보건학석사 학위논문

The Effect of Wealth & Inequality on Infant and Child Mortality Risk in Botswana

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보건학과 보건인구학 전공

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Abstract

The Effect of Wealth & Inequality on Infant and Child Mortality Risk in Botswana

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Background: Botswana has experienced rapid economic and social development over the past few decades. However this has coincided with growing social inequalities in health and wealth. Botswana's GINI coefficient ranks it as one of the most unequal societies in the world and health indicators on under-five mortality are lower in comparison to other development indices. Furthermore there is considerable variance in wealth composition in the 29 administrative districts in the country. This study aims to look specifically at wealth and inequality and their association with infant and child mortality risk. The author expects that child health outcomes will be better for mothers in higher wealth levels and living in more societies where wealth is distributed more equally.

Methods: Using data from the 2011 Botswana Population and Housing census a cross-sectional multilevel logistic regression analysis was conducted to analyze the effects of wealth at the individual- and district levels, as well as to identify whether infant and child mortality risk varies by district. The sample sizes included 40461 and 219584 mothers for

the infant and child mortality risk analyses respectively.

Conclusion: Although there was variation in infant and child mortality risk across districts, this could not be attributed to inequality. In addition, socioeconomic determinants were not associated with infant mortality risk. However, increasing wealth and education were positively associated with child mortality and in most cases with a social gradient. The importance of this study is in contributing to the literature on wealth and health in developing countries. Furthermore it provides recommendations on opportunities to improve health for the under-five subpopulation. As wealth disparities continue to rise in sub-Saharan Africa an awareness of their potential impact on population health should provide more encouragement for a systematic approach to the socioeconomic determinants of health.

Keywords: Infant mortality; Child mortality; Wealth; Inequality; Social determinants of health; Population health; Botswana

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1. Introduction

1.1 Background

Although Botswana has made significant strides in economic and social development social inequality has grown markedly since the early 1990s. Botswana is listed at an upper-middle income country, but recent reports from the International Monetary Fund and the countries own government have noted that the country is one of the most unequal in the world. This disparity, combined with one of the highest HIV/AIDS burdens worldwide means that health and longevity gains made since independence in 1966 have been reversed. Botswana's income distribution as measured by the GINI coefficient stands at .61, up from .53 in 2002 (Okatch, Siddique, & Rammohan, 2013). Social inequality is well known as a risk factor for many communicable and non-communicable diseases; a double burden that is increasing in Botswana.

Figure 1. Location map of Botswana (Public domain)

With a population of 2,021,000 (2013) Botswana's infant mortality rate is estimated at 41 per 1000 live births (World Bank, 2014). Although this is a lower figure compared to other African nations, it is important to also investigate how child deaths vary within the country. Just as research has gone beyond grouping sub-Saharan Africa and its outcomes, inequalities within countries need to be explored further. The Botswana Demographic Survey has demonstrated that there are differentials in life expectancy between men and women and between those who live in rural areas versus those in and urban areas. Botswana's 29 districts display not only differing geographic properties but also socioeconomic indicators. For instance, people living in the Gaborone (capital city) region are more likely to have completed secondary education than those living in the northwest and more remote region of Ngamiland – a place that has one of the highest mortality rates in the country. The capital city also has a higher proportion of residents in the highest wealth quintile than in other regions.

These are just some of the indicators across which health outcomes show a social gradient in Botswana. In addition to the health disparities, it could be argued that the country is lagging behind other countries in the region, relative to its status. With a GDP per capita in the top ten on the continent, one would expect Botswana to have a lower infant mortality rate than its less well-off regional neighbors. However, countries such as Ethiopia, Madagascar, and Zimbabwe (Table 1.) have better or similar infant mortality outcomes, despite having less than 15% of Botswana's GDP per capita. GDP is usually a good indicator of standards of living and development that might be associated with lower infant and child mortality (Shandra, Shandra, & London, 2012). It should be of concern that such a well-resourced and small country is faring worse than other countries that are poorer and

more populous.

Table 1. Selected sub-Saharan countries' GDP per capita and infant mortality rate (2014)

Country	GDP per capita (US$)	Infant Mortality Rate (per 1000)	Country	GDP per capita	Infant Mortality Rate
Botswana	7315	41	Ethiopia	565	43
Uganda	696	39	Senegal	1062	42
Madagascar	463	38	Zimbabwe	896	49

*All data from World Bank

2015 was the final year of the Millennium Development Goals (MDG) and it is important to take stock of how developing countries have performed with regards to improving population health over the past 15 years. MDG 4 was conceived with the recognition that child health is a pivotal condition for many countries to ultimately experience or maintain economic progress. Children represent the future labor force and in Sub-Saharan Africa comprise 40% of the total population (World Bank, 2013). With such a significant proportion of the population yet to transition into adulthood and the labor market, they represents an important commodity that should be protected. Child health is important because most under-five deaths are preventable. It is also highly correlated with the aggregate health of the population. The world infant mortality rate (IMR) is 49.4, but is much lower in developed nations than in their developing counterparts. Parameters such as IMR and under-five (U5) mortality provide an outlook not only about infant health but the general standing of the country's health.

In Botswana healthcare is delivered through public, private and not-for-profit entities. However, the public sector remains the foremost provider for most citizens. The Botswana government has a centralized health provision system, which is available to all at a highly subsidized rate. There is no national health coverage but the costs of seeking care from public facilities are not prohibitive. In fact, according to Statistics Botswana

(2011), 95% of residents in urban areas live within eight kilometers of a health facility. This suggests that improving access to health care may not offer the solution to improving Botswana's U5 survival, especially since the country already has an urbanization rate of 65% (Gwebu, 2015). Botswana is a relatively young nation that is yet to experience the potential economic benefits of the demographic dividend. With that in mind, under-five mortality rates remain above global averages. This should prompt efforts to look beyond traditional proximate determinants to provide returns on health commiserate with the country's other social development indicators.

1.2 Objective

The aim of this research is to address the wealth and inequality relationship with infant and child mortality risk in Botswana. Specifically, the objectives of this study are to:

1. Clarify the association between wealth and infant and child mortality in Botswana
2. Evaluate how individuals and aggregate factors affect child health
3. Determine which groups and regions' health is most vulnerable to wealth effects
4. Formulate recommendations on interventions to reduce health disparities stemming from wealth To address these questions the study will seek to answer the following research questions:

1. How much of the difference in infant/child mortality risk is attributable to district-level variance?
2. What is the relationship between wealth and infant/child mortality risk (controlling for other mother-level variables)?

3. Does this relationship vary among districts?

4. What is the impact of district wealth inequality on infant/child mortality risk?

To the best of my knowledge research of this type has not been conducted in Botswana and the findings could supplement the existing literature on child health and highlight policy implications for social determinants of health-related interventions. This study employed a cross-sectional multilevel (two-level) design with data from the 2011 National Population and Housing Census. Mothers were nested in districts and socioeconomic, demographic, healthcare covariates were included in the multilevel logistic regression. Other district level variables were sourced from the Ministry of Health Accelerated Child Survival and Development Strategy (2009).

2. Literature Review & Hypothesis

2.1 Literature Review

2.1.1 Socioeconomic Status & Health

Since the seminal Whitehall Study (Marmot et al., 1991), many studies have helped to provide evidence of the association between SES and health. Researchers have looked at differences in health outcomes by socioeconomic status, and although there is still debate as to the underlying mechanisms, it is generally accepted that a relationship exists. Numerous studies have found differences in mortality outcomes based on differing socioeconomic status (Johan P Mackenbach et al., 2008; Meara, Richards, & Cutler, 2008). This effect has been found across different cultural and demographic contexts. For instance, Adams found that the effects of early education on health extend into elderly age (2002). Both developed (Braveman, Egerter, & Williams, 2011; Lleras-Muney, 2005; J. P. Mackenbach, Cavelaars, Kunst, & Groenhof, 2000) and developing (Lopez-Arana, Burdorf, & Avendano, 2013; Matthews & Diamond, 1997) countries are beginning to pay more attention to the role that social and environmental factors play in population health. The Commission on the Social Determinants of Health "Closing the Gap in a Generation" report (2008) has also helped to galvanize public health efforts to employ an approach to population health that looks beyond clinical and healthcare factors. The idea is that the places people live and how they live is just important in determining their healthcare.

