ESTIMATING THE TRENDS OF CHILDHOOD MORTALITY INDICATORS AND EFFECTS OF ITS DETERMINANTS: A CASE STUDY OF CAMEROON

By

MUKETE, Mballe Gilbert

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Submitted to

KDI School of Public Policy and Management

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Committee in charge:

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ABSTRACT

From independence in 1960 up to 2010, Cameroon has adopted different development plans, ranging from a series of six five years development plans to the Growth and Employment Strategy Paper whose implementation started in 2010. The implementations of these plans have let Cameroon through all the phases of a typical business cycle. It is assumed that each phase had different impacts on Childhood Mortality Indicators and its Covariates. This study sought to evaluate the trends of childhood mortality indicators and the impacts of their determinants on the trends in each of the four Demographic Health Surveys (DHS) conducted in Cameroon respectively in 1991, 1998, 2004 and 2011.

Using survival models (synthetic cohort life tables), we estimated four Childhood Mortality indicators (PNMR, NMR, IMR, and U5MR) for each of the four DHS datasets. Besides, we used both univariate and multivariate Cox Proportional Hazard Models and the Stratified Cox procedure to investigate the impacts of 29 determinants on each of the four childhood mortality indicators considered.

We obtained the following mortality rates per 1000 live births; for the 1991 dataset PNMR is 22.6, NMR is 36.2, IMR is 58.8 and U5MR is 120.4. For the 1998 dataset; PNMR is 25.5, NMR is 36.5, IMR is 62 and U5MR is 138.1. For the 2004 dataset; PNMR is 29.8, NMR is 33.1, IMR is 62.9 and U5MR is 141.2. And lastly for the 2011 dataset; PNMR is 19.4, NMR is 32, IMR is 51.4 and U5MR is 117.2. The results also show that the most consistent determinants of childhood mortality across the four surveys includes; Child Vaccination Status, Mothers' Number of Birth, Mothers' Current Marital Status, Mothers' Level of Education, Mothers' Preceding Birth Interval, Where The Child Is Raised, Mothers' Current Age, and Mothers Age At First Birth.

Results from univariate analysis revealed that on average the trend of the 29 determinants improved significantly across the four surveys. However, multivariate analysis shows that the magnitude and direction of the correlation in most cases were found to fluctuate from one dataset to another as outlined in chapter four.

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LIST OF TABLES

Table 1: Life table, Demographic Health Survey, Cameroon, 1991 (Survival) 41
Table 2: Life table, Demographic Health Survey, Cameroon, 1998 (Survival) 42
Table 3: Life table, Demographic Health Survey, Cameroon, 2004 (Survival) 43
Table 4: Life table, Demographic Health Survey, Cameroon, 2011 (Survival) 44
Table 5: Summary of childhood mortality indicators considered 45
Table 6: Summary description of Covariates considered 10
Table 7: Results of the proportional-hazards assumption test for the 1991 dataset 57
Table 8: Results of the proportional-hazards assumption test for the 1998 dataset.....58
Table 9: Results of the proportional-hazards assumption Test for the 2004 dataset 59
Table 10: Results of the proportional-hazards assumption Test for the 2011 dataset 60
Table 11: Results of the hypothesis test (association between variables in successive years).....61
Table 12a: Results of the crude models for the 1991 dataset…….....63
Table 12c: Results of the final model for the 1991 dataset…….....67
Table 13a: Results of the crude models for the 1998 dataset…….....70
Table 13c: Results of the final model for the 1998 dataset…….....76
Table 14a: Results of the crude models for the 2004 dataset…….....80
Table 14c: Results of the adjusted model for the 2004 dataset …….....87
Table 15a: Results of the crude model for the 2011 dataset…….....89
Table 15c: Results of the adjusted model for the 2011 dataset…….....97

Table of Contents

CHAPTER 1: Introduction 9
1.1 Overview 9
1.2 Aim and Scope 11
1.3 Research questions 11
2.1 Survey of Main Findings 12
2.2. Theoretical Framework 14
2.3. Approaches Used to Measure Childhood Mortality 15
2.3.1. Vital Registration 15
2.3.2. Multi-Round Surveys and Surveillance Systems 16
2.3.3. Survey Questions on Child Survivorship 16
2.3.4. Retrospective Survey Questions on Household Deaths 16
2.3.5. Life Table (Event History Analysis) 17
CHAPTER 3: Methodology 18
3.1 Design. 18
3.2 Sampling and Data Collection 18
3.3 Measurement 20
3.3.1. Dependent Variables 20
3.3.2. Explanatory Variables 20
3.3.2.1. Wealth Index 21
3.3.2.2. Public Health Variables 21
3.3.2.3. Environmental Variables 22
3.3.2.4. Maternal and Demographic Variables 22
3.3.2.5. Socio-Economic Variables 23
3.4. Analysis 24
3.5. Model Specifications 25
3.6. Methodological Assumptions and Limitations 26
3.7.Administration and Data Collection 27
CHAPTER 4: Findings 28
Descriptive Statistics of Dependent Variables 28
Outline of Univariate Analysis 31
Results of Assumptions Test Conducted 42
Results of Hypotheses Tests 46
Results of Correlation Analysis 48

Results of the Univariate Cox Regression 1998 55
Results of Univariate Cox Regression Analysis for the 2004 Dataset 59
Results of Univariate Cox Regression Analysis for the 2011 Dataset 66
Results of the multiple regression analysis for the 2011 dataset 72
CHAPTER 5: Discussion 74
5.1 Trend of Childhood MortalityIndicators Across the fourSurveys 74
5.2 Comparing consistent findings between Successive Surveys 75
References 79

CHAPTER 1: Introduction

1.1 Overview

The importance of a Healthy population cannot be overemphasized both in terms of achieving development goals and in sustaining them. In 1986, the Ottawa Charter for health Promotion noted that health "… is a resource for everyday life, not the objective of living. It is a positive concept, emphasizing social and personal resources as well as physical capabilities" (Health Promotion Section, para.1). In addition, all the eight Millennium Development Goals (MDGs) are known to have a direct effect on the health status of individuals in all populations. MDG 4 specifically advocated for a decline in the number of dead children from 12 million in 1990 to below 4 million by 2015 (World Health report, 2013). Consequently, improving the health status of countries has, and will ever remain a top priority for most governments, not only as a necessary economic and social development goal, but also as a condition to enhance the living standard of citizens (MINEPAT, 2009). For countries to achieve and sustain an acceptable health status there is need for them to periodically review their population and health policies to accommodate the changing health status of their populace. By frequently reviewing the identified trends of the different health indicators and the influence that their key determinants might have had on them in different time periods, countries stand to achieve at least two substantial benefits.

