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# Partner age gap and child health in Sub-Saharan Africa

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## Abstract

This thesis explores the association between the age gap between parents and health outcomes for children in Sub-Saharan Africa. An average man-older age gap between partners has been observed all over the world and is the largest in many Sub-Saharan African countries. A large age gap is common in patriarchal societies and has been associated with less female autonomy and impeded decision-making for the couple, resulting in less contraceptive use and a possible higher risk of interpersonal violence. This thesis examines another association with age gaps by focusing on the health outcomes for children in families with large and small age gaps between the mother and her partner. It is hypothesized that children will have worse health outcomes in families where the age gap between the mother's partner and the mother herself is larger than average. Using data from the Demographic and Health Surveys (DHS), multilevel logistic regression is run to test the association between three health indicators while controlling for confounding variables such as mother's age, education level and wealth. The health indicators are treatment of fevers, vaccination against measles and underweight. The results show some statistically significant associations, with all three variables supporting the hypothesis that children in age heterogamous families are doing worse. Children of couples with a larger than average age gap have lower likelihood of being treated for fever or cough, and a higher likelihood of being underweight, and children of couples with a smaller than average age gap have a higher likelihood of having received the first measles vaccination. The results show that the age gap between parents is a factor to take into consideration when studying child health and family structures in Sub-Saharan Africa.

**Keywords:** Partner age gap, child health, Sub-Saharan Africa, family structures, gender

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## Introduction

This thesis investigates if there is an association between the age gap between the parents and the health of their children. In a majority of childbearing couples, in all countries and all periods from which we have data, the woman has been younger than the man. This age gap between partners has been characterized as an under-researched demographic and sociological phenomenon (Gustafson & Fransson, 2015; Kolk, 2015; Lehmiller & Christopher, 2008; Presser, 2016; Pyke & Adams, 2010). Previous research has focused on links between partner age gap and contraceptive use, intimate partner violence (IPV), wages and health of the partners. In this literature, a large age gap has often been interpreted as an indicator of inequality between the sexes and of the nature of the relationship (Barbieri et al., 2005; Carmichael et al., 2011; Conroy-Beam & Buss, 2019). If the man is much older than his partner it can be a sign of his power over the woman and other members of the family, and large age gaps have been associated with unequal and patriarchal societies (Carmichael et al., 2011; Casterline et al., 1986). This thesis attempts to broaden the areas studied as an impact of this phenomenon by testing the existence of an association between the parental age gap and the health outcomes for children in a region of the world with large average age gaps.

In Sub-Saharan Africa the average age gap is the largest in the world but there is substantial variation between the countries (Barbieri et al., 2005; Casterline et al., 1986). In this region, preventable diseases are still major causes of death for children which makes it relevant for a study on family structure, parental behavior and the health outcomes for their children (Kassile et al., 2014; Kiross et al., 2019). This thesis explores whether there is an association between the age gap between parents and the health outcomes for their children. The aim is to find out if there is any difference in four indicators of health for children in families where the age gap between the mother and her partner is large and small. To do this it is important to find out why age gaps appear in the first place and what consequences it has for families. Data is collected from the Demographic and Health Survey (DHS) in 26 Sub-Saharan African countries.

The thesis will begin with background on spousal age gaps in the world, followed by a literature review focusing on the evolutionary and social reasons for its existence, the variations across societies and time and its effect on gender relations. After highlighting the research opportunity, the data and multilevel regression models are explained which will be used to analyze the four variables relating to the health of the children – fever treatment, measles vaccination, underweight and low birth weight. These variables are explained in depth along

with the age gap as the main independent variable and the included control variables. Children are the main unit of analysis (level 1) clustered within mother/household (level 2) within 26 countries (level 3). After a review of the results from the models, a discussion is followed about its relationship to previous studies.

## Theoretical background and literature review

In almost all known societies from which we have data, the man has on average been older than his female partner (Bozon, 1991; Buss, 1989; Mignot, 2010). Unions where one partner is much older than the other can be referred to as age heterogamous, while age hypergamy measures how much older the male is compared with the female partner. The average marital age gap is generally higher in developing countries than in developed ones. In half of the countries with available data, the difference in the singulate mean age of marriage (SMAM, defined as the mean age at marriage among men and women who ever marry before the age of 50 years) is larger than 3.3. years (*UN | World Fertility Report 2009*, 2011). The highest recorded age gap is in Western Africa with a difference in SMAM of 6.6 years, and the lowest is in Australia/New Zealand, Northern Europe and North America where the SMAM difference is 2.2–2.3 years (*World Marriage Data 2017*, 2017). Buss (1989) studied mate preferences in 37 cultures on six continents by using data from surveys which asked the respondents to rate partner characteristics on importance and desirability. It was shown that in all cultures, females prefer older males and males prefer younger females. It appeared that females on average prefer a man who is 3.42 years older and males prefer a woman who is 2.66 years younger (Buss, 1989).

What is noteworthy about the countries with the highest preferred age gap, in Nigeria and Zambia where males prefer females who are 6.45 and 7.38 years younger respectively, is that polygyny is common (Buss, 1989). Polygyny is one of the three types of polygamous marriages around the world, referring to when one man is married to several women simultaneously. The other two types are polyandry which refers to women being married to several men simultaneously and cenogamy which is synonymous to group marriage. In polygynous mating systems males are usually older when they acquire wives which explains some of the large age gap compared to other cultures (Buss, 1989). The prevalence of polygyny has declined in many African countries over the last century (Fenske, 2013; Lawson & Gibson, 2018). One study of 35 Sub-Saharan African countries between the 1960s and the 1990s also found that the age gap between spouses decreased in 32 countries and only increased in three (Mignot, 2010).

However, even without the inclusion of polygamous relationships and the decreasing trend of age heterogamous couples, the average age gap between partners is higher in countries in Sub-Saharan Africa compared to other parts of the world (*UN | World Fertility Report 2009*, 2011).

**Partner age gap from an evolutionary perspective**

Assortative mating, for example with regards to age (relatively younger females and older males) of prospective partners, can be explained from an evolutionary perspective. Men have a much higher number of potential offspring in his lifetime than women, which means that the relative value of one offspring is lower for men (Buss & Schmitt, 2019). Men are expected to look for signs of reproductive capacity above other things, which explains the finding that men who are both older and younger tend to be sexually interested in women in their mid-twenties. Women on the other hand, have higher costs of reproduction, and are expected to be more selective when it comes to mate choice. A high-quality male who has resources and the willingness to share them with both her and her offspring is thus preferred, and these men tend to be older, all else equal. Women's preferences often lead to the choice of a mate who is the same age or somewhat older than her. In other words evolutionary theory predicts that, on average, females will mate with males older than themselves(Bech-Sørensen & Pollet, 2016; Buss, 1989; Buss & Schmitt, 2019).

The fact that females in general are more sexually restrictive than males leads to the hypothesis that heterosexual long-term dating activity should more closely reflect the preferences of women than of men (Antfolk et al., 2015). Many studies of multiple methods and data sources have confirmed that age preferences translate into actual mating behavior (Buss & Schmitt, 2019). In almost all known human societies, whichever place and period, men have been older than their partner. It has also been shown that men who couple later do it with a relatively younger woman, whereas the age gap decreases with the increasing age of the woman at marriage (Mignot, 2010).

Fieder & Huber (2007) have shown that the age preferences entails actual fitness effects for men and women in the form of a higher number of offspring. Evolutionary fitness is defined as an capacity of an organism to survive and reproduce in a given environment, and the number of children someone has can be viewed as a proxy for fitness (Fieder & Huber, 2007). In a study of post-reproductive Swedish couples, they found that the offspring count of both men and women increased the younger the female partner was compared with the male (Fieder &

Huber, 2007). Another study of Polish parents found that a 6.5 years age gap between the male and the female partner was associated with the highest number of children (Kuna et al., 2018). Fitness benefits could also be viewed as the survival and future reproductive capacity of the child. In this sense her/his health and development is crucial, which is the focus of this thesis.

**Variation in partner age gap over time and space**

The variation we see between societies could hypothetically be explained in two ways. First, it could be an expression of preferences by the partners based on the cultural and social-structural factors in the society creating differing ideal ages at marriage for women and men. Second, it could be determined by the age distribution of eligible men and women in the marriage market (Casterline et al., 1986; Ni Bhrolchain, 1992). In a comparative analysis of the age gap between spouses in developing countries, Casterline et al. (1986) suggests that the differences between societies are closely linked to the status of women and kinship structure and has less to do with demographic determinants. Certain age gaps are preferred while others are avoided. This conclusion favors the first social structural explanation. In patriarchal societies the age gap between partners is generally larger, and age heterogamy is more common. They also found that men have a larger set of factors that determine their age at marriage than women do. It is therefore often sufficient to know the husband's age at marriage to predict the marital age gap. Whether it is the status of women that determines or is influenced by the age gap is harder to say, but it is most probably a combination (Casterline et al., 1986).

