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Determinants of Under-Five Mortality: Evidence from Zambia

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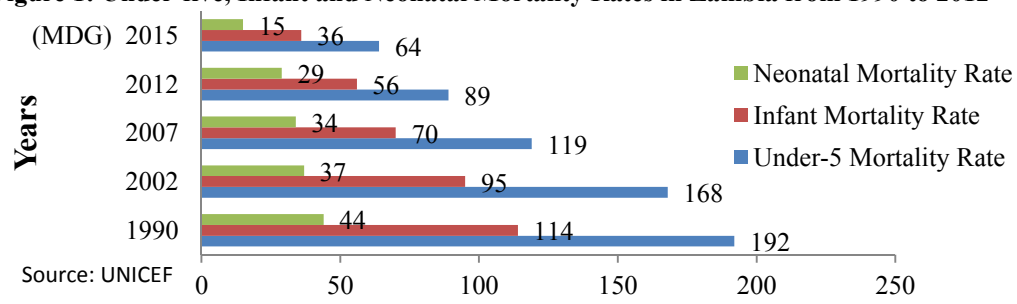
Abstract
Background: Globally, there are concerted efforts to reduce infant and child mortality. In order to achieve this, efforts are concentrated at identifying cost-effective strategies as many international agencies have advocated for more resources to be directed to the health sector. One way of doing this is to identify and rank-order the socioeconomic factors that affect under-five mortality. This will help in prioritizing factors that need to be manipulated for effective health interventions in the face of competing scarce resources.**Methods:** We utilised cross-sectional data from the Zambia Demographic and Health Survey (2013-14). The logit regression was employed to empirically investigate the determinants of under-five mortality.**Results:** The key findings of the multivariate results indicate that mother's age at birth, child's gender and number of children under-five, the level of wealth, mother's level of education, and the region in which a mother resides; smoking cigarettes and the use of contraception are significant determinants of under-five mortality in Zambia.**Conclusion:** To avert more under-five deaths and enhance child survival, efforts by the Zambian government with the support from other stakeholders in the health sector must be aimed at factors identified by the study.
Keywords: Under-five mortality, Empirical investigation, Logit regression, Child survival, Zambia.

1. Introduction

Infant and child mortality rates are not only important measures of the living and socio-economic conditions of a nation but are also powerful indicators of social economic development and can be used to measure the overall health status of a nation. Globally, efforts to reduce child mortality have been substantial with a fall in the under-five mortality from 12.6 million in 1990 to 6.6 million in 2012 representing a decline from 90 deaths per 1000 live births to 48 deaths per live births (UNICEF Report, 2013). The Zambia Demographic Health Survey (ZDHS 2013-14) indicates that under-five mortality rate in the past five years were 75 deaths per 1,000 live births translating into one in every 13 children do not survive to their fifth birthday. UNICEF (2015) also estimated that 17,000 fewer children die each day than in 1990, but more than six million children still die before their fifth birthday each year with an increasing proportion of child deaths occurring in sub-Saharan Africa and Southern Asia. According to their estimates, four out of every five deaths of children under age five occur in these regions.

Despite the reductions in child mortality around the world, UNICEF (2013) showed that, there still exist high levels of child mortality in certain regions especially Southern Asia and Sub-Saharan Africa regions with Zambia still having unacceptably high levels of under-five mortality which ranged from 192 deaths per 1000 live births in 1990 to 89 in 2012, indicative of a decrease of about 54% as opposed to the global target of reducing under-five mortality by two-thirds (about 67% or 64 deaths per 1000 live births). On the other hand, the infant mortality rate declined from 114 deaths per 1000 live births in 1990 to 56 in 2012, and the neonatal mortality rate declined from 44 deaths per 1000 live births in 1990 to 29 in 2012 and this is illustrated in Figure 1.

