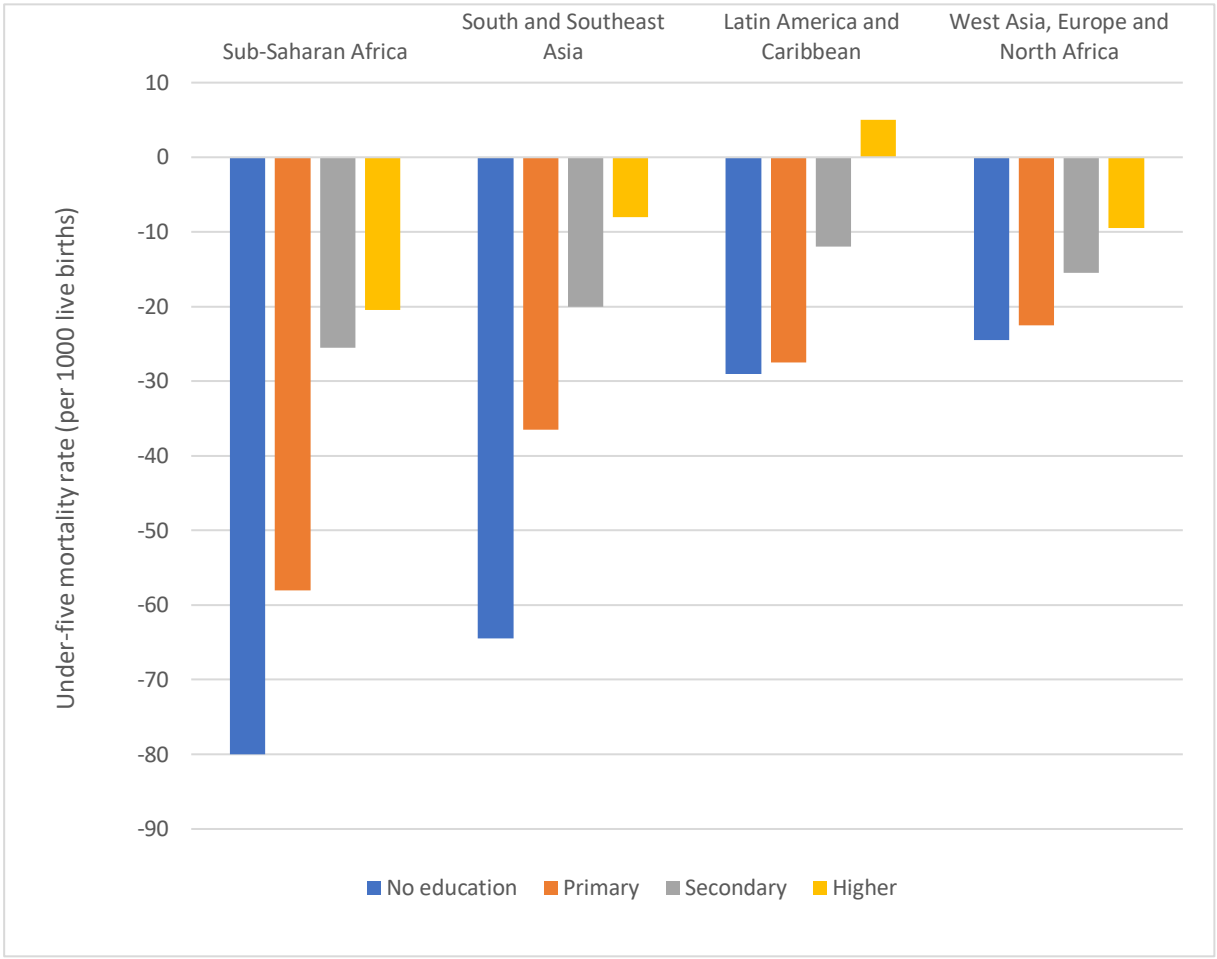
Now, the overall impression of the decrease in under-five mortality based on maternal education levels from the time-period 1985-2000 to 2001-2017 is that most countries show significant decreases for every education-level. Also, and very important, this graphical view declares that children born by mothers with no formal education have the largest decreases in under-five mortality rate in most of the LMICs measured.

A few countries show small or moderate increases in under-five mortality by some maternal education levels. Colombia have increases in under-five mortality for children born by mothers with no education, Dominican Republic for no education and higher education, Gabon and Indonesia for higher education, Morocco for higher and secondary, Mozambique for higher education, Namibia for secondary and primary, Nigeria and Pakistan for higher education, South Africa for higher education and primary and Zimbabwe for children born by mothers with primary or no education. These increases are important, but still exceptions to the rule which graph 9 portray; large decreases for most education levels in most countries – and the largest decreases in under-five mortality overall for children born by mothers with no education.

5.3.1 Decrease in under-five mortality between the two time-periods for each region

To observe the change from a regional perspective, the next page presents a graph showing change in median under-five mortality rate, by maternal education – for every major region of LMICs between the two time-periods 1985-2000 and 2001-2017.

Graph 10:



Median level of change in under-five mortality rate by region, by maternal education level. 1985-2000, 2001-2017 DHS.

The same picture as before is painted in graph 10; the largest reductions in under-five mortality are for those children born by mothers with no education from the time-period 1985-2000 to 2001-2017. Especially Sub-Saharan Africa and South and Southeast Asia have large decreases in under-five mortality for children born by mothers with no education relative to children born by mothers with primary, secondary or higher education. Sub-Saharan Africa also have the largest reductions in under-five mortality for every maternal education level compared to the other major regions of LMIC. The reductions are educationally graded in the sense that no maternal education have the largest – and then primary second largest, secondary third and higher fourth for every region in graph 10. The only region not showing a decrease in under-five mortality for children born by mothers with *higher* education is Latin America and Caribbean – which show a median increase of five under-five mortalities per 1000 live births.

5.4 Absolute and relative change in inequality between maternal education and under-five mortality

To investigate whether inequality has gone down between maternal education levels' under-five mortality rates over the two time-periods, this thesis will use both absolute and relative measures of inequality. 37 LMICs will be investigated. These 37 LMICs have under-five mortality rates for every maternal education-level in both time-periods; 1985-2000 and 2001-2017. Absolute under-five mortality rates between no maternal education and higher education, primary and higher education and secondary and higher education will be compared for each country between the two time-periods. The same will be done in relation to relative inequality, where ratios between every education level compared to higher education will be revealed for each country for the two time-periods. For a more detailed view of every absolute and relative difference in under-five mortality rate between education levels for all 37 LMICs, see appendix.

The development of absolute and relative inequalities between maternal education levels' under-five mortality rates are organized into six categories: One for countries showing decreases in both absolute and relative inequality for every education level compared to higher education, one for countries only showing a decrease in absolute inequality for every education level compared to higher education and one for countries showing mixed results where for example absolute inequality between no maternal education and higher have gone down in one country, but the absolute inequality between secondary and higher maternal education have increased. The same mixed category is also applied for relative change in inequality. Lastly, one category for absolute *increase* and one for relative *increase* in inequality between every maternal education level and higher education's under-five mortality rate.

Table 2: Absolute and relative change in inequality between maternal education and under-five mortality in 37 LMIC, between the two time periods 1985-2000 and 2001-2017

Absolute and relative *decrease*	**Only absolute *decrease***	**Mixed relative increase/decrease**
Bangladesh	Cote d'Ivoire	Cameroon
Bolivia	Eritrea	Colombia
Chad	Ghana	Cote d'Ivoire
Dominican Republic	Guinea	Ethiopia
Egypt	India	Ghana
Gabon	Madagascar	Guinea
Haiti	Philippines	India
Indonesia	Uganda	Jordan
Morocco		Kenya
Nepal		Madagascar
Nicaragua		Philippines
Nigeria		Turkey
Pakistan		
Peru		
Senegal		
Yemen		
Zimbabwe		

Table 2 (continued):

Absolute and relative *increase*	**Only relative *increase***	**Mixed absolute decrease/increase**
Namibia	Burkina Faso	Burkina Faso
	Eritrea	Cameroon
	Niger	Colombia
	Rwanda	Dominican Republic
	Uganda	Ethiopia
	Zambia	Jordan
		Kenya
		Rwanda
		Togo
		Turkey
		Zambia
		Zimbabwe

The purpose of **table 2** is to categorize and paint a bigger picture of where the tendencies are going in the inequalities between maternal education levels' under-five mortality rates in LMICs. If we look at the first column; absolute and relative *decrease*, 17 LMICs look to have a reduction in inequality in under-five mortality based on maternal education – both in absolute and relative measures. A further 8 countries have only decreasing *absolute* inequality in under-five mortality based on maternal education. So, a total number of 25 out of 37 LMICs show decreasing educational inequality in under-five mortality in one form or another.

Now, some countries show a relative *increase* in inequality between maternal education-levels and under-five mortality. Six LMICs look to have increasing relative inequality in under-five mortality based on maternal education. Out of those six, two of them show absolute *decrease* in inequality, but relative *increase.*

In the third column of **table 2,** 12 LMICs have mixed results in terms of increasing or decreasing *relative* inequality between maternal education levels' under-five mortality rates.

As mentioned earlier, this is when for example the under-five mortality rate ratio between no maternal education and higher maternal education has decreased, but the under-five mortality rate ratio between secondary maternal education and higher maternal has *increased*. This is the case for Ethiopia, from 2000 (DHS) to 2016 (DHS), the worst-off – children born by mothers with no education is more equal in relative terms of under-five mortality to the elite, but the two middle categories – primary and secondary education are worse in terms of relative equality to the elite. For a more detailed view of Ethiopia's relative inequality and the other LMICs, see appendix.

The next category contains the only LMIC looking to have increasing educational inequality in under-five mortality, both in absolute and relative terms. Namibia have a wider gap in under-five mortality rate between children born by mothers with no education and children born by mothers with higher education, but also between primary and higher education and secondary and higher education. Children born by mothers with higher education have the greatest decrease in under-five mortality in Namibia. No maternal education also shows decreasing under-five mortality, but not half of what higher education has got. Primary and secondary education have *increased* their under-five mortality rates – making the inequality between the three education-levels in relations to higher education worse in both absolute and relative terms.

The last column includes LMICs where the absolute change in inequality between maternal education levels' under-five mortality rates are mixed. The difference between two education levels have *decreased* – and one or two other education levels show *increasing* inequalities between them. All though there are 12 LMICs in this column, the picture looks very different than LMICs showing mixed results in changing *relative* inequality. Out of the 12 LMICs in this category, 8 of them show decreasing levels of absolute inequality between every maternal education level and higher education, except between secondary and higher maternal education. In this view, the worst-off, children born by mothers with lower levels of education, are in a clear majority of LMICs starting to close the absolute gap between them and the elites in terms of under-five mortality.

5.5 Logistic regression models

Model 1: Maternal education and under-five mortality in Angola (2013 DHS)

	Coef.	SEB	Odds rate	Sig.
Maternal education-level (No education as reference category)				
Primary	2,55	0,080	1,189	<0,05
Secondary	-1,00	0,090	0,904	0,315
Higher	-4,25	0,081	0,249	<0,01
Husband/partners education-level (No education as reference category)				
Primary	3,72	0,115	1,368	<0,01
Secondary	2,3	0,119	1,255	<0,05
Higher	3,07	0,306	1,724	<0,01
Wealth index (Poorest as reference category)				
Poorer	-0,40	0,072	0,970	0,688
Middle	-2,27	0,069	0,824	<0,01
Richer	-2,75	0,078	0,748	<0,01
Richest	-4,55	0,073	0,541	<0,01
Age (15-49)	-1,60	0,027	0,954	0,109
Age squared	5,92	0,0004	1,002	<0,01
Health insurance (1=yes, 0=no)	-2,03	0,111	0,735	<0,05
Women making health decisions (1=not a big problem, 0=big problem)	-2,97	0,050	0,836	<0,01
Visited health facility last 12 months (1=yes, 0=no)	0,74	0,060	1,043	0,458
Women sample weight	4,66	3,07e-08	1	<0,01
Constant	-4,51	0,055	0,116	<0,01
N	7498			
Pseudo R2	0,1796			

The first logistic regression model estimates maternal education's effect on under-five mortality in Angola from 2013. Graph 4 revealed the shape of the educational gradient in under-five mortality in Angola, which was not linearly graded as in it dot show decreasing under-five mortality rates for every level of maternal education. Estimated with logistic

regression in model 1, the dummy set of maternal education level (with no maternal education as the reference category), reveals the same pattern. Primary maternal education has a positive coefficient and is statistically significant at the five per cent-level. Secondary maternal education has a negative coefficient but is not statistically significant. Higher maternal education has a negative coefficient and is statistically significant at the one per cent-level. Primary maternal education interprated through the odds rate: (1,189-1) *100=18,9. Children born by mothers with primary education has 18,9 per cent higher odds of dying before the age of 5 in Angola compared to children born by mothers with no education. Higher maternal education: (0,249-1) *100=-75,1. Children born by mothers with higher education has 75,1 per cent lower odds of dying before the age of 5 in Angola compared to children born by mothers with no education.