The international empirical literature indicates that the age gap between partners tends to be higher for men who have a higher relative social position. The more relative wealth/prestige/power the man has compared to his partner, the younger the partner tends to be (Conroy-Beam & Buss, 2019). This seems to be especially true in agrarian societies. Having a younger female partner gives more years of fertility and a larger number of potential children and can thus be viewed as a fitness benefit. As industrialization and the demographic transition has reduced the need for many children, it has also reduced the importance for men to find a young female partner since many years of fertility is not as important anymore. Likewise, the rise of women's economic activity may have reduced the importance for them to find an older husband with more wealth and power. In more developed countries both women and men spend more years of schooling in a mixed-gender setting that could increase the probability of students meeting a partner of near or identical age (Mignot, 2010). More exposure to same-age

members of the opposite sex might be an explanation for why the average age gap is still large in Sub-Saharan Africa compared to Europe.

**Gender relations and partner age gap**

In the literature about domestic violence and contraceptive use a large man-older age gap is seen as one of many ways in which men can exercise power as the head of the family. This can be in the form of violence against his wife or decisions about family planning (Adebowale, 2018). Research about gender and power highlights that the wife is doubly subordinate to her husband in age heterogamous relationships, both as a woman and his junior (Barbieri et al., 2005). Researchers have linked age heterogamy to a range of negative aspects such as non-egalitarian relationships, lower socioeconomic status, lower marital stability and domestic violence (Kolk, 2015). Some research has examined which factors are most highly correlated with a large age gap and how it differs between regions of the world. In a study of 77 lesser developed countries using data from United Nations, World Bank, DHS and national censuses, Carmichael (2011) found that women with more formal education generally marry later in life and have husbands closer to the same age as them.

Another worldwide trend that reduces the age gap is urbanization, even though it does not have as strong an effect as the women's has (Carmichael, 2011). Both the woman's age at marriage and the age gap to her partner can be indicative of her relative power position within a union, and marriage patterns at large can function as a proxy for female agency (Carmichael et al., 2011). This makes sense with the finding that age gaps are usually larger in more patriarchal societies. Female autonomy and agency are often compromised in age heterogamous relationships. An effect for women of having an older partner is low relationship power, which is the degree to which she can act independently of the control and influence of her partner. A low relationship power and a higher age gap have been linked to IPV (Izugbara, 2018; Volpe et al., 2013), although another study based on DHS data showed lower levels of IPV among couples with larger age gaps between the woman and her partner (Adebowale, 2018). The subordinate status of women in unions, which is based on gender inequality and undereducation of women, can also have an impact on child mortality (Kiross et al., 2019).

In a study of partner age gaps and contraceptive practice in Sub-Saharan Africa, Barbieri et al. (2005) argue that a large age gap between partners functions as a proxy for impeded emotional ties, fewer shared values and gender inequalities within a union. They argue that women have

reduced decision-making power as a consequence of her status and dependent economic situation in unions where the man is much older. A weakened marital bond between the partners can also be an effect, as a man and a woman closer in age are likelier to have a stronger bond and more things in common, and thus higher intimacy when they are not just reduced to a unit of biological reproduction. The improved communication also makes it likelier for family planning efforts within couples of similar ages (Barbieri et al., 2005). The study found that the largest spousal age gaps are associated with low contraceptive use in Sub-Saharan Africa, which has also been confirmed by other (Volpe et al., 2013). The lack of strong emotional ties and shared values in age heterogamous relationships can also be seen in the level of depression in the partners and create marital instability. People from different age groups often have different aspirations and behaviors (Saroukhani, 1979). In South Korea, it was found that the severity of depressive symptoms increased with an increased age gap between husbands and wives, both if the husband is much older or if the wife is much older. Homogamy presumes that individuals are predisposed to marry others who are similar to them, and a larger age gap is often accompanied with larger differences in life experience, maturity, social position and financial resources (Kim et al., 2015). According to Bumpass and Sweet (1972) a higher age gap decreases value consensus and produces an imbalance in the family power structure, especially if the woman is older.

Previous studies have found that husbands are more likely to have the final say on the woman's healthcare if he is much older than her(Osamor & Grady, 2016). Even with good intentions from the man this could on average have negative consequences for the woman's health since she probably knows better what she needs. Ganle et al. (2015) found that of cases in which women said they were unable to access maternal health services during their last pregnancy, 49% said that their husband made the final decision. They highlight that access to maternal healthcare services can be undermined by women's lack of decision-making autonomy, which in turn can be a influenced by gender inequality, economic marginalization, communal decision-making and social power (Ganle et al., 2015). Studies have also shown that increased female autonomy is associated with higher child survival rates and allocation of resources in favor of children in the household (Osamor & Grady, 2016). A study in Kenya found that greater levels of women's autonomy were significantly associated with improved nutrition among children of the ages 3-10 years. They theorize that while men tend to invest more in themselves or the overall worth of the household, women are more likely to prioritize investment in food and health care for children above all other needs. Men and women's

different reproductive strategies, as discussed before, can explain some of why this is the case (Brunson et al., 2009). The mother is often the primary caregiver, and greater maternal control over limited resources can thus be beneficial for their children (Carlson et al., 2015). A similar finding was made in Jordan, where they found a strong negative influence on a child's nutritional status associated with having a mother whose autonomy relative to others in the household is low (Doan & Bisharat, 1990). A study using DHS data found that women were less likely to seeks treatment in response to child illness if they have no say in their own healthcare (Pierce et al., 2016).

## Research opportunity

As shown in the above discussions, few, if any, studies have examined the association between the age gap between parents and the well-being of their children. Presser (2016) finds that neither has any studies been done on the social implications for children of having parents who are close versus different in age. Many studies have instead focused on how the marital or partner age gap affects the status and well-being of women. If the age gap between parents turns out to be a significant factor for their children's health prospects, it would be important to take this into account in future research.

Why would we expect the age gap to have an influence on the well-being of children? The characteristics of those who partners with a much older/younger partner might differ from those who partners with one closer in age in ways that have an impact on their children. This is something we can analyze by including control variables in a regression. Variables that influence both the parental age gap and the well-being of children could be for example the mother's age, the wealth of the parents, and whether they live in an urban or rural area. A higher socioeconomic status for the family could lead to improved conditions for the children by creating better access to food, healthcare and education. As a larger age gap is expected to have an association with lower autonomy for women, this can in turn have health effects for the child if for example the mother is not able to quickly seek health care during periods of illness. We could in other words expect the age gap to function as a proxy for female autonomy within the household. While it might be disadvantageous for the woman in certain ways, perhaps the frequency of age heterogamous relationships can be explained by other factors that make them beneficial for the couple. It is important to have a broader perspective to understand the choices

women make when it comes to marriage and childbearing. Understanding in which kinds of families children are more at risk would also be important for targeted policies to improve their well-being. Any indicator that is associated with the health of a child is important.

I have chosen four variables that will be used as indicators of the children's health status. Two of them show if the parents have invested directly in the health of their child, i.e. health behavior. These two are whether the child has received the first round of *measles vaccines* and whether the child was given any *treatment if they had a fever or cough in the last two weeks*. The third variable is closer to a direct measure of physical health which can also be seen as a proxy for health investment, this is whether the child is *currently underweight*. In-depth descriptions of these three variables are included in the Data and Methods. There are many other variables that could have worked in their place as indicators of the children's well-being. Other variables considered were for example whether the child was alive at the time of interview, if they had a health card, and if they had received drugs for worm infections. Before deciding that health was to be the only outcome measured, educational and parental behavior variables were also considered. However, after considering all the available variables in the dataset I deemed these three to give a good overview. They are more universal in nature than the previously discussed, making them more appropriate for a study including many countries, and they have fewer missing values and are included in most country surveys. Low birth weight was included as an outcome variable in the draft version of this thesis, but it was dropped due to its difference in interpretation compared to the other variables.

