PREDICTORS OF UNDER–FIVE CHILD MORTALITY IN ZIMBABWE

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ABSTRACT

The study examines the role of socio-economic and maternal factors on under–five child mortality in Zimbabwe. The research is based on the analysis of the 2012 population census data. A logistic regression model was employed to determine factors that significantly affect under-five child mortality. The results revealed that maternal educational level, age at first birth, marital status, sanitation and provincial location were significant determinants of under–five child mortality. Public health interventions should focus on mothers; single, formerly married, had early childbearing, uneducated, use unsafe drinking water and toilets.

Keywords: *Under-Five Mortality, Socio–Socioeconomic, Maternal, Determinants, Binary Regression, Zimbabwe.*

Acest studiu examinează impactul factorilor socio-economici şi maternali asupra mortalităţii copiilor în vârstă de 0-5 ani în Zimbabwe. Cercetarea se bazează pe analiza datelor recensământului populaţiei din 2012. Pentru a determina factorii cu impact semnificativ asupra mortalităţii a acestei categorii de copii a fost utilizat un model de regresie logistică. Rezultatele au arătat că nivelul de educaţie al mamei, vârsta la prima naştere, statutul marital, sanitaţia şi mediul de reşedinţă sunt factorii determinanţi ai mortalităţii copiilor. Reieşind din acestea, intervenţiile în sănătatea publică trebuie să fie orientate spre mame singure, divorţate, cele care au născut un copil la vârstă prematură, fără studii, utilizează surse nesigure de apă şi toalete.

Cuvinte-cheie: *mortalitatea copiilor de 0-5 ani, factorii socio-economici, caracteristicile mamei, regresie binară, Zimbabwe.*

В данном исследовании рассматриваются социально-экономические и материнские факторы смертности детей до пятилетнего возраста лет в Зимбабве. Исследование основано на анализе данных переписи населения 2012 года. Для определения факторов, имеющих существенное влияние на смертность этой категории детей, была использована модель логистической регрессии. Результаты показали, что уровень образования матери, возраст при первом рождении, семейное положение, здоровье и место жительства являются одними из определяющих факторов смертности детей. Исходя из этого, меры общественного здравоохранения должны быть направлены на следующую категорию матерей: одиноких, разведенных, родивших детей в раннем возрасте, не имеющих образования, использующих небезопасные источники воды и туалеты.

Ключевые слова: *детская смертность 0-5 лет, социально-экономические, материнские, детерминанты, бинарная регрессия, Зимбабве.*

INTRODUCTION

Globally, the probability of dying before reaching the age of five is estimated at 45 deaths per 1000 live births. This translates into approximately 59 million childhood deaths every year throughout the world (UN 2017). Studies have revealed that the majority of this death (95%) occur in the sub-Saharan

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and South Asia (Chadoka-Mutanda and Odimegwu 2017). In sub-Saharan Africa the under–five mortality has declined by 49% from 183 in 1990 to 93 per 1000 children in 2015, this is still unacceptably high as 1 in 11 children aged below five years still dies every year compared with 1 in 147 on developed countries (UN 2017).

An estimated 45% of newborn babies die within the first month of being born as a result of infections, birth asphyxia, preterm birth complications or intrapartum – related complications (Liu Johnson et al. 2012, Chadoka-Mutanda and Odimegwu 2017). However, a large proportion of this mortality is avoidable mortality. Specific causes of death including pneumonia, undernutrition, diarrhoea and malaria account for 50% of the death that occurs after the first 30 days of life and before turning five years (Black et al. 2010, Liu Oza et al. 2015, Chadoka Mutanda and Odimegwu 2017, Black et al. 2013). Access to health and family planning by girls and mothers before pregnancy, during and after delivery is vital for the welfare of both the mother and the survival of the child (Dodzo and Mhloyi 2017). While immediate and exclusive breastfeeding for six months and immunisation is essential for the survival of children beyond five years (Liu et al. 2015, Black et al. 2013). Furthermore, studies have shown that improvements in sanitation, safe drinking water, vaccinations, and exclusive breastfeeding can reduce childhood deaths caused by diarrhoea and pneumonia (Browne and Barrett 1991, Liu et al. 2015, Pradhan et al. 2018).

Mothers are the primary caregivers of children under five. Their health-seeking behaviour during, before and after pregnancy tends to influence the chances of child survival during the first five years of life. Literature has shown that the access to health of mothers is, in turn, defined by maternal education, province, residence (urban–rural), marital status (Browne and Barrett 1991, Black et al. 2010). To the extent that women are not empowered to seek such services, such women might experience high infant and child mortality, accompanied by high maternal mortality (Black et al. 2013, Cutler et al. 2006, Caldwell 1986).