Firstly it provides a base for monitoring the effects of new health determinants on the current health status and the effect of old ones for which public health programs had been put in place (WHO, 2000). Secondly it helps government authorities to identify and reduce health inequalities among different populations and cohorts within their countries. Knowledge of health inequality combined with knowledge of the attributes of national populations (age pattern, socioeconomic differentials, causes of death, and the structure and distributions) often provides causal explanations needed in the design and the implementation of national and regional development programs.

In addition, human history has taught us that population growth, stagnation or failure to survive has depended more on mortality than on fertility or migration (Palmore & Gardner, 1996). The same source maintains that within every population different subgroups are exposed to different risk of dying owing to differences in age, gender, occupations and marital status. Perhaps this could justify the frequent use of childhood mortality indicators (like Child Mortality) by the IMF et al. (2000) and UNICEF (2001) to measure the average health of populations. In some cases, such estimates have not only been used to identify gaps between the rich and the poor in terms of health outcomes (Gwatkin et al., 2000 & Wagstaff, 2000), but has also served as an instrument in the evaluation of development interventions.

Consequently, this study constitutes an evaluation of the trends of the health status of Cameroon and the effects of its key determinants for the period 1991 to 2011using four waves of demographic health survey datasets in Cameroon (Phase-II in 1991, Phase-III in 1998, Phase - IV in 2004 and Phase-VI in 2011). Against this backdrop, this study attempts to verify two major claims:

1) That the health status of the population of Cameroon has not experienced any significant improvements from the period covering 1991 to 2011.
2) That the effects of the major determinants of Childhood Mortality Indicators (PNMR, NMR, IMR, and U5MR) have been improving over the period considered.

The validity of the above claims will be ascertained by estimating values of childhood mortality indicators and the coefficients of its determinants in each of the four demographic health surveys to capture their causal relations. Although different measures of mortality have been used to estimate the health status of populations in history, this study focused on; Post Neonatal Mortality Rate (PNMR) considered as the difference between Infant Mortality Rate (IMR) and Neonatal Mortality Rates (NMR), Neonatal Mortality Rate (NMR) considered as the probability of dying between birth and exact age 1 month, Infant Mortality Rate (IMR) considered as the probability of dying between birth and 1 year of age expressed as the number of death children per 1,000 live births, Child Mortality Rate(CMR) considered as the probability of dying between exact ages 1 and 5 years

expressed as the number of children who died before their fifth birthday in every 1,000 live births. And Under-Five Mortality Rate (U5MR) considered as the probability of dying between birth and exact age 5 (Adair, 2012).

1.2 Aim and Scope

A number of studies have evaluated the effects of one or more determinants of childhood mortality indicators at different time periods in different populations. But no such studies have yet focused on the estimation of childhood mortality indicators and the trend of the effects of its determinants using four waves of DHS datasets within the context of Cameroon. This study will focus on Cameroon and will cover the period 1991 to2011. In other to achieve the above goal, we hope to achieve the following specific objectives:

1) To estimate and determine the trends of 4 childhood mortality indicators (PNMR, NMR, IMR, U5MR)
2) To compare the association of childhood mortality indicators with 28 of its relevant covariates.

This study will adopt Mosley and Chen's 1984 combined framework to achieve objective (1) and (2). The results of this study may provide a clue about the trend of each of the four childhood mortality indicators and the extent to which each of their relevant determinants have influenced their evolution. By so doing, the results will inform the policy making process in the domain of Population and social change in general.

1.3 Research questions

i. What are the most relevant determinants of Childhood Mortality indicators in Cameroon from 1991 to 2011?
ii. What is the trend of childhood mortality indicators over the same period?
iii. What is the trend of the effect of each covariate on childhood mortality indicators?

CHAPTER 2: Literature Review

The Literature on childhood mortality and its determinants is extensive both for cross country and single country studies in developed and developing countries, perhaps because they occupied a prominent position in international development targets, like the Millennium Development Goals (MDGs), and currently still features in the Sustainable Development Goals (SDGs) for the period 2016 to 2030. Consequently, improving our knowledge of childhood mortality indicators is crucial and will remain as such considering its influence on Population, Economic Growth, Health and Environmental protection, which are all important in the evaluation of countries' development efforts.

2.1 Survey of Main Findings

Hanmar, Lensink and White (n.d.), examined the robustness of the determinants of infant and child mortality in developing countries using over 420,000 equations and found that income per capita, health indicators, education and gender inequality are significant determinants of Infant and Child Mortality. In the same vein, Mekonnen (2011) studied infant and child mortality in Ethiopia using demographic health survey (DHS) data for the period 2000 and 2005 using logistic regression. Mekonnen found that Bio-demographic factors such as marital status, Birth Order, Type of Birth and Preceding Birth Interval are important socioeconomic determinants. Mekonnen also found that education and household size are the most important socioeconomic determinants of health in a given population. However, he noted that the effect of other socioeconomic variables and environmental factors on infant and child mortality diminished over time.