Figure 1: Under-five, Infant and Neonatal Mortality Rates in Zambia from 1990 to 2012



As one of the key indicators of the physical well-being of children and the core of development, child mortality reduction in Zambia still remains a major concern with rates of child mortality being ranked as one of the highest in the world even though interventions by the Ministry of Health to promote child survival are underway. This denotes that Zambia requires accelerating its efforts towards achieving the reduction of child mortality. Kalikiti (2013) proposed that certain interventions to improve child survival are being administered

and some of these interventions involve: the initiation of a national programme of Emergency Obstetric and Neonatal Care, and strengthening of family planning through emphasis on long-term permanent methods of family planning and increased financial commitment to better maternal health through the creation of a separate budget line for reproductive health commodities. Nevertheless, much needs to be done to reach the global target.

Actually, in order to realise the goal of reducing under-five mortality, it is appropriate to take into consideration the factors that influence the death of under-five children. Mzuri (2012) suggests that the major causes of child mortality in Zambia include HIV/AIDS and preventable diseases such as malaria, respiratory infections, diarrhoea, malnutrition, and anaemia. This is in line with the Medical Journal of Zambia (2008) which showed that among the preventable diseases, malaria was the major cause of under-five children deaths which accounted for 28.7%. Other causes included; malnutrition (16.2%), pneumonia (15%), neonatal disorders (13.4%), diarrhea (10.5%), anemia (8.3%), and AIDS (8.0%). Mzuri (2012) further asserts that most of the causes are due to; the worsening poverty levels and increase in food insecurity which is associated to 70% of the population in Zambia, lack of access to health care especially communities in the rural areas with limited access to health care, and low knowledge about post-natal care.

In addition, Hossain and Islam (2008), Younger and Ssewanya (2005), and Kimani and Ettarch (2012) point out factors such as; female education (mother's education), area of residence, traditional cultural beliefs and religion, breastfeeding, poor maternal nutrition and education, infrastructure such as water and sanitation, sex of child, and family incomes that cause variations in the infant and child mortality rates. They further argued that an increase in household income improves maternal and child nutrition and increases in public spending improve sanitation and heath care facilities. Consequently, these influences can be clustered into the following categories: socio-economic status, fertility behaviours and maternal factors, child-specific factors, environmental health conditions, nutritional status, geographical differences, and service provision. Alternatively, these can be grouped into the following: Individual-specific variables, household-specific variables, district-specific (geographical) variables, and national variables.

Despite facing a strong uplift in its economic performance in the past decade (World Bank, 2013) and all its dedicated efforts in reforming the health sector essentially through promoting maternal and child health, Zambia still lags behind in terms of reducing child mortality. A decrease from 192 to 89 deaths per 1000 live births was recorded in 1990-2012 and a decline of more than one third was acknowledged but indicated a scanty drop over the years. This implies that the reduction in infant and child mortality still remains a major challenge and concern to the nation. This provides a case for conducting an empirical investigation into the determinants of under-five mortality in Zambia.

Once the main determinants of under-five mortality are identified in Zambia, the government and partners need to strategize on how to improve health systems so that the nation can get closer to achieving the reduction of child mortality significantly. Therefore, findings of the study would assist policymakers to adopt vibrant measures to improve child survival and generally improve the livelihoods of people in the country.

2.0 Literature Review

In Zambia, studies on the determinants of under-five mortality have hardly been conducted despite the levels of under-five mortality remaining alarmingly high. However, there exists a large body of literature worldwide. Williamson and Shen (1997) claim that under-five mortality is one of the best indicators of social economic development in any country and to certain extents show a country's level of socioeconomic development. It entails a consequent association with the status of women as the core of development, levels of employment, literacy levels, and the general standard of living of citizens in any nation. In addition, Kyei (2011) asserts that high child mortality levels in any country are a sign of inadequate basic infrastructure needed to combat poor sanitation, environmental degradation, basic facilities such as toilet facilities, water, and sewerage, and living conditions in a country.

Mzuri (2012) attaches the causes of under-five mortality to; preventable diseases and HIV/AIDS, lack of access to health care and facilities especially in the rural areas, high poverty levels which lead to worst cases of malnutrition, low knowledge about postnatal care, low levels of attendance by skilled health workers. This is in line with the Zambia MDG Report (2013) which also indicated that the leading causes of death among children included; respiratory infections, diarrheal diseases, malaria, measles, and malnutrition. Kalikiti (2013) further stipulated that the causes of deaths in under-five children are mainly attributed to: neonatal causes (22.9%), pneumonia (21.8%), malaria (19.4%), diarrhea (17.5%), HIV/AIDS (16.1%), measles (1.2%) and others (0.2%). In terms of malnutrition, it is estimated that 29.4% of children are underweight and 55% of children are stunted. Mzuri (2012) also added that about 70% of the population in Zambia is food insecure.