Mass education has been shown to reduce child mortality in developing countries (Caldwell 1976, Goujon et al. 2015). Mass education opens access to family planning, increases, utilisation of health services, and better employment for mothers. Moreover, female mass education reduces childbearing that is too early, too close and too late in the mother's reproductive life, typical of high infant and child mortality societies. Child Mortality has fallen both the rich and poor developing societies. Furthermore, empowered women are on the forefront in experiencing and leading infant and child mortality decline (Muza 2019, Reher 2004, Caldwell 1976).

Several researches have shown that mothers age at last birth, age first birth, mothers level of education, sanitation, source of drinking water, wealth status, preceding birth interval, birth weight and birth order are significantly associated with risk of dying during childhood (Kembo and Ginneken 2009, Kembo and Ginneken 2011, Mturi and Curtis 1995, Black et al. 2013). Taken together, these factors influence child survival probability.

Mother's province of residence affects their children's mortality experiences. This stems from variations in provincial economic and socio-cultural environments, which may influence children's chances of survival. According to ZIMSTAT (2012), infant mortality for the five years preceding the survey ranged from 36 deaths per 1000 live births in Bulawayo province. During the same period, it ranged from 49 deaths per 1000 children in the province of Bulawayo to 87 deaths per 1000 children in the province of Manicaland. Children in the urban provinces and the two provinces of Matabeleland were less exposed than their counterparts in other provinces to the risk of dying in childhood. During the same period, the under-five mortality rate was 80 deaths per 1,000 live births in rural areas compared to 62 deaths per 1,000 live births in urban areas (ZIMSTAT 2012). Access to health facilities also plays a role in affecting the mortality rates between the urban and rural areas.

Children of widowed women experienced the highest infant and under-five mortality rates of 63 and 97 respectively, followed by those of divorced (53 and 79 respectively) and married (49 and 72, respectively). Infant and under-five mortality rates were 49 per 1,000 live births and 73 per 1,000 children born to women who responded as unmarried at the time of the census. Infant and under-five mortality rates were 49 per 1,000 live births and 73 per 1,000 children respectively for children born to women who responded as never married at the time of the Census. It may not be surprising that kids of formerly married females suffered the largest mortality rate as it may reflect the elevated correlation between their husbands and children's mortality.

Zimbabwe is one of the countries in the sub-Saharan Africa region, where under-five mortality is still unacceptably high. The under-five mortality in Zimbabwe has declined from 103 to 69 death per 1000 live births in 1999 to 2015 respectively (ZIMSTAT and ICF 2015). The progress or gains in under-five mortality decline has been affected significantly in the 1990s due to HIV/AIDS–induced mortality (Adetunji 2000, Garrenne and Gakusi 2006, ZIMSAT 2012), Economic Adjustment Structural Programmes (ESAP) in the 1990s (Kebede et al. 2019, Lutz et al. 2015) and the general economic collapse in 2000 (ZIMSTAT 2012). In 1994, the high prevalence of HIV among adults of reproductive age was accountable for 61% of under–five deaths. Goujon et al. (2015), have argued that mortality has stalled or increased in sub-Saharan Africa because of lack of investments in female education in the 1990s (Goujon et al. 2015, Muza 2019).

In Zimbabwe, the National Child Survival strategy for the 2010 – 15 report has shown that HIV/AIDs accounted for 22% of childhood deaths. Specific causes of death like pneumonia, diarrhoea, measles and malaria are common and still contribute to the deaths that occur before children reach fifth birthday (Liu et al. 2015). This means Zimbabwe has still a high prevalence of infectious diseases as defined by (Omran 2005). Thus Zimbabwe is one of the countries that failed to meet the MDG-4 goal of reducing deaths by 2/3 by 2015 (Chadoka-Mutanda and Odimegwu). It remains unknown if Zimbabwe can achieve the newly set Agenda 2030 for sustainable goals (SDGs). Previous studies have explored the determinants of under–five mortality utilising country's specific Demographic Health Survey (Aheto 2019, Akinyemi et al. 2013, Kaberuka et al. 2017). There is dearth of studies which have used Census data. In most African countries, civil registration and vital statistics (CRVS) are not easily utilisable. Thus, leaving most countries relying on their censuses to inform planning. Nevertheless, existing census data sources are underused and insufficiently analysed because of lack of resources and time. Therefore, utilising the census data will enable the production of indicators at highly disaggregated levels. This study seeks to investigate the socio-economic and maternal predictors of under-five mortality in Zimbabwe using recent 2012 census data.

DATA AND METHODS

This study draws on data from the 2012 Zimbabwe National Census (ZIMSTAT 2012). The decennial national censuses are used to inform policy decisions and planning in Zimbabwe. The 2012 census collected data on various demographic and health indicators including maternal and child health, as well as fertility data, employment, education, occupation, migration and mortality. From the census, a total of 1,373,263 live births occurred five years before the census, and 47,401 under-five deaths occurred.