As previous research, to my knowledge, has not studied the link between child health and parental age gap, few clear theoretical perspectives are available for a study like this. We might expect children to fare better in households with more wealth, where the woman has more autonomy and a higher education level. A large age gap between the man and his female partner might benefit the mother and her children in terms of the resources and status she gets access to from marrying an older man with more resources and social capital (Buss, 1989; Presser, 2016). On the other hand, it could be detrimental to her agency within the relationship and could possibly lead to weaker emotional ties and fewer shared values which would not be the case if the age gap was smaller (Barbieri et al., 2005). Based on previous research the age gap between partners is one of the main factors predicting female autonomy. A mother with less decision-making power would have less capacity to make the right health investments for her children, and it would also lower the family's capacity as a decision-making unit. Likewise, a

weaker emotional bond between the parents has been shown to make it less likely for family planning, contraceptive use and a higher risk of depressive symptoms. With these facts in mind, a larger age gap between the parents can be expected to create unfavorable circumstances for the child's health. I therefore propose these four hypotheses for the health indicators:

*H1: A higher man-older age gap between the mother and her partner is related to a lower likelihood that the child has been treated or sought advice for in case of fever or cough in the last two weeks.*

*H2: A higher man-older age gap between the mother and her partner is related to a lower likelihood of the child having received the first measles vaccination.*

*H3: A higher man-older age gap between the mother and her partner is related to a higher likelihood that the child is underweight.*

## Data and methods

### Sample

For this thesis I will use data from the Demographic and Health Surveys (DHS). The DHS program carries out household surveys in developing countries and provides one of the best resources for data on health in developing countries (*DHS*, 2019). Included in this study are 26 African countries in the Sub-Saharan region: Angola, Burkina Faso, Burundi, Cameroon, DR Congo, Cote D'Ivoire, Benin, Ethiopia, Ghana, Guinea, Kenya, Lesotho, Madagascar, Malawi, Mali, Mozambique, Namibia, Niger, Nigeria, Rwanda, Senegal, South Africa, Tanzania, Uganda, Zambia and Zimbabwe. The surveys are collected between 2008 and 2017, the latest waves of surveys from the available countries in Sub-Saharan Africa. Children under the age of 5 (under 3 in some surveys) are the primary unit of analysis, and the data consist of 83,152–201,100 observations depending on the health outcome. No weights have been used for this study.

The data from the DHS is anonymized, and the program has strict standards for protecting the privacy of respondents and household members. Ethical considerations are important in research, and the DHS program have high standards and a good reputation in the research community. It is important that personal information is secured, and that data is anonymized when it reaches the researchers. The surveys must comply with the U.S. Department of Health and Human Services regulations for the protection of human subjects, and with the laws and norms of the nations where the surveys are taking places. All surveys ensure voluntary and informed consent by reading a statement to the respondent, who may accept or decline to participate.

### Models

For the analysis of the three variables I will use multilevel binary logistic regressions with the children as the first level, the mother/household as the second level and country as the third level. There are strong reasons to assume that the outcomes for children from the same mother and even the same country are correlated. They might have genetic or environmental factors that make them more alike than two children chosen at random. This is a kind of clustering that multilevel modelling can handle. It allows for residual components at the child (level 1), mother/household (level 2) and country levels (level 3), so that the residual variance is partitioned. The effects at level 2 and 3 represents unobserved characteristics that affect the

health outcomes for children and leads to correlation (Snijders & Bosker, 1999). Using multilevel models with a relatively small number of countries is useful when analyzing individual-level effects but not for summarizing country-level effects (Bryan & Jenkins, 2016). However, country-level effects will not be of main interest in these models.

In Stata, a stepwise modeling approach has been used to fit the best model for each outcome variable with the use of Akaike information criteria. After the best logistic models were found, the command meqrlogit was used to run multilevel logistic regressions. The interclass correlation coefficient (ICC) is used to denote the expected correlation in the propensity of the health outcomes between two children who has the same mother (level 2) or two children who live in the same country (level 3). The models each analyze one of the four hypotheses. The parental age gap is the main independent variable at the household level. The models have a set of control variables which are included for all models with the addition of model specific controls that relate to the outcome variable. Below follows a description of the main independent variable, the outcome variables and a brief description of the control variables.

**Main independent variable**

Table 1. Characteristics of age gap groups.

| | | **Age gap between the partner and the mother in years** | | | | |
|---|---|---|---|---|---|---|
| | | **< 0** | **0 – 4** | **5 – 9** | **10 – 14** | **15 >** |
| Frequency | | 9,066 | 78,460 | 88,403 | 46,216 | 37,850 |
| Mean age gap in years | | – 3.8 | 2.5 | 6.7 | 11.5 | 21.5 |
| Polygynous (%) | | 14 | 13 | 19 | 28 | 52 |
| Mother had one more union (%) | | 27 | 11 | 11 | 13 | 20 |
| Mother's education (%) | None | 35 | 31 | 41 | 50 | 64 |
| | Primary | 45 | 43 | 36 | 30 | 24 |
| | Secondary | 17 | 22 | 20 | 17 | 11 |
| | Higher | 3 | 4 | 3 | 2 | 1 |
| Partner's education (%) | None | 27 | 24 | 34 | 44 | 60 |
| | Primary | 46 | 41 | 32 | 26 | 21 |
| | Secondary | 24 | 29 | 28 | 23 | 15 |
| | Higher | 4 | 6 | 6 | 6 | 4 |
| Wealth index (%) | Poorest | 24 | 23 | 23 | 25 | 28 |
| | Poorer | 24 | 22 | 22 | 21 | 22 |
| | Middle | 21 | 20 | 20 | 20 | 21 |
| | Richer | 18 | 18 | 18 | 18 | 17 |
| | Richest | 13 | 16 | 16 | 17 | 13 |
| Residence (%) | Urban | 25 | 28 | 29 | 30 | 25 |
| Husband/partner decides on woman's health care (%) | | 31 | 35 | 45 | 53 | 60 |

The primary explanatory variable will be the age gap between the partners. The question about the partner's age is addressed to the woman in the union. This is the partner at the time of the survey, and it is thus not clear if he was her partner at the time of the child's birth. This is an important limitation since we cannot know for sure who their previous partner was. The definition of union or marriage is also based on criteria by the respondent themselves and thus not on legal recognition. This thesis will use the term partner in order to include both legally recognized and unrecognized unions. Some caution should also be used when reporting on ages in this DHS sample. Age heaping has been observed in many African countries with a larger than plausible number of rounded ages ending in 5 or 0. The reporting of male ages might also be influenced by the fact that age is recognized as an attribute of male power in these contexts (Barbieri et al., 2005). A tendency to exaggerate the partner's age risks overestimating the age gap between the partners. On the other hand, there is also evidence that women tend to estimate in a way that reduces the age gap, by underestimating the age of older husbands and overestimating the age of younger husbands (Pullum & Staveteig, 2017).

For the data used in this thesis, the age gap is broken down into five groups: when the woman is older, same age to 4 years older male partner, 5 to 9 years older male partner, 10 to 14 years older male partner and 15 years or older male partner. This stratification was decided upon as it gives an interpretable number of groups while still not having too dissimilar number of subjects in each. It was inspired by the stratification done in a study by Stephen Adebowale (2018), although the woman-older group is not excluded. Other stratifications were considered, such as 2-year age gap groups (too many groups), a more arbitrary stratification used by Barbieri et al. (2005) (not enough distinction between woman-older and man-older groups) and leaving the age gap as a continuous variable (does not highlight the difference in outcomes between age homogamous and heterogamous groups).

Table 1 shows a summary of characteristics of the age gap groups. The largest of these groups, 5 to 9, will be used as the reference group for the study. In the <0 group the average age gap between the mother and her partner is 3.8 years, and it is most common that she is one to three years older. The average age gap in the 15> group is 21.5 years with the most common age gap of 15 years. About 6% of the male partners in the whole sample are more than 20 years older than their partners. As can be seen in table 1, the two extreme groups are both likelier to live in rural areas, be less educated and to be less wealthy than the other groups. Those in the richest quartile also have the lowest average age gap, 7.6 years compared with 8.5 years for the poorest.

It is more likely for women in the <0 and 15> age gap groups to have been in more than one union. The surveys also include a question about who in the family has the final say on the woman's health care. In the <0 group 13% say that the husband or partner has the final say, while in the 15> group this number rises to 60%. This is a large difference which supports the hypothesis that women have less say on decisions relating to her own health care. This thesis hypothesizes that this is also true for the health care of the couple's children, namely that a husband also has the final say on children's health in families where the husband is relatively older than the mother.

The mean age gap in the whole sample is 8.1 years and varies greatly between the countries from 5.3 years in Malawi to 13.5 years in Guinea (see table 5 in appendix). The west African countries show a much larger age gap than countries in the southern and eastern part of the continent. All the countries with a mean age gap larger than 10 are located in this region. The only countries with more than 5% of partners being older than their partners are Burundi, Madagascar and Rwanda, which also has the lowest age gap. The proportion of women older unions is highest in Rwanda with 14% followed by South Africa and Madagascar with around 9%. By contrast they make up less than 1% of couples in Niger. The 0-4 group varies more with the largest percentage in Burundi at 51% and the smallest in Guinea at 9%. The reference group 5-9 is more stable (24% to 42%) and so is the 10-14 group (8% to 28%). The last group of age gap over 15 years ranges from 4% in Malawi to 37% in Guinea.

