Factors That Affect Under-Five Mortality among South African Children: Analysis of the South African Demographic and Health Survey Data Set

Zeleke Worku

Abstract— **The South African Demographic Health Survey data set (SADHS) contains massive individual-level information on South African children under the age of five years selected from a random sample of 7, 759 households. The data set contains data on socio-economic, demographic, health-related and sanitary variables gathered by using multi-stage cluster sampling. The objective of study was to identify key predictors of mortality among children under the age of five years. Survey logistic regression analysis and Cox regression were used for performing data analysis. Under-five mortality was significantly influenced by 3 predictor variables (duration of breastfeeding, marital status, and ownership of flush toilet). The hazard ratio of the variable breastfeeding was 3.09 with P=0.000 and 95% confidence interval of (1.899, 5.033). The hazard ratio of the variable toilet was 2.35 with P=0.016 and 95% confidence interval of (1.172, 4.707). The hazard ratio of the variable marital status was 1.74 with P=0.035 and 95% confidence interval of (1.041, 2.912). Adjustment was done for the level of education of the mother and wealth index.**

Index Terms— **Breastfeeding, Cox regression, hazard ratio, Survival**

I. INTRODUCTION AND OBJECTIVE

This is a study based on the analysis of the South African Demographic and Health Survey (SADHS) data set of 2003. The under-five mortality rate for South Africa is 59 per thousand live births [1]. The study aims to identify key socio-economic and health-related factors that are responsible for mortality among South African children under five years of age, and recommend feasible remedial actions to the South African National Department of Health with a view to reduce mortality among South African children under the age of five years. Data was gathered on socioeconomic, demographic and health-related variables associated with under-five mortality such as the loss of at least one under-five child, place of residence of mother, level of education of mother, level of income of household, access to clean water, ownership of toilet, duration of breastfeeding, age of the mother at the birth of the child, marital status of mother, use of modern family planning methods, and sanitary variables.

II. METHODS AND MATERIALS

A. Study design, sampling technique and sample size

The study design is cross-sectional and descriptive. Data was gathered from 7, 759 households selected from all over South Africa, using the multi-stage cluster sampling. Approximately 12, 000 completed interviews with women between the ages of 15 and 49. The country was stratified into nine provinces and each province was further stratified into urban and rural areas. The sampling frame for the SADHS was a list of approximately 86, 000 enumeration areas which were created by Statistics South Africa for the 1996 census. Within each stratum, a two-stage sample was selected. A total of 972 primary sampling units (PSUs) were selected with probability proportional to size (PPS) from urban (690) and rural (282) areas.

B. Statistical methods of data analysis

Suitable statistical procedures were used for exploring and quantifying the relationship between the loss of a child and key predictors of under-five mortality. This was done by obtaining frequency tables for discrete variables, summary statistics for continuous variables, Pearson's chi-square tests of association [2] and survey logistic regression analysis [3]. These procedures led to the identification of a manageable size of predictor variables that were used for subsequent data analysis based on the Cox proportional hazards model [4]. Odds ratios and hazard ratios were used as an epidemiological measure of effect. Adjustment was done for potential confounding variables. Sampling weights were used.

III. RESULTS OF STUDY

The study showed that 4.5% of women in the study had experienced the death of a child. Out of the 2, 221 women who took part in the study, 1, 125 (50.65%) had boys whereas 1, 096 (49.35%) had girls. Out of the 100 children who died, 91 (91%) were younger than 12 months, eight (8%) died when they were older than a year but younger than two, and one child died at an age older than two years or 24 months. The mean age of the children was 5.8 months (Std. Err. =1.51; 95% Confidence Interval of 2.84 to 8.84). The average age of mothers in the study was 27.17 years. The largest proportions of mothers were in the age categories 20 - 24 and 25 - 29 years, amounting to 50%. Mothers younger than 20 years of age made up 153 of the total (6.9%). In terms of ethnicity, out of the 2, 221 women who participated in the study, black women constituted about 76%, coloureds 16%, and Asians/Indians and whites 6% and 3% respectively. The majority of mothers (more than half) who participated in the study (55%) were urban women and the remainder (45%) were from rural areas.

A. Results from survey logistic regression analysis

Table I: Results from survey logistic regression analysis

Variable	Adjusted Odds Ratio*	95% C.I.	P-value
Residence	0.356	0.142 - 0.889	0.027
Water	1.097	0.853 - 1.412	0.470
Toilet	2.147	1.405 - 3.28	0.000
Literacy	0.729	0.542 - 0.982	0.038
Marital status	1.293	1.075 - 1.556	0.007
Income	0.823	0.607 - 1.116	0.208
Age at first birth	0.747	0.575 - 0.971	0.029
Place of delivery	1.028	0.774 - 1.366	0.849
Duration of breastfeeding	1.339	1.165 - 1.538	0.000

* Adjustment was done for the level of education of the mother and the wealth index.