The next dummy set estimates husband or partner's education level's effect on under-five mortality. The results are quite surprising. Each education level shows a positive coefficient and is statistically significant at either one or five per cent-level compared to the reference category of no education. Calculating odds for higher education: (1,724-1) *100=72,4. Children born by mothers with a husband or partner with higher education have 72,4 per cent higher odds of falling into category 1 of the dependent variable, dead under 5 years, compared to children born by mothers with a husband or partner with no education. Next independent variable is the household wealth index, also presented as a dummy set. The poorest are the reference category. Every climb up the wealth index show a negative coefficient and is statistically significant at the one per cent-level, except for the "poorer"-category. More household wealth lowers the odds of children dying before the age of 5 in Angola, except between the "poorer" and "poorest" category.

Women's age, ranging from 15-49 years, show a negative coefficient but is not statistically significant. Age squared on the other hand is positive and statistically significant at the one per cent-level and indicates that there is a curvilinear relationship between women's age and under-five mortality in Angola – starting negative and then turning, demonstrating that after a certain age, for each year older the mother gets, the higher odds of under-five mortality.

The next three are all dummy variables. The first, whether a woman has health insurance or not, show a negative coefficient and is statistically significant at the five per cent level. Odds

interpretation: (0,735-1) *100=-26,5. Children born by mothers with health insurance in Angola have 26,5 per cent lower odds of dying before the age of 5 than children born by mothers with no health insurance. Women who have independence in health-decision making lowers the odds of under-five mortality, (0,836-1) *100=-16,4, with 16,4 per cent compared to women who do not have the same decision-making power over their health. Lastly, whether the mother visited a health facility during the last 12 months has no statistically significant effect on under-five mortality in Angola.

Model 2: Maternal education and under-five mortality in the Dominican Republic (2015-2016 DHS)

	Coef.	SEB	Odds rate	Sig.
Maternal education-level (No education as reference category)				
Primary	-4,59	0,078	0,442	<0,01
Secondary	-8,79	0,035	0,180	<0,01
Higher	-6,89	0,048	0,216	<0,01
Husband/partners education-level (No education as reference category)				
Primary	-2,14	0,118	0,692	<0,01
Secondary	-5,04	0,072	0,392	<0,01
Higher	-5,74	0,061	0,264	<0,01
Wealth index (Poorest as reference category)				
Poorer	2,73	0,159	1,372	<0,01
Middle	3,00	0,195	1,484	<0,01
Richer	2,81	0,227	1,521	<0,01
Richest	2,18	0,265	1,479	<0,05
Age (15-49)	-3,69	0,050	0,791	<0,01
Age squared	2,99	0,001	1,004	<0,01
Health insurance (1=yes, 0=no)	6,22	0,157	1,749	<0,01
Women making health decisions (1=not a big problem, 0=big problem)	0,30	0,163	1,048	0,762
Women sample weight	-0,44	4,77e-08	1	0,660
Constant	3,84	10,993	15,425	<0,01
N	3,894			
Pseudo R2	0,093			

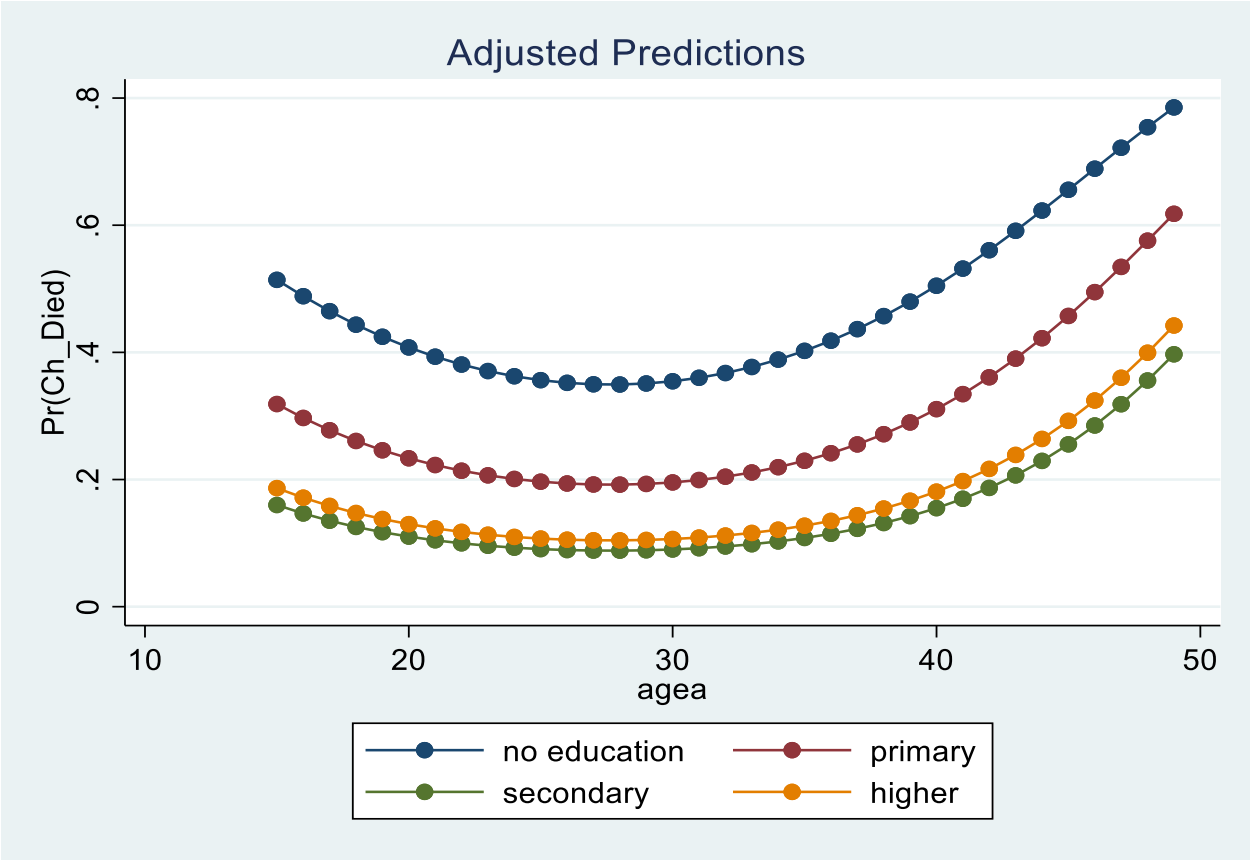
Model 2 estimates maternal education's effect on under-five mortality in the Dominican Republic from 2015-16. In graph 5 we demonstrated that children born by mothers with no education had significantly higher under-five mortality rates than children born by mothers with either primary, secondary – or higher education in the Dominican Republic. The dummy set of maternal education levels estimates the same pattern – children born by mothers with every education level above no education have statistically significant lower odds of under-five mortality than children born by mothers with no education. Odds calculation for primary education: (0,442-1) *100=-55,8. Children born by mothers with primary education have 55,8 per cent lower odds of dying before the age of 5 compared to children born by mothers with no education. Odds for secondary maternal education: (0,180-1) *100=-82. Children born by mothers with secondary education have 82 per cent lower odds of dying before the age of 5 compared to children born by mothers with no education. Odds for higher maternal education: (0,216-1) *100=-78,4. Children born by mothers with higher education have 78,4 per cent lower odds of dying before the age of five compared to children born by mothers with no education. So, the only exception from the shape of the educational gradient from graph 5, is that secondary maternal education has the strongest negative effect on under-five mortality when controlled for other relevant variables in Dominican Republic.

The dummy set estimating husband or partner's education level's effect on under-five mortality in Dominican Republic show that the higher education level of husband, the lower odds of under-five mortality. Odds of husband or partner with higher education: (0,264-1) *100=-73,6. Children born by mothers who have a husband or partner with higher education have 73,6 per cent lower odds of dying before the age of five than children born by mothers with a husband or partner with no education.

The household wealth index reveals a surprising result. Controlled for other relevant variables, every wealth category above the poorest have a positive coefficient and is statistically significant at either one or five per cent-level. With a simpler logistic regression model, estimating only household wealth as the independent variable, the result is apposite and shows negative coefficients for every climb of the wealth index-latter – as one would expect. This indicates that wealth increases the odds under-five mortality when maternal and husband/partner's education level, and other variables, are controlled for.

Mothers' age between 15 and 49 show a negative coefficient and is statistically significant at

one per cent level. Age squared shows a positive coefficient and is statistically significant at one per cent level. This reveals a curvilinear relationship between age and under-five mortality – starting negative (reducing odds of under-five mortality) and turning positive (increasing odds) at some stage. The margins plot below illustrates how the interaction between maternal education and age affect under-five mortality in Dominican Republic. Here again we can see that children born by mothers with secondary education have the lowest chances of dying before the age of five for every maternal age between 15 and 49. Children born by mothers with no maternal education have the clearly highest odds of dying before the age of five for every maternal age. Every age category starts negative, indicating lower chances of under-five mortality, before it turns for every maternal education level when the mother is in her late twenties, and from there on showing increasing odds of under-five mortality for each year older the mother gets.



Health insurance has a positive coefficient in Dominican Republic and is statistically significant at one per cent-level. Odds: 74 per cent higher odds of under-five mortality when mothers have health insurance, which is quite astonishing. Independence in health decision-making have no statistically significant effect in Dominican Republic.

Model 3: Maternal education and under-five mortality in Pakistan (2017-2018 DHS)

	Coef.	SEB	Odds rate	Sig.
Maternal education-level (No education as reference category)				
Primary	-0,04	0,062	0,997	0,971
Secondary	-3,08	0,065	0,770	<0,01
Higher	-7,23	0,050	0,420	<0,01
Husband/partners education-level (No education as reference category)				
Primary	-1,10	0,075	0,912	0,270
Secondary	-1,60	0,063	0,891	0,109
Higher	-3,64	0,066	0,713	<0,01
Wealth index (Poorest as reference category)				
Poorer	-2,36	0,062	0,838	<0,05
Middle	-0,38	0,080	0,969	0,707
Richer	-2,62	0,074	0,779	<0,01
Richest	-3,26	0,076	0,698	<0,01
Age (15-49)	-2,00	0,031	0,935	<0,05
Age squared	6,25	0,0005	1,003	<0,01
Health insurance (1=yes, 0=no)	1,51	0,257	1,337	0,131
Women making health decisions (1=not a big problem, 0=big problem)	2,00	0,067	1,127	<0,05
Visited health facility last 12 months (1=yes, 0=no)	-2,03	0,060	0,87	<0,05
Women sample weight	4,09	2,84e-08	1	<0,01
Constant	-2,40	0,147	0,275	<0,01
N	7852			
Pseudo R2	0,2008			

Model 3 estimates maternal education's effect on under-five mortality in Pakistan from 2017-18. Graph 3 showed Pakistan to have a linear, negative shape of the educational gradient in under-five mortality, with lower levels of under-five mortality for every increasing maternal education level. In the dummy set estimating each education level's effect on under-five mortality compared to the reference category "no maternal education", every education level shows a negative coefficient. But children born by mothers with primary education have no

statistically significant lower chances of dying before the age of 5 than children born by mothers with no education. Still, secondary and higher maternal education are both statistically significant at the one per cent-level. Children born by mothers with secondary education have 23 per cent lower odds of dying before the age of five compared to children born by mothers with no education. Children born by mothers with higher education have 58 per cent lower odds of dying before the age of five compared to children born by mothers with no education. This clearly illustrates the importance of maternal education level on the chance of survival for children under five years in Pakistan.

Similar pattern can be observed in the dummy set estimating husband or partner's education level on under-five mortality. All education levels show negative coefficients, but only higher education is statistically significant. If the mother has a husband or partner with higher education in Pakistan, her child has a 28,7 per cent lower odds of dying before turning five years old compared to if the mother has a husband or partner with no education.

The household wealth index reveals that the category poorer, richer and richest all have statistically significant lower odds of under-five mortality than the poorest category. The middle category is not statistically significant. There is 30,2 per cent lower odds of under-five mortality if the household is from the richest category compared to the poorest in Pakistan.

Continuing, model 3 estimates mother's age to have a negative relationship with under-five mortality. The variable is statistically significant at the five per cent-level. Age squared is also statistically significant, at the one per cent-level, and show a positive coefficient – indicating a curvilinear relationship between mothers age and under-five mortality in Pakistan also.