Model specification

The study employs Mosley and Chen (1984) model of infant and child mortality in developing countries. The model is based on the assumption that socio-economic determinants of under-five mortality essentially work through a common set of biological mechanisms, or proximate determinants, to apply an effect on mortality. Moreover, variables considered in this study were selected based on previous studies that have been conducted at the global level. Potential determinant factors expected to be correlated with under-five child mortality were included as variables of the study. Variables considered in this study were categorised into dependent and explanatory/predictor variables.

Dependent Variables

Data was extracted from the 2012 census section E (for women age 15-49 years). This section, with regards to women's childbirth history, is solely answered by the women. The section on the women's questionnaire asks the status of the last live birth, (When was (name's) last live birth? This was used during data analysis to filter birth that occurred five years before the census (2012, 2011, 2010, 2009, 2008). Later the survival status of the last birth was ascertained by the following question: Is the child still alive? The outcome variable is child survival status (alive or dead). Hence, this variable exhibited a binary outcome; a child born within the previous five years and still alive a value of one (1) was assigned. On the other hand, a value of zero (0) was assigned to those deceased children within the previous five years.

Independent variables

In this study, socio-economic, demographic, and environmental possible determinants of child mortality related factors were considered. Demographic variables: marital status, age of mother at first

and last birth. Socio-economic variables: maternal education and environmental factors: place of residence, sanitation: sources of drinking water and type of toilet.

Education was categorised as: "1= no education", "1= primary", "3= secondary and tertiary". Place of residence of the child was according to provinces which were: 1=Bulawayo, 2=Manicaland, 3=Mashonaland Central, 4=Mashonaland East, 5=Mashonaland West, 6=Matabeleland North, 7=Matabeleland South, 8=Midlands, 9=Masvingo and, 10=Harare. Harare and Bulawayo are also metropolitan cities. Marital status categorised as (1=never married, 2=married, 3=formerly married, which included divorced/separated and widowed). Maternal Age: The respondents were asked about their age in completed years. However, for the purposes of the present analysis, Mother's age at first birth ages were grouped into 4 categories such as: <20, 20–29, 30–39 and 40–49 years. Maternal age at last birth into two categories, 1=<20 years: 2=40–49 years. Toilet facility: categorised as 1=safe toilet (flush toilet, ventilated/improved latrine or toilet) and 2=unsafe toilet (bucket, open field, bush). Drinking water source: 1=safe (piped water, protected: wells, borehole, spring or rainwater): 2=unsafe water (unprotected; rain, spring, well water, other.).

Methods of analysis

Data were statistically analysed using SPSS version 22 and analysed at three levels (univariate, bivariate and multivariate). Descriptive statistics were presented in frequency tables, testing for associations between two variables was done using $\chi 2$ (were used to examine the statistically significant relationship between sociodemographic and child survival), while at the multivariate level logistic regression model was used. The dependent variable for this study was dichotomised; hence, a binary regression model (negative log-log) was used to analyse the factors associated under-five mortality. When the probability of a case is very low or very big, negative log-log models are frequently used (Mangombe and Kalule-Sabiti 2018, McCullagh 1980). The adverse log-log feature is asymmetrical, unlike logit and probit models. In SPSS, the function of the nlog log link is the same as the additional log-log in STATA. The complete number of participants reported to be alive was 1,325,682 and dead were 47,401 children, representing only 3.5 % of the total children born.

RESULTS

Univariate results

Table 1 presents the socio-economic and demographic characteristics of the respondents and their under–five survival status. Of the total eligible under–five children born alive (1,373,263) in Zimbabwe since 2008-2012, 1,325,682 (96.5%) were alive, and 47,401 (3.5%) were dead. The results indicate that Harare (capital city) had the highest number of births recorded (17%) while Bulawayo the second biggest city had the lowest (4.4%). The results show that 13.5 % of the children were born in Manicaland province compared to 9.2% in Mashonaland Central. Moreover, majority of children, 57% and 30% were born to mother's age at first birth in the age group 20-29 and 30-39 years old respectively while 7% and 4.6% were born to mother's age at first birth age group <20 and 40-49 years old respectively. The study further reveals that most last births (98.6%) occurred to mothers <29 years old. Table 1, further shows that at least 29.9% of children born were to mothers with primary education compared to 70.1% of those born to mothers with secondary and higher. An overwhelming 87% of under-five children had mothers who were married. About an equal percentage of the respondents and children had safe and unsafe toilets facilities. Of water safety, 71% and 29% of children had access to safe and unsafe water respectively.