Defo and Palloni (n.d.) on the other hand focused their studies on child health and survival using a panel data structure collected through a sample survey of children in Yaoundé, Cameroon between 1978 and 1980 .Using a two-state hazard model, Defo and Palloni determined the effect of breast feeding and the intervals between conception on infants and early child mortality while controlling for potentially confounding factors. They found that "…the effect of breast feeding and premature [birth] following conception on mortality risks during early childhood are strong and unlikely due to Spurious

Relations, Simultaneity biases, unmeasured characteristics or Selective losses to follow up"(Abstract).

Akoto and Tambashe(1989) reviewed some factors that are likely to explain the observed urban-rural differences in Infant and Child Mortality in Sub-Saharan Africa. Akoto and Tambashe focused on the factors likely to be associated with excess urban mortality emphasizing the trends in infant and Child Mortality in a few selected countries in Sub-Saharan Africa. They also examined the determinants of Infant and Child mortality with emphasis on the role of urban- rural residence as differentiating factors. They established that the impact of living in urban or rural areas on child mortality were narrowing in some cases and disappearing in others, while the influence of other variables was becoming more significant. For instance, they observed that in all countries they studied, regardless of the period considered, Mothers' Education is the most significant determinants of Child Mortality. They further contended that as mother's schooling level increases, the risk of her losing her child decreases progressively, and drops sharply as soon as mothers attends secondary and higher levels of education. Akoto and Tambashe(1991) concluded that Child Mortality, the Immediate Environment and Mother's level of Education are the most significant determinants of child mortality in Cameroon.

Islam , Kamal and Ali(2009) examined the factors that influenced Infant and Child Mortality in the Rajshahi district of Bangladesh and establish that, although several Socioeconomic, Demographic and Health related variables affects Infant and Child Mortality, the most significant predictors of Neonatal, Post-natal and Child Mortality are Immunization, Ever Breastfeeding, Mother's Age at Birth and Birth interval .

Hanmer, Lensink, and White (n.d.) through their studies using World Fertility and Demographic Health Surveys showed the existence of a fairly consistent pattern between demographic determinants (Sex and Birth Spacing) and mortality rates (Hobcraft et al., 1984). However, they noted a relatively less consistent result with socioeconomic determinants. Equally, Desai, Sonalde and Alva (1998) showed that Mothers' Education is a significant determinant of Mortality only in some countries.

Doepke (2004) studied the relationship between Child Mortality and Fertility decline using three

variants of the Altruistic Parent model of Barro and Becker and concluded that the empirical evidence on the Mortality-Fertility relation is consistent with his earlier claim that, the decline in child mortality lowers fertility rates, although it did not cause a decrease in net fertility. His results suggest that besides decreasing Infant and Child Mortality other factors are responsible for the large decline in the net production rates observed in industrialized countries over the last centuries.

Uddin and Hossain(2008) evaluated the predictors of Neonatal and Post-Neonatal Mortality in Bangladesh using Bangladesh Demographic Health Survey for the period 1990 to 2000. They showed that Infant Mortality varied significantly with several variables among which include Parental Education, which they found to have a negative significant effect on Infant Mortality.

2.2. Theoretical Framework

Different fields of research have offered different answers related to mortality questions. For instance, Social scientific research has noted the important association between socioeconomic status and levels and patterns of mortality in populations. Medical research has attributed mortality to specific disease processes like infections or malnutrition.Impact assessment programes have helped to determine the effects of different policy actions in the level and spread of mortality in different populations. Epidimeological studies have showned the role of the physical environment (like poluted water) on mortality through the spreed of diseases like Colera and Malaria. Nutrition researchers on their part have focused on how quality, quantity and methods of delivering nutrient affects the health status of populations.Collectively, the different fields of reseach have directed humanity towards a multidimensional and intergrated approach in studying child mortality and its determinants. Mosely and Chen (1984) in their framework noted that all social and economic determinants of child mortality essentially operate through a common set of biological mechanisms owing to their ability to exert an impact on mortality. Mosely and Chen's framework successfully unified the most significant variables from different fields of reseach, thus permitting the specification of different orders of causalities

UNICEF (1990) conceptualized mortality in children and women as the results of a long sequence of interlinked events. It contends that, inadequate dietary intake and disease are the most significant immediate causes of mortality. It argues that death from diseases may result from one or a combination of causes like Lack of/ Low utilization of health services, Inadequate Water Supplies and Sanitation Facilities, Poor Hygiene or Inadequate Child Care. Consequently, the framework offers a multi-sectorial guide in selecting the most important determinants and in different context. It also gives room for dialogue and cooperation among different actors by providing an enabling environment for identifying and assessing how causality relationships should be identified and analyzed.

Although Masuy-Stroobant (2001), Meegama (1980), Garenne &Vimard (1984), and UNICEF (1990) proposed different useful frameworks, Mosely and Chen's 1984 framework was considered for this study for being the most cited and most inclusive framework.

2.3. Approaches Used to Measure Childhood Mortality

Different data sources have imposed different approaches for measuring childhood mortality indicators. However each approach has generally strived to consider the accuracy and recent time bound property (Hill, 1991). Hill contended that for a given approach to provide sufficient information on childhood mortality and permit sufficient analysis, it must be capable of capturing the level of childhood mortality and its associated causes, trends, and differentials within the socioeconomic, cultural and environmental context, preferably at the individual level.

2.3.1. Vital Registration

The complete and continuous registration of births and deaths in a given spatial location provides the richest source of data about childhood mortality (Hill, 1991). According to Hill, vital registration data is constrained by the amount of socioeconomic data that it can realistically collect and the fact that it can only allow for the direct measurement of infant mortality while broader childhood mortality measure like Child Mortality cannot readily be estimated, thus reducing the scope of any potential analysis.

2.3.2. Multi-Round Surveys and Surveillance Systems

According to Hill (1991), multi-round survey is a series of multi-round visits to some shortlisted households in predefined sampled areas to record demographic events. Hill contends that multi-round surveys can produce accurate estimates of child mortality levels and age patterns. However, He noted that multi-round visits cannot provide estimates of trends prior to the data collection period. Besides, the amount of background information it contains is limited to the availability of resources. Furthermore, its longitudinal nature can make it vulnerable to political and economic instability in most cases.