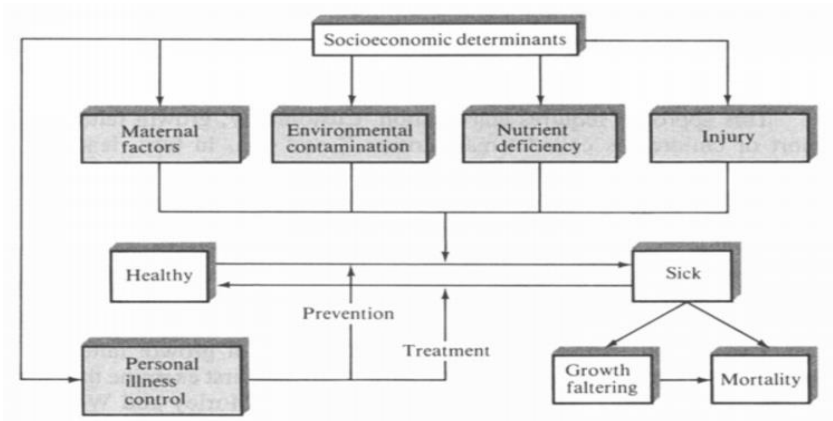

Figure 2. Conceptual model of socio-economic determinants on health (Mosley & Chen, 1984)

Education, income, wealth, inequality, employment, labor and housing policies, discrimination, social capital, place of residence are just some of the social determinants that can independently or collectively affect the health of populations. For instance, in a cross-national study of Sub-Saharan countries, when national debt levels and adult HIV prevalence are controlled for, Mogford (2004) found that women's education was an important protective factor for child deaths. This provides an entry point for interventions that can target already established institutions such as schools and places of work to address health issues. Figure 2 shows Mosley's conceptual model of how socioeconomic determinants work through proximate determinants of infant and child health (maternal factors, environment, nutrition, injury and personal illness control) to enhance or reduce their effect on individual health. This same framework can be applied to this study, which not only considers asset-based wealth, but also other social determinants that may work directly or indirectly to affect mortality risk.

2.1.3 Wealth & Infant and Child Mortality

Among the social determinants of health, wealth and income are important in the context of the free market that dominates today's global landscape. Although it is difficult to disentangle the independent effects of wealth from education and income, some scholars suggest that its effect on health is additive over and above other the effects of other measures of SES. In the context of the planned study, there are two issues to consider: how wealth and inequality affect child health and how these factors operate differently at individual and contextual levels.

Evidence from single level study designs, have provided the most consistent results in the literature on social determinants of health. In general, factors such as maternal and parental characteristics, ante- and prenatal care, neonatal variables and delivery conditions are associated with child survival (Mosley & Chen, 1984). For instance, mother's education level, in particular, can have protective effects on child's stunting (Adekanmbi, Kayode, & Uthman, 2013) and child mortality (Breierova & Duflo, 2004). Furthermore, parents' education and location (urban or rural) have also been shown to be predictive of vaccination uptake (Matthews & Diamond, 1997). Research conducted in Botswana has also showed the role played by social factors in orphan health, where household conditions and wealth level negatively affected the probability of being underweight (Miller, Gruskin, Subramanian, & Heymann, 2007).

Wealth can affect health by increasing an individuals' access to healthcare services, safer living environment, and health promoting activities. Furthermore, it is likely that people with a lower wealth status will be exposed to more discrimination over time, thereby affecting their health differentially than wealthier people. For example, a poorer person

may not be able to afford material goods that may be viewed in other parts of society as standard. This may lead to shame and being excluded (subconsciously or otherwise) by others who can identify this 'marker' of being from a lower SES. This constant social comparison and subsequent behavioral adjustment could lead to high levels of stress over an extended period of time – an established risk factor for chronic conditions such as cardiovascular diseases (Chandola, Brunner, & Marmot, 2006; Vitaliano et al., 2002). The lack of social support then means that these people also face the risk of mental health conditions such as depression. Although the research on the underlying pathway between wealth and health in ongoing, there are some patterns that have emerged that highlight the manner in which this relationship manifests itself in populations.

Wealth is not only associated with health but often displays a gradient effect. Successively higher strata of SES will progressively show better or worse health outcomes. There is also evidence of this pattern in child health outcomes based on the mother's SES (Acevedo-Garcia, Soobader, & Berkman, 2005; Hosseinpoor et al., 2005). While this dose-response-like effect cannot be taken as direct causality, it does create impetus to reduce the disparities by SES in order to improve overall population health. A multilevel analysis of neonatal mortality in Ghana found both that people who lived in areas of high socioeconomic deprivation had a higher risk of infant mortality, with the authors concluding that interventions based on empowerment and infrastructural development should have a positive impact on neonatal health outcomes (Kayode et al., 2014). Based on finding associations with mortality from individual and community level variables they recommended that multifaceted approaches to child health would be more efficacious than those focused on more proximal determinants.

An area of SES and health that needs further investigation is that of neighborhood or contextual effects. Measurement, definitional, and interpretation issues mean that how one's neighborhood affects his/her health is not yet settled. For instance one study found that mother's nation of origin was more important that neighborhood factors in explaining infant birth weight among recent immigrants (Urquia et al., 2009). Nevertheless there have been some studies that have attempted to quantify and show the effect that characteristics of a person's physical and social space have on health. Some scholars believe that psychosocial insults such as discrimination can lead to prolonged stress that eventually affect biological pathways that can impact wellbeing negatively (Elzinga et al., 2008; Glaser & Kiecolt-Glaser, 2005; Kiecolt-Glaser & Glaser, 2002)

An analysis of 28 sub-Saharan countries found that community level variables were associated with better child survival (Boco, 2010). Furthermore, risks of preterm birth, small-for-gestational-age birth, still birth, and neonatal and post-neonatal births were all positively associated with maternal education and neighborhood income levels (Luo, Wilkins, & Kramer, 2006). Jorgenson and Rice (2010) have highlighted the quality of the built environment as being a catalyst for growing health disparities, by imparting cognitive, behavioral, and physiological effects on their societies. These place-based benefits also mean that wealthier people tend to have better access to healthier food options, transportation, school systems, employment opportunities, and healthcare (Woolf, 2015). Although these studies have found differing effects it could be that some socio-structural determinants take time to negatively (or positively) affect health. That said, it is important to establish the current linkages between wealth and health in Botswana to be able to later track changes as appropriate social policies are implemented.

Finally, macro-social theories of development have also been assessed in Sub-Saharan nations, and with regards to infant mortality. They found that the gender stratification theory was predictive of a lower IMR (Frey & Field, 2000). This theory refers to the unequal distribution of wealth, power, and privilege, and Frey and Field (2000) argued that the higher the status of women the lower the risk of infant mortality. In rural areas of Botswana the women tend to take on different social and work roles and are more often employed in the informal labor sector. This raises the possibility of uneven health outcomes compared to mothers in urban areas (Adetunji, 1994). In addition to different employment structures, education, marital status, and head the household gender tend to vary between rural and urban areas – another factor associated with inequalities in infant mortality risk. It is thought that these factors can affect the ease with which mothers can access necessary healthcare services in a timely manner. In order to achieve health for all, governments should been looking into ways to ensure that these socio-structural variations are acknowledged in order to address population health.

2.2 Hypothesis

The hypotheses of this study are as follows:

1. There is district level variability in the risk of infant and child mortality
2. Mothers with higher levels of wealth will be associated with lower risks of infant and child mortality
3. Inequality will have a negative effect on infant and child mortality risk
4. The effect of wealth on infant and child mortality risk will vary randomly by district

3. Method

3.1 Data & Sample

Data was sourced from the 2011 Botswana Population and Housing dataset based on 4185 enumeration areas. This tool was developed by the Central Statistics Office of Botswana and has gone through a number of iterations and enhancements since first implementation in 1971. The data quality of the census was analyzed using the United Nations Age-Sex Accuracy Index and was adjudged to be of “acceptable quality” and “could be used to derive credible estimates” (Bainame & Letamo, 2015).

The census contains several demographic and socioeconomic variables that were used to analyze the relationship between wealth and infant and child mortality risk. There are summary birth history items on the census questionnaire, which pertain to reporting infant and child mortality and are asked to all women between the ages of 15 and 49. Women are asked how many children they have given birth to in the preceding year who are still alive. They are also asked about how many live births they have had over their lifetime. These are followed by questions that check how many of these born children are still alive on the day of the survey. Using the difference between these values information about infant and child mortality risk (for at least one child) can be deduced. The inclusion criteria for the sample was women between 20 and 39 years old for both infant and child mortality outcomes. This resulted in sample sizes of 40461 and 219584 mothers for infant and child mortality analyses respectively.