Whether the mother has health insurance or not has no statistically significant effect on under-five mortality in Pakistan. The variable measuring women having autonomy in their health-decision making estimates a positive coefficient and is statistically significant. The odds between the two categories "independent" or "not independent" is 12,7 per cent. So even if the result is not expected, the difference in odds between the two are not very large. Lastly, whether women visited a health facility during the last 12 months has a negative coefficient and is statistically significant at the one per cent-level. Children born by mothers who visited a health facility during the last 12 months have 13 per cent lower odds of under-five mortality compared to children born by mothers who did not visit a health-facility during the last 12

months.

Model 4: Maternal education and under-five mortality in Niger (2012 DHS)

	Coef.	SEB	Odds rate	Sig.
Maternal education-level (No education as reference category)				
Primary	-1,50	0,065	0,895	0,134
Secondary	-2,31	0,096	0,739	<0,05
Higher	-2,37	0,150	0,276	<0,05
Husband/partners education-level (No education as reference category)				
Primary	-2,54	0,057	0,841	<0,05
Secondary	-3,05	0,074	0,733	<0,01
Higher	-2,03	0,155	0,583	<0,05
Wealth index (Poorest as reference category)				
Poorer	3,89	0,085	1,292	<0,01
Middle	3,83	0,083	1,283	<0,01
Richer	2,63	0,078	1,188	<0,01
Richest	-1,94	0,061	0,871	<0,10
Age (15-49)	4,05	0,025	1,098	<0,01
Age squared	1,37	0,0003	1,000	0,171
Health insurance (1=yes, 0=no)	-1,70	0,137	0,724	<0,10
Woman making health decisions (1=not a big problem, 0=big problem)	-1,25	0,047	0,937	0,210
Visited health facility last 12 months (1=yes, 0=no)	0,92	0,043	1,039	0,355
Women sample weight	7,40	3,69e-08	1	<0,01
Constant	-9,64	0,009	0,025	<0,01
N	12294			
Pseudo R2	0,1590			

Model 4 estimates maternal education's effect on under-five mortality in Niger from 2012. From graph 6 showing Niger's shape of the educational gradient in under-five mortality, Niger was one of the LMICs where the elite, children born by mothers with higher education, had very low under-five mortality rates compared to the three other maternal education levels.

The dummy set estimating maternal education levels' effect on under-five mortality compared to the reference category, no maternal education, show negative coefficients for every education level. But, of the three, secondary and higher maternal education are the ones that are statistically significant – at the five per cent-level. Children born by mothers with secondary maternal education have 26,1 per cent lower odds of dying before the age of five compared to children born by mothers with no education. As for the children born by mothers with higher education, they have 72,4 per cent lower odds of dying before the age of five compared to children born by mothers with no education. This resembles the shape of the educational gradient in under-five mortality presented in graph 6; there is a divide favoring the elites compared to the rest of the population regarding under-five mortality in Niger.

The dummy set of husband or partner's education level reveals a linear, educational gradient in its relationship with under-five mortality. The coefficients are statistically significant at either five or one per cent-level. For every gained education level for mother's husband or partner, the lower odds of under-five mortality compared to if mother's husband or partner had no education. The inequality is not as large as between maternal education levels: Children born by mothers with a husband or partner with higher education have 41,7 per cent lower odds of dying before the age of five compared to children born by mothers with a husband or partner with no education.

The household wealth index reveals a mixed result from different wealth categories compared to the lowest category: poorest. The three wealth categories poorer, middle and richer all estimate higher odds of under-five mortality than the poorest category. This ranges from 18,88 per cent to 29,2 per cent higher odds than the poorest categories. Only the richest category is estimated to have *lower* odds of under-five mortality compared to the poorest category. As much as this is a little unexpected, it again demonstrates how the elites – in this case the richest, are the ones standing out to have better survival-odds for their children under five compared to the rest.

Next up is the variable age, measuring women's age between 15 and 49. The coefficient is positive and statistically significant at the one per cent level. This means that for every year older the mother gets; the odds of under-five mortality increase with 9,8 per cent in Niger. The age squared variable is not statistically significant. In contrast to the other three countries

estimated with logistic regression, Niger does not have a curvilinear relationship between mothers' age and under-five mortality.

Whether the mother has health insurance or not has a negative coefficient and is statistically significant at the ten per cent-level. Children born by mothers with health insurance have 27,6 per cent lower odds of dying before the age of five than children born by mothers without health insurance. The variable estimating women's independence in health decision making has a negative coefficient also but is not statistically significant in Niger. Neither is the variable estimating the effect of whether women visited a health facility during the last 12 months.

6.0 Discussion

The results of this thesis provide evidence supporting the first hypothesis – there is a negative relationship between maternal education and under-five mortality in LMICs. The results also give supporting evidence of the existence of an educational gradient in under-five mortality in most LMICs (60 out of 86 countries) and overall for every region, disfavoring the lower educated. The third hypothesis is supported partly with evidence showing a trend of *absolute decreases* in educational inequality and under-five mortality in LMICs. *Relative decreases* have mixed evidence and is not supported in the same way as absolute decreases. Even so, the worse-off, children born by mothers with no formal education, have the largest decreases in under-five mortality in most of the LMICs monitored – and in every major region of LMICs. The fourth hypothesis is clearly supported in all four LMICs estimated with logistic regression; maternal education has a significant, negative effect on under-five mortality in LMICs with different shapes of the educational gradient in under-five mortality.

Before these main findings are discussed, some methodological issues should be raised:

I) The surveys conducted by the DHS in the first time-period (1985-2000) of this thesis have significantly fewer respondents than the surveys conducted in the last time period (2001-2017). The most recent surveys for each country have over 10 000 respondents, while the eldest surveys in many cases have under 5000. This should not be a big concern for the reliability of the results but is important to note. For a detailed view of every DHS-survey

used in the thesis, including number of respondents, see appendix.

II) The estimation of absolute and relative change in inequality between maternal education levels' under-five mortality rate is done without including confidence intervals, which means that the thesis cannot conclude whether the change in absolute or relative inequalities are statistically significant or not. To know this for sure, more sophisticated and appropriate statistical tests need to be conducted, including confidence intervals, in future research on this topic.

The point of still categorizing countries into whether they have decreasing or increasing relative and absolute educational inequalities in under-five mortality rate is to reveal how the trend most likely is going. This thesis is first and foremost done for monitoring how maternal education affect under-five mortality in LMICs, how the shape of the educational gradient looks for all LMICs and give an overview of how the tendency of educational inequality related to under-five mortality is heading. In this frame I think the approach applied is feasible and provide valid results in forms of overall trends.

6.1 Negative relationship between maternal education and under-five mortality in LMICs

The thesis has observed a negative relationship between maternal education and under-five mortality, both in descriptive graphs between maternal education levels and in the four LMICs where maternal education's effect on under-five mortality have been estimated with logistic regression. This finding goes in line with the literature of Caldwell (1979; 1994), proclaiming maternal education to have an independent, negative effect on child mortality. The negative correlation between maternal education and under-five mortality is very intuitive in graph 1 and 2 in the results where every LMICs' under-five mortality rates are estimated based on *two* maternal education-levels; I) no education and primary and II) secondary and higher. Only Trinidad and Tobago show higher under-five mortality for the two highest education-levels out of the 67 and 62 LMICs from the two respective time-periods. The worse-off countries in terms of both total under-five mortality rates and inequality between the two groups of maternal education is in Sub-Saharan Africa, which is in line with UNICEF (2018) and Ruger & Kim (2006).

Estimating maternal education's effect on under-five mortality, controlled for relevant independent variables, was done by using logistic regressions for the most recent DHS-surveys from Angola, Dominican Republic, Pakistan and Niger. The most important finding from these logistic regressions was that maternal education had a significant, negative effect on under-five mortality in four LMICs with a different shape of the educational gradient in under-five mortality – giving support for this thesis' fourth hypothesis. This follows previous research confirming the independent effect of maternal education on under-five mortality, using different statistical methods (Caldwell & McDonald, 1982; Cleland & Van Ginneken, 1988; Desai & Alva, 1998; Frost et al., 2005; Grépin & Bharadwaj, 2015; Mosley & Chen, 1984; Ware, 1984).

The four LMICs revealed different shapes of their educational gradients in descriptive graphs, and these educational gradients were in large part confirmed by the logistic regressions. Dominican Republic was the only country where children born by mothers with every education level beyond no education had statistically significant lower chances of dying before their fifth birthday compared to children born by mothers with no education. The shape of the educational gradient in Dominican Republic clearly disfavors children born by mothers with no education, and the logistic regression model gives supporting evidence of this.

In Pakistan and Niger there was no statistically significant difference in the odds of under-five mortality if their mother had primary compared to no education. Niger's shape of the educational gradient in under-five mortality is also strengthened by the logistic regression model, where the elites, children born by mothers with higher education have clearly lower odds of dying before the age of five than the rest. This is also in line with Houweling & Kunst (2009) who found that the elites had clearly lower under-five mortality rates in LMICs with high overall rates of under-five mortality. The difference in odds of under-five mortality are significantly larger between no maternal education and secondary or higher than the rest in all four regression models. This may indicate that despite different shapes of the educational gradient in under-five mortality in these four LMICs, the lower educated should be the main priority for policymakers when trying to further decrease under-five mortality rates in LMICs.

Husband or partner's education level has a negative effect on under-five mortality in every country except for Angola. Dominican Republic, Pakistan and Niger go in line with previous literature saying that father's education has a negative effect on child mortality, but not as

strong as mothers' education (Breierova & Duflo, 2004; Chou et al. 2010).

The wealth index' effect on under-five mortality is estimated primarily to control for the increasing wealth that in most cases follows with increased maternal education (Cleland & Van Ginneken, 1988; Defo, 1997). We have observed that every wealth category compared to the poorest has a negative and statistically significant effect in two of the four LMICs. In Niger, only the richest category has significantly lower chances of having a child dead before the age of five than the poorest category. In Niger, as shown graphicly, the educational elite stands out with clearly lower levels of under-five mortality, and this notion it further strengthened in terms of wealth. The overall impression of the wealth index is expected and supports previous research from Barrett & Browne (1996) and Cleland & Van Ginneken (1988).

The exception is Dominican Republic, where every wealth category has higher odds of under-five mortality compared to the poorest category. This is, alike husband or partner's education level having a positive effect on under-five mortality in Angola, very surprising. One source of reason may be the way wealth is measured by the DHS. The wealth index measures the value and quality of the respondent's home, and this may not always give the valid measurement of for example purchasing power relating to health care expenditures.

Either way, the four logistic regression models give support for maternal education to be of more importance for improving child health than both husband or partner's education level and household wealth. This evidence supports Caldwell (1979) who found maternal education to be of more importance for child health than the wealth of the household. This finding goes against the conclusion of Desai & Alva (1998) who argued that maternal education work as a proxy for socio-economic status in its effect on child mortality. Bicego & Ahmad (1996) found that maternal education has stronger effect as the child grows older. This can again partly explain the lack of statistically significant effects in Desai and Alva's (1998) study of maternal education's effect on *infant* mortality, which measures under-one mortality in developing countries.

The variable age has a curvilinear relationship in three of the four countries, except for Niger. This was illustrated graphicly in Dominican Republic where the interaction between mothers' age and education level have the same curvilinear relationship with under-five mortality for

each level of education, but different starting points on the Y-axis. The difference in under-five mortality between maternal education levels are relatively consistent for every age between 15-49, which provides further strengthening of the importance maternal education has for under-five mortality in LMICs.

Lastly from the logistic regression models we observed that autonomy in health-decision making and whether the respondent visited a health facility during the last 12 months gave mixed evidence for what we would expect. Autonomy in health-decisions was only found to have a negative statistically significant effect on under-five mortality in Angola, and at the same time revealed a *positive* effect in Pakistan. Whether the respondent visited a health-facility was estimated to have a negative effect on under-five mortality in Pakistan only - and non-significant effects elsewhere. In previous research, increased maternal education is found to have negative effects on under-five mortality through intermediate health-behavior and increased autonomy in health-making decisions within the household (Caldwell, 1990; Bloom, Wypji & Gupta, 2001; Addai, 2000; Desai & Alva, 1998). Controlling for mother and husband/partner's education and household wealth may have erased the effect of both health-behavior and autonomy in health-decisions for women. In addition, outside factors of the society may play a more vital role in the autonomy of women than this thesis has controlled for (Niraula & Morgan, 1996).

6.2 Educational gradient in under-five mortality in LMICs

The negative relationship observed between maternal education and under-five mortality has been portrayed in multiple graphs showing the shape of the educational gradient in under-five mortality in LMICs. This thesis categorized each country into the same four categories as Houweling & Kunst (2009) did. We have demonstrated that most LMICs show a clear educational gradient in under-five mortality (60 out of 86 LMICs) in addition to every region measured by median-levels of under-five mortality by maternal education levels. The shape of this educational gradient reveals that for each increased level of maternal education, the child has lower chances of under-five mortality. This educational gradient in under-five mortality goes in line with Houweling & Kunst's (2009) finding of social gradients across education and wealth affecting under-five mortality in LMICs. This also gives support for Marmot's (2006) "status syndrome" – the higher social position, in this case in terms of maternal education level, the better health outcome for the child. This also indicates that educational

inequalities in under-five mortality are felt across the whole social hierarchy, not only for worse-off. Furthermore, this gives supporting evidence for the theory of fundamental causes by Link & Phelan (1995) arguing that socio-economic position is a fundamental and enduring cause of inequalities in health. Lastly, it also goes in line with Phelan et al. (2004) who found that socio-economic position have strong explanatory power of the social gradient in mortality caused by highly preventable diseases, which are exactly what causes most under-five mortalities today (Hug, Sharrow, & You, 2017).