2.3.3. Survey Questions on Child Survivorship

Childhood mortality has been measured by incorporating specific questions asking women of reproductive age about the survival history of their children within the context of a cross-sectional data collection procedure, like during mainstream national population census (Hill, 1991). The reproductive section of the core questionnaires used during demographic health surveys is designed to capture the fertility history of women of reproductive age in national representative samples (DHS II Individual Recode, 2008). Hill noted that, although the integrated questions that aggregates the number of children ever borne and/ or dead are useful in calculating child mortality levels and trends, they have proven to be inadequate in assessing patterns of child mortality because of the aggregated nature of the data they generates.

2.3.4. Retrospective Survey Questions on Household Deaths

Childhood mortality has also been measured by collecting retrospective information on household deaths by age and sex during a reference period prior to a regular national survey (Hill, 1991). This approach sometimes helps to estimate childhood mortality differentials along any dimensions included in a survey and could yield even better estimates of trends if repeated in a small scale. However, Hill noted that retrospective survey questions on household deaths are not reliable in providing information on the trend of childhood mortality in large-scale enquiries.

2.3.5. Life Table (Event History Analysis)

Life tables have been used to measure mortality and describe the survival experience of specific populations in a specified period of time (Lee, n.d.). According to Palmore and Gardner (1996), life tables are suitable in measuring mortality in situations where there is a significant change in the number of births from one year to another. They noted that, Life-table techniques are helpful in comparing the mortality of countries such that differences in their age distribution will not serve as a distorting factor and consequently will not require age standardization for comparison to be done. Pandey et al (1998) used a Cohort life-table to estimate mortality before age five in India using national family health survey data. Arnold, Choe and Roy, (1998) have also used life-table to study mortality in India.

2.4. Research questions

From the survey of main findings, the determinants of childhood mortality can conveniently be summarized into four categories, Sociocultural, Biological, Environmental and Demographic variables (Mosely & Chen, 1984). The extent to which each subcategory influences the magnitude of each indicator is neither universal nor limited to particular populations. The following hypothesis would explore the 29 determinates of childhood mortality indicators and their impact on childhood mortality within the context of Cameroon, using four waves of demographic health survey datasets by seeking reasonable answers to the following research questions.

i. What is the main effect of each of the 29 determinants on each of the four childhood mortality indicators considered in each of the four datasets?
ii. What is the controlled effect of each of the 29 determinants on each of the four indicators considered in each of the four datasets?
iii. What are the most significant determinants of Childhood Mortality indicators in the four datasets considered?
iv. What is the trend of the main effect of each of the determinants of childhood mortality indicators between each of the successive surveys (1991/1998, 1998/2004, 2004/2011)?

In sum univariate and multivariate analysis using cox proportional hazard model will help provide reasonable answers to the above hypothesis.

CHAPTER 3: Methodology

In the preceding chapter we reviewed major findings, theoretical frameworks, approaches to the measurement of childhood mortality indicators, Models for estimating the impact of determinants of childhood mortality. From the insights, we selected a suitable technique to estimate the hazard rates (childhood mortality indicators), determine their distributions over different age groups, and model the correlation between hazard rates and their determinants. This chapter comprises six sections, Research Design, Sampling, Measurements, Analysis, and Methodological Assumptions.

3.1 Design.

To sufficiently describe the trends of the health status of the Cameroonian population from 1991 to 2011, we initially estimated the value of four childhood mortality indicators (PNMR, NMR, IMR, and U5MR) for each of the four available DHS datasets using life table technique. Next we estimated the effect of 28 relevant covariates of childhood mortality indicators using Cox Proportional Hazard model for each of the seven years that preceded each of the four DHSs surveys.

3.2 Sampling and Data Collection

This study used secondary data collected through household-based demographic health surveys (DHS) conducted within Cameroon from1991 to 2011.The DHS use weighted samples of national representations of households, women aged 15-49 and men aged 15 – 59. DHS surveys are designed to collect data on Marriage, Fertility, Family Planning, Reproductive Health, Child Health, and HIV/AIDS (MEASURE DHS, 2006). The DHS program uses three standard model questionnaires which sometimes accommodates additional questions to capture country specific interest. The household questionnaire is designed to capture data on listed household members, visitors, household assets and characteristics. The household questionnaire helps to identify children≤ 5 years old, and

women and husbands that are eligible for interview. The women and men's questionnaires are designed to capture a wide variety of individual level characteristics.

This study specifically used data generated from Phase-II (1991), Phase-III (1998), Phase-IV (2004), and Phase-VI (2011) of the DHSs conducted in Cameroon. The data Collection, Compilation and Processing was conducted locally by the National Institute of Statistics (NIS), Ministry of Economy Planning and Regional Development(MINEPAT) in collaboration with the Comité National de Lutte contre le Sida (CNLS) and Bureau Central des Recensements et des Etudes de Population (BUCREP) with the technical support of the Demographic Health Survey (DHS) program.

	Phase-II (1991)	**Phase-III (1998)**	**Phase IV (2004)**	**Phase VI (2011)**
Period	April to Sept	February to June	February to August	Jan 24 to Aug 15
Household shortlisted	3 647	4 791	10 719	14 354
Household Surveyed & response rate	3 538(97 %)	4 697(98 %)	10 462(97.6 %.)	14 214(99 %.)
Eligible women	4 106	5 760	11 304	15 852
Women effectively interviewed & response rate	3 871(94.3%)	5 501(95.5 %.)	10 656(94.3 %.)	15 426(97 %)
Eligible Men & Spouses	998	2 806	5 676	7 191
Men/Spouses effectively interviewed & response rate	814 (81.6 %)	2 562(91.3 %)	5 280(93 %)	7 525(96 %)
Source of data	(Direction Nationale du 2nd RGPH, 1992).	(BUCREP, 1999).	(INS, 2005).	(INS, 2012).