Table 1

Frequencies and percent distribution of explanatory variables, 2012, Zimbabwe

Variable		Frequency	Percent
	Alive (yes)	1,325,862	96.5
	Dead (No)	47,401	3.5
Provinces			
	Bulawayo	60,830	4.4
	Manicaland	185,088	13.5
	Mashonaland Central	125,720	9.2

Variable		Frequency	Percent
	Mashonaland East	142,636	10.4
	Mashonaland West	166,596	12.1
	Matabeleland North	70,695	5.1
	Matabeleland South	63,373	4.6
	Midlands	169,297	12.3
	Masvingo	152,032	11.1
	Harare	236,996	17.3
Mothers age at first birth			
	<20 years	104,534	7.6
	20–29 years	779,174	56.7
	30–39 years	424,074	30.9
	40–49 years	65,481	4.8
Mothers age at last birth			
	< 29 years	1,353,955	98.6
	30–49 years	19,308	1.4
Marital status			
	Never Married	65,889	4.6
	Married	1,196,778	87.1
	Formerly married	113,596	8.1
Education			
	No education	3,639	0.2
	Primary	407,409	29.7
	Secondary and higher	962,215	70.1
Toilet type			
	Safe Sanitation	688,752	50.2
	Unsafe Sanitation	684,511	49.8
Water safety			
	Safe	976,580	71.1
	Unsafe	396,683	28.9

Source: ZIMSATAT (2012) and own calculations.

Bivariate results

Table 2 shows the relationship between the socio–demographic characteristics and survival status of their under-five children. A chi-square ($\chi 2$) test for independence was used to assess whether there were significant associations between each of the background variable and survival status of the children below five years. The results reveal that all the selected variables; provinces, mothers age at last birth, mother's age at first birth, marital status, mother's education, sanitation variables water safety and toilet type were all statistically significant at $p< 0.05$, 0.01 or 0.001.

Table 2

Cross–tabulation of under–five mortality and selected background characteristics, 2012, Zimbabwe

		Dead %	Alive %	$\chi 2$	Total
Survival status					
	Total	3.5	96.5		1,373,263
Provinces				0.018	
	Bulawayo	2.9	97.1		60,830
	Manicaland	3.9	96.1		185,088
	Mashonaland Central	3.5	96.5		125,720
	Mashonaland East	3.7	96.3		142,636

		Dead %	Alive %	χ2	Total
	Mashonaland West	3.6	96.4		166,596
	Matabeleland North	3.0	97.0		70,695
	Matabeleland South	2.9	97.1		63,373
	Midlands	3.6	96.4		169,297
	Masvingo	3.4	96.6		152,032
	Harare	3.1	96.9		236,996
Mothers age at first birth				0.021	
	<20 years	4.2	95.8		104,534
	20–29 years	3.2	96.8		779,174
	30–39 years	3.6	96.4		424,074
	40–49 years	4.6	95.4		65,481
Mothers age at last birth				0.006	
	< 29 years	3.4	96.6		1,353,955
	30–49 years	4.4	95.6		19,308
Marital status				0.028	
	Never Married	3.9	96.1		65,889
	Married	3.2	96.8		1196,778
	Formerly married	4.4	95.6		113,596
Education				0.016	
	No education	4.1	95.9		3,639
	Primary	3.9	96.1		407,409
	Secondary and higher	3.3	96.7		962,215
Toilet type				0.007	
	Safe Sanitation	3.3	96.7		688752
	Unsafe Sanitation	3.6	96.4		684511
Water safety				0.002	
	Safe	3.4	96.6		976,580
	Unsafe	3.5	96.5		396,683

Notes: P < 0.05.
Source: ZIMSTAT (2012) and own calculations.

Table 2, also, reveals that a significant relationship was found between provinces and survival status. The study also indicates that child mortality is lowest among children born to mothers from Bulawayo and Matabeleland South at (2.9%) for each province. Manicaland had the highest percentage of under-five mortality, 3.9%, and Mashonaland provinces had an average of about 3.6% per province. Mother's age at first birth and under-five mortality show statistically significant a U-shaped relationship. The mortality of under-five children born to older mothers, 40-49 and youngest mothers <20 years were 4.6 and 4.2% respectively The study also indicates that child mortality is higher among children born to mothers who had their last birth at aged 30-49 years while mother's aged less than 29 years had the lowest (3.4%) under-five mortality. The study further reveals that child death to mothers who never married had a higher rate of child mortality compared to married women.

A statistically significant relationship was found between the level of mother's education level and under-five mortality. Women with no education had higher (4.1%), than primary, secondary and higher education, which had 3.9% and 3.3% respectively. There was a significant association in under-five mortality between and availability of safe toilets. About four percent (3.6%) of death were recorded among children who resided in households with unsafe toilets compared to 3.3% with safe toilets. Another important finding was a marginal difference in child mortality between children whose household had access to safe water (3.4%) and unsafe water (3.5%).