Out of the 60 LMICs showing a shape of the educational gradient in under-five mortality which disfavors the lower educated, four LMICS reveal a shape of the educational gradient in under-five mortality where the worst-off, children born by mothers with no education, have significantly higher levels of under-five mortality than the rest. We also observed three LMICs where the elites, children born by mothers with higher education, had significantly *lower* levels of under-five mortality than the rest. There could probably be more LMICs included in the two latter categories, but the ones included stands clearly out from the rest. As an example, Angola and Mozambique are described in graph 4 to not have a linear educational gradient in under-five mortality for every education level, but still show the elites having considerably lower levels of under-five mortality than the rest. Namibia, Niger, Sierra Leone and Mozambique all reveal a divide in under-five mortality rates between the elites and the rest of the population. This follows previous research from Houweling & Kunst (2009) saying that the countries with the highest overall levels of under-five mortality, mostly in Sub-Saharan Africa, also often have a great divide between the elites and the rest of the population in under-five mortality.

The main point of categorizing and monitoring the different shapes of the educational gradient in under-five mortality in all LMICs is to have a starting-point for developing evidence-based policy interventions which are designed according to the characteristics of the inequalities of each country (Houweling & Kunst, 2009). The different educational gradients each country reveals in relation to under-five mortality strengthens Houweling & Kunst's (2009) conclusion that these inequalities are amenable for policy-interventions, both domestically and internationally. It is important to emphasize that the different educational gradients in under-five mortality is an entry into further research into what these inequalities means for each LMIC. The importance of each country's context, and what a certain social position within that context gives the individuals in terms of autonomy and participation

within *that* society is what ultimately matters, as Marmot (2006) highlights.

6.3 Decreasing under-five mortality, relative and absolute inequalities

This thesis has demonstrated that under-five mortality rates are decreasing in most LMICs and for most maternal education levels from the first time-period (1985-2000) to the second time-period (2001-2017). Great reductions of under-five mortality in LMICs only confirms what we already know from Hug et al. (2017) and Dicker et. al (2018). More noteworthy is the finding that the decrease is largest for the worst-off, namely children born by mothers with no education. Additionally, the two worst regions in terms of under-five mortality, Sub-Saharan Africa and South and Southeast Asia, also reveal the largest decreases of overall under-five mortality. This means that both within and between countries, the tendencies of educational inequalities in under-five mortality are positive. This tendency goes against previous research from Ruger & Kim (2006) who found that the most unfavorable countries in terms of under-five mortality, especially in Sub-Saharan Africa, made the least progress in reducing under-five mortality rates.

In terms of inequality, this thesis has demonstrated a trend of absolute inequalities between maternal education levels' under-five mortality rates to decline in most LMICs between the two time-periods 1985-2000 and 2001-2017. In relative terms, more countries show decreasing levels of educational inequality than increasing, but the majority of LMICs have mixed evidence on this measurement. Mackenbach (2015) argues that in a time when mortality-levels are declining in high tempo, relative inequalities are not likely to decrease. This would require a radical shift in how policies work to reduce mortality levels, and a much stronger focus on improving the health for the worst-off. In this view, the tendencies seem to go in line with what Mackenbach (2015) argues; overall under-five mortality rates are declining with high pace, together with declining absolute inequalities in under-five mortality between maternal education levels. To not observe the same reductions in relative inequalities is in this sense not too problematic. But as this thesis demonstrates; the worst-offs *are* improved at a higher pace in terms of under-five mortality in most LMICs. A policy shift to improve them even more does not necessarily need to be so radical as perhaps Mackenbach (2015) argues.

The strong tendency of declining absolute educational inequalities in under-five mortality for most LMICs, and the weaker tendency in relative measurements, is a contrast to what the theory of fundamental causes by Link and Phelan (1995) predicts, which is that social inequalities in health will persist despite changes in disease and risk-factors, because the better-off are adaptable to these changes. It is also different from the conclusion of Ruger et al. (2006) which found widening inequality gaps in child mortality – explaining this with widening gaps in variables relating to the health-sector and socio-economic position. It is also contrasting to the increasing inequalities in health reported from OECD-countries and the U.S. (Co-operation & Development, 2011; Singh & Siahpush, 2006).

The tendency found in this thesis of declining absolute educational inequality in under-five mortality is in line with Vapattanawong et al. (2007) who found decreasing inequalities in under-five mortality rates based on wealth in Thailand between 1990 and 2000. The poorest had the largest decline in under-five mortality and inequalities had gone down with over 50 % after successful and targeted policies improving the worst-off had been implemented.

7.0 Conclusion

This master thesis has monitored the development between educational inequalities and under-five mortality in LMICs from 1985-2000 till 2001-2017. No previous research has examined the development of social inequalities in LMICs over time. Maternal education has a negative relationship with under-five mortality in LMICs – and in LMICs with different shapes of the educational gradient. Educational inequalities in under-five mortality in LMICs are deep and persistent, like the theory of fundamental causes would predict (Link & Phelan, 1995; Phelan et al., 2004). Despite these findings, the thesis has also observed optimistic tendencies: Children born by the lowest educated mothers show the largest decreases of under-five mortality from the first time-period (1985-2000) till the second (2001-2017). In addition, absolute inequalities between maternal education levels' under-five mortality rates are decreasing in most LMICs observed.

The thesis has revealed that under-five mortality is educationally graded in 60 out of 86 LMICs, and in every region, disfavoring the lower educated. This means that only one level of increased maternal education decreases under-five mortality in most LMICs – which

indicates that educational inequalities concern the whole educational hierarchy. This demonstrates clearly that in order to continue the overall decrease in under-five mortality rates observed by Hug et al. (2019) and Dicker et al. (2018), in addition to reach The Millennium Development Goal by WHO of a two-third reduction in under-five mortality, the worse-off must be prioritized harder by policymakers in order to get them closer to the levels of the better-off. In a nutshell, the way to further reduce under-five mortality rates in LMICs are to reduce socio-economic inequalities – and as this thesis proves: educational inequalities in LMICs.

The different shapes of the educational gradient in under-five mortality in LMICs are a key starting point for further research into what these inequalities mean for each group within society, and to investigate the importance of education – and other socio-economic, geographical, religious and ethnical determinants of child mortality in LMICs. Each country has its own context which influence what a certain social position means in terms of health, as Marmot (2006) argues. By doing this, evidence-based policies aiming to reduce inequalities in child mortality can be implemented with success, as Vapattanawong et al. (2007) demonstrated in Thailand.

Literature

Abuya, B., Onsomu, E., Kimani, J., & Moore, D. (2011). Influence of maternal education on child immunization and stunting in Kenya. *Maternal and child health journal, 15*(8), 1389-1399.

Achen, C. H. (2000). *Why lagged dependent variables can suppress the explanatory power of other independent variables.* Paper presented at the annual meeting of the political methodology section of the American political science association, UCLA.

Addai, I. (2000). Determinants of use of maternal–child health services in rural Ghana. *Journal of biosocial science, 32*(1), 1-15.

Babalola, S., & Fatusi, A. (2009). Determinants of use of maternal health services in Nigeria-looking beyond individual and household factors. *BMC pregnancy and childbirth*

9(1), 43.

Barrett, H., & Browne, A. (1996). Health, hygiene and maternal education: Evidence from The Gambia. *Social Science & Medicine, 43*(11), 1579-1590.

Bicego, G., & Ahmad, O. B. (1996). Infant and child mortality. *Demographic and Health Surveys Comparative Studies*(20).

Bloom, S. S., Wypij, D., & Gupta, M. D. J. D. (2001). Dimensions of women's autonomy and the influence on maternal health care utilization in a north Indian city. *Demography, 38*(1), 67-78.

Breierova, L., & Duflo, E. (2004). *The impact of education on fertility and child mortality: Do fathers really matter less than mothers?* (NBER Working Paper No. 10513). Retrieved from https://www.nber.org/papers/w10513

Cai, L., & Chongsuvivatwong, V. J. (2006). Rural-urban differentials of premature mortality burden in south-west China. *International Journal for Equity in Health, 5*(1), 13.

Caldwell, J. (1990). Cultural and social factors influencing mortality levels in developing countries. *The Annals of the American Academy of Political Social Science, 510*(1), 44-59.

Caldwell, J. (1994). How is greater maternal education translated into lower child mortality? *Health transition review, 4*(2), 224-229.

Caldwell, J., & Caldwell, P. (1987). The cultural context of high fertility in sub-Saharan Africa. *Population development review*

13(3), 409-437.

Caldwell, J., & McDonald, P. J. (1982). Influence of maternal education on infant and child mortality: levels and causes. *Health policy education, 2*(3-4), 251-267.

Chou, S.-Y., Liu, J.-T., Grossman, M., & Joyce, T. J. (2010). Parental education and child health: evidence from a natural experiment in Taiwan. *American Economic Journal: Applied Economics, 2*(1), 33-61.

Christiaensen, L., & Alderman, H. (2004). Child malnutrition in Ethiopia: can maternal knowledge augment the role of income? *Economic Development and cultural change, 52*(2), 287-312.

Cleland, J. G., & Van Ginneken, J. K. (1988). Maternal education and child survival in developing countries: the search for pathways of influence. *Social Science and Medicine, 27*(12), 1357-1368.

Curtis, V., & Cairncross, S. J. (2003). Effect of washing hands with soap on diarrhoea risk in the community: a systematic review. *The Lancet infectious diseases, 3*(5), 275-281.

Defo, B. K. (1997). Effects of socioeconomic disadvantage and women's status on women's health in Cameroon. *Social Science & Medicine, 44*(7), 1023-1042.

Desai, S., & Alva, S. J. (1998). Maternal education and child health: Is there a strong causal relationship? *Demography, 35*(1), 71-81.

Development, O. f. E. C.-o. (2011). *Divided we stand: why inequality keeps rising*. Paris: OECD.

DHS. (2019a). The DHS program STATcompiler. Funded by US AID. . Retrieved from https://www.statcompiler.com/en/

DHS. (2019b). What we do. Retrieved from https://www.dhsprogram.com/What-We-Do/index.cfm

Dicker, D., Nguyen, G., Abate, D., Abate, K. H., Abay, S. M., Abbafati, C., . . . Abdela, J. J. (2018). Global, regional, and national age-sex-specific mortality and life expectancy, 1950–2017: a systematic analysis for the Global Burden of Disease Study 2017. *The lancet, 392*(10159), 1684-1735.

Dye, C. J. (2008). Health and urban living. *Science, 319*(5864), 766-769.

Eikemo, T. A., Skalická, V., & Avendano, M. J. (2009). Variations in relative health inequalities: are they a mathematical artefact? *International Journal for Equity in Health, 8*(1), 32.

Erikson, R. J. (2001). Why do graduates live longer? Education, occupation, family and mortality during the 1990s. In J. M. Jonsson, C (Ed.), *Cradle to grave. Life-course change in modern Sweden* (pp. 211-227). Durham, NC: Sociology Press.

Evans, T., Whitehead, M., & Diderichsen, F. (2001). *Challenging inequities in health: from ethics to action*: Oxford University Press.

Fernandez, R. (1984). *Analysis of information about mother-child care taken from fertility surveys in Latin America*. Voorburg: International Statistical Institute.

Fotso, J.-C. (2006). Child health inequities in developing countries: differences across urban and rural areas. *International Journal for Equity in Health, 5*(1), 9.

Frost, M. B., Forste, R., & Haas, D. W. (2005). Maternal education and child nutritional status in Bolivia: finding the links. *Social Science & Medicine, 60*(2), 395-407.

Gould, W. T. J. (1998). African mortality and the newurban penalty'. *Health place, 4*(2), 171-181.

Grépin, K. A., & Bharadwaj, P. J. (2015). Maternal education and child mortality in Zimbabwe. *Journal of health economics, 44*, 97-117.

Guerrant, R. L., Oriá, R. B., Moore, S. R., Oriá, M. O., & Lima, A. A. (2008). Malnutrition as an enteric infectious disease with long-term effects on child development. *Nutrition Reviews, 66*(9), 487-505.

Güneş, P. M. J. (2015). The role of maternal education in child health: Evidence from a compulsory schooling law. *Economics of Education Review, 47*, 1-16.