The DHS dataset is generally stored in nine recodes; Birth Recode (BR), Couple's Recode (CR), Household Recode (HR), Height and Weight Scores(HW), Individual Recode (IR), Children Recode (KR), Men's Recode (MR), Service Available Raw (SQ), and Wealth Index (WI) (Rutstein & Rojas, 2006). The dependent variables (childhood mortality indicators) are estimated from variables

stored in the BR. The BR contains data on every child ever delivered to every interviewed woman and was captured in the reproductive section of the women's questionnaire.

3.3 Measurement

3.3.1. Dependent Variables

The dependent variables (childhood mortality indicators) are basically estimated survival rates calculated using the Direct Mortality Estimation Approach. This approach uses the survival function s(t) to generate a life table for each dataset. The life table estimates the survival probability of a child following its exposure from birth until the occurrence of death for those that experienced death and from child birth to the survey date for censored cases. Besides estimating survival rates, life tables determine associated statistics and their distributions among the different age groups considered. The Life tables were calculated using the approach outlined in O'Donnell, Doorslaer, Wagstaff, and Lindelow (2008).

More specifically, the dependent variables were calculated from three variables, the time variable, the survival status variable and the child identification variable. The time variable is the child's age at interview (i.e. the duration of life before death). It is generated from each child's date of birth (b3) and mother's date of interview (v008) expressed in years. The survival status of each child at the time of interview was generated from (b5). The child identification variable identifies each child ever delivered.

3.3.2. Explanatory Variables

All Covariates were converted into dummy variables and the lowest level within each dummy variable was set as the reference during the regression of life tables. All missing values within the dummy variables were not considered since the missing values were not consistent in all the four datasets considered, and the sample sizes were large enough to be given due consideration. The

variables were organized into five categories following Mosely and Chen's1984 classification to ease the discussion of findings in chapter four. See Table 6.

3.3.2.1. Wealth Index

The wealth index, here considered as proxy for the household income is a composite variable generated from information on household characteristics and assets obtained from the birth recode of DHS dataset. The wealth index was estimated as discussed in Fry, Firestone and Chakraborty (2014).In accordance with Fry et al., relevant variables were converted into binary variables; Continuous variables were converted into multiple binary variables in accordance with the ICF convention (DHS Program, 2014). The principal component analysis (PCA) was used to determine the relative importance (weight) of each variable considered alongside their mean and standard deviation. The wealth index for each datasets was estimated and the quintile to which each respondent belongs was determined. Wealthindex ("household_income_level") comprises three levels ("Poor_Income_Homes", "Average_Income_Home" and "Above_Average_Income_Homes").

3.3.2.2. Public Health Variables

Composite variables were generated to investigate the effect of different actors involved in the public health sector on childhood mortality. Emphasis was placed on who, where and what was the source of prenatal care, delivery, antenatal care, treatment for diarrhea and fever/cough.

The variable "TPPPrNaC" represents the type of personnel providing prenatal care to mothers, and it's composed of four levels; medical doctors (RPrNaCFrDr), nurse/midwife (RPrNaCFNoM), auxiliary midwife (RPrNaCFAMW) and traditional birth attendant (RPAFTBA) (See Table 6).

"TPSDD" represents the types of personnel sough during delivery by mothers composed of four levels; medical doctors (WDBMD), nurse/midwife (WDBNMW), auxiliary midwife (WDBAuMw) and traditional birth attendants (WDBTPAR).

"MWHANV" and "ChWRAV" represents mothers who had antenatal visits and children who received adequate vaccination respectively, and these were respectively captured the effect of antenatal visits and the role of vaccination on child survival.

Composite variables were equally generated to evaluate the effect of the type of place children age ≤ 5 years consulted during episodes of diarrhea. Type of place consulted during episodes of diarrhea (TOPCDEOD) is composed of three levels; "ChWDTMPuS" denotes Children treated in the medical public sector, "ChWDTMPrS" for Children treated in the medical private sector, "ChWEDTOPrSec" for children treated in other private sector (traditional practitioners, friend and others) and "ChWEODNC" for children not consulted at all. "TOTAFD" is a binary variable representing children that received medical treatment during episodes of diarrhea (See Table 6).

The types of place consulted during episodes of fever/cough ("TOPCDEOFC") is composed of four levels; Children with Episode of fever/cough consulted in medical public sector (ChWEOFCCIMPS), Children Consulted in medical private sector (ChWEOFCCIMPrS), Children Consulted in other private sector (ChWEOFCCIOPS) and children not consulted (ChWEOFCNC).

3.3.2.3. Environmental Variables

The variables "SOHhDW" and "TOHhTF" respectively signify the Source of household drinking water and type of household toilet facilities were generated to evaluate the effect of the environment on children survival. SOHhDW is composed of four levels; used piped borne water supply (UPipeBWS), used well water supply (UWWS), used surface water supply (USWS), and used bottled water (UBW). "TOHhTF" is composed of three levels; use flush toilet (UFlushT), use pit toilet (UPT), and used inadequate toilet facilities (UInATF).

3.3.2.4. Maternal and Demographic Variables

The variable "MAAFB" stands for mother's age at first birth, composed of four levels; mothers between 9-14yrs (PrematureMothers), mothers between 15-25yrs(Youngmothers), Mothers between 26-30years (MidMothers) and Mothers between 31-39yrs (LateMothers).

Mother's number of birth in the last 5 years"MNoBiL5ys"; has five levels, mothers with no birth in the last five years (No_births), mothers with at most two births (Max2_births), and mothers with two to four births (3-4_births).

Mother's current age "MCA" contains four levels; mothers between 15-19years (Teenage Mothers), mothers between 20-29 years (Mothers_in_their_20s), mothers between 30-35 years (Mothers_in_their_Mid-30s), and mothers between 36-49 years (Mothers Above 35 years).