The Final Child Health Summary Situation in Zambia (2008) described the factors affecting child health and survival in Zambia as mainly focusing on the worsening poverty levels felt by citizens in the country. This implies that much of the population cannot afford access to health care (20.7%) and even pay for medication (22.5%). The other factors affecting child health include female education and area of residence as results

showed that children born of women with no formal education are 1.6 times more likely to die before reaching the age of 5 than those with secondary school education. In relation to area of residence, results indicated that 60% of the population lives in rural areas of which children in the rural are 1.3 times more likely to die before reaching the age of 5 as compared to those in the urban areas.

Garenne and Gakusi (2006) examined the economic, political, and epidemiologic determinants of the changes in the under-five mortality trends. They associated the rise in under-five mortality with the economic downturn experienced by some sub-Saharan African countries in the 1980s. Specifically, they attributed the worsening trend to declining income per capita resulting from lower copper prices on international markets and decreasing production, and the effects of developing diseases such as HIV/AIDs and malaria.

Simms (2000) stressed the fact that under-five mortality is usually influenced by reduced access to effective health services and reduced incomes through maternal factors, environmental contamination, and nutrient deficiency. He argued that due to the cuts in public health expenditure that were due to the adoption of SAPs administered by the IMF, children living in the poorest and remote parts of Zambia were severely affected.

Kimani and Ettarh (2012) examined the level of influence of geographical location and maternal factors on the death of under-five children in the rural and urban areas of Kenya using the 2008-2009 Kenya Demographic and Health Survey. They found that under-five mortality rates were significantly higher in rural areas than urban areas attributing this to inadequate breastfeeding, poorer households, and younger mothers. Further, the attainment of secondary school or higher by mothers, the sex of child, place of delivery, and postnatal visits 2 months after delivery proved not to be statistically significant determinants of under-five mortality.

Buwembo (2010) also acknowledged that mother's place of residence, birth order, and mother's age at the time of delivery as some of the factors that influence infant and under-five mortality. He argued that other factors such as type of birth, mother's education (as opposed to Kimani and Ettarh (2012)), provision of piped drinking water, and access to sanitation such as type of toilet facilities by households have an impact on under-five mortality especially infant mortality. Kyei (2011) and Hossain and Islam (2008) conducted two parallel studies on the socioeconomic factors affecting infant and under-five mortality. Hossain and Islam (2008) by the use of the logistic model discovered that mother's and husband's education, couples occupation, watching TV, listening to the radio, receiving tetanus injection, and medical check-up are significantly correlated to infant and under-five mortality in Bangladesh. However, family income and religion was an insignificant determinant of under-five mortality.

Mahfouz *et al* (2009) argued that the reported socio-economic variables important to the study with the inclusion of factors such as immunization, family size, and family income are vital for measuring the determinants of infant and under-five mortality. A number of studies (Chowdhury 2013 and Negera *et al* 2013) found that the determinants of deaths in infants and under-five children are; sex of child, birth order, birth interval, type of birth, marital status, place of delivery, place of residence, region of residence, access to improved toilet facilities, access to improved water facilities, maternal age and education, paternal education, preventable diseases such as pneumonia, malaria, diarrheal diseases, meningitis and neonatal tetanus, vaccination status of the child, contraceptive use, wealth index, and duration of breastfeeding.

3.0 Methods

The study involved using a binary outcome model to estimate the determinants of under-five mortality at national level controlling for the most relevant variables.

3.1 Data

The study used the 2013-14 Zambia Demographic and Health Survey data. The 2013-14 ZDHS used a two-stage stratified cluster design with the first stage having 722 clusters. Out of these, 305 were in urban areas while 417 were in rural areas. In the second stage, an average of 25 households was selected in every cluster and a nationally representative sample of 18,052 households was selected. All women age 15-49 and men age 15-59 who were either permanent residents of the households or visitors present in the households on the night before the survey were eligible to be interviewed. About 16,381 women age 15-49 were interviewed and about 14,750 men were interviewed. The research variables used in this paper, are described in Table 1.