Harper, S., King, N. B., Meersman, S. C., Reichman, M. E., Breen, N., & Lynch, J. J. (2010). Implicit value judgments in the measurement of health inequalities. *The Milbank Quarterly, 88*(1), 4-29.

Heaton, T. B., & Forste, R. J. (2003). Rural/urban differences in child growth and survival in Bolivia. *Rural Sociology, 68*(3), 410-433.

Hobcraft, J. (1993). Women's education, child welfare and child survival: a review of the evidence. *Healt transition review, 3*(2).

Hobcraft, J., McDonald, J. W., & Rutstein, S. (1984). Socio-economic factors in infant and child mortality: a cross-national comparison. *Population studies, 38*(2), 193-223.

Houweling, T. A., & Kunst, A. E. J. (2009). Socio-economic inequalities in childhood mortality in low-and middle-income countries: a review of the international evidence. *British medical bulletin, 93*(1), 7-26.

Hug, L., Sharrow, D., & You, D. (2017). Levels & trends in child mortality: report 2017. Estimates developed by the UN Inter-agency Group for Child Mortality Estimation.

ICF. (2012-2018). *Demographic and Health Surveys (various) [Datasets]. Funded by USAID.*

Jong-wook, L. J. (2005). Public health is a social issue. *The lancet, 365*(9464), 1005-1006.

Kadushin, C. J. (1964). Social class and the experience of ill health. *Sociological Inquiry, 34*(1), 67-80.

Link, B. G., & Phelan, J. (1995). Social conditions as fundamental causes of disease. *Journal of health social behavior*, 80-94.

Mackenbach, J. P. (2015). Should we aim to reduce relative or absolute inequalities in mortality? *European Journal of Public Health, 25*(2).

Marmot, M. (2006). Status syndrome: a challenge to medicine. *Significance, 295*(11), 1304-1307.

Marmot, M., Rose, G., Shipley, M., & Hamilton, P. (1978). Employment grade and coronary heart disease in British civil servants. *Journal of Epidemiology Community Health, 32*(4), 244-249.

Mehmetoglu, M., & Jakobsen, T. G. (2016). *Applied statistics using Stata: a guide for the social sciences*: Sage.

Mensch, B., Lentzner, H., & Preston, S. (1985). *Socio-Economic Differentials in Child Mortality in Developing Countries*. United Nations, New York

Monteiro, C. A., Benicio, M. H. D. A., Conde, W. L., Konno, S., Lovadino, A. L., Barros, A. J., & Victora, C. G. J. (2010). Narrowing socioeconomic inequality in child stunting: the Brazilian experience, 1974-2007. *Bulletin of the World Health Organization, 88*, 305-311.

Morris, S. S., Black, R. E., & Tomaskovic, L. J. (2003). Predicting the distribution of under-five deaths by cause in countries without adequate vital registration systems. *International Journal of Epidemiology, 32*(6), 1041-1051.

Moses, J., & Knutsen, T. (2012). *Ways of knowing: competing methodologies in social and political research*: Macmillan International Higher Education.

Mosley, W. H., & Chen, L. C. (1984). An analytical framework for the study of child survival in developing countries. *Population development review, 10*(0), 25-45.

Ndong, I., Gloyd, S., & Gale, J. J. (1994). An evaluation of vital registers as sources of data for infant mortality rates in Cameroon. *International Journal of Epidemiology, 23*(3), 536-539.

Niraula, B. B., & Morgan, S. P. J. (1996). Marriage formation, post-marital contact with natal kin and autonomy of women: evidence from two Nepali settings. *Population studies, 50*(1), 35-50.

Phelan, J. C., Link, B. G., Diez-Roux, A., Kawachi, I., & Levin, B. J. (2004). "Fundamental causes" of social inequalities in mortality: a test of the theory. *Journal of health social behavior, 45*(3), 265-285.

Ruger, J. P., & Kim, H.-J. J. (2006). Global health inequalities: an international comparison. *Journal of epidemiology community health*

60(11), 928-936.

Singh, G. K., & Siahpush, M. (2006). Widening socioeconomic inequalities in US life expectancy, 1980–2000. *International Journal of Epidemiology, 35*(4), 969-979.

Streatfield, K., Singarimbun, M., & Diamond, I. J. (1990). Maternal education and child immunization. *Demography, 27*(3), 447-455.

UNIGME. (2018). *Levels & Trends in Child Mortality: Report 2018*. Retrieved from https://www.unicef.org/publications/index_103264.html:

Van de Poel, E., O'Donnell, O., & Van Doorslaer, E. (2007). Are urban children really healthier? Evidence from 47 developing countries. *Social science medicine*

65(10), 1986-2003.

Vapattanawong, P., Hogan, M. C., Hanvoravongchai, P., Gakidou, E., Vos, T., Lopez, A. D., & Lim, S. S. J. (2007). Reductions in child mortality levels and inequalities in Thailand: analysis of two censuses. *The lancet, 369*(9564), 850-855.

Victora, C. G., Wagstaff, A., Schellenberg, J. A., Gwatkin, D., Claeson, M., & Habicht, J.-P. J. (2003). Applying an equity lens to child health and mortality: more of the same is not enough. *The lancet, 362*(9379), 233-241.

Wagstaff, A., Bustreo, F., Bryce, J., Claeson, M., Health, W. W. B. C., & J, P. W. G. (2004). Child health: reaching the poor. *American journal of public health, 94*(5), 726-736.

Ware, H. J. (1984). Effects of maternal education, women's roles, and child care on child mortality. *Population development review, 10*, 191-214.

Wilkinson, R. G. J. (1997). Socioeconomic determinants of health: Health inequalities: relative or absolute material standards? *The Bmj, 314*(7080), 591.

World Bank. (1997). *Health, Nutrition, and Population Sector Strategy*: World Bank.

Zeitlin, M. F., Ghassemi, H., Mansour, M., Levine, R. A., Dillanneva, M., Carballo, M., & Sockalingam, S. (1990). *Positive deviance in child nutrition: with emphasis on psychosocial and behavioural aspects and implications for development*: United Nations University Tokyo.

Appendices

A1: Data material for monitoring inequalities in child mortality

	DHS 1985-2000	DHS 2001-2017
Indicator	Under-five mortality rate	
Measure	Rate	Rate
Number of countries	62	67
Group	Infant and Child Mortality. Early childhood mortality rate	
Definition	Probability of dying before the fifth birthday in the ten years preceeding the survey, per 1000 live births. Estimates are given for ten year periods for all charachterstics	
Denominator	Per thousand children exposed in period in age group	
Characteristic	Maternal education level. “No education”, “primary”, “secondary” and “higher”	

A2: LMICs and DHS surveys used. Respondents are women between the age of 15 and 49

Region/country	Year of survey	Number of respondents
Sub Saharan Africa		
Angola	2015-16	14379
Benin	1996	5491
Benin	2011-12	16599
Botswana	1988	4368
Burkina Faso	1998-99	6445
Burkina Faso	2010	17087
Burundi	1987	3970
Burundi	2016-17	17269
Cameroon	1998	5501
Cameroon	2011	15426
Central African Republic	1994-95	5884
Chad	1996-97	7454
Chad	2014-15	17719
Comoros	1996	3050
Comoros	2012	5329
Congo	2011-12	10819
Congo Democratic Republic	2013-14	18827
Cote d'Ivoire	1998-99	3040
Cote d'Ivoire	2011-12	10060
Eritrea	1995	5054
Eritrea	2002	8754
Ethiopia	2000	15367
Ethiopia	2016	15683
Gabon	2000	6183
Gabon	2012	8422
Gambia	2013	10233
Ghana	1998	4843
Ghana	2014	9396
Guinea	1999	6753
Guinea	2012	9142
Kenya	1998	7881
Kenya	2014	31079
Lesotho	2014	6621
Liberia	1986	5239
Madagascar	1997	7060
Madagascar	2008-09	17375
Malawi	2000	13220
Malawi	2015-16	4562
Mali	1995-96	9704
Mali	2012-13	10424

Mauritania	2000-01	7728
Mozambique	1997	8779
Mozambique	2011	13745
Namibia	2000	6755
Namibia	2013	9176
Niger	1998	7577
Niger	2012	11160
Nigeria	1990	8781
Nigeria	2013	38948
Rwanda	2000	10421
Rwanda	2014-15	13497
Sao Tome and Principe	2008-09	2615
Senegal	1997	8593
Senegal	2017	16787
Sierra Leone	2013	16658
South Africa	1998	11735
South Africa	2016	8514
Sudan	1989-90	5860
Tanzania	1999	4029
Tanzania	2015-16	13266
Togo	1998	8569
Togo	2013-14	9480
Uganda	2000-01	7246
Uganda	2016	18506
Zambia	1996	8021
Zambia	2013-14	16411
Zimbabwe	1999	5907
Zimbabwe	2015	9955

North Africa/West Asia/Europe

Albania	2008-09	7584
Armenia	2000	6430
Armenia	2015-16	6116
Azerbaijan	2006	8444
Egypt	2000	15573
Egypt	2014	21762
Jordan	1997	5548
Jordan	2012	11352
Moldova	2005	7440
Morocco	1992	9256
Morocco	2003-04	16798
Tunisia	1988	4184
Turkey	1998	8576
Turkey	2003	8075
Ukraine	2007	6841
Yemen	1997	10414
Yemen	2013	25343

Central Asia		
Kazakhstan	1999	4800
Kyrgyz Republic	1997	3848
Kyrgyz Republic	2012	8208
Tajikistan	2017	10718
Turkmenistan	2000	7919
Uzbekistan	1996	4415
South & Southeast Asia		
Afghanistan		
Bangladesh	1999-00	10544
Bangladesh	2014	17863
Cambodia	2000	15351
Cambodia	2014	17578
India	1998-99	90303
India	2015-16	699686
Indonesia	1997	28810
Indonesia	2012	45607
Maldives	2009	7131
Myanmar	2015-16	12885
Nepal	1996	8429
Nepal	2016	12862
Pakistan	1990-91	6611
Pakistan	2012-13	13558
Philippines	1998	13983
Philippines	2017	25074
Sri Lanka	1987	5865
Thailand	1987	6675
Timor-Leste	2009-10	13137
Vietnam	1997	5664
Vietnam	2002	5665
Latin America & Caribbean		
Bolivia	1998	11187
Bolivia	2008	16939
Brazil	1996	12612
Colombia	2000	11585
Colombia	2015	38718
Dominican Republic	1999	1286
Domincan Republic	2013	9372
Ecuador	1987	4713
El Salvador	1985	5207
Guatemala	1998-99	6021
Guatemala	2014-15	25914
Guyana	2009	4996
Haiti	2000	10159
Haiti	2016-17	14371
Honduras	2011-12	22757

Mexico	1987	9310
Nicaragua	1998	13634
Nicaragua	2001	13060
Paraguay	1990	5827
Peru	2000	27843
Peru	2012	23888
Trinidad and Tobago	1987	3806

A3: LMICs' values on under-five mortality rate (per 1000 live births, by maternal education levels (1985-2000 DHS)