Duration of breastfeeding "DOBF " is composed of three levels; mothers who never breastfed baby(NBFB), mothers who breastfed baby for up to six months (BFBF6M), and mothers who breastfed for above six months (BChFM6M).

Type of birth "TOB" represent mothers' experience, could either be (Normal) or (Abnormal) birth. "Normal birth "for children delivered within the expected time (usually nine months), without caesarian, and had the expected average size at birth. And "Abnormal birth" represents children who did not fit into the normal birth category.

Preceding birth intervals" precd_birth_intls" has three levels, preceding birth interval between 0 -12 months (predbirth0:12ms), Preceding birth intervals between 13-24 months (predbirth13:24ms), and preceding birth interval between 25-328 months (predbirth25:328ms). Sex of Child at birth "SoCh" represents either (male) or (female).

3.3.2.5. Socio-Economic Variables

Mother's current marital status "MCMS" has three levels; Never married woman (NMW), married and once married women (MAOMW), and woman currently living alone (WCLA).

Place of delivery "POD" has three levels; children delivered at home (DAH), children delivered in a hospital (DIH) and children neither delivered at home nor in hospital (DNAHNH).

Mother's Level of Education"MLOE" comprise three levels, mothers with no education (NEdu), mothers with primary education (PEdu) and mothers with Secondary and higher levels of education (SAHEdu). Likewise, mothers' partner's level of education "PLOE" has three levels;

partners without education (No_education), partners with primary education (PWP_Education), and partners with secondary and higher education (PWSAH_Education).

Type of place of residence "TOPOR"; represents whether mothers resided in urban or rural area. Partners' with source of income "PWSOI" indicates whether Partners has a source of income or not.

Mothers' religion "MReligion" has three levels; "Christians" representing Catholics, Protestants and other denominations, "Muslims" for Muslim religion, and "OReligion" for other religions.

"Househod_income_level" is a composite variable with three levels; (Poor_Income_Homes) for households whose wealth score falls in the first two quintiles, (Average_Income_Home) for those in the third quintile and (Above_Average_Income_Homes) for those in the last two quintile. See section 3.3.2.1.

Mothers' Access to Mass Media "MATMM" is generated from mother's accesses to electricity, ownership of a radio, ownership of television; watch TV and listens to radio every week. Finally "Who the child lives with" "WChLW" before they attain 5 years could be biological mother or other relatives.

3.4. Analysis.

Univariate analysis was undertaken after checking the internal consistency of the covariates using Kaplan-Meier curve[1] and the goodness of fit tests approach[2] in accordance with Harrel and Lee (1986). Variables whose Kepler Meier curves were parallel or separated along a significant portion were considered to satisfy the proportionality requirement. Harrel and Lee's test (the goodness of fit tests) is a more rational method we used to confirm the results of the proportionality test suggested by the graphical method. The test estimates the Schoenfeld residuals and the ranked failure time of each covariate and check the correlation between them (Kleinbaum & Klein, 2005). It considers each fitted

[1] sts graph, by(Xi)
[2]

covariates while adjusting for the other covariates in the model. The test assumes that the correlation between the Schoenfeld residuals and the ranked failure time is zero (H_0: $\rho = 0$). Hence failing to reject H_0 implies that the proportionality assumption is not violated. The shapes of the Kaplan-Meier curves combined with the P-value from the goodness of fit tests (i.e., when P>0.50), were used to select variables suitable for further analysis using cox regression. Variables that did not pass the proportionality test were subjected to the stratified cox regression procedure during the multivariate analysis. After passing the proportionality test the observed values of each covariate was expressed in percentages to allow for their comparison across the four surveys considered. Pearson chi-square test[3]was then used to determine whether the differences in successive years are statistically significant. Pearson chi-square test was preferred because the variables were categorical and independent in nature, and the sample sizes were sufficiently large in all cases (at least 5 in each level), See Table 6 & 11.

Univariate and Multivariate analysis was undertaken by fitting Cox models with different combinations of covariates. The normal cox regression was adopted for covariates that pass the proportionality test and the stratified Cox procedure was used for variables that failed the proportionality test. The log-rank test of equality was also used to determine which variables among those that passed the proportionality test will fit in the final model. Variables with P-values < 0.05 in the log-rank test were further analyzed using multiple cox regression. The above cut-off criteria were motivated by the fact that most of the covariates are considered relevant from previous studies.

3.5. Model Specifications

To evaluate the correlation between the dependent and independent variables, we first setup a crude model by fitting each shortlisted covariate into a univariate cox regression model to determine the main effect of each variable. Next we setup the adjusted model by fitting all variables that had passed the proportionality test, the long-rank test, and are statistical significant in the crude model. Next, we introduced interaction terms into the adjusted model to obtain the interaction model. Finally,

[3]tabi #11 #12 [...] \ #21 #22 [...] [\ ...], chi2

the likelihood-ratio test[4] was used to compare the adjusted model (model with interactions) with the adjusted model without interactions to select the better of the two models. The better of the tow model is subsequently referred to as the final model. The Cox-Snell residual was used to determine how well the final model fits the data by conditioning its true cumulative hazard function on the covariate vector and see if it generates an exponential distribution with a hazard rate of one. The above processes helped to estimate the hazard ratios of covariates in each of the four datasets and compare them.

3.6. Methodological Assumptions and Limitations

This study assumed that time invariant variables like cultural practices, climate changes and other geographical factors were consistent across the four surveys. Thus, any variations in the values and estimated coefficients in the covariates are attributed to actions implemented seven years prior to each survey. The selected population samples are assumed to be perfect national representations of the Cameroonian population. However, according to the Institut National de la Statistique (INS), as cited in DHS report of 2004, Cameroon has 230 ethnic groups which might not have been effectively considered.