Under-five mortality: This was the binary dependent variable where 0 was assigned to child death and 1 to child survival.

$$\text{Under} - 5 \text{ mortality} = \begin{cases} 0, & \text{if child died} \\ 1, & \text{if child is alive} \end{cases}$$

The independent variables were classified into five categories and are described in Table 1:

Table 1: Description of Study Variables

Variable	Description
Maternal Variables	
Mother's age	The mother's current age was used as a proxy for the mother's age at birth.
Child's gender	Child's gender was dichotomous: male and female.
Number of children under-five	Number of children under-five in the household.
Socio-economic Variables	
Mother's labour market status	Mothers who are currently working were used as a proxy for the mother's labour market status. This was dichotomised into mothers who are not currently working, and those currently working.
Wealth index	This variable was categorical and recoded as poorest, poorer, middle, richer and richest.
Region	This was categorised into the ten provinces of Zambia. Some of these provinces are more rural than others.
Mother's education	This was categorised as mothers with: no education, primary education, secondary education, and higher education.
Mother's marital status	Current marital status recoded as bivariate variable: married and single.
Health Behavioral Variables	
Drinks alcohol	This was treated as a dichotomous variable with mothers that drink alcohol and those that do not.
Contraceptive use	Women of child bearing age who are either using or not using any form of contraception.

3.2 Estimation Strategy

Given the nature of the data used for this study, the logit model which is a binary outcome model, was employed. This is guided by the dependent variable which is a discrete outcome with dichotomous mutually exclusive categories: whether mortality among under-five occurred or not. The modelling of whether a child died before attaining 5 years or not is as follows:

$$y_i = \begin{cases} 0, & child\ did\ not\ die \\ 1, & child\ died. \end{cases}$$

The logit model is given by:

$$\Lambda(\mathbf{x}'\gamma) = \frac{e^{-\mathbf{x}'\gamma}}{1 + e^{-\mathbf{x}'\gamma}}$$

where; $\Lambda(\mathbf{x}'\gamma)$ is the probability that the response $y = 1$, $\mathbf{x}'$ is a vector of regressors and γ is a vector of parameters. In terms of log-odds;

$$Let\ \Lambda(\mathbf{x}'\gamma) = y_i$$
$$Logit\ \Lambda(\mathbf{x}'\gamma) = ln\left(\frac{y_i}{1 - y_i}\right) = \gamma_0 + \mathbf{x}'\gamma$$

Hence,

$$Logit\ (y_i) = ln\left(\frac{y_i}{1 - y_i}\right)$$
$$Logit\ (y_i) = \gamma_0 + \gamma_1\mathbf{x}_1 + \gamma_2\mathbf{x}_2 + \gamma_3\mathbf{x}_3 + \gamma_4\mathbf{x}_4$$

where; y_i is the probability of the child dying before reaching the age of 5 and (0/1 is an indicator of whether the child died or is alive). In addition, $\mathbf{x}_1$ is the vector of maternal variables; $\mathbf{x}_2$ is the vector of socio-economic variables; $\mathbf{x}_3$ is the vector of the nutritional status of a child and $\mathbf{x}_4$ is the vector of health-behavioural variables.

4.0 Results

4.1 Characteristics of the Sample

Table 2 shows the characteristics of the sample of our study which included women of child bearing age.