Country	Survey	No education	Primary	Secondary	Higher
Armenia	2000 DHS			53 (CI: 44 – 62)	22 (CI: 6 – 37)
Bangladesh	1999-00 DHS	130 (CI: 121 – 140)	100 (CI: 88 – 111)	73 (CI: 62 – 84)	32 (CI: 14 – 49)
Benin	1996 DHS	194 (CI: 181 – 206)	163 (CI: 140 – 187)	81 (CI: 52 – 110)	
Bolivia	1998 DHS	154 (CI: 133 – 174)	116 (CI: 106 – 126)	61 (CI: 52 – 71)	26 (CI: 16 – 37)
Botswana	1988 DHS	62 (CI: 49 – 75)	53 (CI: 44 – 63)	42 (CI: 28 – 57)	85 (CI: 28 – 143)
Brazil	1996 DHS	119 (CI: 98 – 140)	67 (CI: 59 – 75)	40 (CI: 33 – 47)	9 (CI: 0 – 18)
Burkina Faso	1998-99 DHS	230 (CI: 216 – 243)	170 (CI: 136 – 204)	101 (CI: 68 – 134)	81 (CI: -30 – 192)
Burundi	1987 DHS	191 (CI: 175 – 207)	154 (CI: 126 – 182)	62 (CI: 27 – 97)	283 (CI: -52 – 619)
Cambodia	2000 DHS	135 (CI: 124 – 147)	122 (CI: 114 – 131)	76 (CI: 61 – 91)	
Cameroon	1998 DHS	198 (CI: 177 – 220)	128 (CI: 112 – 143)	91 (CI: 75 – 106)	56 (CI: -12 – 125)
Central African Republic	1994-95 DHS	175 (CI: 161 – 189)	159 (CI: 143 – 174)	84 (CI: 65 – 103)	75 (CI: -10 – 159)
Chad	1996-97 DHS	205 (CI: 192 – 219)	189 (CI: 171 – 207)	135 (CI: 100 – 170)	60 (CI: -63 – 183)
Colombia	2000 DHS	44 (CI: 23 – 65)	33 (CI: 27 – 39)	24 (CI: 19 – 29)	15 (CI: 5 – 25)
Comoros	1996 DHS	121 (CI: 105 – 136)	98 (CI: 74 – 122)	75 (CI: 49 – 102)	50 (CI: -52 – 152)
Cote d'Ivoire	1998-99 DHS	193 (CI: 160 – 225)	153 (CI: 123 – 184)	78 (CI: 50 – 107)	101 (CI: -41 – 244)
Dominican Republic	1999 DHS	39 (CI: -9 – 86)	64 (CI: 44 – 83)	32 (CI: 10 – 55)	2 (CI: -2 – 7)
Ecuador	1987 DHS	159 (CI: 113 – 205)	93 (CI: 82 – 104)	54 (CI: 41 – 67)	27 (CI: 9 – 44)
Egypt	2000 DHS	89 (CI: 82 – 96)	74 (CI: 63 – 85)	43 (CI: 37 – 49)	29 (CI: 20 – 38)
El Salvador	1985 DHS	127 (CI: 104 – 150)	77 (CI: 66 – 88)	31 (CI: 13 – 49)	24 (CI: -7 – 54)
Eritrea	1995 DHS	158 (CI: 144 – 172)	135 (CI: 100 – 171)	105 (CI: 77 – 133)	44 (CI: -27 – 115)
Ethiopia	2000 DHS	197 (CI: 187 – 208)	147 (CI: 123 – 171)	89 (CI: 52 – 126)	93 (CI: 23 – 163)
Gabon	2000 DHS	112 (CI: 78 – 146)	93 (CI: 81 – 106)	90 (CI: 77 – 102)	47 (CI: 7 – 87)
Ghana	1998 DHS	131 (CI: 115 – 147)	112 (CI: 90 – 135)	88 (CI: 74 – 101)	71 (CI: 11 – 130)
Guatemala	1998-99 DHS	79 (CI: 65 – 92)	60 (CI: 49 – 71)	36 (CI: 5 – 68)	85 (CI: -51 – 221)
Guinea	1999 DHS	204 (CI: 193 – 215)	162 (CI: 131 – 193)	112 (CI: 85 – 139)	79 (CI: 32 – 127)

Haiti	2000 DHS	150 (CI: 137 – 164)	140 (CI: 119 – 162)	75 (CI: 56 – 94)	51 (CI: -1 – 103)
India	1998-99 DHS	124 (CI: 121 – 128)	86 (CI: 81 – 91)	55 (CI: 51 – 59)	36 (CI: 30 – 41)
Indonesia	1997 DHS	108 (CI: 92 – 124)	79 (CI: 72 – 86)	38 (CI: 32 – 43)	12 (CI: 5 – 19)
Jordan	1997 DHS	62 (CI: 44 – 81)	41 (CI: 31 – 51)	31 (CI: 27 – 36)	24 (CI: 16 – 31)
Kazakhstan	1999 DHS			65 (CI: 51 – 79)	55 (CI: 30 – 80)
Kenya	1998 DHS	122 (CI: 98 – 147)	118 (CI: 103 – 133)	61 (CI: 48 – 73)	49 (CI: 9 – 88)
Kyrgyz Republic	1997 DHS		256 (CI: -419 – 930)	79 (CI: 67 – 91)	56 (CI: 34 – 77)
Madagascar	1997 DHS	197 (CI: 173 – 221)	172 (CI: 155 – 188)	106 (CI: 92 – 121)	65 (CI: -6 – 137)
Malawi	2000 DHS	214 (CI: 203 – 226)	203 (CI: 192 – 213)	119 (CI: 94 – 144)	
Mali	1995-96 DHS	265 (CI: 254 – 276)	205 (CI: 181 – 229)	105 (CI: 78 – 132)	
Mauritania	2000-01 DHS	110 (CI: 95 – 126)	76 (CI: 59 – 92)	95 (CI: 68 – 121)	8 (CI: -8 – 24)
Mexico	1987 DHS	115 (CI: 97 – 133)	71 (CI: 61 – 82)	31 (CI: 19 – 43)	12 (CI: 2 – 23)
Morocco	1992 DHS	91 (CI: 81 – 102)	60 (CI: 45 – 76)	24 (CI: 12 – 36)	12 (CI: -12 – 35)
Mozambique	1997 DHS	229 (CI: 200 – 257)	214 (CI: 189 – 239)	124 (CI: 4 – 244)	39 (CI: -56 – 134)
Namibia	2000 DHS	84 (CI: 57 – 110)	66 (CI: 53 – 79)	48 (CI: 37 – 59)	39 (CI: 3 – 75)
Nepal	1996 DHS	149 (CI: 139 – 159)	99 (CI: 76 – 123)	65 (CI: 47 – 83)	25 (CI: -11 – 61)
Nicaragua	1998 DHS	82 (CI: 71 – 92)	56 (CI: 50 – 62)	36 (CI: 29 – 42)	20 (CI: 4 – 36)
Niger	1998 DHS	314 (CI: 297 – 330)	225 (CI: 190 – 261)	134 (CI: 87 – 182)	37 (CI: -39 – 113)
Nigeria	1990 DHS	211 (CI: 186 – 235)	161 (CI: 142 – 180)	120 (CI: 92 – 147)	56 (CI: 8 – 103)
Pakistan	1990-91 DHS	128 (CI: 115 – 142)	107 (CI: 78 – 136)	69 (CI: 45 – 93)	14 (CI: -3 – 31)
Paraguay	1990 DHS	78 (CI: 48 – 107)	50 (CI: 42 – 58)	34 (CI: 24 – 44)	5 (CI: -2 – 12)
Peru	2000 DHS	106 (CI: 93 – 119)	76 (CI: 70 – 83)	40 (CI: 34 – 45)	24 (CI: 18 – 31)
Philippines	1998 DHS	136 (CI: 90 – 181)	73 (CI: 65 – 81)	46 (CI: 40 – 52)	28 (CI: 22 – 35)
Rwanda	2000 DHS	233 (CI: 219 – 246)	200 (CI: 187 – 213)	117 (CI: 96 – 138)	105 (CI: -6 – 216)
Senegal	1997 DHS	154 (CI: 144 – 165)	96 (CI: 79 – 113)	58 (CI: 36 – 81)	25 (CI: -15 – 64)
South Africa	1998 DHS	84 (CI: 66 – 101)	67 (CI: 55 – 79)	48 (CI: 41 – 55)	29 (CI: 11 – 47)
Sri Lanka	1987 DHS	72 (CI: 55 – 89)	43 (CI: 34 – 52)	41 (CI: 34 – 49)	26 (CI: 18 – 35)
Sudan	1989-90 DHS	152 (CI: 141 – 162)	108 (CI: 95 – 122)	87 (CI: 70 – 103)	53 (CI: -4 – 111)

Tanzania	1999 DHS	165 (CI: 134 – 197)	164 (CI: 144 – 183)	61 (CI: 24 – 98)	250 (CI: ?)
Thailand	1987 DHS	76 (CI: 57 – 95)	49 (CI: 40 – 58)	14 (CI: 5 – 22)	34 (CI: -8 – 77)
Togo	1998 DHS	159 (CI: 150 – 168)	127 (CI: 114 – 140)	83 (CI: 62 – 104)	65 (CI: -66 – 195)
Trinidad and Tobago	1987 DHS	69 (CI: -75 – 213)	29 (CI: 21 – 36)	40 (CI: 26 – 54)	40 (CI: -15 – 95)
Tunisia	1988 DHS	84 (CI: 72 – 96)	61 (CI: 49 – 74)	40 (CI: 22 – 58)	31 (CI: -5 – 67)
Turkey	1998 DHS	84 (CI: 70 – 98)	56 (CI: 47 – 66)	30 (CI: 16 – 45)	39 (CI: 5 – 73)
Turkmenistan	2000 DHS	133 (CI: 61 – 206)	30 (CI: -14 – 73)	90 (CI: 81 – 99)	67 (CI: 40 – 95)
Uganda	2000-01 DHS	187 (CI: 169 – 204)	154 (CI: 142 – 166)	97 (CI: 75 – 118)	73 (CI: 33 – 113)
Uzbekistan	1996 DHS			55 (CI: 45 – 66)	55 (CI: 32 – 77)
Vietnam	1997 DHS	74 (CI: 56 – 91)	58 (CI: 43 – 74)	37 (CI: 29 – 44)	34 (CI: -14 – 82)
Yemen	1997 DHS	126 (CI: 117 – 135)	92 (CI: 78 – 105)	75 (CI: 56 – 94)	31 (CI: 2 – 61)
Zambia	1996 DHS	222 (CI: 201 – 243)	201 (CI: 190 – 212)	144 (CI: 126 – 163)	125 (CI: 62 – 188)
Zimbabwe	1999 DHS	119 (CI: 85 – 152)	94 (CI: 79 – 109)	82 (CI: 68 – 95)	21 (CI: -4 – 46)

A4: LMICs values on under-five mortality rate (per 1000 live births, by maternal education levels (2001-2017 DHS)

Country	Survey	No education	Primary	Secondary	Higher
Afghanistan	2015 DHS	65 (CI: 58 – 71)	46 (CI: 35 – 58)	45 (CI: 31 – 59)	20 (CI: 5 – 34)
Angola	2015-16 DHS	80 (CI: 70 – 90)	98 (CI: 87 – 109)	55 (CI: 45 – 64)	18 (CI: -5 – 42)
Armenia	2015-16 DHS		15 (CI: 0 – 33)	12 (CI: 6 – 17)	9 (CI: 5 – 14)
Azerbaijan	2006 DHS	68 (CI: -16 – 152)	56 (CI: -19 – 130)	60 (CI: 48 – 71)	45 (CI: 14 – 76)
Bangladesh	2014 DHS	63 (CI: 52 – 75)	60 (CI: 51 – 70)	49 (CI: 42 – 55)	24 (CI: 14 – 34)
Benin	2011-12 DHS	80 (CI: 74 – 86)	61 (CI: 51 – 71)	58 (CI: 44 – 71)	16 (CI: -7 – 38)
Bolivia	2008 DHS	134 (CI: 107 – 161)	87 (CI: 79 – 95)	50 (CI: 42 – 59)	28 (CI: 18 – 37)
Burkina Faso	2010 DHS	156 (CI: 147 – 164)	110 (CI: 96 – 124)	65 (CI: 48 – 81)	31 (CI: -15 – 77)
Burundi	2016-17 DHS	92 (CI: 85 – 100)	75 (CI: 68 – 82)	46 (CI: 34 – 59)	57 (CI: -38 – 151)
Cambodia	2014 DHS	79 (CI: 61 – 98)	46 (CI: 40 – 53)	30 (CI: 22 – 38)	17 (CI: -1 – 36)
Cameroon	2011 DHS	175 (CI: 162 – 189)	125 (CI: 115 – 136)	79 (CI: 70 – 88)	52 (CI: 25 – 79)
Chad	2014-15 DHS	140 (CI: 131 – 148)	179 (CI: 152 – 206)	135 (CI: 113 – 158)	63 (CI: 16 – 110)
Colombia	2015 DHS	65 (CI: 35 – 95)	24 (CI: 19 – 29)	17 (CI: 14 – 21)	13 (CI: 8 – 17)
Comoros	2012 DHS	50 (CI: 36 – 65)	62 (CI: 46 – 77)	42 (CI: 27 – 57)	6 (CI: 0 – 13)
Congo	2011-12 DHS	106 (CI: 85 – 128)	93 (CI: 80 – 106)	75 (CI: 64 – 85)	41 (CI: 6 – 77)
Congo Democratic Republic	2013-14 DHS	122 (CI: 106 – 138)	122 (CI: 113 – 132)	93 (CI: 84 – 101)	45 (CI: 18 – 73)
Cote d'Ivoire	2011-12 DHS	124 (CI: 111 – 136)	109 (CI: 92 – 126)	76 (CI: 56 – 96)	65 (CI: 6 – 124)
Dominican Republic	2013 DHS	91 (CI: 48 – 134)	35 (CI: 25 – 45)	33 (CI: 24 – 43)	27 (CI: 16 – 39)
Egypt	2014 DHS	41 (CI: 34 – 48)	34 (CI: 26 – 42)	28 (CI: 25 – 32)	19 (CI: 13 – 25)
Eritrea	2002 DHS	121 (CI: 110 – 131)	83 (CI: 71 – 95)	63 (CI: 42 – 84)	13 (CI: -13 – 39)
Eswatini	2006-07 DHS	150 (CI: 113 – 186)	105 (CI: 89 – 122)	100 (CI: 86 – 115)	53 (CI: 29 – 77)
Ethiopia	2016 DHS	86 (CI: 76 – 95)	74 (CI: 62 – 87)	54 (CI: 29 – 78)	42 (CI: 8 – 77)
Gabon	2012 DHS	70 (CI: 31 – 109)	66 (CI: 55 – 77)	62 (CI: 51 – 73)	55 (CI: 11 – 99)
Gambia	2013 DHS	69 (CI: 60 – 78)	67 (CI: 50 – 84)	37 (CI: 27 – 48)	36 (CI: 8 – 63)
Ghana	2014 DHS	92 (CI: 80 – 104)	72 (CI: 58 – 87)	55 (CI: 46 – 63)	48 (CI: 11 – 85)
Guatemala	2014-15 DHS	55 (CI: 46 – 64)	38 (CI: 34 – 42)	24 (CI: 19 – 30)	13 (CI: 5 – 20)
Guinea	2012 DHS	139 (CI: 127 – 151)	126 (CI: 100 – 152)	68 (CI: 48 – 88)	51 (CI: 2 – 99)
Guyana	2009 DHS	62 (CI: 20 – 105)	48 (CI: 34 – 61)	36 (CI: 26 – 46)	30 (CI: 4 – 57)
Haiti	2016-17 DHS	103 (CI: 88 – 117)	90 (CI: 76 – 104)	60 (CI: 52 – 69)	52 (CI: 20 – 84)
Honduras	2011-12 DHS	29 (CI: 20 – 38)	31 (CI: 27 – 34)	24 (CI: 19 – 29)	39 (CI: 21 – 58)
India	2015-16 DHS	69 (CI: 68 – 71)	60 (CI: 57 – 62)	39 (CI: 38 – 41)	23 (CI: 20 – 25)
Indonesia	2012 DHS	96 (CI: 74 – 118)	60 (CI: 53 – 66)	32 (CI: 28 – 36)	18 (CI: 12 – 25)
Jordan	2012 DHS	16 (CI: 5 – 27)	24 (CI: 14 – 35)	23 (CI: 16 – 29)	15 (CI: 10 – 20)
Kenya	2014 DHS	51 (CI: 44 – 57)	60 (CI: 55 – 64)	54 (CI: 45 – 62)	40 (CI: 26 – 55)