**Outcome variables**

Fever treatment

The first variable regards treatment of fevers and coughs. The mother was asked if the child had any fever or cough in the last 14 days, and whether they sought any advice or treatment for the child. For children under five who reportedly had fever or cough, the variable reports whether any sort of treatment or advice was sought. It relates to the research question by being an indicator of the parental health-seeking behavior for their children. The sample is understandably smaller with only a quarter of all children since only a fraction experienced fever in the last two weeks. Since all children can experience fever or cough there should be little reason to suspect bias in the data, even though some populations might be likelier to fall ill.

There are many possible reasons for why children are not given this life-saving and simple interventions. There might simply be a lack of access to health care facilities in the region where the family lives. Priorities might lie somewhere else when the family does not have feel like they have enough time and ability to provide health treatments for the child. Seeking advice or treatment if their child has fever or cough is more common among richer families (Filmer, 2005). The importance of the partner's presence at home led one study to consider the lack of collective decision-making by the parents as an important factor. Low decision-making capacity could also be an effect caused by a large age gap, leading to less fever treatment for children in age heterogamous families. It has also been found that seeking advice is more common for infants than for older children, and that distance to the nearest health facility is an important factor (Kassile et al., 2014).

Measles vaccination

The second variable is an indicator of measles vaccination. In all the included countries there are data on whether the child received rounds of vaccinations for different diseases. This variable can be seen as a health indicator for the child and the willingness and capacity of the parents to provide the best health benefits for their children. Measles is a highly contagious disease which infects 90% of people who are sharing the same living space. The measles vaccine is highly effective and safe, but measles is still one of the leading causes of death in the world that is preventable by a vaccine (*WHO | Measles*, 2019). I chose to focus on only the first of a series of recommended measles vaccinations. The information was taken from the vaccination card with immunization records for their children if this was available, otherwise they are not included in the study. The information refers to measles as an individual vaccination or as a vaccine containing measles, and the data are included for all the 26 countries. Surviving children either under the age of three or under the age of five were included depending on the survey country. The first dose of measles vaccination is recommended between 12 and 15 months of age, so children under age one are excluded and the reference group for this model is 12-23 months.

One thing to keep in mind is the prevalence of disinformation that exists about vaccines. Existing evidence shows that vaccine hesitancy is a growing problem in Africa which leads some to delay or refuse recommended vaccines for themselves and their children. Not much is known about the nature and cause of vaccine hesitancy. In Africa it is also the case that many families face barriers in their access to vaccines, so there is certainly a mix of structural and

psychological factors relating to measles vaccination (Cooper et al., 2018). Would it be the case that the parents believe that vaccines are overall harmful for their kids, we must accept that their desire to provide their child with the best health provisions is genuine. Theoretically this should be separated from the actual health outcome, but that will not be possible with these data.

Underweight

The third variable indicates if the child has a BMI score indicating underweight according to a baseline by WHO (*WHO | Global Database on Child Growth and Malnutrition*, 2020). Sub-Saharan Africa is home to one third of all undernourished children globally, and just like in the case of insufficient fever treatment, low parental education is one of the factors that are strongly linked to underweight in children. The mother's education translates to greater health care utilization and female agency, and the father's education to higher household income and food security (Akombi et al., 2017).

Surviving children born three to five years before the study and who lives in the household with their mother are included in a variable. About 6% are also dropped because of missing data or implausible measurements, which leaves a sample of 139,079 children. The variable reports the difference between the child's body mass index (BMI) and the median BMI of a reference population of the same age and sex. It is expressed in units equal to 100 times the Z-score of the distribution of the reference population. This variable can be used to assessing underweight or overweight status of children, which in turn can be a cause of malnutrition or obesity. The height and weight used to calculate the BMI is taken from the survey and the data for the variable is taken from all countries except for Madagascar and Zimbabwe.

**Control variables**

*The sex of the child (level 1)* is an important distinction in the underweight variable and might also affect the two other behavioral variables by how the parents treat their children differently based on their sex. In my sample there is an even distribution of male and female children. The *birth order of the child (level 1),* if the child was the first, second or later child born, can also be an important indicator of how the parents invest in their health. *The current age of the child (level 1)* is included in all regressions and influences how much time the parents have had to invest in their child's health. Children under the age of five are included in the sample, and the distribution is roughly evenly distributed between the ages zero to four.

On the household level we have the *age of the mother (level 2)* which can influence the outcome variables through both differing levels of life experience and physical health. Mothers are between the ages of 15 and 49 and the distribution roughly resembles a bell curve with the mean age of just over 29 years. *The level of education of the mother (level 2)* and *the level of education of the partner (level 2)* are divided into four categories; no education, primary, secondary and higher education. The parents' level of education is certainly related to both knowledge about measles vaccines and availability of resources to feed her child. It was revealed that 40% of children are born to mothers without any formal education, and it is also most common for the male partner to have no education. A *wealth index (level 2)* divided into five quintiles from poorest to richest describes the relative wealth of the household. It relates to the family's living standards, assessing things such as ownership of televisions and bicycles; materials used for housing construction; and types of water access and sanitation facilities. The last control variable indicates if the family lives an *urban or a rural area (level 2)*. Only 29% of children live in urban areas, and in most countries, there is a difference in wealth and a better access to resources compared to living in rural areas.

*Polygyny (level 2)*, or whether the mother is married to a man who currently has more than one wife, is another important factor to control for. For the polygynous couples, most commonly there is one more wife and sometimes two or three. Almost one fourth of children in the current sample are born to mothers who are the only wife. These polygynous relationships generally have higher age gaps since men take relatively younger wives later in life. For these data, the mean age gap in polygamous relationships is over 12 years, while the mean age gap for non-polygamous couples is just under 7 years. We can also see this in that over half of all women in the group with largest age gap are polygamous. It is often necessary for men to accumulate resources in order to afford a second wife. This process can take many years leading to an even larger age gap to the second wife. Many women included in this study might also become part of a polygynous union in the future when their husband takes a second wife. Another reason why people in polygynous unions have larger age gaps might be because they are less concerned with building an emotionally close relationship which thus can affect the household dynamics in the same way as the spousal age gap. Polygamous households have a slightly lower average wealth than non-polygamous, and they are likelier to live in rural areas. There is great variety in the frequency of polygynous unions between the countries. The highest proportion is in Guinea where 46% of mothers are not their

husband's only wife. West Africa has in general a higher rate of polygamy, while Eastern and Southern Africa have lower, as low as 2% in Lesotho.

# Results

## Descriptive

Table 3. Proportion of health outcomes in age gap groups.

| Age gap | Fever treatment % | Measles vaccination % | Underweight % |
|---|---|---|---|
| < 0 (3%) | 59.03 | 66.23 | 7.08 |
| 0 – 4 (30%) | 63.41 | 64.26 | 6.91 |
| 5 – 9 (34%) | 62.30 | 60.89 | 8.88 |
| 10 – 14 (18%) | 60.43 | 57.92 | 10.48 |
| 15 > (15%) | 57.25 | 56.19 | 11.58 |
| Total | 61.58 | 60.82 | 8.97 |

Table 3 shows the rates of measles vaccination, fever treatment and underweight in each age gap group. Two trends can be seen. Both measles vaccination and underweight gets progressively worse the more age heterogamous the union becomes. The older the partner is compared to the mother, the worse the health outcome is the child. In the fever treatment variable, the trend looks slightly different. A much older partner is still worse for the child than the most common age gap groups (0-4 and 5-9), but the situation is also worse when the mother is older than her partner.

Children in families with a small age gap are likelier to be treated in case of fever or cough. It is gradually less likely with a higher age gap, although the group of older mothers is the second to least likely. It follows the hypothesis with the exception of the <0 group which is the second-least likely of having been vaccinated against measles. Fever treatment is the highest in Tanzania at 81% and lowest in Ethiopia at 36%.

The rate of children vaccinated against measles decreases from 66% in the <0 group to 56% in the 15> group. Here it seems like children in families with a large age gap are disadvantaged compared to those in more age homogamous families. This follows the hypothesis that children fare worse in families with a large age gap. The highest rate of measles vaccination is in Rwanda where around 79% of the surveyed children are vaccinated. The lowest rate can be found in Nigeria where only 38% were covered. There does not seem to be much difference

between the regions in Africa, although the rate of missing values makes some countries more representative than others.

Of the children who have data on BMI, just over 8% are classified as underweight. As we can see in table 3, the percentage is higher in the less equal age gap groups. The mean standard deviation of BMI decreases with an increasing age gap which it seems to support the hypothesis that children are worse off in families with a larger age gap between the parents. Underweight among children under five is most common in the sample from Niger with just over 16%, and lowest in Rwanda at 2%. Samples from West African countries generally have a much higher percentage of underweight children.