3.2 Measures

3.2.1 Wealth and Inequality

At the individual level the explanatory variable “wealth quintile”, a categorical variable with the first quintile (poorest group) being the reference group. Calculation of individual wealth scores was determined through a principal components analysis (PCA) based on household assets (Mmopelwa, 2015). Measures for income and expenditure are not readily available in some developing countries (Sahn & Stifel, 2003) including Botswana. Therefore use of an asset-based wealth index has been found to be a reliable alternative to studying wealth in developing countries (Vyas & Kumaranayake, 2006). The PCA was calculated based on scores from type of housing unit, wall material, floor material, roof material, water supply, toilet facilities, energy for lighting, energy for cooking, energy for heating, and other durable assets (e.g. vehicles, refrigerators, and technology devices). After summing individual scores, mothers were placed into the corresponding wealth quintile.

Related to individual wealth scores, district-level inequality was considered as the explanatory variable for differences in mortality risks. This was computed by finding the ratio of the mean score of the highest wealth quintile to that of the lowest. This is also known as the 20:20 ratio and is utilized by the United Nations Development Programme in the Human Development Index. It is sometimes preferred to measures such as the GINI coefficient at it deals with the reducing impact outliers and of the middle 60% on revealing inequality. Maps with the regional inequality and mean regional wealth were produced in order to visualize the variations across the country. The map were rendered using Epi Info

software.

3.2.2 Infant & Child Mortality

There are two dependent variables for two separate analyses: infant mortality risk and child mortality risk. These come from self-reported infant mortality and child mortality outcomes. These variables were coded as be binary with "1" representing death and "0" no death. The census enumeration process began on the 22nd of August, 2011 and was carried out for 10 days until completion. Infant mortality risk was estimated from this following two questions: "How many children have been born alive by Independence Day 2010 (30th of September, 2010)?" This question was followed by, "How many of these children are still alive?" Child mortality risk was estimated from the following questions: "How many children have been born alive by Independence day 2009?" with the follow up question asked, "How many of the children have died?" Finally the mother were asked, "At what age did this child die?" These questions were used to establish the risk of a mother responding that her child had died within the first year of life or after that.

3.2.3 Control Variables

Other control variables that were included are education level, age, marital status, and household size. All of the control variables were coded as categorical variables as follows: education four levels (no school, primary, secondary, and tertiary), age group two levels (20-24, 25-29, 30-34, 35-39), marital status four levels (married, never married,

cohabiting, and divorced/separated/widowed), and household size five levels (1-2, 3-4, 5-6, 7-10, and more than 10). In order to account for the effect of number of children on mortality (which would likely increase of child mortality as these mothers will have had more children over time, and therefore a higher probability of experiencing a child death), children ever born was also included in the child mortality analysis. This variable was not included for the infant mortality analysis as the number of mothers who gave birth to more than one child in this sample represented a very small proportion. At the regional level individual measures for residents of respective districts will be aggregated to produce measures for wealth and inequality, proportion of women with university-level education, and vaccine coverage. Data for the latter was sourced from the Ministry of Health Accelerated Child Survival and Development Strategy (2009).

3.3 Statistical Analysis

The first analysis was a descriptive summary of the distributions of wealth by district and other district-level demographic, socioeconomic, and healthcare indicators. This was performed to provide an overview of pertinent measures in this study and how they varied across the 28 districts. Secondly a bivariate analysis of the socioeconomic and demographic variables by mortality outcome was performed along with a chi-square test of independence was performed to see which socio-demographic variables had a statistical associations with infant and child mortality. Following the descriptive analysis of the sample, a multilevel logistic regression with four models was utilized for the analysis. The first was the null model to provide the component of variance analysis:

$$\eta_{ij} = \gamma_{00} + \mu_{0j} \tag{1}$$

The second model controlled for district-level variables, while the third model included district- and individual-level variables.

$$\eta_{0j} = \gamma_{00} + \gamma_{01} inequality_j + \gamma_{02} womeneducation_j + \gamma_{03} vaccination_j + \mu_{0j} \tag{2}$$

$$\eta_{ij} = \gamma_{00} + \gamma_{01} inequality_j + \gamma_{02} womeneducation_j + \gamma_{03} vaccination_j + \gamma_{10} wealth_{ij} + \gamma_{20} education_{ij} + \gamma_{30} age_{ij} + \beta_{4j} marital_{ij} + \beta_{5j} hhsize_{ij} + \mu_{0j} \tag{3}$$

The final model added the random effect of wealth quintile in order to attempt to explain variability in the intercepts.

$$\eta_{ij} = \gamma_{00} + \gamma_{01} inequality_j + \gamma_{02} womeneducation_j + \gamma_{03} vaccination_j + \gamma_{10} wealth_{ij} + \gamma_{20} education_{ij} + \gamma_{30} age_{ij} + \beta_{4j} marital_{ij} + \beta_{5j} hhsize_{ij} + \mu_{1j} wealth_{ij} + \mu_{0j} \tag{4}$$

All analyses was conducted using SPSS 23 statistical software.

4. Results

4.1 Socioeconomic & Demographic Characteristics

Botswana has 28 administrative districts that range from collections of small villages and towns in a shared region to the capital city (Gaborone), which stands on its own as a district. (Only 27 districts are listed in table 2, with the Central Kgalagadi Game Reserve (CKGR) – inhabited by indigenous people of Botswana – removed as it has a quite

different social and economic context to the rest of the country.) While Kweneng West is the largest district population-wise (252942), Gaborone is the city with the largest population and highest mean wealth when the three special mineral mining districts (Jwaneng, Sowa Town, and Orapa) are not taken into consideration. Many services and employment opportunities are concentrated in Gaborone, which is evidenced by its population being more than twice as large as the next biggest city, Francistown. Ngamiland West was the poorest district.

Chobe, Ghanzi, and Ngamiland East (97% survival response) were the districts where mothers were most likely to respond that their infants had survived the first year of life. Ngwaketse West (92.2%) had the lowest infant survival response rate, while for child survival Okavango (80.9) and Boteti (97.3%) had the lowest and highest respectively. Mean vaccination coverage rate for the country was 89.2% with Mahalapye (96.2%) as the highest and Okavango (78.8%) with the lowest coverage. Kweneng West had the highest proportion of university educated women (39.1%), while the capital city Gaborone had the lowest (8.8%). In terms of wealth distribution, Kweneng West was also the most unequal district with a 20:20 ratio of 6.3, with the least unequal district being Orapa (1.3).