We also assumed that retrospective reporting of events by respondents is accurate. However retrospective reporting might have made the results liable to all biases associated with it. For instance, some information about fertility and mortality might have been lost due to omissions or inaccurate reporting by the respondents or errors in data recording by the interviewees. Furthermore, obtaining information about surviving children from deceased mothers might produce inaccurate results. Besides, information about children that are missing or unlawfully adopted or trafficked might have led to underestimation of mortality estimates. Thus, our methodology is liable to biases that depends on the extended to which the experience of surviving and non-surviving mothers differ, the level of adult female mortality and the length of time for which mortality is estimated (Macleod,n.d.). However, to reduce biases, the estimates are constrained to the seven years that preceded each of the four DHS surveys to ensure a constant time effect.

[4] lrtest

Life table estimations assumes that the number of deaths in each age group does not vary substantially from one survey to another: There is no major mortality differential between sexes, no factors besides mortality operate to reduce the size of the starting cohort, the experience of children who died plus those censored are identical, and death/ censoring occur uniformly in the intervals considered.

3.7.Administration and Data Collection

Data was obtained free of charge upon request from the DHS program[5]after dully fulfilling the Step-by-step application requirements outline in their official website.

[5] http://www.measuredhs.com/data/Access-Instructions.cfm

CHAPTER 4: Findings

This chapter summarizes the results of data analyses conducted. It begins with a descriptive statistics of the dependent variables, followed by an outline of the results of univariate analysis. Next it presents proportionality test results (goodness of fit test results), followed by hypothesis tests results and concludes with regression analysis results.

Descriptive Statistics of Dependent Variables

Table 1: Life table, Demographic Health Survey, Cameroon, 1991(Survival)

Interval	Beg. Total	Deaths	Lost	Survival	Std. Error	[95% Conf.	Int.]
0	0	4712	170	29	0.9638	0.0027	0.9581	0.9688
1	1	4077	11	52	0.9412	0.0035	0.9340	0.9476
5	5	1441	0	52	0.8796	0.0053	0.8687	0.8896

Row 1 in Table 1 shows the first thirty days of the first age group (about 0.08333[6] of the first year). It shows that 4,712 children were born in the 7 years that preceded the 1991 DHS, 170 experienced deaths by the end of their 30th day and 29 where censored (lost); the 29 children were not fully exposed (or where exposed for just 15 days) to the risk of death since they were delivered within 30 days of the date of interview. Children who have not experienced death had 0.9638 survival rate. Thus the probability of a child dying between birth and exact age 1 month is 36.2[7] per 1000 live births which approximates to Neonatal Mortality Rate (NMR).

Row 2 indicates that 4077 children lived for up to 1 year, 11 of them experienced death before the end of the first year and 52 were censored, which gives a cumulative survival rate of 0.9412. Thus the probability of dying between birth and exact age 1year is 58.8[8] per 1000 live births, which approximates to infant mortality rates (IMR).

Row 3 shows that 1441 children lived up to their fifth year, with none experiencing death and 52 of them were lost, giving a cumulative survival rate of 0.8796. Thus the probability of dying

[6]The first year in the life table was converted into months by introducing int(0.08333) into life table command
[7]36.2 is the complement of the cumulative survival function at the end of the first 30 days(1- 0.9638) per 1000 live births)
[8] 58.8 is the complement of the cumulative survival function at the end of the first 1 year(1- 0.9412) per 1000 live births)

between birth and exact age 4 years is 120.4[9] per 1000 live births which approximate to under five mortality rate (U5MR). Post Neonatal Mortality is obtained by subtracting the value of neonatal mortality rate (NMR) from infant mortality (IMR), which gives 26.6 per 1000 live birth.

Table 2: Life table, Demographic Health Survey, Cameroon, 1998 (Survival)

Interval		Beg. Total	Deaths	Lost	Std. Survival	Error	[95% Conf.	Int.]
0	0	5662	206	37	0.9635	0.0025	0.9583	0.9681
1	1	4880	18	71	0.9380	0.0032	0.9314	0.9441
5	5	1767	0	64	0.8619	0.0052	0.8513	0.8717

Row 1 of Table 2 shows that 5662 children were born in the 7 years that preceded the 1998 survey, and 206 experienced death by the end of their first 30 days with 37 censored (lost). Children who did not experience death had 0.9635 survival chances giving a NMR of 36.5 per 1000 live births.

Row 2 of Table 2 shows that 4,880 children lived for up to one year; 18 of them died by the end of the year and 71 were not fully exposed to the risk of dying, giving a 0.9380 survival chance. This implies that IMR is 62 per 1000 live birth. Row 3 of Table 2 indicates that 1,767 children survived for up to 1 year, none of them experienced death and 64 were lost giving a cumulative survival rate of 0.8619, implying that U5MR is 138.1 per 1000 live births. And the corresponding NMR is 25.5 per 1000 live births.

Table 3: Life table, Demographic Health Survey, Cameroon, 2004 (Survival)

Interval		Beg. Total	Deaths	Lost	Std. Survival	Error	[95% Conf.	Int.]
0	0	11277	372	85	0.9669	0.0017	0.9634	0.9700
1	1	9690	49	122	0.9371	0.0023	0.9324	0.9415
5	5	3118	0	90	0.8588	0.0037	0.8513	0.8659

Row 1 of Table 3 indicates that 11,277 children were delivered during the 7 years that preceded the 2004 survey, and 372 died before the end of their 30thday with 85 of them censored giving a

[9] 120.4is the complement of the cumulative survival function at the end of the fourth year(1- 0.8796) per 1000 live births

survival rate of 0.9669, which corresponds to a NMR of 33.1 per 1000 live births. Row 2 of Table 3 indicates that 9,690 children survived for up to 1 year; 49 of them died before the end of the year and 112 were not fully exposed to the risk of dying, giving a 0.9371 survival rate, which corresponds to IMR of 62.9 per 1000 live births. Row 3 of Table 3 indicates that 3,118 children survived right up to 1 year, none experienced death, and 90 of them were not fully exposed to the risk of dying, thus giving 0.8588 survival rate, which correspond to U5MR of 141.2 per 1000 life birth. The corresponding PNMR for the 2004 dataset is 29.8 per 1000 live births.