## Regression results

Table 4. Logistic multilevel model regression results for three health indicators. 95% confidence intervals in parenthesis and coefficients statistically significant (p<0.05) in bold. Variance at level 3 (country) and level 2 (household) with confidence interval in parenthesis. Interclass correlation coefficient (ICC) with ICC from the same model but without the age gap variable in parenthesis.

| Variables | | Fever treatment<br>Odds ratio | Measles vaccination<br>Odds ratio | Underweight<br>Odds ratio |
|---|---|---|---|---|
| Age gap between the partner and the mother in years (5–9) | <0 | 0.86 (0.70, 1.06) | 0.99 (0.86, 1.14) | 1.15 (0.99, 1.32) |
| | 0–4 | 0.97 (0.89, 1.06) | **1.07** (1.01, 1.14) | 0.97 (0.92, 1.03) |
| | 10–14 | 0.96 (0.86, 1.07) | 0.94 (0.88, 1.00) | **1.08** (1.01, 1.14) |
| | 15> | **0.86** (0.76, 0.97) | 1.04 (0.97, 1.11) | **1.07** (1.00, 1.14) |
| Sex (male) | Female | 1.01 (0.95, 1.08) | 1.00 (0.97, 1.11) | **0.87** (0.84, 0.91) |
| Current age in months (0–11) | 12–23 | **1.19** (1.08, 1.31) | Ref | **0.62** (0.58, 0.65) |
| | 24–35 | 0.98 (0.89, 1.08) | **1.51** (1.43, 1.60) | **0.38** (0.36, 0.41) |
| | 36–47 | **0.82** (0.74, 0.91) | **1.59** (1.50, 1.69) | **0.31** (0.29, 0.33) |
| | 48–59 | **0.77** (0.70, 0.86) | **1.48** (1.39, 1.57) | **0.31** (0.29, 0.33) |
| Birth order (first) | Second | 0.93 (0.83, 1.03) | **0.86** (0.80, 0.93) | 0.98 (0.91, 1.05) |
| | Third | 0.89 (0.78, 1.01) | **0.75** (0.69, 0.81) | 0.99 (0.91, 1.07) |
| | Fourth | **0.82** (0.71, 0.95) | **0.69** (0.63, 0.76) | 0.99 (0.90, 1.08) |
| | Fifth | **0.82** (0.69, 0.96) | **0.64** (0.58, 0.70) | 1.04 (0.94, 1.15) |
| | Sixth or > | **0.74** (0.62, 0.87) | **0.53** (0.48, 0.59) | 1.05 (0.95, 1.16) |
| Polygyny (only wife) | Multiple wives | 0.97 (0.88, 1.06) | **0.76** (0.72, 0.80) | 1.05 (0.99, 1.10) |
| Mother's age in years (25–29) | 15–19 | 0.93 (0.77, 1.12) | **0.51** (0.45, 0.58) | 1.09 (0.97, 1.22) |
| | 20–24 | 0.97 (0.87, 1.09) | **0.70** (0.65, 0.75) | 1.03 (0.96, 1.10) |
| | 30–34 | 1.00 (0.90, 1.12) | **1.29** (1.20, 1.38) | 0.98 (0.92, 1.04) |
| | 35–39 | 1.12 (0.98, 1.29) | **1.51** (1.39, 1.64) | 1.01 (0.94, 1.10) |
| | 40> | 1.02 (0.86, 1.21) | **1.61** (1.46, 1.77) | 0.94 (0.86, 1.04) |
| Mother's education level (none) | Primary | **1.24** (1.12, 1.37) | **2.15** (2.02, 2.29) | **0.81** (0.76, 0.86) |
| | Secondary | **1.37** (1.20, 1.57) | **4.54** (4.15, 4.97) | **0.79** (0.73, 0.86) |
| | Higher | **1.71** (1.26, 2.30) | **9.04** (7.28, 11.23) | **0.62** (0.52, 0.73) |
| Partner's education level (none) | Primary | **1.20** (1.08, 1.34) | **1.88** (1.76, 2.00) | **0.78** (0.73, 0.83) |
| | Secondary | **1.36** (1.20, 1.55) | **2.17** (2.01, 2.35) | **0.80** (0.74, 0.86) |
| | Higher | **1.60** (1.29, 1.97) | **2.94** (2.57, 3.37) | **0.79** (0.71, 0.89) |
| Wealth index in quintiles (poorest) | Poorer | **1.33** (1.20, 1.48) | **1.58** (1.49, 1.69) | **0.83** (0.79, 0.89) |
| | Middle | **1.53** (1.37, 1.71) | **2.12** (1.99, 2.27) | **0.79** (0.74, 0.85) |
| | Richer | **1.62** (1.43, 1.83) | **3.15** (2.90, 3.41) | **0.77** (0.71, 0.83) |
| | Richest | **2.15** (1.83, 2.52) | **4.27** (3.84, 4.74) | **0.69** (0.63, 0.76) |
| Urban/rural (rural) | Urban | **1.18** (1.06, 1.31) | 0.94 (0.88, 1.00) | **1.12** (1.06, 1.19) |
| Intercept | | 1.39 (0.94, 2.04) | 2.37 (1.51, 3.71) | 0.15 (0.12, 0.20) |
| Variance $\sigma^2$ | Level 3 | 0.74 (0.21) | 1.25 (0.35) | 0.35 (0.11) |
| | Level 2 | 7.64 (0.31) | 4.04 (0.12) | 0.74 (0.04) |
| Interclass correlation coefficient (ICC) | Level 3 | 0.064 (0.064) | 0.146 (0.146) | 0.080 (0.081) |
| | Level 2 | 0.718 (0.718) | 0.616 (0.617) | 0.248 (0.249) |
| N | | 61,233 | 151,684 | 133,733 |

Age gap

The regression results in table 4 show some support for the hypotheses for the three health indicators. The results show that children living in the 15> group have 14% lower odds of being treated for fever or cough compared to the reference group (5–9 years age gap). This supports the hypothesis which states that a larger age gap between the partner and the mother should be linked to a lower rate of fever treatment. The other age gap groups are not statistically significant at the 0.05 significance level and are also not significant in a model with only child-level controls (see appendix table 6). When comparing with this model, we see that a large part of the association between a large age gap and fever treatment weakens with the inclusion of control variables at level 2. The main contributors to this association are the education of the parents, the wealth of the household and whether they live in a rural or urban area.

The only statistically significant coefficient in the measles model is the 0–4 group. It shows that children in this age gap group have 7% higher odds of having received the first round of measles vaccinations compared to the reference group. This also supports the hypothesis, as a lower age gap is associated with a better health outcome for the child. As presented in table 7 in the appendix, all age gap groups except for the <0 group are highly significant in the model with only age difference. When including child-level controls at level 1, the significance and associations remains similar. It is with the inclusion of control variables at level two that most statistical significance disappears, which means that most of that association is explained by the control variables at the household-level.

For the underweight model, both the 10–14 and the 15> groups have statistical significance. Children living with parents with a 10–14-year age gap between the partner and the mother have 8% higher odds of being underweight, and children from the 15> group have 7% higher odds of being underweight compared to the reference group. Again, we see that children living with parents who have a larger age gap have a worse health outcome, here in the form of higher chance of being underweight. The models including only the age gap and control for child-level factors, presented in table 8 in the appendix, have higher statistical significance and stronger associations. The 0–4 group is also statistically significant in this model with lower odds of underweight compared with the reference group. The association between the parents' age gap and the child's underweight status is thus mostly explained by other included control variables at the household-level, in this case primarily the education of the parents and the wealth of the household.

The ICC shows that the correlation between children within the same country is generally weak, ranging from 0.08 in the underweight model to 0.146 in the measles vaccination model. Cultural and political differences between the countries have a much larger impact on the variation in measles vaccinations than any of the other health indicators. The correlation between children of the same mother is much higher, especially for the health behavior indicators with 0.718 for fever treatment and 0.616 for measles vaccination. This shows that children of the same mother are very likely to get the same health interventions. The correlations for underweight is not as strong at 0.248. When comparing with the same models but excluding the age gap variable, the ICC doesn't change much for any of the models. This suggests that only a small part of the variation in child health outcomes between different mothers can be explained by their age gap to their partners.

Control variables

The sex of the child is statistically significant for the underweight model, which was expected since the physical characteristics of girls and boys are different from birth. Girls have 13% lower odds of being underweight compared to boys, and it has been shown in previous research that boys are more likely to be underweight compared to girls in Sub-Saharan Africa (Akombi et al., 2017). The current age of the child is a significant factor for all the three models. For fever treatment, the odds are gradually lower for every added age of the child compared to those who are 0–11 months old. Parents might see fever and cough as more urgent for very young children. Measles vaccination is likelier for children over 24 months compared to those who are 12–23 months old and have the highest odds among those who are 36 to 47 months old. Children have gradually lower odds of being underweight for every added year of age, and those who are 48 to 59 months old have 69% lower odds of being underweight compared to those under 12 months of age. This is surprising as most studies have found underweight to be associated with increasing age of the child (Akombi et al., 2017). Birth order is also a significant factor which and the fever treatment and measles vaccination models show that being the first-born child to the mother is beneficial compared to those who are born later. Perhaps the capacity to care for the child is slightly decreasing with the birth of every new child as resources and time must be distributed among more children. Birth order is not a significant factor in the underweight model, while the association is reversed in the low birth weight model. Being born as the sixth or later child of a mother makes it 48% less likely of having a low birth weight compared to the first-borns. Higher birth order has previously been shown to be associated with higher birth weight for unknown reasons (Swamy et al., 2012).