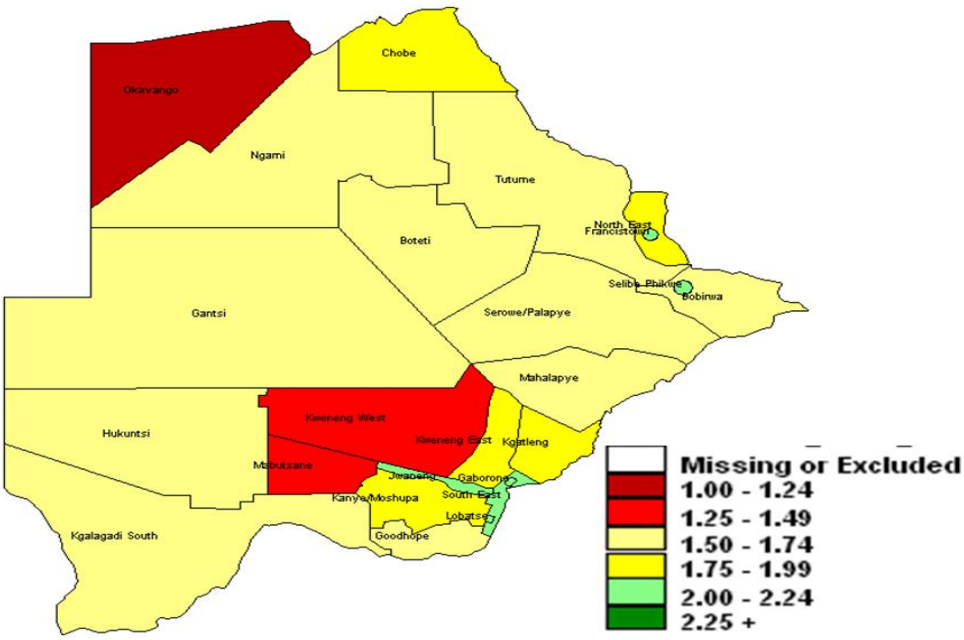

Figure 3. Distribution of wealth by districts in Botswana

Table 2. Selected descriptive statistics for districts in Botswana

District	Population (N)	Inequality (20:20 Ratio)	Women Universit y (%)	Vacc. Coverage (%)	Mean Regional Wealth Score	Infant Survival (%)	Child Survival (%)
Gaborone	222952	3.385	8.8	90.9	2.24	94.4	91.6
Francistown	95694	3.542	14	79.3	2.13	96.8	90.6
Lobatse	28042	3.544	13.9	80.4	2.10	96.1	90.0
Phikwe	48479	3.714	13.7	95.1	2.12	95.3	89.5
Orapa	9106	1.336	9.7	86.1	2.41	94.9	91.2
Jwaneng	16721	3.411	10.4	95.7	2.23	94.8	89.1
Sowa Town	3137	5.622	10.4	87.6	2.29	96.8	82.9
Ngwaketse	127382	5.284	25.3	93.1	1.76	93.9	87.6
Barolong	51779	4.764	26.5	96.6	1.70	93.4	84.0
Ngwaketse W.	13120	5.361	36.6	85.7	1.41	92.2	85.1
South East	81397	4.210	17.1	93.7	2.13	93.6	91.0
Kweneng East	252942	5.228	20.4	91.3	1.92	95.8	89.7
Kweneng West	45947	6.282	39.1	91.1	1.32	95.8	85.4

Kgatleng	90460	4.388	18.9	93.7	1.96	96.4	88.5
Serowe-PLP.	172284	5.445	25.1	91.3	1.71	94.8	86.2
Mahalapye	114659	4.831	26.8	96.2	1.67	95.7	86.3
Bobonong	68774	5.072	26.8	91	1.66	94.6	85.6
Boteti	54212	5.867	33.1	86.1	1.52	95.8	97.3
Tutume	141594	5.568	27.9	87.6	1.54	95.8	85.8
North East	56942	4.592	22.1	85.1	1.74	95.7	87.2
Ngamiland E.	87498	5.101	25.8	84.8	1.74	97.0	89.1
Ngamiland W.	56898	6.402	38.8	84.8	1.23	96.5	84.2
Chobe	20792	4.793	21.5	80.7	1.89	97.0	88.4
Okavango	1294	4.922	39.9	78.8	1.42	96.2	80.9
Ghanzi	40016	4.660	31.7	94.4	1.61	96.6	84.9
Kgalagadi S.	28847	4.672	26.6	92.2	1.66	93.9	85.6
Kgalagadi N.	18156	4.943	26.4	94.1	1.69	93.2	85.7
Total	1949187	4.61	25.7	89.2	1.81	94.2	88.4

Figure 2 shows the distribution of wealth by districts and gives a better indication of how this distribution varies across the country. Ngamiland West, for instance, while being the most unequal district also has the highest proportion of people in the first wealth quintile. This is in contrast to Gaborone, Francistown, Lobatse, Phikwe, Orapa, Jwaneng, and the South East districts that all have less than 10% of their population in the poorest wealth quintile. Orapa, a diamond mining town has almost 90% of its residents in the richest wealth quintile. Almost all residents there are affiliated with the mining company – which is part of a highly lucrative industry that relies on highly skilled employees.

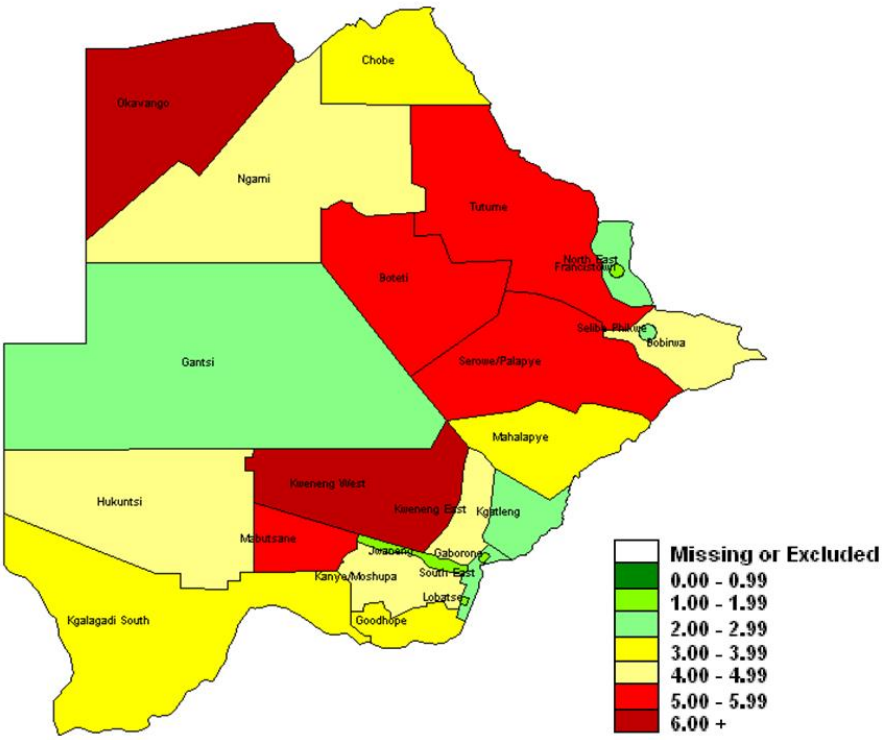

Figure 4. Distribution of inequality by districts in Botswana

4.2 Distribution of Infant & Child Mortality

The total sample size for the infant mortality risk analysis was 40461. The richest wealth quintile were most likely to report a death (5.1%). This was followed by the poorest quintile (4.9%), with the middle three quintiles reporting similar infant deaths. Among the sample the second wealth quintile had the highest proportion (22%), with the richest quintile representing only 17% of the sample. Secondary school educated women represent almost two-thirds of the sample as compared to four percent who have never attended or attended non-formal education. The latter group also had the lowest survival with 94.6%, while those with tertiary-level education had the lowest (95.5%).

Table 3. Demographic and socioeconomic characteristics of study sample by infant mortality

		No Infant Mortality (n)	%	Infant Mortality (n)	%	Total (n)
Wealth quintile	Poor	7957	95.1%	407	4.9%	8364
	Less poor	8464	95.5%	401	4.5%	8865
	Medium	7825	95.7%	348	4.3%	8173
	Less Rich	7682	95.5%	361	4.5%	8043
	Rich	6660	94.9%	356	5.1%	7016
Education	Never attended	1407	94.6%	80	5.4%	1487
	Primary	4812	95.1%	250	4.9%	5062
	Secondary	25535	95.4%	1220	4.6%	26755
	Tertiary	6834	95.5%	323	4.5%	7157
Age group	20-24	12374	95.5%	589	4.5%	12963
	25-29	12683	95.5%	601	4.5%	13284
	30-34	8605	95.5%	407	4.5%	9012
	35-39	4926	94.7%	276	5.3%	5202
Marital status	Married	6667	95.4%	318	4.6%	6985
	Never married	15217	95.4%	736	4.6%	15953
	Cohabiting	16296	95.4%	794	4.6%	17090
	Divorced/Separated	406	94.2%	25	5.8%	431
Household size	1-2	1439	92.9%	110	7.1%	1549
	3-4	10124	95.1%	524	4.9%	10648
	5-6	10305	95.3%	512	4.7%	10817
	7-10	12349	95.8%	548	4.2%	12897
	11+	4371	96.1%	179	3.9%	4550

Most births were accounted for between the two youngest age groups (20-24 and 25-29) who accounted for two-thirds of the sample. This was followed by 30-34 (22%) and 34-39 (13%). The oldest age group had the lowest survival (94.7%) while the remaining

three age groups were equal at 95.5%. Over 80% of the sample were never married (39%) or cohabiting (42%). Married women represented 17% of the sample, with separated, divorced, or widowed mothers making up the remaining 2%. Survival was equal for married, never married, and cohabiting (95.4%), with divorced, separated, and widowed lower at 94.2%.