Table 2: Characteristics of the Sample

Variables	Statistic	
Dependent Variable		
Under-five mortality (%)		
Children died	11.39	
Independent Variables		
Mother's age (mean and s.d.)	35.08	7.94
Child's gender (%)		
Male	50.1	
Number of children under-five (mean and s.d)	1.49	1.05
Mother's labour market status		
Yes	64	
Wealth index (%)		
Poorest	21.41	
Poorer	22.71	
Middle	24.16	
Richer	18.77	
Richest	12.95	
Region (%)		
Central	8.84	
Copperbelt	9.37	
Eastern	12.99	
Luapula	11.07	
Lusaka	8.98	
Muchinga	9.42	
Northern	11.24	
North Western	9.85	
Southern	10.45	
Western	7.79	
Mother's education (%)		
No formal education	13.58	
Primary education	60.28	
Secondary education	23.21	
Higher education	2.92	
Mother's marital status (%)		
Single	3.44	
Drinks alcohol (%)		
Yes	11.49	
Contraceptive use	13.12	
Yes	45.35	

Under the multivariate analysis, the logit regression generated estimates of the influence of selected maternal, socio-economic, nutritional and health behavioural variables on the under-five mortality. To avoid producing inconsistent and inefficient maximum likelihood estimates because of the unobserved heterogeneity that is potentially present as individuals are accorded a chance to report these data, we specified robust standard errors and clustered them at probability sampling unit level. To ensure that separate effects of each of the explanatory variables on the explained variable were disentangled, we tested for multicollinearity. A test for omitted relevant variable(s) and correct specification of the link function was also conducted. We found that the covariates used in modelling determinants of under-five mortality are appropriate as the overall model is highly significant.

Table 3: Logit Regression Output

Variable Dependent variable : Under-five mortality	Coefficient	Robust Standard errors	p-value
Mother's age at birth	0.0294	0.0021658	0.000
Number of children under five	−1.1970	0.0172264	0.000
Child's gender (male)	0.1249	0.0288099	0.000
Mother's labour market status (Works)	0.0235	0.0315645	0.457
Wealth index (Reference: Poorest)			
Poorer	−0.0832	0.0415639	0.045
Middle	−0.1011	0.0424511	0.017
Richer	−0.2502	0.0498532	0.000
Richest	−0.2851	0.0652196	0.000
Region (Reference: Central)			
Copperbelt	−0.0562	0.0713019	0.431
Eastern	0.3473	0.0620949	0.000
Luapula	0.1846	0.0654734	0.005
Lusaka	−0.1616	0.0756693	0.033
Muchinga	0.1192	0.0673131	0.077
Northern	0.2176	0.0647569	0.001
North Western	−0.1092	0.0713127	0.126
Southern	−0.0901	0.0701003	0.199
Western	−0.0407	0.0736260	0.580
Mother's education (Reference: No formal education)			
Primary education	−0.1012	0.041137	0.014
Secondary education	−0.2896	0.0548692	0.000
Higher education	−0.7106	0.1285034	0.000
Mother's marital status (Single)	−0.0950	0.1025669	0.354
Drinks alcohol (Yes)	0.1857	0.0429432	0.000
Contraceptive use (Yes)	−0.2630	0.0304814	0.000

$N = 49177$
Wald chi2 (23)=1163.90
Prob>chi2 (23)=0.000
Pseudo R2=0.0334

Maternal Variables

Table 3 shows the generated estimates of the determinants of under-five mortality in Zambia. The results indicated that among the maternal variables, mother's age at birth, child's gender and number of children under-five are statistically significant. The log likelihood of a child dying increases with the mother's age at birth by about 0.029. The gender of a child showed some interesting associations with the log likelihood of under-five mortality reducing by 0.125 for female children as opposed to their male counterparts. The results also suggested that having one more member of the household under-five years of age decreases the chance of a child dying before reaching their fifth birthday by log odds of about 0.197.

Socio-economic Variables

Results revealed that the level of wealth, mother's level of education and the region a mother resides in are important socioeconomic determinants of under-five mortality. Compared to a woman in the poorest level of wealth, being in the poorer, middle, richer and richest quintiles of wealth reduces the log likelihood of a child dying before the age of five years by 0.083, 0.101, 0.250 and 0.285 respectively. This indicates that the marginal probability of a child dying before reaching the age of five years decreases as mothers accumulate more and more wealth.

The mother's province of residence generated mixed results with some surprising findings for Lusaka and Copperbelt Provinces where the estimated coefficients did not show statistical significance. Compared to children born of mothers living in Central Province, children born of mothers in Eastern, Luapula, Muchinga and Northern Provinces, on average, increases the log likelihood of the children dying before the age of five by 0.347, 0.185, 0.119 and 0.218 respectively. However, compared to children born of mothers living in Central Province, being born of mothers residing in North Western Province reduces the log likelihood of dying before attaining

the age of five by an average of 0.146.