Whether or not the mother is in a polygynous relationship with her partner is only a significant factor in the measles vaccination model. This might relate to traditional values or the greater amount of people in the household to provide vaccinations for. This is however not supported by the other models where the polygyny status is not statistically significant. The large age gap in polygynous relationship explains some of the loss of significance for the age gap variable in the full model. The age of the mother is also a significant factor in the measles vaccination model, and children whose mother is 40 years or older have the highest odds at 61% higher than the reference group (25–29 years) of being vaccinated for measles, while those whose mother is 15 to 19 years old have 49% lower odds. The mother's age probably explains much of the loss in significance for the age gap variable.

The education of the mother and her partner is highly significant for all models. As previously explained, there are strong associations between the education of the partners and their age gap, explains why much of the association between their age gap and the health outcome for the child is explained by their education. The odds of fever treatment are 71% and 60% higher for mothers and partners respectively compared to those without education. The association is strongest for measles vaccination, where a mother has higher education have over nine times higher odds and the partner almost three times higher odds of having her child vaccinated compared to those who have no education. This is not surprising since measles vaccination is related to knowledge about disease risks and vaccines, and how the family should allocate time and money to protect their children. Any kind of education for the mother and her partner is also associated with a lower likelihood that the child is underweight, while secondary and higher education for the mother are the only significant associations with lower odds of low birth weight. Just as with formal education and its association with the age gap, the wealth of the household has strong associations with the health outcomes for the child. Children living in the richest families have more than twice the odds of getting treated for fever or cough compared to those living in the poorest families, and more than four times the odds of having been vaccinated for measles compared to the poorest. The child also has 31% lower odds of being underweight in these families compared to those in the reference group.

Whether the family lives in an urban or rural area has a statistically significant association with fever treatment and underweight. Children living in urban areas have 18% higher odds of being treated in case of fever or cough compared to those who live in rural areas. This might relate to easier access to medicines and health care professionals. Surprisingly, children

in urban areas are 12% and 17% likelier of being underweight compared to those in rural areas. Those in the <0 and 15> groups are more likely to live in rural areas, which is why some of the associations between the health outcomes and the age gap is explained by the area of residence.

## Discussion and conclusions

This thesis has tested whether there is an association between the age gap between the parents and the health outcomes for their children. More specifically for this thesis, what is measured is the age gap between the mother of the child and her partner. It used DHS data from 26 Sub-Saharan African countries since this is a region where many preventable diseases are still common in young children, and where the average spousal age gap is large while varying greatly between countries. Previous literature has indicated that women can be disadvantaged in age heterogamous male-older relationships. Women's lower status within the family has been shown to hinder their decision-making regarding practices such as family planning and the woman's health (Barbieri et al., 2005; Casterline et al., 1986). This thesis expands on the range of possible outcomes of age heterogamous relationships by focusing on the couple's children. The main hypothesis was that children whose parents have a large age gap would have worse health outcomes on average compared to those whose parents are closer in age. Three variables were chosen which indicate health outcomes for children: fever treatment, measles vaccination and underweight. For each variable only one or two age gap groups are statistically significant compared with the reference group, but always in the direction that was hypothesized. Other stratifications that were initially tested also showed significant results. Which age gap groups that are significant depends on the reference group, but the direction of the association remains the same regardless of which reference group is chosen. The results of the analysis therefore show support for the overall hypothesis, although the parental age gap makes up only a small share of the variation at the mother/household level.

These data indicate that is more likely that the family seeks out treatment or advice for the child in case of fever or cough if the age gap is small. Before adding controls, the likelihood is also lower in woman-older families, although when controlling for confounding variables in the regression the significance of this group disappears (see appendix table 6). Children in families where the male partner is at least 15 years older than the mother are still significantly less likely

to be treated for fever or cough compared to the most common group. This shows support for the hypothesis. Measles vaccination is more common the older the partner is compared with the mother, and mother-older couples have the highest odds. After controlling for relevant variables only those who have an age gap of 0-4 years are significantly likelier than those with a 5-9 years age gap (see appendix table 7). This also confirms the hypothesis, although the confounding variables are responsible for most of the association. Children who are underweight are also more likely to live in families where the male partner is at least 10 years older compared with the reference group. This association is still significant after controlling for confounding variables at the child and household level (see appendix table 8).

These results presented here for the sample of Sub-Saharan African countries might not necessarily be found in other continents or countries. Both the average age gap and local cultures vary greatly across the world, and in countries where the average male-older age gap is smaller we might find different results in health outcomes for children. Higher female autonomy and stable marital relationships in more age homogamous families would benefit the health outcomes for the child. Large age gaps, whether they are man-older or woman-older, might also just as well be a result of liberal values in cultures without strong norms around age and dating. In these countries I would therefore not expect the age gap to be strongly associated with female autonomy or shared values between the partners. Subsequently it is possible that age gaps would have lesser effect on child health. Some child health indicators studied in this thesis might not be easily comparable to different contexts in for example more highly developed countries. Access to and information about vaccines is much more specific to each country while seeking treatment for fevers can be seen as a more universal health seeking behavior.

The reasons for why people end up in relationships with large and small age gaps might also be different across regions. Patriarchal and poorer societies, in which large average age gaps are common, can uphold the benefits of men and women to find differently aged partners. Lower educated women can for example benefit herself and her children by marrying an older man with more resources and experience. The same opportunities to meet age-similar people of the opposite sex might also not exist in many regions of Sub-Saharan Africa. Societies where many people meet their future partner in school as a result of longer education are generally more age homogamous (Mignot, 2010), like for example countries in Europe and wealthier regions of Africa. This is compared with regions of Sub-Saharan Africa where higher education

is less common, and it takes away one of the main platforms in which age homogamous relationships can be initiated. A lack of situations where people are likely to meet same-age partners can also be related to factors about these individuals and their environments that have a negative impact on the health of their future children. For example, it might be harder to meet more compatible partners to build stable relationships with without these large institutions with large amounts of similar-aged people of the opposite sex. Selection into age heterogamous relationships can therefore vary between poorer and richer countries, and can create different circumstances for children to grow up in.

Polygyny only had a significant association with measles vaccination, which could relate to a lack of access to vaccines or vaccine hesitancy in regions where these families are more common. For the other variables it does not seem to be a contributing factor when we have controlled for other variables (see appendix tables 6, 7, 8 and 9). Vaccination is a one-time decision which probably is seen as more important than a decision about whether or not to treat a child for fever. I would suspect that this makes it likelier to be affected by the opinions of others in the household, and thus more related with the woman's lower status and autonomy within the family. The mother's partner (or someone else in the household) might in other words be more willing to let the mother take care of fever treatment of the child than of the decision about vaccinations. The fact that measles vaccination is a one-time decision as compared with fever treatment which happens multiple times throughout childhood highlights another important distinction to make. Getting the first measles vaccination is an event that can only happen once in a child's life, while treatment of fevers and their underweight status might change over time. Fever treatment is especially affected by this if the most recent way of seeking advice/treatment is not representative of how it is usually done within the family. Studies have found that if government health facilities are at a long distance, health seeking behavior is less common (Kanté et al., 2015; Mbagaya & Odhiambo, 2005). Regions within countries could have both different cultural norms and better or worse access to health care facilities. These two factors could simultaneously affect the average age gap and the health of children. In that case, the wealth index and rural/urban variables used in this thesis are not sufficient to give a good picture of the socioeconomic conditions for families.

There are some limitations to this study that must be highlighted. Firstly, we cannot be sure who is the father of the focal child. The DHS data does not give information on this and we can thus only be sure about who is the mother's partner at the time of interview. As the children

are all under the age of five, we could assume that a majority of male partners are indeed the father of the child. The questions that are answered are thus whether health outcomes of the children are different depending on the age gap between the mother and her current partner. As the question regards the influence of environmental/family factors, this is not necessarily a big problem because we mainly interested in each particular environment which each child grows up in. A partner of the mother can hold the same kind of position in relation to the child as a biological father. He provides resources and care for the family to the extent that is possible. In the DHS data, fathers in polygamous unions are randomly counted in which household they slept the previous night. This is a limitation with the data, also because polygamous unions usually have larger age gaps. However, for this study it doesn't create a problem because polygamous relationships are controlled for.