Most households had seven to 10 residents (32%) with the lowest represented by households with 1-2 people (4%). Those in households between three and six members accounted for roughly 53% of the sample, with those over size 11 making up 11% of the sample. This largest household size was also the least likely to report infant death (3.9%), with survival reporting getting progressively worse as the household size decreases; one-to-two member household size reported infant death 7.1% of the time.

Table 4. Demographic and socioeconomic characteristics of study sample by child mortality

Covariates		No Child Mortality (n)	%	Infant Mortality (n)	%	Total (n)
Wealth quintile	Poor	26311	88.1%	3560	11.9%	29871
	Less poor	29277	89.3%	3512	10.7%	32789
	Middle	40618	90.5%	4271	9.5%	44889
	Less Rich	51424	91.1%	5039	8.9%	56463
	Rich	51637	92.9%	3935	7.1%	55572
Education	Never attended	7782	91.2%	747	8.8%	8529
	Primary	16796	86.2%	2695	13.8%	19491
	Secondary	126381	90.7%	12914	9.3%	139295
	Tertiary	43142	93.2%	3154	6.8%	46296
Age group	20-24	43723	92.2%	3724	7.8%	47447
	25-29	65361	90.9%	6576	9.1%	71937
	30-34	53610	90.4%	5710	9.6%	59320
	35-39	36573	89.5%	4307	10.5%	40880

Marital status	Married	37200	93.3%	2662	6.7%	39862
	Never Married	87744	90.6%	9154	9.4%	96898
	Living together	70791	89.8%	8084	10.2%	78875
	Divorced/Separated	3526	89.4%	416	10.6%	3942
Household size	1-2	40567	85.9%	6679	14.1%	47246
	3-4	60509	91.3%	5778	8.7%	66287
	5-6	42571	92.8%	3324	7.2%	45895
	7-10	41719	92.5%	3384	7.5%	45103
	11+	13901	92.3%	1152	7.7%	15053

The total sample size for the child mortality risk analysis was 219584, with about half of represented by the top two wealth quintiles. The middle wealth quintile represented 20% of the sample with the lowest representation coming from the poorest wealth quintile (14%). Survival was best for the richest wealth quintile (92.9%), in contrast to 88.1% in the poorest wealth quintile. The gradual increase in survival from poorest to richest should also be noted.

Almost two-thirds of women in the sample were secondary school educated, followed by university level at 21%. Mothers with primary school education of accounted for 13% of the sample. Tertiary school educated mothers we least likely to report a child's death (6.8%), with primary school educated mothers reporting at the highest rate (13.8%). The four age groups were almost even represented, ranging from 22% (20-24) up to 33% (24-29). The older two groups made up 46% of the sample. Survival reduced gradually with age from 92.2% at the youngest age band to 89.5% at the highest.

Never married and cohabiting mothers accounted for the bulk of the sample (80%). This was followed by married women (18%) and separated, divorced, or widowed women (2%). Married mothers reported child deaths at the lowest rate (6.7%) with living together

and separated, divorced and widowed having the highest rates with 10.2% and 10.6% respectively. Most households had 3-4 members (30%), while those above 10 residents had the smallest share at 7%. Household with one-to-two, five-to-six, and seven-to-10 people had similar proportions at roughly 21%. There was a general trend of reduced reporting of child deaths as household size increased. The smallest household size had 85.9% survival, while household sizes about 5 averaged 92.5%.

4.3 Wealth and Inequality on Infant & Child Mortality

4.3.1 Infant Mortality Risk

From model one of the multilevel logistic regression (Table 5) there was evidence of variance in infant mortality risk that is attributable to district level variation ($z = 2.47$, $p = 0.14$). Model two introduced district-level covariates (inequality, percentage of university educated women, and vaccination coverage), with only vaccination coverage showing a statistically significant effect. The odds ratio for vaccination coverage was 1.03 (*CI*: 1.01, 1.05) suggesting that mothers in districts with higher vaccination coverage were more likely to report infant mortality. There was still evidence of district-level infant mortality variation ($z = 2.06$, $p = 0.04$).

The third model considered both district- and individual-level covariates. While the odds ratios for the higher wealth quintiles were less than one (poorest was reference group) none of them were statistically significant. In fact the only variable with a statistically significant odds ratios were household size. In comparison to one-to-two person households all other sizes had lower odds for infant mortality risk. Furthermore the

effect was gradually stronger the larger the household size. Again, the random intercept was statistically significant (z = 2.06, p = 0.04), informing the decision to adding the random effect of wealth for the final model. The coefficients for the socioeconomic and demographic variables remained roughly the same in model four. However, neither the random intercept (z = 1.86, p = 0.06) nor the random wealth effect (z = 1.18, p = 0.24) were statistically significant.

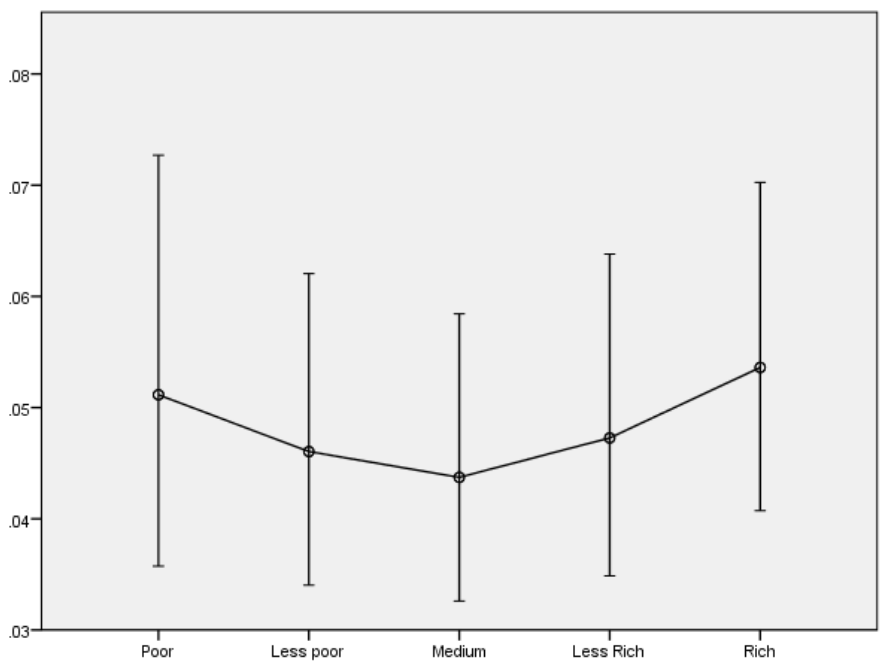

Figure 5. Estimated marginal means infant mortality risk at different wealth quintile levels

4.3.2 Child Mortality Risk

For child mortality risk (Table 6) the first model random intercept also supported the idea that variability that could be attributed to district-level variation as evidence (z =

2.95, p = 0.03). The second model, which considered only district-level covariates, there was no real increase or decrease in mortality risk based on inequality, proportion of university educated women, or vaccine coverage. The random intercept remained statistically significant (z = 2.49, p = 0.01). From the third model (district- and individual-level covariates) there was evidence that those in higher wealth quintiles experienced lower risk of child mortality than those in lower wealth quintiles. Compared to the poorest group, the odds ratio for the wealthiest group was 0.783 (CI: .725, .845). In fact the risk gradually decreased from the poorest to the middle, and fourth wealth quintiles. Only the second wealth quintile was not significantly different from the reference group, although the effect direction did reduce the risk.