Kyrgyz Republic	2012 DHS		63 (CI: -40 – 165)	34 (CI: 27 – 41)	31 (CI: 24 – 39)
Lesotho	2014 DHS	95 (CI: 23 – 168)	103 (CI: 89 – 118)	82 (CI: 67 – 98)	58 (CI: 26 – 90)
Liberia	2013 DHS	122 (CI: 109 – 135)	111 (CI: 96 – 126)	100 (CI: 81 – 120)	73 (CI: 28 – 118)
Madagascar	2008-09 DHS	97 (CI: 85 – 110)	85 (CI: 78 – 92)	55 (CI: 46 – 65)	24 (CI: 4 – 45)
Malawi	2015-16 DHS	79 (CI: 69 – 89)	78 (CI: 73 – 83)	58 (CI: 51 – 65)	48 (CI: 13 – 83)
Maldives	2009 DHS	47 (CI: 29 – 65)	28 (CI: 22 – 34)	14 (CI: 7 – 20)	
Mali	2012-13 DHS	106 (CI: 97 – 115)	120 (CI: 97 – 143)	62 (CI: 39 – 84)	24 (CI: 0 – 58)
Moldova	2005 DHS			28 (CI: 21 – 35)	20 (CI: 9 – 32)
Morocco	2003-04 DHS	63 (CI: 56 – 70)	42 (CI: 33 – 52)	26 (CI: 18 – 34)	32 (CI: 14 – 50)
Mozambique	2011 DHS	109 (CI: 98 – 119)	113 (CI: 103 – 122)	82 (CI: 67 – 96)	45 (CI: -14 – 104)
Myanmar	2015-16 DHS	108 (CI: 86 – 131)	75 (CI: 64 – 86)	44 (CI: 34 – 55)	29 (CI: 10 – 49)
Namibia	2013 DHS	76 (CI: 54 – 99)	71 (CI: 57 – 86)	55 (CI: 47 – 62)	24 (CI: 4 – 44)
Nepal	2016 DHS	60 (CI: 51 – 68)	43 (CI: 33 – 52)	34 (CI: 26 – 42)	21 (CI: 9 – 33)
Nicaragua	2001 DHS	72 (CI: 62 – 81)	43 (CI: 37 – 49)	26 (CI: 20 – 33)	19 (CI: 7 – 30)
Niger	2012 DHS	158 (CI: 150 – 167)	121 (CI: 103 – 139)	97 (CI: 65 – 128)	10 (CI: -5 – 24)
Nigeria	2013 DHS	180 (CI: 169 – 191)	128 (CI: 118 – 137)	91 (CI: 84 – 98)	62 (CI: 50 – 75)
Pakistan	2012-13 DHS	112 (CI: 103 – 121)	93 (CI: 77 – 110)	63 (CI: 51 – 76)	36 (CI: 24 – 48)
Peru	2012 DHS	43 (CI: 28 – 57)	33 (CI: 28 – 39)	20 (CI: 16 – 25)	18 (CI: 10 – 25)
Philippines	2017 DHS	59 (CI: 24 – 94)	47 (CI: 37 – 57)	26 (CI: 21 – 31)	16 (CI: 11 – 20)
Rwanda	2014-15 DHS	89 (CI: 76 – 102)	65 (CI: 59 – 70)	43 (CI: 29 – 56)	15 (CI: 3 – 27)
Sao Tome and Principe	2008-09 DHS	138 (CI: 87 – 190)	72 (CI: 58 – 86)	49 (CI: 23 – 76)	
Senegal	2017 DHS	71 (CI: 66 – 76)	38 (CI: 31 – 45)	37 (CI: 27 – 46)	19 (CI: 0 – 41)
Sierra Leone	2013 DHS	180 (CI: 171 – 190)	167 (CI: 149 – 186)	155 (CI: 137 – 173)	79 (CI: 44 – 114)
South Africa	2016 DHS	29 (CI: 0 – 57)	75 (CI: 48 – 102)	49 (CI: 40 – 57)	45 (CI: 14 – 76)
Tajikistan	2017 DHS	62 (CI: 22 – 101)	31 (CI: 12 – 49)	34 (CI: 29 – 38)	29 (CI: 20 – 38)
Tanzania	2015-16 DHS	83 (CI: 71 – 94)	79 (CI: 72 – 86)	63 (CI: 48 – 78)	12 (CI: -3 – 28)
Timor-Leste	2016 DHS	48 (CI: 40 – 57)	43 (CI: 31 – 54)	36 (CI: 30 – 42)	26 (CI: 13 – 39)
Togo	2013-14 DHS	108 (CI: 97 – 119)	89 (CI: 78 – 101)	65 (CI: 53 – 78)	23 (CI: -6 – 53)
Turkey	2003 DHS	78 (CI: 67 – 90)	42 (CI: 35 – 49)	23 (CI: 14 – 33)	30 (CI: 3 – 56)
Uganda	2016 DHS	105 (CI: 93 – 116)	76 (CI: 71 – 81)	49 (CI: 42 – 57)	29 (CI: 19 – 40)
Ukraine	2007 DHS			19 (CI: 10 – 27)	19 (CI: 12 – 27)
Vietnam	2002 DHS	66 (CI: 12 – 120)	31 (CI: 21 – 41)	30 (CI: 22 – 38)	
Yemen	2013 DHS	62 (CI: 57 – 68)	54 (CI: 48 – 60)	41 (CI: 28 – 53)	31 (CI: 17 – 45)
Zambia	2013-14 DHS	109 (CI: 93 – 125)	82 (CI: 76 – 88)	67 (CI: 58 – 75)	43 (CI: 26 – 60)
Zimbabwe	2015 DHS	140 (CI: 84 – 197)	106 (CI: 88 – 125)	73 (CI: 65 – 81)	26 (CI: 9 – 43)

A5: Relative change in inequality in under-five mortality between levels of maternal education in 37 LMICs

Country	No education: Higher	Primary: Higher	Secondary: Higher
Bangladesh (1999-00)	65:16/ 4,06	25:8/ 3,12	73:32/ 2,28
Bangladesh (2014)	21:8/ 2,62	5:2 / 2,5	49:24/ 2,04
Bolivia (1998)	77:13/ 5,92	58:13/ 4,46	61:26/ 2,35
Bolivia (2008)	67:14/ 4,79	87:28/ 3,11	25:14/ 1,79
Burkina Faso (1998-99)	230:81/ 2,84	170:81/ 2,10	101:81/ 1,25
Burkina Faso (2010)	156:31/5,03	110:31/ 3,55	65:31/ 2,10
Cameroon (1998)	99:28/ 3,54	16:7/ 2,29	13:8/ 1,62
Cameroon (2011)	175:52/ 3,37	125:52/ 2,40	79:52/ 1,52
Chad (1996-97)	41:12/ 3,42	63:20/ 3,15	9:4/ 2,25
Chad (2014-15)	20:9/ 2,22	179:63/ 2,84	15:7/ 2,14
Colombia (2000)	44:15/ 2,93	11:5/ 2,2	8:5/ 1,6
Colombia (2015)	5:1/ 5	24:13/ 1,85	17:13/ 1,30
Cote d'Ivoire (1998-99)	193:101/ 1,92	153:101/ 1,51	78:101/ 0,77
Cote d'Ivoire (2011-12)	124:65/ 1,90	109:65/ 1,68	76:65/ 1,17
Dominican Republic (1999)	39:2/ 19,5	32:1/ 32	16:1/ 16
Dominican Republic (2013)	91:27/ 3,37	35:27/ 1,30	11:9/ 1,22
Egypt (2000)	89:29/ 3,07	74:29/ 2,55	43:29/ 1,48
Egypt (2014)	41:19/ 2,16	34:19/ 1,79	28:19/ 1,47
Eritrea (1995)	79:22/ 3,59	135:44/ 3,07	105:44/ 2,39
Eritrea (2002)	121:13/ 9,31	83:13/ 6,38	63:13/ 4,85
Ethiopia (2000)	197:93/ 2,12	49:31/ 1,58	89:93/ 0,95
Ethiopia (2016)	43:21/ 2,04	37:21/ 1,76	9:7/ 1,29
Gabon (2000)	112:47/ 2,38	93:47/ 1,98	90:47/ 1,91
Gabon (2012)	14:11/ 1,27	6:5/ 1,2	62:55/ 1,13
Ghana (1998)	131:71/ 1,85	112:71/ 1,57	88:71/ 1,24
Ghana (2014)	23:12/ 1,92	3:2/ 1,5	55:48/ 1,15
Guinea (1999)	204:79/ 2,58	162:79/ 2,05	112:79/ 1,42
Guinea (2012)	139:51/ 2,73	42:17/ 2,48	4:3/ 1,33
Haiti (2000)	50:17/ 2,94	140:51/ 2,75	25:17/ 1,47
Haiti (2016-17)	103:52/ 1,99	45:26/ 1,74	15:13/ 1,15
India (1998-99)	31:9/ 3,44	43:18/ 2,39	55:36/ 1,52

India (2015-16)	3:1/ 3	60:23/ 2,61	39:23/ 1,70
Indonesia (1997)	9:1/ 9	79:12/ 6,58	19:6/ 3,17
Indonesia (2012)	16:3/ 5,33	10:3/ 3,33	16:9/ 1,78
Jordan (1997)	31:12/ 2,58	41:24/ 1,71	31:24/ 1,29
Jordan (2012)	16:15/ 1,07	8:5/ 1,6	23:15/ 1,53
Kenya (1998)	122:49/ 2,49	118:49/ 2,41	61:49/ 1,24
Kenya (2014)	51:40/ 1,27	3:2/ 1,5	27:20/ 1,35
Madagascar (1997)	197:65/ 3,03	172:65/ 2,65	106:65/ 1,63
Madagascar (2008-09)	97:24/ 4,04	85:24/ 3,54	35:24/ 1,46
Morocco (1992)	91:12/ 7,58	5:1/ 5	2:1/ 2
Morocco (2003-04)	63:32/ 1,97	21:16/ 1,31	13:16/ 0,81
Namibia (2000)	28:13/ 2,15	22:13/ 1,69	16:13/ 1,23
Namibia (2013)	19:6/ 3,17	71:24/ 2,96	55:24/ 2,29
Nepal (1996)	149:25/ 5,96	99:25/ 3,96	13:5/ 2,6
Nepal (2016)	20:7/ 2,86	43:21/ 2,05	34:21/ 1,62
Nicaragua (1998)	41:10/ 4,1	14:5/ 2,8	9:5/ 1,8
Nicaragua (2001)	72:19/ 3,79	43:19/ 2,26	26:19/ 1,37
Niger (1998)	314:37/ 8,49	225:37/ 6,08	134:37/ 3,62
Niger (2012)	79:5/ 15,8	121:10/ 12,1	97:10/ 9,7
Nigeria (1990)	211:56/ 3,77	23:8/ 2,87	15:7/ 2,14
Nigeria (2013)	90:31/ 2,90	64:31/ 2,06	91:62/ 1,47
Pakistan (1990-91)	64:7/ 9,14	107:14/ 7,64	69:14/ 4,93
Pakistan (2012-13)	28:9/ 3,11	31:12/ 2,58	7:4/ 1,75
Peru (2000)	53:12/ 4,42	19:6/ 3,17	5:6/ 0,83
Peru (2012)	43:18/ 2,39	11:6/ 1,83	10:9/ 1,11
Philippines (1998)	34:7/ 4,86	73:28/ 2,61	23:14/ 1,71
Philippines (2017)	59:16/ 3,69	47:16/ 2,94	13:8/ 1,62
Rwanda (2000)	233:105/ 2,22	40:21/ 1,90	39:35/ 1,11
Rwanda (2014-15)	89:15/ 5,93	13:3/ 4,33	43:15/2,87
Senegal (1997)	154:25/ 6,16	96:25/ 3,84	58:25/ 2,32
Senegal (2017)	71:19/ 3,74	2:1/ 2	37:19/ 1,95
Togo (1998)	159:65/ 2,45	127:65/ 1,95	83:65/ 1,28
Togo (2013-14)	108:23/ 4,69	89:23/ 3,87	65:23/ 2,83
Turkey (1998)	28:13/ 2,15	56:39/ 1,43	10:13/ 0,77
Turkey (2003)	13:5/ 2,6	7:5/ 1,4	23:30/ 0,76
Uganda (2000-01)	187:73/ 2,56	154:73/ 2,11	97:73/ 1,33