Another thing that is not clear in this data is who is performing the health investment for the child, whether it is treating or seeking advice for fever, providing measles vaccination, or ensures that the child is adequately fed. We can assume that it is most likely the mother or her partner, but it could also be other members of the household. As far as this thesis is concerned, it matters less in what way the child is receiving the adequate health interventions, and more whether they get them at all in families of different age gaps between partners. Lastly, the other main limitation is the missing data discussed above, primarily affecting the underweight model.

This thesis has indicated that that there is a need to look at the children's health outcomes in relation to the parental age gap. It found evidence for the hypothesis that the health outcomes for children are worse in families where the mother's partner is older than the mother. Just like in the case of women's health and autonomy, the health of a child can be compromised in these families. In the dataset used for this study, women are less likely to have the final say on their own health care if her partner is much older than herself. This is a clear indication of the compromised autonomy for the woman, and a measure closely related to the one studied here. In this thesis it was hypothesized that negative health outcomes for the child can be an extension of the compromised autonomy and bargaining power of the mother, associated with worse decision-making process with her partner. If the negative outcomes for children and mothers are linked, it might relate to who in the family is performing the health-seeking behavior for the child. As previous research has shown, women are usually the primary caregivers for their children and are more focused on parenting as a reproductive strategy compared with men. The fact that one of the main mating priorities for women is to find a man willing to channel his

resources specifically to the woman and her children suggests that not all men have this willingness (Buss & Schmitt, 2019). In conditions with scarce resources, like for many families in Sub-Saharan Africa, a mother's capacity to focus the resources on their children is very important for their health. Previous studies have linked higher female autonomy with both better nutrition (Carlson et al., 2015) and higher likelihood of seeking treatment for their child in case of illness (Pierce et al., 2016). Women with lower autonomy are more often in age heterogamous relationships with her partner, and therefore we can explain some of the association between larger age gaps and worse health outcomes for their children. A larger age gap between the parents can create a power imbalance detrimental to the woman and her priorities, especially if the man has higher education and control over household resources. Less female autonomy may in turn lead to less priority in the household for the health care of her and her children. Other reasons might exist for why children of age heterogamous parents in Sub-Saharan Africa are doing worse, most importantly selection into age homogamous partnerships. However, this is the most plausible explanation with the current state of knowledge and data availability in mind.

For future studies, a dataset with more reliably representative data would improve the ability to draw conclusions about these variables specifically. The DHS data is widely used for this kind of research and is currently the best we have for this region of the world. It is also appropriate for cross-country analysis so that it is not necessary to limit the study to one country. Any future study of a related topic would benefit from using a sample from a country that has data on the father of the child and few missing values on the most important variables. It would also be beneficial to study other outcomes for the children such as educational attainment. When it comes to child health, it would also be interesting to look at attitudes toward health investments in children among parents, both before and after the birth of their child. This would give an idea of what mechanisms are behind the different health outcomes. Preferably longitudinal data from a survey that answers child-specific questions and parental attitudes should be used to follow children from the time of birth to adult age to see the outcomes and attitudes over time.

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# Appendix

Table 5. Descriptive table of age gap and health outcomes for all the included countries.

| | Age gap (%) | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Country** | **<0** | **0–4** | **5–9** | **10–14** | **15>** | **Fever treatment** | **Measles vaccination** | **Under-weight** |
| Angola | 5 | 41 | 32 | 13 | 8 | 56 | 41 | 5 |
| Benin | 4 | 27 | 36 | 18 | 14 | 57 | 61 | 16 |
| Burkina Faso | 1 | 19 | 34 | 21 | 25 | 63 | 72 | 14 |
| Burundi | 6 | 51 | 27 | 10 | 7 | 65 | 69 | 4 |
| Cameroon | 2 | 23 | 35 | 21 | 20 | 56 | 64 | 5 |
| Cote d'Ivoire | 3 | 24 | 33 | 21 | 19 | 59 | 56 | 6 |
| DR Congo | 3 | 34 | 39 | 16 | 9 | 52 | 61 | 7 |
| Ethiopia | 3 | 28 | 39 | 18 | 13 | 36 | 41 | 11 |
| Ghana | 4 | 36 | 34 | 14 | 12 | 74 | 75 | 5 |
| Guinea | 1 | 9 | 26 | 27 | 37 | 51 | 56 | 10 |
| Kenya | 3 | 34 | 35 | 15 | 12 | 65 | 73 | 5 |
| Lesotho | 2 | 49 | 34 | 10 | 5 | 65 | 76 | 3 |
| Madagascar | 10 | 42 | 29 | 11 | 8 | 44 | 61 | - |
| Malawi | 4 | 47 | 34 | 11 | 4 | 69 | 68 | 3 |
| Mali | 1 | 12 | 33 | 27 | 26 | 49 | 62 | 12 |
| Mozambique | 5 | 40 | 33 | 14 | 8 | 57 | 72 | 5 |
| Namibia | 9 | 37 | 31 | 13 | 9 | 58 | 79 | 6 |
| Niger | 0 | 12 | 37 | 27 | 25 | 61 | 60 | 16 |
| Nigeria | 1 | 17 | 35 | 25 | 22 | 75 | 38 | 16 |
| Rwanda | 14 | 47 | 24 | 8 | 6 | 54 | 79 | 2 |
| Senegal | 2 | 12 | 31 | 28 | 27 | 48 | 63 | 9 |
| South Africa | 10 | 40 | 32 | 13 | 6 | 68 | 75 | 3 |
| Tanzania | 4 | 36 | 35 | 15 | 10 | 81 | 62 | 4 |
| Uganda | 5 | 42 | 31 | 13 | 8 | 78 | 60 | 4 |
| Zambia | 2 | 38 | 42 | 12 | 5 | 70 | 75 | 6 |
| Zimbabwe | 3 | 39 | 38 | 13 | 7 | 52 | 61 | - |
| Total | 3 | 30 | 34 | 18 | 15 | 62 | 61 | 9 |

Table 6. Regression results for fever treatment with three models.

| **Variables** | | **Model 1 – age gap** Odds ratio | **Model 2 - children** Odds ratio | **Model 3 - parents** Odds ratio |
|---|---|---|---|---|
| Age gap between the husband and mother in years (5–9) | <0 | **0.81** (0.66, 0.99) | 0.85 (0.69, 1.04) | 0.86 (0.70, 1.06) |
| | 0–4 | 0.99 (0.90, 1.08) | 0.97 (0.89, 1.06) | 0.97 (0.89, 1.06) |
| | 10–14 | 0.93 (0.83, 1.03) | 0.95 (0.85, 1.05) | 0.96 (0.86, 1.07) |
| | 15+ | **0.74** (0.66, 0.83) | **0.78** (0.69, 0.87) | **0.86** (0.76, 0.97) |
| Sex (male) | Female | - | 1.01 (0.95, 1.08) | 1.01 (0.95, 1.08) |
| Current age in months (0–11) | 12 – 23 | - | **1.19** (1.08, 1.31) | **1.19** (1.08, 1.31) |
| | 24 – 35 | - | 0.98 (0.89, 1.08) | 0.98 (0.89, 1.08) |
| | 36 – 47 | - | **0.82** (0.74, 0.91) | **0.82** (0.74, 0.91) |
| | 48 – 59 | - | **0.78** (0.70, 0.86) | **0.77** (0.70, 0.86) |
| Birth order (first) | Second | - | 0.91 (0.83, 1.01) | 0.93 (0.83, 1.03) |
| | Third | - | **0.85** (0.76, 0.95) | 0.89 (0.78, 1.01) |
| | Fourth | - | **0.75** (0.67, 0.85) | **0.82** (0.71, 0.95) |
| | Fifth | - | **0.72** (0.63, 0.82) | **0.82** (0.69, 0.96) |
| | Sixth or > | - | **0.62** (0.55, 0.69) | **0.74** (0.62, 0.87) |
| Polygyny (only wife) | Polygynous | - | - | 0.97 (0.88, 1.06) |
| Mother's age in years (25–29) | 15–19 | - | - | 0.93 (0.77, 1.12) |
| | 20–24 | - | - | 0.97 (0.87, 1.09) |
| | 30–34 | - | - | 1.00 (0.90, 1.12) |
| | 35–39 | - | - | 1.12 (0.98, 1.29) |
| | 40> | - | - | 1.02 (0.86, 1.21) |
| Mother's education level (none) | Primary | - | - | **1.24** (1.12, 1.37) |
| | Secondary | - | - | **1.37** (1.20, 1.57) |
| | Higher | - | - | **1.71** (1.26, 2.30) |
| Husband's education level (none) | Primary | - | - | **1.20** (1.08, 1.34) |
| | Secondary | - | - | **1.36** (1.20, 1.55) |
| | Higher | - | - | **1.60** (1.29, 1.97) |
| Wealth index in quintiles (poorest) | Poorer | - | - | **1.33** (1.20, 1.48) |
| | Middle | - | - | **1.53** (1.37, 1.71) |
| | Richer | - | - | **1.62** (1.43, 1.83) |
| | Richest | - | - | **2.15** (1.83, 2.52) |
| Urban/rural (rural) | Urban | - | - | **1.18** (1.06, 1.31) |
| Intercept | | 2.51 (1.78, 3.55) | 3.19 (2.22, 4.59) | 1.39 (0.94, 2.04) |
| Level 3 variance | | 0.75 (0.21) | 0.76 (0.22) | 0.74 (0.21) |
| Level 2 variance | | 7.59 (0.30) | 7.68 (0.31) | 7.64 (0.31) |
| ICC level 3 | | 0.064 | 0.065 | 0.064 (0.064) |
| ICC level 2 | | 0.717 | 0.720 | 0.718 (0.718) |
| N | | 61,233 | 61,233 | 61,233 |