Multivariate results. In order to examine the factors that determine the under–five child mortality rate in Zimbabwe, a negative log-log logistic regression model was fitted, and the results are presented in table 3. The results indicated that provinces, mothers' age at first birth, marital status, education, toilet type and water safety were the main predictors of child survival. Mashonaland provinces (Central, East and West), Manicaland, Midlands and Masvingo provinces were less likely to experience child survival than Harare province. The place of residence (province) shows a statistically significant relationship with under-five child mortality. Children from the following Matabeleland provinces: Matabeleland South and Matabeleland North had a higher risk of dying before five years of age (OR= 1.05, p<0.001 and OR=1.04, p<0.001) respectively than Harare province. In addition, children from Manicaland province were less likely to die compared to Harare province (OR=0.94, p<0.001). The mother's age at first birth revealed a strong association with child survival. Women who had their first birth at <20 years were more likely to have reported a child who died before five years (OR=1.03, p<0.001) than those who first gave birth at 40-49 years. There was an unexpected finding by women had had their first birth aged 20 29 years who had the highest likelihood ratio (OR=1,1, p<0.001) of a child under*five mortality than any other age group. Mothers who have last birth at age <29 years were less likely to experience child death than older mothers at age 40-49 years, although this likelihood was not statistically significant.

It can be seen from table 3, that children born to mothers who reported that they were never married had more risks of dying before age five years when compared to those born to married mothers (OR=1.028, p<0.001). Under-five children born to formerly*married mothers also had more likelihood of dying (OR=1.149, p<0.001) compared to children of formerly married mothers. Children born to mothers with secondary and higher education (OR=0.953, p<0.1) and primary education (OR=0.96, p<0.01) were less likely die before five years than those of women with no education. The statistics show that children born to mothers who had unsafe water were more likely to die before the age of five years (OR=1.006, p < 0.05). Children who had access to safe toilet facilities were less likely to die (OR=0.990, p < 0.01) than children with unsafe toilet.

Table 3

Odds ratio of selected predictors of under-five mortality, 2012, Zimbabwe

	95% CI		
	Exponentiated β	Lower	Upper
Threshold	– 1.016	– 1.093	– 0.938
Provinces			
Harare (Ref.)			
Bulawayo	1.043****	0.027	0.056
Manicaland	0.946****	– 0.065	– 0.045
Mashonaland Central	0.984***	– 0.028	– 0.005
Mashonaland East	0.961****	– 0.050	– 0.029
Mashonaland West	0.972****	– 0.038	– 0.017
Matabeleland North	1.044****	0.029	0.057
Matabeleland South	1.058****	0.041	0.071
Midlands	0.968****	– 0.043	– 0.022
Masvingo	0.989**	– 0.022	0.002
Mother's age first birth			
40–49 years (Ref.)			
<20 years	1.036****	0.020	0.050
20–29 years	1.105****	0.088	0.112
30–39 years	1.073****	0.058	0.083
Mother's age at last t birth			
30–49 years (Ref.)			
<29 years	0.972	– 0.107	0.051
Marital status			
Married (Ref.)			

		95% CI		
	Never married	1.028****	0.013	0.043
	Formerly married	1.149****	0.130	0.148
Education				
	No education (Ref.)			
	Secondary and higher	0.953*	– 0.098	0.002
	Primary	0.960***	– 0.047	– 0.035
Toilet type				
	Safe sanitation (Ref)			
	Unsafe sanitation	1.006**	0.001	0.013
Water safety				
	Unsafe (Ref.)			
	Safe	0.990***	– 0.017	– 0.004
		χ2	Df	Sig.
Pearson		3867.105	3204	0.000
Deviance		3355.05	3204	0.031

Notes: Negative Log–log regression.
**p < 0.1, **p < 0.05, ***p < 0.01, ****p < 0.001*
Source: ZIMSTAT (2012) and own calculations.

DISCUSSION AND CONCLUSIONS

The results of the multivariate analysis revealed that in general, the strength of the independent variables with dependent variables under-five (U5MR) were strong for the period under consideration. The provincial inequalities in the odds ratio of the mortality burden of U5MR were statistically significant. Harare, Bulawayo Matabeleland North and South had the highest odds of under-five mortality. Since both Harare and Bulawayo are metropolitan cities, this finding is not consistent with other studies that have found lower risks of under-five mortality. It is possible that the high odds of under-five mortality in the metropolitan cities (Harare and Bulawayo) than rural areas is related to the deteriorating socio*economic conditions in Zimbabwe (ZIMSTAT and ICF 2016). Urban cities in Zimbabwe faced water and sanitation in 2008 leading to the resurgence of infectious diseases such as cholera (ZIMSTAT and ICF 2015)

The finding of high under-five mortality in Matabeleland North and South and Bulawayo than in Mashonaland provinces of (Central, South, East), Manicaland and Masvingo provinces ties very well with the hypothesis that provincial inequalities of child survival in Zimbabwe are perhaps driven by socio-economic and cultural differentials (Liu et al. 2015, Adedini et al. 2015). The geo-socio-cultural regions in Zimbabwe composed of predominantly 2 groups, Ndebele speaking people in Matabeleland provinces (Bulawayo, Matabeleland North and South), and Shona speaking in seven remaining provinces. Similar, results have been reported in Nigeria (Adedini et al. 2015).