Uganda (2016)	105:29/ 3,62	76:29/ 2,62	49:29/ 1,69
Yemen (1997)	126:31/ 4,06	92:31/ 2,97	75:31/ 2,42
Yemen (2013)	2:1/ 2	54:31/ 1,74	41:31/ 1,32
Zambia (1996)	222:125/ 1,78	201:125/ 1,61	144:125/ 1,15
Zambia (2013-14)	109:43/ 2,53	82:43/ 1,91	67:43/ 1,56
Zimbabwe (1999)	17:3/ 5,67	94:21/ 4,48	82:21/ 3,90
Zimbabwe (2015)	70:13/5,38	53:13/ 4,08	73:26/ 2,81

A6: Absolute change in inequality in under-five mortality between levels of maternal education in 37 LMICs

Country	No education: Higher	Primary: Higher	Secondary: Higher
Bangladesh (1999-00)	98	68	41
Bangladesh (2014)	39	36	25
Bolivia (1998)	128	90	35
Bolivia (2008)	106	59	22
Burkina Faso (1998-99)	149	89	20
Burkina Faso (2010)	125	79	34
Cameroon (1998)	142	72	35
Cameroon (2011)	123	73	27
Chad (1996-97)	145	129	75
Chad (2014-15)	77	116	72
Colombia (2000)	29	18	9
Colombia (2015)	52	11	4
Cote d'Ivoire (1998-99)	92	52	-23
Cote d'Ivoire (2011-12)	59	44	11
Dominican Republic (1999)	37	62	30
Dominican Republic (2013)	64	8	6
Egypt (2000)	60	45	14
Egypt (2014)	22	15	9
Eritrea (1995)	114	91	61
Eritrea (2002)	108	70	50
Ethiopia (2000)	104	54	-4
Ethiopia (2016)	44	32	12
Gabon (2000)	65	46	43
Gabon (2012)	15	11	7
Ghana (1998)	60	46	17
Ghana (2014)	44	24	7
Guinea (1999)	125	83	33
Guinea (2012)	88	75	17

Haiti (2000)	99	89	24
Haiti (2016-17)	51	38	8
India (1998-99)	88	50	19
India (2015-16)	46	37	16
Indonesia (1997)	96	67	26
Indonesia (2012)	78	42	14
Jordan (1997)	38	17	7
Jordan (2012)	1	9	8
Kenya (1998)	73	69	12
Kenya (2014)	11	20	14
Madagascar (1997)	132	107	41
Madagascar (2008-09)	73	61	31
Morocco (1992)	79	48	12
Morocco (2003-04)	31	10	-6
Namibia (2000)	45	27	9
Namibia (2013)	52	47	31
Nepal (1996)	124	74	40
Nepal (2016)	39	22	13
Nicaragua (1998)	62	36	16
Nicaragua (2001)	53	24	7
Niger (1998)	277	188	97
Niger (2012)	148	111	87
Nigeria (1990)	155	105	64
Nigeria (2013)	118	66	29
Pakistan (1990-91)	114	93	55
Pakistan (2012-13)	76	57	27
Peru (2000)	82	52	16
Peru (2012)	25	15	2
Philippines (1998)	108	45	18
Philippines (2017)	43	31	10
Rwanda (2000)	128	95	12
Rwanda (2014-15)	74	50	28

Senegal (1997)	129	71	33
Senegal (2017)	52	19	18
Togo (1998)	94	62	18
Togo (2013-14)	85	66	42
Turkey (1998)	45	17	-9
Turkey (2003)	48	12	-7
Uganda (2000-01)	114	81	24
Uganda (2016)	76	47	20
Yemen (1997)	95	61	44
Yemen (2013)	31	23	10
Zambia (1996)	97	76	19
Zambia (2013-14)	66	39	24
Zimbabwe (1999)	98	73	61
Zimbabwe (2015)	114	80	47

A7: Median level of under-five mortality rate by region, by maternal education levels. DHS (1985-2000)

Region	No education	Primary	Secondary	Higher
Sub-Saharan Africa	189	153,5	89,5	62,5
South and Southeast Asia	130	86	55	30
Latin America and Caribbean	94	65,5	38	22
West Asia, Europe and North Africa	86,5	60,5	40	29

A8: Median level under-five mortality rate by region, by education levels. DHS (2001-2017)

Region	No education	Primary	Secondary	Higher
Sub-Saharan Africa	109	95,5	64	42
South and Southeast Asia	65,5	49,5	35	22
Latin America and Caribbean	65	38	26	27
West Asia, Europe and North Africa	62	38	24.5	19,5

A9: Angola: Descriptive statistics for Angola (2015-16 DHS)

Variables	Obs.	Mean	Std. Dev.	Min	Max
Child dead	42,002	0,109	0,311	0	1
Child age u/ 60 months	11,355	0,957	0,202	0	1
Maternal education	42,002	0,881	0,791	0	3
Husband/partner's education	28,647	1,343	0,833	0	3
Household wealth index	42,002	2,599	1,277	1	5
Age	42,002	33,741	8,298	15	49
Autonomy health decisions	42,002	0,339	0,473	0	1
Health insurance	42,002	0,043	0,203	0	1
Visited health facility last 12 months	42,002	0,421	0,493	0	1
Woman sample weight	42,002	979062,4	913933,2	61540	7402439

A10: Dominican Republic: Descriptive statistics for Dominican Republic (2013 DHS)

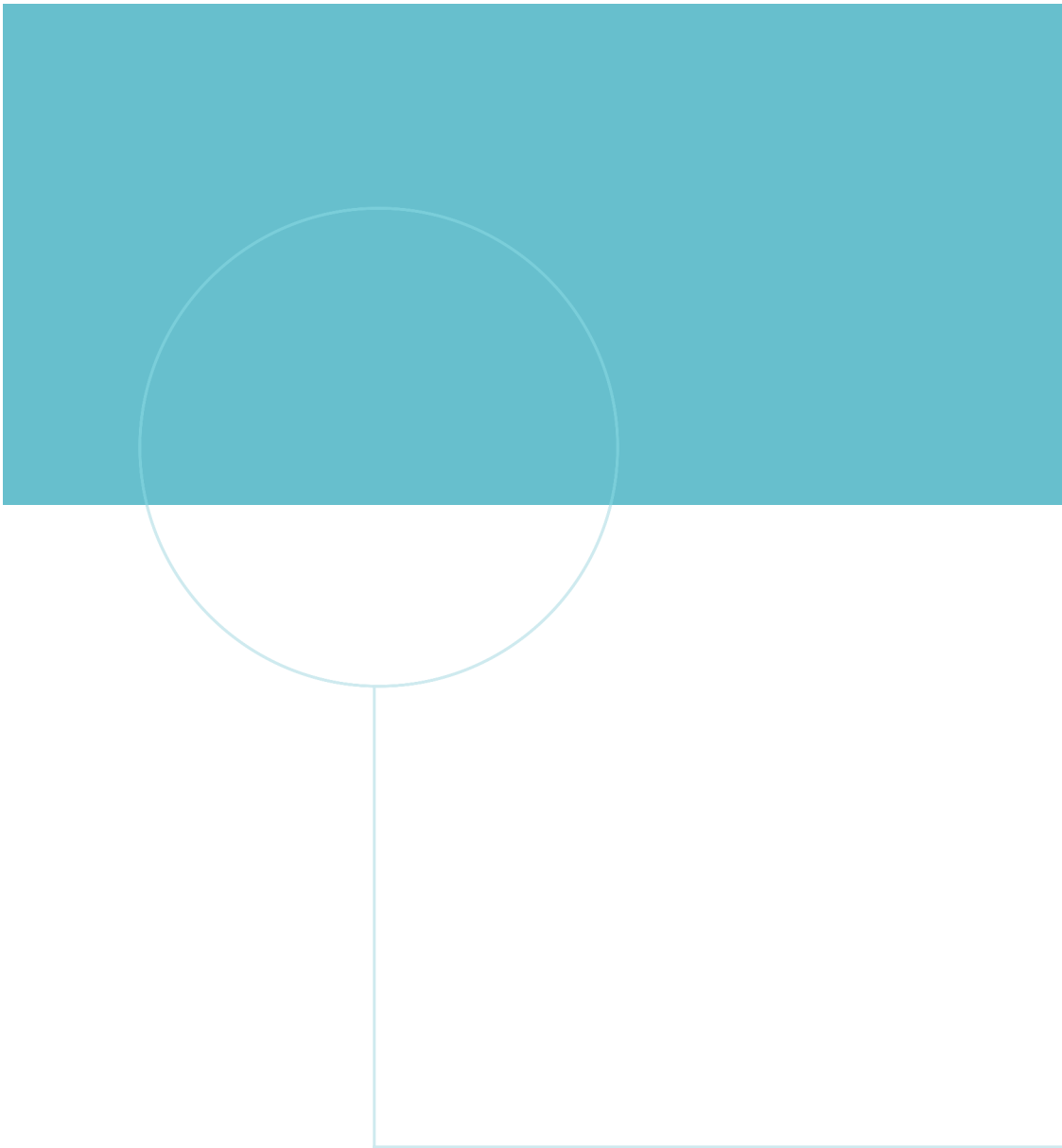
Variables	Obs.	Mean	Std. Dev.	Min	Max
Child dead	18,167	0,051	0,221	0	1
Child age u/ 60 months	4,324	0,976	0,151	0	1
Maternal education	18,167	1,600	0,846	0	3
Husband/partner's education	16,915	1,492	0,803	0	3
Household wealth index	18,167	2,637	1,353	1	5
Age	18,167	35,885	8,324	15	49
Autonomy health decisions	18,165	0,920	0,271	0	1
Health insurance	18,164	0,620	0,485	0	1
Woman sample weight	18,167	962804,8	926590	62730	1.25e+07

A11: Pakistan: Descriptive statistics for Pakistan (2017-18 DHS)

Variables	Obs.	Mean	Std. Dev.	Min	Max
Child dead	50,495	0,075	0,264	0	1
Child age u/ 60 months	8,334	0,966	0,180	0	1
Maternal education	50,495	0,741	1,037	0	3
Husband/partner's education	48,524	1,397	1,140	0	3
Household wealth index	50,495	2,815	1,394	1	5
Age	50,495	36,018	7,486	15	49
Autonomy health decisions	50,466	0,743	0,436	0	1
Health insurance	50,490	0,023	0,152	0	1
Visited health facility last 12 months	50,482	0,739	0,438	0	1
Woman sample weight	50,495	808608,1	896383,9	0	4095189

A12: Niger: Descriptive statistics for Niger (2012 DHS)

Variables	Obs.	Mean	Std. Dev.	Min	Max
Child dead	44,183	0,181	0,385	0	1
Child age u/ 60 months	13,583	0,924	0,264	0	1
Maternal education	44,114	0,188	0,509	0	3
Husband/partner's education	43,470	1,261	1,645	0	3
Household wealth index	44,183	3,158	1,435	1	5
Age	44,183	34,281	7,782	15	49
Autonomy health decisions	44,124	0,787	0,409	0	1
Health insurance	44,150	0,022	0,148	0	1
Visited health facility last 12 months	44,127	0,527	0,499	0	1
Woman sample weight	44,183	1057391	595942,9	69289	4095189



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