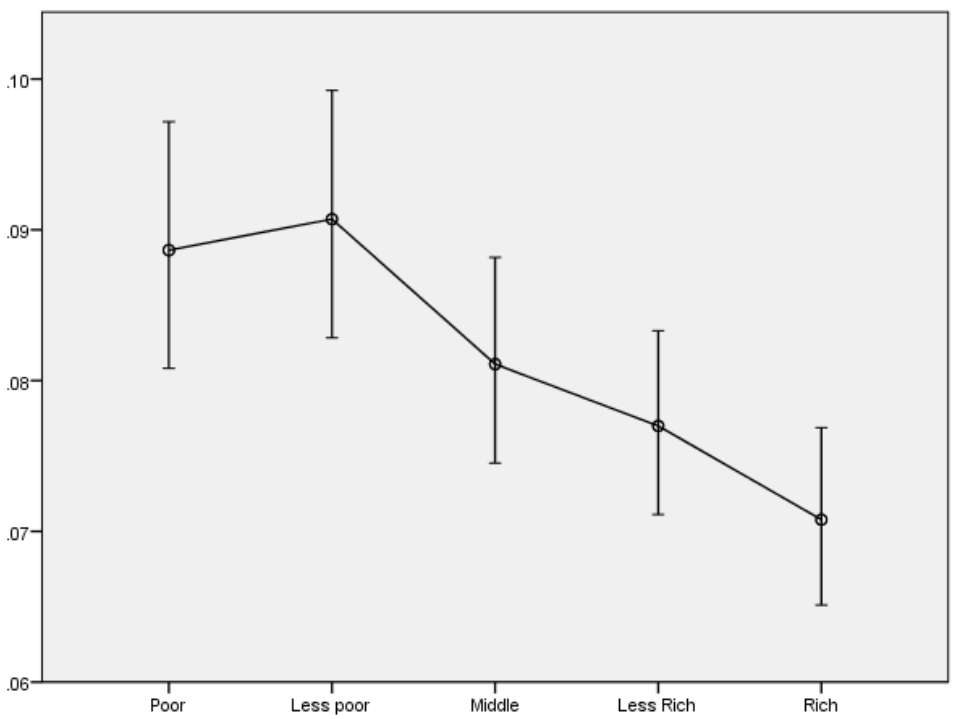

Figure 6. Estimated marginal means child mortality risk at different wealth quintile levels

Education showed a similar trend with wealth in regards to its association with child mortality risk. Compared to mothers with no education, those with secondary (*OR*: .820 *CI*: .740, .908) and tertiary-level education (*OR*: .726, *CI*: .669, .788) had lower odds of child mortality risk. In contrast primary school educated mothers had a higher risk of reporting child mortality than no-education mothers (*OR*: 1.02, *CI*: .932, 1.11). There was no evidence of a relationship between age and child mortality risk, once children ever born was included in the model.

Married mothers had the lowest risk of reporting child mortality. All other marital status categories had higher odds ratios. Never married, cohabiting, and divorced and widowed had odds ratios of 1.56, 1.45, and 1.34 (all statistically significant at 95%) respectively, in comparison to the reference group. Household size and child mortality risk showed an inverse relationship, with the odds ration getting lower the larger the household size. Those with households larger than 7 were 60% less likely to report a child death (OR: .368, CI: .346, .393) than those in one- or two-person homes. Finally the random intercept remained significant ($z = 2.00$, $p = .045$), informing the decision to assess wealth as a random effect in the final model. Odds ratios for district- and individual-level covariates did not vary much from the in previous model, however the random intercept ($z = 1.73$, $p = .084$) and the random effect of wealth ($z = 1.77$, $p = .086$) were not statistically significant

Table 5. Fixed and random effects odds ratios of mother- and district-level infant mortality risk

	Model 1		**Model 2**		**Model 3**		**Model 4**	
Covariates	*Odds ratio*	*(95% CI)*	*Odds ratio*	*(95% CI)*	*Odds ratio*	(95% CI)	*Odds ratio*	*(95% CI)*
District-level								
Inequality			.802	(.363, 1.77)	.873	(.397, 1.92)	.859	(.389, 1.90)
University women %			1.01	(.975, 1.04)	1.00	(.973, 1.03)	1.00	(.974, 1.04)
Vaccination coverage			1.03**	(1.01, 1.05)	1.03**	(1.01, 1.05)	1.03**	(1.01, 1.05)
Mother-level								
Intercept	.049	(.044, 0.54)	.005	(.001, .033)	.007**	(.001, .045)	.007**	(.001, .046)
Wealth Quintile								
Rich					.996	(.817, 1.22)	.992	(.813, 1.21)
Less rich					.876	(.719, 1.07)	.904	(.741, 1.10)
Middle					.838	(.677, 1.04)	.833	(.676, 1.03)
Less poor					.905	(.768, 1.07)	.911	(.770, 1.08)
Poor^{R}								
Education level								
Tertiary					.785	(.569, 1.08)	.786	(.569, 1.08)
Secondary					.874	(.666, 1.15)	.877	(.666, 1.15)
Primary					.911	(.670, 1.24)	.915	(.670, 1.24)
No School^{R}								
Age group								
35-39					1.17	(.914, 1.49)	1.16	(.913, 1.49)
30-34					.989	(.800, 1.22)	.989	(.800, 1.22)
25-29					.991	(.869, 1.13)	.990	(.868, 1.13)
20-24^{R}								
Marital status								
Divorced/Widowed					1.32	(.926, 1.89)	1.32	(.927, 1.89)
Cohabiting					1.06	(.904, 1.25)	1.07	(.906, 1.25)
Never married					1.10	(.940, 1.28)	1.10	(.943, 1.28)
Married^{R}								
Household size								
11+					.518**	(.403, .665)	.516	(.402, .662)
7-10					.558**	(.443, .703)	.557	(.442, .701)
5-6					.628**	(.536, .736)	.625	(.534, .733)
3-4					.678**	(.557, .826)	.677	(.556, .823)
1-2^{R}								
Random Effect	**z**	***p***	**z**	***p***	**z**	p	**z**	***P***
Intercept	2.47*	.014	2.06*	.040	2.05*	.040	1.86+	.063
Wealth quintile							1.18	.238
ICC	.016		.011		.011			
AIC	241389.44		241538.18	242085.77	242085.77		241907.14	

Table 6. Fixed and random effects odds ratios of mother- and district-level child mortality risk

Covariates	**Model 1** *Odds ratio*	*95% CI)*	**Model 2** *Odds ratio*	*95% CI)*	**Model 3** *Odds ratio*	*95% CI)*	**Model 4** *Odds ratio*	*95% CI)*
District-level								
Inequality			1.06	(.863, 1.29)	1.07	(.899, 1.26)	1.06	.894, 1.25
University women %			1.01	(.983, 1.04)	1.01	(.996, 1.02)	1.01	.996, 1.02
Vaccination coverage			1.00	(.985, 1.01)	1.00	(.980, 1.02)	1.00	.982, 1.02
Mother-level								
Intercept	.111**	(.102, .121)	.077**	(.023, .261)	.029**	(.012, .071)	.031**	(.013, .074)
Wealth Quintile								
Rich					.783**	(.725, .845)	.791**	(.729, .857)
Less rich					.858**	(.803, .916)	.863**	(.804, .925)
Middle					.907**	(.863, .953)	.848**	(.848, .958)
Less poor					1.03	(.975, 1.08)	1.03	(.971, 1.10)
Poor^{R}								
Education level								
Tertiary					.726**	(.669, .788)	.725**	(.668, .787)
Secondary					.820**	(.740, .908)	.819**	(.739, .907)
Primary					1.02	(.932, 1.11)	1.02	(.932, 1.03)
No School^{R}								
Age group								
35-39					.989	(.905, 1.08)	.989	(.905, 1.08)
30-34					.965	(.909, 1.02)	.965	(.909, 1.02)
25-29					.994	(.962, 1.03)	.995	(.962, 1.03)
20-24^{R}								
Marital status								
Divorced/Widowed					1.34**	(1.20, 1.51)	1.34**	(1.20, 1.51)
Cohabiting					1.45**	(1.38, 1.51)	1.44**	(1.38, 1.51)
Never married					1.56**	(1.49, 1.64)	1.56**	(1.49, 1.68)
Married^{R}								
Household size								
11+					.342**	(.315, .371)	.342**	(.315, .372)
7-10					.368**	(.346, .393)	.369**	(.346, .394)
5-6					.384**	(.361, .408)	.384**	(.361, .409)
3-4					.547**	(.519, .577)	.548**	(.519, .578)
1-2^{R}								
Children ever born					1.73	(1.64, 1.82)	1.73	(1.64, 1.82)
Random Effect	**z**	***p***	**z**	***p***	**z**	***p***	**z**	***p***
Intercept	2.95**	.003	2.49*	.013	2.00*	.045	1.73+	.084
Wealth quintile							1.77+	.086
ICC	.013		.009		.004		.005	
AIC	1169121.02		1169113.24		1164740.57		1153915.39	

5. Discussion

The main findings of this study relate to the impact of individual-level wealth on the mortality risk of infants and children in Botswana. First, results provide evidence that the higher the wealth quintile the lower the risk of infant and child mortality. Although the wealth-infant mortality relationship was not statistically significant the odds ratios for wealthier mothers were related with a lower risk of infant mortality than for poorer groups. Nevertheless, this pattern remains the same for child mortality, where the lower odds for the middle, fourth, and fifth wealth quintiles are all statistically significant. This finding is consistent with other studies that have looked at socioeconomic determinants of infant health (DaVanzo, Butz, & Habicht, 1983; Madise, Banda, & Benaya, 2003). They suggest that bio-demographic factors are more pivotal in infant survival, but that social determinants begin to have more of an influence as children get older. This could be explained by the idea that as children get older they experience more exposure to their social and physical environments. Furthermore, there could be lag time between exposure to certain socioeconomic health risks and physiological manifestation. Given that the wealth score was an asset-based measure, the higher the wealth of a family means that a child could have adequate access to safe shelter, good nutrition, and social support.