Unlike Kembo and Ginnkem (2009) who found U-shaped under-five mortality curve by mother's age at first birth, this research finds that the mortality risks for under-five is higher for children born to mothers of 20-40 years of age groups. The study expected to find high mortality risks to children born to very young mothers <20 years and older mothers 40-49 years old. Although the statistic was not significant, mothers who had their last birth <29 years had less likelihood of under-five child death than mothers who had their last birth at 30-49 years. This is in line with other studies that find under-five mortality risks increases in older reproductive age groups (Mugura et al. 2018, Kembo and Ginnekem 2011, Adedini et al. 2015).

Children born to formerly married mothers had more likelihood of death than those born to married and never married. It is possible that such mothers might be vulnerable widows given the patriarchal nature of Zimbabwe, which promotes the intergenerational marriage of older men to younger girls (Mhloyi 1988, Tabutin et al. 2004). It is possible to hypothesise that such male partners will die before the wife leaving the mothers vulnerable. This might be amplified by the fact that Zimbabwe has a high prevalence rate of HIV, which kills more men than women in reproductive ages

(ZIMSTAT 2012). Moreover, HIV is one of the leading causes of under-five mortality (Global Burden of Disease Collaborative Network 2018). Overall this finding suggests the need for protective policies for children to divorced separated and widowed women.

The findings of this study show that under-five mortality decreased with increases in the mother's educational status. This finding is line with other studies in Zimbabwe (Kembo and Ginnekem 2009, Kembo 2011, in Nigeria, (Adedini et al. 2015) and in Kenya, (Gruebner Lautenbach et al. 2015). This is probably because maternal education has been found to better women's socio-economic status, nutrition, housing, sanitation, access to reproductive health, family planning, and child health services (Caldwell 1976,) all of which reduce under-five mortality (Caldwell 1986, Cutler et al. 2006). Maternal education was also found to be an essential factor in the European historical child mortality revolutions (Reher 2004, Dyson 2013). This suggests the need for empowering girls beyond universal primary education as was proposed by MDG-2.

The findings of this study indicated that the provision of improved drinking water and toilets to households has a stronger impact on under-five mortality reduction. This finding supports the thesis that exogenous factors are dominant during the childhood stage (Kembo and Ginnekem 2009, Mosley and Chen 1984). Table 1, above revealed that only about half of the households had improved sanitation. This suggests that Zimbabwe needs to invest more on water and sanitation improvement.

There were significant limitations to the research which should be taken into consideration when interpreting the findings of this study. First, a recall prejudice for household death documents may have underestimated numbers slightly. At the same time, data on deaths reported by respondents during surveys are also incomplete partly because some relatives are reluctant to discuss details of their deceased relatives. However, I am confident that this bias is negligible since I only used the data about the last born kid. Second, since I only looked at the last born baby, this research did not consider all children born alive who died. Moreover, my measure did not include maternal mortality, which could have resulted in less reported under-five deaths in Zimbabwe. Third, it is possible that age heaping of under-five deaths might have affected the study findings. Children under five ages might have been reported older than their actual age, hence their ages plausibly fell outside the under-five age criteria.

Finally, the combination of exposure variables in the model is only one of the possible outcomes, and it should, therefore, be borne in mind that these are not the only possible risk factors that could predict under-five deaths in Zimbabwe. Other factors, such as birth intervals, breastfeeding duration, wealth, place of birth etc., were also discovered to be significant predictors of under-five mortality (Dodzo et al. 2016, Kembo and Ginnekem 2009). Some of this data, however, was not accessible from the census and could not, therefore, be used.

Notwithstanding these constraints, this is the first study to my understanding that used a comprehensive national census data to explore risk factors of under-five death in Zimbabwe at the individual level. The research showed that individual and socio-economic risk variables differ between provinces, maternal age at birth, maternal education, marital status, sanitation and secure drinking water. Public health interventions on under-five mortality should ideally include improvements in maternal education, toilet sanitation, and provision of safe drinking water. Promoting birth postponement by younger mothers and birth stopping before older reproductive ages should also be at the core childhood mortality interventions.

REFERENCES

1. ADEDINI, S.A., ODIMEGWU, C. et al. Regional variations in infant and child mortality in Nigeria: a multilevel analysis. In: Journal of Biosocial Science. 2015, vol. 47 (2), pp. 165-187. ISSN 0021-9320, eISSN 1469-7599.
2. ADETUNJI, J. Trends in under-5 mortality rates and the HIV/AIDS epidemic. In: Bulletin of the World Health Organization. 2000, vol. 78, pp.1200-1206. ISSN 0042-9686, eISSN 1564-0604.
3. AHETO, J.M.K. Predictive model and determinants of under-five child mortality: evidence from the 2014 Ghana demographic and health survey. In: BioMed Central public health. 2019, vol. 19 (1), p. 64. ISSN 1471-2458.