Survey binary logistic regression analysis was performed for estimating odds ratios of key predictors of mortality [1]. The outcome variable of study is the loss of an under-five child (Yes, No). As such, the outcome variable of study is dichotomous. The outcome variable of study is regressed on key socio-economic and health-related factors that are related to the loss of an under-five child by the mother or caretaker. The epidemiological measure of effect is the odds ratio. Significant odds ratios are characterised by odds ratios that are significantly different from 1; P-values that are smaller than 0.05; and 95% confidence intervals of odds ratios that do not contain 1. The results show that 6 of the 9 predictor variables used for survey logistic regression analysis were influential predictors of survival at the 0.05 level of significance. The odds ratio of the variable toilet facility is equal to 2.147. This shows that a mother who does not have a flush toilet is 2.147 times as likely to have lost a child as another mother who has a toilet.

Table II: Results from survival analysis

Variable	Adjusted Hazard Ratio*	95% CI	P-value
Residence	0.80	0.449- 1.410	0.434
Water	0.94	0.414- 2.137	0.884
Toilet	2.35	1.172- 4.707	0.016
Literacy	0.18	0.024- 1.278	0.086
Marital status	1.74	1.041- 2.912	0.035
Income	1.51	0.837- 2.724	0.171
Age at first birth	0.67	0.367- 1.239	0.204
Place of delivery	1.42	0.649- 3.101	0.381
Duration of breastfeeding	3.09	1.899- 5.033	0.000

* Adjustment was done for the level of education of the mother and the wealth index.

The Cox proportional hazards model [2] was used for estimating hazard ratios of key predictors of mortality. The hazard ratio of the variable breastfeeding is 3.09. This shows that a mother who does not breastfeed her child is 3.09 times as likely to have lost a child as another woman who breastfeeds her child. The hazard ratio of the variable marital status is 1.74. This shows that a mother who is married is 1.74 times as likely to have lost a child as another woman who is not married. The hazard ratio of the variable toilet is equal to 2.35. This shows that a mother who does not have a flush toilet is 2.35 times as likely to have lost a child as another mother who has a toilet.

Fig 1: Kaplan-Meier survival probability plot of breastfeeding
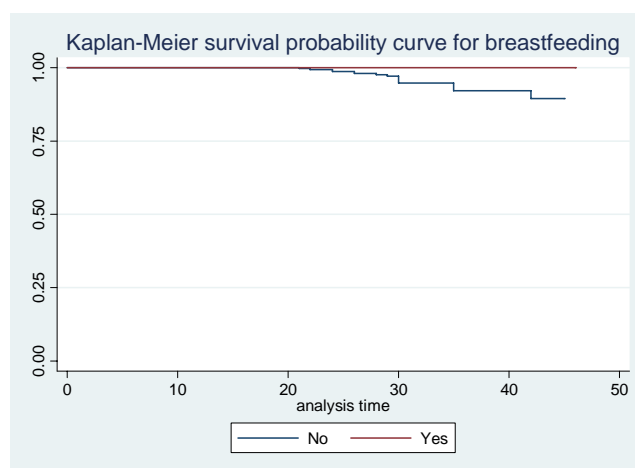
IV. MAJOR FINDINGS

The study has shown that under-five mortality is significantly influenced by the duration of breastfeeding, marital status of the mother, ownership of toilet facilities, the level of education of the mother, residential area and place of delivery of the child, and that rural mothers and children are particularly disadvantaged with regards to basic health and socio-economic services.

V. RECOMMENDATIONS

Based on findings of this study, the following recommendations are made to the South African Department of Health so that where possible, remedial actions could be taken with a view to reduce morality among South African children under the age of five years.

- The South African government must provide improved access to basic health services and health education to rural mothers and their children.
- The bucket system of toilets should be discarded by providing the rural population with safe toilets. It must be pointed out that although the government has made a commitment to eliminate the bucket system of toilets by 2014, this goal is unlikely to be met in 2014. The task must be pursued with enough vigour, adequate resources and the necessary political commitment.
- Community based initiatives should be used among the rural population in order to create job opportunities for poor, rural mothers and empower them economically. The unemployment rate among rural mothers and the gap between the rich and the poor are major problems that must be addressed by the national government. Young rural mothers leave their children and habitat to go to urban centres in search of jobs and livelihood. This is particularly true of single mothers.

REFERENCES

[1] South African National Department of Health. (2008, November). Results of the South African Demographic and Health Survey. [Online]. 1(1). pp. 1-5. Available at: http://www.doh.gov.za/facts/index.html

[2] B. Dawson & R. G. Trapp, Basic Clinical Biostatistics, 4th edition. New York: McGraw Hill, 2004, ch. 4.

[3] D. W. Hosmer & S. Lemeshow, Applied Logistic Regression, 2nd edition. New York: John Wiley and Sons, ch. 2.

[4] M. Cleves, W. Gould & R. Gutierrez, An Introduction of Survival Analysis using STATA. Houston, Texas: STATA Press, 2004, ch. 3.