Findings also suggest that the level of education matters in determining under-five mortality. However, different education attainments have different effects on under-five mortality. On average, the log likelihood of under-five mortality occurring in children born of mothers with primary school education, secondary education and higher education decreases by about 0.101, 0.290 and 0.711 respectively, compared to those under-five children born of mothers with no formal education. The generated results actually indicate that the higher the mother's level of education, the higher the log likelihood of them averting death in their under-five children.

Health Behavioural Variables

Results showed that if a child is born of a mother that smokes cigarettes, the log likelihood of a child dying before the age of five increases by about 0.186. On the other hand, the use of contraception reduces the log likelihood of a child dying under the age of five by about 0.264.

5.0 Discussion

Using the logit model to model the determinants of under-five mortality is common. We have identified that mother's age at birth, child's gender and number of children under-five, the level of wealth, mother's level of education, and the region in which a mother resides; smoking cigarettes and the use of contraception are important determinants of under-five mortality. With regards the findings on mother's age, Buwembo (2010) found similar results explaining that the risk of complications increases for elderly mothers. The findings also indicated that female children under that age of five are less likely to die as opposed to the males. This supports existing evidence which suggest that despite the fact that more boys than girls are born, the number of living males decreases rapidly (Gjonca *et.al*., 1999). In additions, Negera *et al* (2013) also found that male babies are at a higher risk of dying than female babies. It is not surprising that having more children under the age of five in a household increases the chances of child survival. Having more children under the age of five in households may require that caregivers pay more attention to the children reducing the infectious but preventable diseases and injury, factors which contribute to Zambia's high childhood indicators.

Mother's education indicated that children born to mothers with any level of formal education were less likely to die before the age of five compared to those born to mothers with no education. UNICEF (2015) suggested that children of educated mothers, even mothers with only primary schooling, are more likely to survive than children of mothers with no education. Kembo and Ginneken (2009) and Murray (2010) found similar results indicating that mother's education reduces under-five mortality. However, others like Rubalcava and Teruel (2004) found that maternal cognitive ability is an important factor in improving child health rather than schooling.

Results show that children born to mothers residing in provinces where women have limited access to health facilities, skilled birth attendance are at risk of dying before reaching the age of five. Children under the age of five not coming from the poorest households have a lower likelihood of under-five deaths than children born from the better to do households. This is because being born from the poorest household compromises access to decent health services. This finding is also supported by UNICEF (2015) who postulated that children born into poverty are almost twice as likely to die before the age of five as those from wealthier families.

Children of mothers that drank alcohol were at greater risk of dying before reaching their fifth birthdays as compared to those that did not drink alcohol. This is associated to babies being born with birth disorders and increase in susceptibility to illness due mothers' consumption of alcohol during pregnancy. Children born to mothers that practiced use of some contraceptive method are less likely to die before the age of five compared those born of mothers who did not. Chowdhury (2013) found similar results stating that children born of mothers who used contraceptives had a 45% lower likelihood of dying below the age of five compared to children born of mothers who never used any method. This is because contraceptive use by mothers is important in facilitating birth spacing and prolonged breastfeeding, avoidance of unwanted pregnancies, and hence leads to child survival.

6.0 Conclusion

We have established that mother's age at birth, child's gender and number of children under-five in a household, the level of wealth, mother's level of education, and the region in which a mother resides; smoking cigarettes and the use of contraception are important determinants of under-five mortality in Zambia.

The findings of this study suggest that these determinants have to be controlled for in order to enhance child survival and reduce under-five mortality. Therefore, concerted efforts by Government with the support from stakeholders in the health sector is needed to develop and implement necessary interventions aimed at the advancement of child survival and generally reducing under-five mortality. For instance, the Ministry of Health can increase health education, on the use contraceptive methods among married women. This comes along with the availability of counselling by health workers in all assigned health stations. This helps in avoiding unplanned pregnancies, large number of children within the household, better allocation of resources, and advocates for long birth spacing.