Second, the wealth quintile, education and household size covariates showed evidence of a social gradient. That is, there was a sequential increase or decrease in mortality risk between the reference group and successive categories. (This pattern was also evident for marital status, although it is not possible to describe this variable as having progressive levels.) Wealthier groups had better child risk outcomes than the level previous wealth level. This means that there is no threshold across which people move from being

unhealthy to being healthy. The more wealth one has the higher their health returns can be. It is important however to remember that this study focused only on under-five mortality and that other studies in Botswana will need to look at other health outcomes and age groups.

Third, there were differences in mortality risk by district. However, these cannot be explained by district-level inequality. It could be that there is no association or that it takes times for the noxious effects of inequality to become evident in the community and then to actually affect health. Vaccination coverage was the only level-2 variable with a statistically significant effect on infant mortality. Vaccination is not only a direct measure to reduce the risk of mortality, but its coverage could be viewed as a proxy for quality of healthcare services in a given region. This supports the idea that healthcare factors (e.g. ante and prenatal care and health facility delivery), are more crucial for infant and neonatal survival than for child survival. Further investigation will be needed to understand exactly which contextual effects can be associated with these differences.

This study has several limitations on the findings proposed. First, this was a cross-sectional analysis, which denies the opportunity to see any changes over time and thus to conclude causality. Second, clinical determinants may be more key to infant mortality and therefore a measure of health that pertained directly to the mothers in the study may have been more beneficial to the social determinants of health approach. Third, measurement of wealth was based on households, which may confer a different health effect depending on the individual's role. For instance further analysis (not shown) revealed that being the head of household was protective for child mortality

risk. This could explain the u-shaped mortality risk trend from poorest to richest, which mirrors the wealth quintile in which women are the majority head of household. Therefore the effect of wealth on maternal and child health could be mediated by women's roles in the household and associated benefit they accrue from its wealth categorization.

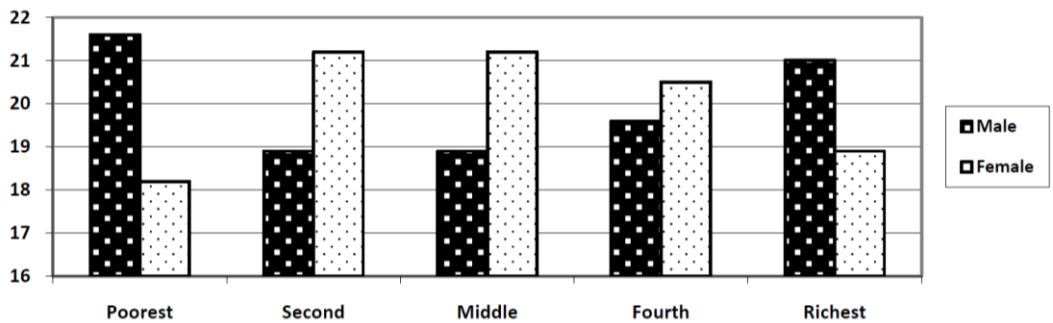

Figure 7. Percentage of female- and male-headed household by wealth quintile (Mmopelwa, 2015)

Alternatively, this could be a result of data underreporting. Perhaps mothers who lost children before their first birthday would be less inclined to report this during the census survey, as the children may have died very early on resulting in the mothers never registering the child. This underreporting would become less of an issue in child mortality as children have more likely been registered at in their district office and/or schools.

Despite these limitations, this study has provided evidence of the association between SES and health in under-five mortality and met its intended objectives. As a social determinant of health, wealth (as represented by where we

live and the access to resources associated with this) could be one of the key determinants for improving population health in developing countries. This results of this study have reconfirmed the wealth-health relationship and hopefully provided a platform for more evidence based interventions and social policies. Future study should also reassess the impact of time and what changes occur in child health as more national data becomes available.

6. Conclusion

The goal of this study was to analyze whether the risk of infant and child mortality was linked to the level of the mother's wealth. In particular it sought to address the question of whether wealthier women experience a lower risk of infant and child mortality than their less advantaged counterparts. Additionally, the study wanted to look at another aspect of wealth: inequality; with the goal of examining whether mothers in more unequal societies are more prone to poorer child health outcomes. The findings suggest that in Botswana wealth has a relationship with child mortality but not infant mortality. Ensuring that people have access to living spaces with proper sanitation, clean water, hygienic food storage and cooking facilities, and reliable means of transport could provide and entry point for government policy and interventions into social health. Future studies should investigate specifically which items that comprise the wealth index have an effect on health outcomes. For instance, how does ownership of walled housing, a refrigerator, or a cellular phone affect health of the population? This would be a meaningful step as it would provide information on clear and implementable measures.

Addressing social determinants of health is a complicated endeavor. Many of the factors are interlinked making it even more difficult to buttress health against the risks. People born in a certain place are likely to be subject to the conditions of that location. If it is a poorer area the schools are likely to have a less conducive learning environment – large class sizes, poor nutrition in cafeterias, etc. These effects accumulate over time, determining where (or if) one goes to university, what kind of job he/she gets, and ultimately his/her level of wealth. Despite genetic uniqueness or individual behavioral choices, in a sense people become product of their environments. As we move into the era of the Sustainable Development Goals (SDG) the focus remains on child health and reduction of inequalities. SDG 10 refers to "adopting policies, especially fiscal, wage and social protection policies, and progressively achieve greater equality" (UN, 2015). Through its National Development Plan Botswana must strive to ensure that all policies consider their potential effect on health as a way to reduce existing inequalities.

References

Acevedo-Garcia, D., Soobader, M.-J., & Berkman, L. F. (2005). The differential effect of foreign-born status on low birth weight by race/ethnicity and education. *Pediatrics, 115*(1), e20-e30.

Adams, S. J. (2002). Educational attainment and health: Evidence from a sample of older adults. *Education Economics, 10*(1), 97-109.

Adekanmbi, V. T., Kayode, G. A., & Uthman, O. A. (2013). Individual and contextual factors associated with childhood stunting in Nigeria: a multilevel analysis. *Maternal & child nutrition, 9*(2), 244-259.

Adetunji, J. A. (1994). Infant mortality in Nigeria: effects of place of birth, mother's education and region of residence. *Journal of biosocial science, 26*(04), 469-477.

Bainame, K., & Letamo, G. (2015). Evaluation of Data Quality of the Botswana 2011 Population and Housing Census. *Botswana Notes and Records, 46*.

Boco, A. G. (2010). Individual and community level effects on child mortality: an analysis of 28 Demographic and Health Surveys in Sub-Saharan Africa.

Braveman, P., Egerter, S., & Williams, D. R. (2011). The social determinants of health: coming of age. *Annual review of public health, 32*, 381-398.

Breierova, L., & Duflo, E. (2004). *The impact of education on fertility and child mortality: Do fathers really matter less than mothers?* Retrieved from

Chandola, T., Brunner, E., & Marmot, M. (2006). Chronic stress at work and the metabolic syndrome: prospective study. *Bmj, 332*(7540), 521-525.

DaVanzo, J., Butz, W. P., & Habicht, J.-P. (1983). How biological and behavioural

influences on mortality in Malaysia vary during the first year of life. *Population Studies, 37*(3), 381-402.