4. AKINYEMI, J.O., BAMGBOYE, E.A., AYENI, O. New trends in under-five mortality determinants and their effects on child survival in Nigeria: a review of childhood mortality data from 1990-2008. In: African Population Studies. 2013, vol. 27 (1) [citat 11 februarie 2020]. Disponibil: https://aps.journals.ac.za/pub/article/view/5/3
5. BLACK, R.E., COUSENS, S. et al. Global, regional, and national causes of child mortality in 2008: a systematic analysis. In: The lancet. 2010, vol. 375 (9730), pp. 1969-1987. ISSN 0140-6736, eISSN 1474-547X.
6. BLACKlack, R.E., VICTORA, C.G. et al. Maternal and child undernutrition and overweight in low–income and middle–income countries. In: The lancet. 2013, vol. 382 (9890), pp. 427-451. ISSN 0140-6736, eISSN 1474-547X.
7. BROWNE, A.W., BARETT, H.R. Female Education in Sub-Saharan Africa: the key to development? In: Comparative education. 1991, vol. 27 (3), pp. 275-285. ISSN 0305-0068, eISSN 1360-0486.
8. CALDWELLl, J.C. Demographic transition theory. London: Springer Science & Business Media, 2007. 404 p. ISBN 9781402044984
9. CALDWELL, J.C. Routes to low mortality in poor countries. In: Population and development review. 1986, pp. 171–220. ISSN 1728-4457.
10. CALDWELL, J.C. Toward a restatement of demographic transition theory. In: Population and development review. 1976, pp. 321–366. ISSN 1728-4457.
11. CHADOKA–MUTANDA, N., ODIMEGWU, C.O. Maternal health–seeking behaviour and under–five mortality in Zimbabwe. In: Journal of Biosocial Science. 2017, vol. 49 (3), pp. 408–421. ISSN 0021-9320, eISSN 1469-7599.
12. CUTLER, D., DEATON, A., LERAS–MUNEY, A. The determinants of mortality. In: The Journal of Economic Perspectives. 2006, vol. 20 (3), pp. 97–120. ISSN 0895-3309.
13. DODZO, M.K., MHLOYI, M. Home is best: Why women in rural Zimbabwe deliver in the community. In: PloS one. 2017, vol. 12 (8) [citat 11 februarie 2020]. Disponibil: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5549963/
14. DODZO, M.K, MARVELLOUS, M., DODZO, M. Blood Drain: A Threat to Maternal Health in Zimbabwe. In: American Journal of Health Research. 2018, vol. 6 (6), pp. 130-137. ISSN 2330-8788.
15. DODZO, M.K., MARVELLOUS, M. et al Praying until death: apostolicism, delays and maternal mortality in Zimbabwe. In: PloS one. 2016, vol. 11 (8) [citat 11 februarie 2020]. Disponibil: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4979998/
16. DYSON, T. Population and development: the demographic transition. London: Zed Books Ltd., 2013. 288 p. ISBN 9781848139138.
17. GARENNE, M., GAKUSI, E. Health transitions in sub-Saharan Africa: overview of mortality trends in children under 5 years old (1950-2000). In: Bulletin of the World Health Organization. 2006, vol. 84, pp. 470-478. ISSN 0042-9686, eISSN 1564-0604.
18. INSTITUTE FOR HEALTH METRICS AND EVALUATION. Finding from the Global Burden of Disease Study 2017. Seattle, 2018. 25 p.
19. GOUJON, A., LUTZ, W, SAMIR, K. Education stalls and subsequent stalls in African fertility: A descriptive overview. In: Demographic Research. 2015, vol. 33, pp. 1281-1296. ISSN 1435-9871.
20. GRUEBNER, O., LAUTENBACH, S. et al. Place of residence moderates the risk of Infant Death in Kenya: Evidence from the most Recent Census 2009. PloS one. 2015, vol. 10 (10) [citat 11 februarie 2020]. Disponibil: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4599946/
21. KABERUKA, W., MUGARURA, A., TINDYEBWA, J. and BISHOP, D.S. Factors determining child mortality in Uganda. In: International Journal of Social Economics. 2017, vol. 44 (5), pp. 633-642. ISSN 0306-8293.
22. KAHARUZA, F., SABROE, S., SCHEUTZ, F. 2001. Determinants of child mortality in rural Ugandan community. In: East African medical journal. 2001, vol. 78 (12), pp. 630-636. ISSN 0012-835X.
23. KEBEDE, E., GOUJON, A. and LUTZ, W. Stalls in Africa's fertility decline partly result from disruptions in female education. In: Proceedings of the National Academy of Sciences of the United States of America. 2019, vol. 116 (8), pp. 2891-2896. ISSN 0027-8424.
24. KEMBO, J. and VAN GINNEKEN, J.K. Levels and trends in under–five mortality in Zimbabwe: findings from an analysis of recent Demographic and Health Surveys. In: Genus. 2011, 67 (1), pp. 61-74. ISSN 0016-6987.