Even if this study has not controlled for the number of health workers, the health worker crisis in Zambia requires Government, with assistance from partners, to continue putting in place measures to help increase the number and quality of health workers trained. A Clinton Health Access Initiative (CHAI) analysis of health outcome and staffing data from 2009 and 2011 at rural health centres with less than 10 staff (94% of all RHCs) across Zambia found that adding a nurse could increase the facility's outpatient visits by 15%, adding a midwife could increase women attending their first antenatal care visit by 30% and adding a midwife could increase facility deliveries by 33%. According to CHAI, these increases in health service utilization can be expected to reduce the number of times that untreated diseases result in severe morbidity and death, and positively impact on reducing unnecessary maternal and new-born deaths.

References

Ali. S. (2001) Poverty and Child Mortality in Pakistan, MIMAP Technical Paper Series, 6.

Central Statistical Office (CSO), Ministry of Health (MOH), and ICF International. March 2015. 2013-14 ZDHS Key Findings. Rockville, Maryland, USA: Central Statistics Office (CSO), Ministry of Health (MOH), and ICF International.

Chowdhury. A. (2013). Determinants of Under-Five Mortality in Bangladesh, Open Journal of Statistics, 3, p.213-219.

Clinton Health Access Initiative. (2013). Human Resources for Health and Population Health, The impact of recent investments in health workers on utilization of health services and population health in Zambia, February 2013, CHAI-MoH.

Gjonca, A, Tomassini, C, and Vaupel, W, J. (1999). Male-Female Differences in Mortality in the Developed World, *MPIDR Working Paper WP* 1999-009.

Garenne. M. and Gakusi. A. (2006) Vulnerability and Resilience: Determinants of Under-Five Mortality Changes in Zambia, *World Development*, 34(10), p.1765-1787.

Hossain, M Islam, M.(2008). Socio-economic Variables Affecting Infants and Children Mortality in Bangladesh. *The Internet Journal of Health*. Volume 9 Number 2.

Kembo. J. and Ginneken. J. (2009) Determinants of Infant and Child Mortality in Zimbabwe:Results of Multivariate Hazard Analysis, *Demographic Research*, 12(13), p.367-384.

Kimani, J and Ettarh, R. (2012). Determinants of under-five mortality in rural and urban Kenya.

Kyei. K. (2011) Socio-Economic Factors Affecting Under-Five Mortality in South Africa: An Investigative Study, 2(2), p.104-110.

Mani. K. *et al*, (2012). Determinants of Under-Five in Rural Empowered Action Group States in India: An application of the Cox Frailty Model, *International Journal of MCH and AIDS*, 1(1), p. 60-72.

Mahfouz , M.S, Surur, A.A, Ajak , D.A.A, Eldawi, E.A. (2015). Level and Determinants of Infant and Child Mortality in Malakal Town – Southern Sudan.

Rubalcava. L. and Teruel. G.. (2004). The Role of Maternal Cognitive Ability on Child Health, *Economics and Human Biology*, Elsevier, 2(3), p.439-455.

Simms. C. (2000) Health Reformers' Response to Zambia's Childhood Mortality Crisis, *IDS Working Paper 121*, Institute of Development Studies.

Buwembo. P. (2010). Factors Associated with Under-5 Mortality in South Africa: Trends 1997- 2002, South Africa: University of Pretoria.

Negera. A. *et al* (2013) An Analysis of the Trends, Differentials and Key Proximate Determinants of Infant and Under-Five Mortality in Ethiopia: Further Analysis of the 2000, 2005, and 2011 Demographic and Health Surveys, USA: ICF International.

Murray. C. and Brown. D.(2010). A Mother's Education has a Huge Effect on a Child's Health, The Washington Post [Online]. 16th September, 2010. Available from: http://www.washingtonpost.com/wp-dyn/cont... [Accessed: 10th September, 2016].

UNICEF Report (2013) The Inter-Agency Group for Child Mortality Estimation: The Levels and Trends in Child Mortality.

UNICEF Zambia Report , 2010.

Notes

Competing Interest

All authors declare no competing interest.

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