Elzinga, B. M., Roelofs, K., Tollenaar, M. S., Bakvis, P., van Pelt, J., & Spinhoven, P. (2008). Diminished cortisol responses to psychosocial stress associated with lifetime adverse events: a study among healthy young subjects. *Psychoneuroendocrinology, 33*(2), 227-237.

Frey, R. S., & Field, C. (2000). The determinants of infant mortality in the less developed countries: a cross-national test of five theories. *Social Indicators Research, 52*(3), 215-234.

Glaser, R., & Kiecolt-Glaser, J. K. (2005). Stress-induced immune dysfunction: implications for health. *Nature Reviews Immunology, 5*(3), 243-251.

Gwebu, T. D. (2015). Policy Implications of Urbanisation Patterns and Processes in Botswana. *Botswana Notes and Records, 46*.

Hosseinpoor, A. R., Mohammad, K., Majdzadeh, R., Naghavi, M., Abolhassani, F., Sousa, A., . . . Vega, J. (2005). Socioeconomic inequality in infant mortality in Iran and across its provinces. *Bulletin of the World Health Organization, 83*(11), 837-844.

Jorgenson, A. K., & Rice, J. (2010). Urban slum growth and human health: a panel study of infant and child mortality in less-developed countries, 1990–2005. *Journal of Poverty, 14*(4), 382-402.

Kayode, G. A., Ansah, E., Agyepong, I. A., Amoakoh-Coleman, M., Grobbee, D. E., & Klipstein-Grobusch, K. (2014). Individual and community determinants of neonatal mortality in Ghana: a multilevel analysis. *BMC pregnancy and childbirth, 14*(1), 1.

Kiecolt-Glaser, J. K., & Glaser, R. (2002). Depression and immune function: central pathways to morbidity and mortality. *Journal of psychosomatic research, 53*(4), 873-876.

Lleras-Muney, A. (2005). The relationship between education and adult mortality in the United States. *The Review of Economic Studies, 72*(1), 189-221.

Lopez-Arana, S., Burdorf, A., & Avendano, M. (2013). Trends in overweight by educational level in 33 low-and middle-income countries: the role of parity, age at first birth and breastfeeding. *Obesity Reviews, 14*(10), 806-817.

Luo, Z.-C., Wilkins, R., & Kramer, M. S. (2006). Effect of neighbourhood income and maternal education on birth outcomes: a population-based study. *Canadian Medical Association Journal, 174*(10), 1415-1420.

Mackenbach, J. P., Cavelaars, A. E., Kunst, A. E., & Groenhof, F. (2000). Socioeconomic inequalities in cardiovascular disease mortality; an international study. *Eur Heart J, 21*(14), 1141-1151. doi:10.1053/euhj.1999.1990

Mackenbach, J. P., Stirbu, I., Roskam, A.-J. R., Schaap, M. M., Menvielle, G., Leinsalu, M., & Kunst, A. E. (2008). Socioeconomic inequalities in health in 22 European countries. *New England Journal of Medicine, 358*(23), 2468-2481.

Madise, N. J., Banda, E. M., & Benaya, K. W. (2003). Infant mortality in Zambia: socioeconomic and demographic correlates. *Social biology, 50*(1-2), 148-166.

Marmot, M. G., Stansfeld, S., Patel, C., North, F., Head, J., White, I., . . . Smith, G. D. (1991). Health inequalities among British civil servants: the Whitehall II study. *The Lancet, 337*(8754), 1387-1393.

Matthews, Z., & Diamond, I. (1997). Child immunisation in Ghana: the effects of family,

location and social disparity. *Journal of biosocial science, 29*(03), 327-343.

Meara, E. R., Richards, S., & Cutler, D. M. (2008). The gap gets bigger: changes in mortality and life expectancy, by education, 1981–2000. *Health Affairs, 27*(2), 350-360.

Miller, C. M., Gruskin, S., Subramanian, S., & Heymann, J. (2007). Emerging health disparities in Botswana: Examining the situation of orphans during the AIDS epidemic. *Social science & medicine, 64*(12), 2476-2486.

Mmopelwa, K. R. L. (2015). Household Wealth Status: An Asset Based Approach. *Global Journal of Human-Social Science Research, 15*(6).

Mogford, L. (2004). Structural determinants of child mortality in sub-Saharan Africa: A cross-national study of economic and social influences from 1970 to 1997. *Social biology, 51*(3-4), 94-120.

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

Okatch, Z., Siddique, A., & Rammohan, A. (2013). *Determinants of Income Inequality in Botswana*: University of Western Australia, Business School, Economics.

Sahn, D. E., & Stifel, D. (2003). Exploring alternative measures of welfare in the absence of expenditure data. *Review of income and wealth, 49*(4), 463-489.

Shandra, C. L., Shandra, J. M., & London, B. (2012). The international monetary fund, structural adjustment, and infant mortality: A cross-national analysis of Sub-Saharan Africa. *Journal of Poverty, 16*(2), 194-219.

Statistics Botswana. (2011). Population and Housing Census, 2011. *Gaborone: Statistics Botswana*.

UN. (2015). Goal 10: Reduce inequality within and among countries. Retrieved from http://www.un.org/sustainabledevelopment/inequality/

Urquia, M. L., Frank, J. W., Glazier, R. H., Moineddin, R., Matheson, F. I., & Gagnon, A. J. (2009). Neighborhood context and infant birthweight among recent immigrant mothers: a multilevel analysis. *American Journal of Public Health, 99*(2), 285-293.

Vitaliano, P. P., Scanlan, J. M., Zhang, J., Savage, M. V., Hirsch, I. B., & Siegler, I. C. (2002). A path model of chronic stress, the metabolic syndrome, and coronary heart disease. *Psychosomatic medicine, 64*(3), 418-435.

Vyas, S., & Kumaranayake, L. (2006). Constructing socio-economic status indices: how to use principal components analysis. *Health policy and planning, 21*(6), 459-468.

Woolf, S. H. (2015). How are Income and Wealth Linked to Health and Longevity?

World Bank. (2013). Indicators Data. 2013.

국문초록

보츠와나에서 부와 불평등이 영유아 사망 위험에 미치는 영향

배경: 보츠와나는 최근 몇 십 년 동안 급격한 경제사회발전을 겪었다. 하지만 이러한 발전은 부와 건강 측면에서 점점 증가하는 사회적 불평등과 동시에 일어 났다. 보츠와나의 GINI 계수는 보츠와나가 세계에서 가장 불평등한 사회 중 하나임을 보여준다. 또한 5세 미만 사망률에 대한 건강지표는 다른 개발 지수들과 비교해 낮다. 뿐만 아니라 이 나라의 29개 행정구역별 부의 구성에는 상당한 차이가 있다. 본 연구의 목적은 부와 불평등을 특정적으로 살피고 영유아 사망 위험과의 연관성을 알아보는데 있다. 저자는 보다 높은 부의 수준을 지니고 더 평등한 사회에 살고 있는 엄마에게서 아이의 건강이 보다 좋게 나타날 것이라고 예상한다.

방법: 개인 수준과 행정구역 수준에서 부의 영향을 분석하고 영유아 사망 위험이 행정구역별로 다른지 확인하기 위해 2011 보츠와나 인구주택총조사 데이터를 이용하여 단면적인 다수준 로지스틱 회귀분석을 실행하였다. 표본 크기는 영아 사망 위험 분석을 위한 엄마 40461명과 유아 사망 위험 분석을 위한 엄마 219584명이다.

결론: 각 행정구역별 영유아 사망률 사이에 차이는 있었지만 불평등에 의한 차이는 볼 수 없었다. 또한 사회경제적 결정요인들과 영아 사망 위험은 연관성이 없었다. 하지만 부와 교육의 증가는 대부분의 경우 사회적 기울기와 함께 유아 사망률 증가와 양의 관계를 보였다. 본 연구의 의의는 개발도상국에서 부와 건강에 대한 문헌에 기여를 하는데 있다. 또한 이 연구는 5세 미만 소집단의 건강을 개선할 수 있는 기회들을 권고해준다. 사하라 이남 아프리카에서 부의 격차가 계속 커지면서 그러한 격차가 인구집단건강에 미칠 수 있는 잠재적 영향에 대한 의식은 사회경제적 건강 결정요인에 대한 보다 체계적인 접근방법을 장려하게 될 것이다.

주요어: 영아사망, 유아사망, 부, 불평등, 사회적 건강 결정요인, 인구집단건강, 보츠와나

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