Table 7. Regression results for measles vaccination with three models.

| Variables | | Model 1 – age gap<br>Odds ratio | Model 2 – children<br>Odds ratio | Model 3 – parents<br>Odds ratio |
|---|---|---|---|---|
| Age gap between the husband and mother in years (5–9) | <0 | 1.09 (0.96, 1.25) | 1.14 (0.99, 1.30) | 0.99 (0.86, 1.14) |
| | 0–4 | **1.20** (1.13, 1.27) | **1.19** (1.13, 1.26) | **1.07** (1.01, 1.14) |
| | 10–14 | **0.83** (0.79, 0.89) | **0.85** (0.80, 0.90) | 0.94 (0.88, 1.00) |
| | 15+ | **0.70** (0.65, 0.74) | **0.72** (0.67, 0.76) | 1.04 (0.97, 1.11) |
| Sex (male) | Female | - | 1.00 (0.96, 1.04) | 1.00 (0.97, 1.11) |
| Current age in months (0–11) | 12 – 23 | - | Ref | Ref |
| | 24 – 35 | - | **1.50** (1.43, 1.58) | **1.51** (1.43, 1.60) |
| | 36 – 47 | - | **1.56** (1.47, 1.65) | **1.59** (1.50, 1.69) |
| | 48 – 59 | - | **1.50** (1.42, 1.59) | **1.48** (1.39, 1.57) |
| Birth order (first) | Second | - | **0.91** (0.85, 0.97) | **0.86** (0.80, 0.93) |
| | Third | - | **0.80** (0.75, 0.86) | **0.75** (0.69, 0.81) |
| | Fourth | - | **0.75** (0.69, 0.80) | **0.69** (0.63, 0.76) |
| | Fifth | - | **0.67** (0.62, 0.72) | **0.64** (0.58, 0.70) |
| | Sixth or > | - | **0.54** (0.51, 0.58) | **0.53** (0.48, 0.59) |
| Polygyny (only wife) | Polygynous | - | - | **0.76** (0.72, 0.80) |
| Mother's age in years (25–29) | 15–19 | - | - | **0.51** (0.45, 0.58) |
| | 20–24 | - | - | **0.70** (0.65, 0.75) |
| | 30–34 | - | - | **1.29** (1.20, 1.38) |
| | 35–39 | - | - | **1.51** (1.39, 1.64) |
| | 40> | - | - | **1.61** (1.46, 1.77) |
| Mother's education level (none) | Primary | - | - | **2.15** (2.02, 2.29) |
| | Secondary | - | - | **4.54** (4.15, 4.97) |
| | Higher | - | - | **9.04** (7.28, 11.23) |
| Husband's education level (none) | Primary | - | - | **1.88** (1.76, 2.00) |
| | Secondary | - | - | **2.17** (2.01, 2.35) |
| | Higher | - | - | **2.94** (2.57, 3.37) |
| Wealth index in quintiles (poorest) | Poorer | - | - | **1.58** (1.49, 1.69) |
| | Middle | - | - | **2.12** (1.99, 2.27) |
| | Richer | - | - | **3.15** (2.90, 3.41) |
| | Richest | - | - | **4.27** (3.84, 4.74) |
| Urban/rural (rural) | Urban | - | - | 0.94 (0.88, 1.00) |
| Intercept | | 11.96 (7.68, 18.64) | 12.25 (7.82, 19.20) | 2.37 (1.51, 3.71) |
| Level 3 variance | | 1.26 (0.36) | 1.27 (0.36) | 1.25 (0.35) |
| Level 2 variance | | 4.00 (0.10) | 4.16 (0.11) | 4.04 (0.12) |
| ICC level 3 | | 0.148 | 0.146 | 0.146 (0.146) |
| ICC level 2 | | 0.615 | 0.623 | 0.616 (0.617) |
| N | | 151,684 | 151,684 | 151,684 |

Table 8. Regression results for underweight with three models.

| Variables | | Model 1 – age gap<br>Odds ratio | Model 2 - children<br>Odds ratio | Model 3 - parents<br>Odds ratio |
|---|---|---|---|---|
| Age gap between the husband and mother in years (5–9) | <0 | 1.11 (0.96, 1.27) | 1.12 (0.97, 1.29) | 1.15 (0.99, 1.32) |
| | 0–4 | **0.95** (0.89, 1.00) | **0.94** (0.89, 1.00) | 0.97 (0.92, 1.03) |
| | 10–14 | **1.09** (1.03, 1.16) | **1.10** (1.04, 1.17) | **1.08** (1.01, 1.14) |
| | 15+ | **1.15** (1.08, 1.22) | **1.17** (1.10, 1.25) | **1.07** (1.00, 1.14) |
| Sex (male) | Female | - | **0.88** (0.84, 0.91) | **0.87** (0.84, 0.91) |
| Current age in months (0–11) | 12 – 23 | - | **0.62** (0.59, 0.66) | **0.62** (0.58, 0.65) |
| | 24 – 35 | - | **0.38** (0.36, 0.41) | **0.38** (0.36, 0.41) |
| | 36 – 47 | - | **0.32** (0.30, 0.34) | **0.31** (0.29, 0.33) |
| | 48 – 59 | - | **0.32** (0.30, 0.34) | **0.31** (0.29, 0.33) |
| Birth order (first) | Second | - | 0.98 (0.92, 1.05) | 0.98 (0.91, 1.05) |
| | Third | - | 1.01 (0.94, 1.09) | 0.99 (0.91, 1.07) |
| | Fourth | - | 1.03 (0.96, 1.12) | 0.99 (0.90, 1.08) |
| | Fifth | - | **1.11** (1.02, 1.20) | 1.04 (0.94, 1.15) |
| | Sixth or > | - | **1.16** (1.08, 1.24) | 1.05 (0.95, 1.16) |
| Polygyny (only wife) | Polygynous | - | - | 1.05 (0.99, 1.10) |
| Mother's age in years (25–29) | 15–19 | - | - | 1.09 (0.97, 1.22) |
| | 20–24 | - | - | 1.03 (0.96, 1.10) |
| | 30–34 | - | - | 0.98 (0.92, 1.04) |
| | 35–39 | - | - | 1.01 (0.94, 1.10) |
| | 40> | - | - | 0.94 (0.86, 1.04) |
| Mother's education level (none) | Primary | - | - | **0.81** (0.76, 0.86) |
| | Secondary | - | - | **0.79** (0.73, 0.86) |
| | Higher | - | - | **0.62** (0.52, 0.73) |
| Husband's education level (none) | Primary | - | - | **0.78** (0.73, 0.83) |
| | Secondary | - | - | **0.80** (0.74, 0.86) |
| | Higher | - | - | **0.79** (0.71, 0.89) |
| Wealth index in quintiles (poorest) | Poorer | - | - | **0.83** (0.79, 0.89) |
| | Middle | - | - | **0.79** (0.74, 0.85) |
| | Richer | - | - | **0.77** (0.71, 0.83) |
| | Richest | - | - | **0.69** (0.63, 0.76) |
| Urban/rural (rural) | Urban | - | - | **1.12** (1.06, 1.19) |
| Intercept | | 0.05 (0.04, 0.07) | 0.10 (0.07, 0.13) | 0.15 (0.12, 0.20) |
| Level 3 variance | | 0.42 (0.13) | 0.44 (0.13) | 0.35 (0.11) |
| Level 2 variance | | 0.61 (0.04) | 0.74 (0.66, 0.82) | 0.74 (0.04) |
| ICC level 3 | | 0.097 | 0.099 | 0.080 (0.081) |
| ICC level 2 | | 0.239 | 0.263 | 0.248 (0.249) |
| N | | 133,733 | 133,733 | 133,733 |

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