25. KEMBO, J. and VAN GINNEKEN, J.K. Determinants of infant and child mortality in Zimbabwe: Results of multivariate hazard analysis. In: Demographic Research. 2009, vol. 21, pp. 367-384. ISSN 1435-9871.
26. LIU, L., OZA, S., HOGAN, D., PERIN, J., RUDAN, I., LAWN, J.E., COUSENS, S., MATHERS, C. and BLACK, R.E. Global, regional, and national causes of child mortality in 2000-13, with projections to inform post-2015 priorities: an updated systematic analysis. In: The Lancet. 2015, vol. 385 (9966), pp. 430-440. ISSN 0140-6736.
27. MANGOMBE, K. and KALULE-SABITI, I. Predictors of male circumcision among men aged 15-35 years in Harare, Zimbabwe. In: Journal of Biosocial Science. 2018, vol. 50 (2), pp. 193-211. ISSN 0021-9320.
28. MCCULLAGH, P. Regression models for ordinal data. In: Journal of the Royal Statistical Society. Series B Methodological. 1980, vol. 42 (2), pp. 109-127. ISSN 1369-7412.
29. MHLOYI, M.M., 1988. The determinants of fertility in Africa under modernization. In: African Population: conference/congres Africain de Population: Dakar, Senegal, 7-12 november, 1988. International Union for the Scientific Study of Population (IUSSP). Liege, Belgium : IUSSP, 1988, vol. 1, 2-3, pp.1-22. ISSN 0254-5217.
30. MOSLEY, W.H. and CHEN, L.C. An analytical framework for the study of child survival in developing countries. In: Population and development review. 1984, vol. 10 (0), pp. 25-45. ISSN 0098-7921.
31. MTURI, A.J., and CURTIS, S.L. The determinants of infant and child mortality in Tanzania. In: Health policy and planning. 1995. vol. 10 (4), pp. 384-394. ISSN 1460-2237.
32. MUZA, C. Demographic revolution in developing countries with a special regards to Africa and Zimbabwe: doctoral thesis. Charles University. Faculty of Science. Department of Demography and Geodemography. Prague, 2019. 186 p. [citat 29 februarie 2020]. Disponibil: https://dspace.cuni.cz/bitstream/handle/20.500.11956/111233/140080265.pdf?sequence=1&isAllowed=y
33. OMRAN, A.R. The epidemiologic transition: a theory of the epidemiology of population change. In: Milbank Quarterly. 2005, vol. 83 (4), pp. 731-757. ISSN 0887-378X.
34. PRADHAN, E., SUZUKI, E.M., MARTÍNEZ, S., SCHÄFERHOFF, M. and JAMISON, D.T. The Effects of Education Quantity and Quality on Child and Adult Mortality: Their Magnitude and Their Value. In: BUNDY, Donald A. P., NILANTHI, Silva, SUSAN, Horton, JAMISON, Dean T., PATTON, George C. editor. Optimizing Education Outcomes: High–Return Investments in School Health for Increased Participation and Learning. Washington, D.C. : World Bank Group, 2018, vol. 8, pp. 211-229 [citat 11 februarie 2020]. Disponibil: http://documents.worldbank.org/curated/en/781571521530863121/pdf/124419-PUB-PUBLIC-pubdate-3-20-18.pdf
35. REHER, D.S. The demographic transition revisited as a global process. In: Population, space and place. 2004, vol. 10 (1), pp. 19-41. ISSN 1544-8444.
36. TABUTIN, D., SCHOUMAKER, B. and RABENORO, M. The Demography of Sub-Saharan Africa from the 1950s to the 2000s. In: Population. 2004, vol. 59, (3-4), pp. 457-556. ISSN 1443-2447.
37. UNITED NATIONS. Department of Economic and Social Affairs. World Population Prospects: The 2017 Revision. 2017, 21 iune [citat 11 februarie 2020]. Disponibil: https://www.un.org/development/desa/publications/world-population-prospects-the-2017-revision.html
38. ZIMSTAT. Census 2012 National Report. Harare: ZimStat, 2012 [citat 22 februarie 2020]. Disponibil: https://unstats.un.org/unsd/demographic-social/census/documents/Zimbabwe/ZWE_CensusPreliminary2012.pdf
39. ZIMBABWE STATISTICAL AGENCY. Census 2012. Mortality Thematic Report. Harare, Zimbabwe, 2015, august. 88 p. [citat 29 februarie 2020]. Disponibil: https://zimbabwe.unfpa.org/sites/default/files/pub-pdf/Mortality_Thematic.pdf
40. ZIMBABWE NATIONAL STATISTICS AGENCY. Zimbabwe Demographic and Health Survey 2015: Final Report. The DHS Program ICF International, Rockville, Maryland, USA. 2016, november. 547 p. [citat 29 februarie 2020]. Disponibil: https://dhsprogram.com/pubs/pdf/FR322/FR322.pdf

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