Table 4: Life table, Demographic Health Survey, Cameroon, 2011(Survival)

Interval		Beg. Total	Deaths	Lost	Survival	Std. Error	[95% Conf.	Int.]
0	0	16167	515	118	0.9680	0.0014	0.9652	0.9706
1	1	14013	40	197	0.9486	0.0018	0.9450	0.9519
5	5	4700	0	143	0.8827	0.0029	0.8769	0.8882

Row1 of table 4 shows that 16167 children survived for up to 30 days of which 515 of them experienced death before the end of their 30thdays. And 118 children were censored during the same period of time given a 0.9680 survival rate, which corresponds to NMR of 32 per 1000 live birth. Row2 indicates that 14013 children lived for up to 1 year, 40 of them died and 197 were lost before the end of year 1. This gives 0.9486 cumulative survival rates, which correspond to an IMR of 51.4 per 1000 live births. According to Row 3, 4700 children survived up to the fifth year, and none of them died with 143 censored given 0.8827 survival rate which corresponds to U5MR of 117.3 per 1000 live births. The corresponding PNMR for the 2011 dataset is 19.4 per 1000 live births.

Table 5: Summary Of Childhood Mortality Indicators As Estimated Using Life Tables

	PNMR	NNMR	IMR	U5MR
1991	22.6	36.2	58.8	120.4
1998	25.5	36.5	62	138.1
2004	29.8	33.1	62.9	141.2
2011	19.4	32	51.4	117.2

Outline of Univariate Analysis

Table 6: Summary Description of Covariates Considered

Variables Considered (%)	**DHS 1991**	**DHS 1998**	**DHS 2004**	**DHS 2011**
PUBLIC HEALTH VARIABLES	**N_T=11,612**	**N_T=15,187**	**N_T=29,455**	**N_T=42,312**
Type of Personnel Providing Prenatal care (TPPPrNaC)	**n= 2,778**	**n= 1,890**	**n= 4,526**	**n=6,604**
Receive Prenatal care from doctor (RPrNaCFrDr)	10.87	14.87	11.42	17.69
Receive Prenatal care from nurse/midwife (RPrNaCFNoM)	78.55	77.14	76.36	67.91
Receive prenatal care from auxiliary midwife (PrNaAuMW))	9.58	7.04	11.73	14.14
Received prenatal care from trad.birth attendant (RPrNaCFTBA)	1.01	0.95	0.49	0.26
Type of Personnel Sough During Delivery (TPSDD)	**n= 2,623**	**n= 1,632**	**n=5,869**	**n= 8,659**
Women Delivered by medical Doctor (WDBMDrDD)	4.50	8.46	5.40	10.60
Women Delivered by Nurses/midwifes (WDBNMWDD)	73.69	73.71	70.35	62.14
Women Delivered by Auxiliary midwife (WDBAuMw)	9.30	7.54	10.56	14.34
Women delivered by Traditional birth attendant (WDBTBAT)	12.50	10.29	13.68	12.91
Mothers who had antenatal visits (MWHANV) Antenatal visits	**n=3,344** 79.46	**n= 2,296** 80.40	**n=5,308** 84.19	**n= 7,687** 86.94
Children who received adequate vaccination (ChWRAV)	n=3,350 34.63	n= 2,123 28.17	n= 7,281 38.40	n= 10,800 46.22
Type of Place consulted during episode of diarrhea (TOPCDEOD)	**n= 506**	**n= 390**	**n=1108**	**n= 2,188**
"Children With Episode of Diarrhea not consulted" (ChWEODNC)	63.44	62.56	58.57	38.80
Children With Episode of Diarrhea consulted in other private sector ChWEODCIOPS	15.81	5.64	17.96	28.63
Children With Episode of Diarrhea consulted in medical private sector facility" (ChWEODCIMPrS)	5.14	11.54	8.48	8.89
Children With Episode of Diarrhea consulted in medical public sector facility" (ChWEODCIMPuS	15.61	20.26	14.98	23.68
Type of treatment administered for diarrhea (TOTAFD)	**n= 506**	**n=390**	**n= 1,110**	**n= 2,026**
Medical treatment was administered for diarrhea(MTAFD)	85.97	88.72	67.75	71.92
Type of place consulted for fever/cough(TOPCDEOFC)	**n= 1,182**	**n= 850**	**n=2,900**	**n= 4,609**
Children With Episode of fever/cough not consulted (ChWEOFCNC)	48.22	51.18	37.45	43.33
Children With Episode of fever/cough consulted in other private sector ChWEOFCCIOPS	12.35	14.00	19.28	22.82
Children With Episode of fever/cough consulted in medical private sector (ChWEOFCCIMPrS)	13.71	14.00	17.69	15.47
Children With Episode of fever/cough consulted in medical public sector (ChWEOFCCIMPuS	25.72	20.82	25.59	18.38

ENVIRONMENTAL VARIABLES				
Access to drinking water (SOHhDW)	**n= 11,582**	**n= 14,482**	**n= 28,112**	**n= 40,961**
Use Piped Borne water supply (UPipeBWS)	43.27	39.22	32.08	32.42
Use Well Water supply (UWWS)	22.66	26.67	34.07	37.62
Use Surface water supply (USWS)	31.98	32.84	32.92	28.55
Use Bottle Water supply (UBW)	1.65	1.21	-	0.20
Use Other sources of Water supply (UOSWS)	0.44	0.06	0.93	1.22
Type of toilet facilities(TOHhTF)	**n= 11,599**	**n= 14,491**	**n=28,107**	**n= 40,910**
Use Flush Toilet (UFlushT)	7.72	7.57	5.57	7.14
Use Pit Toilet (UPT)	81.21	83.85	86.52	85.02
Inadequate Toilet Facilities (UInATF)	11.07	8.58	7.91	7.83
MATHERNAL AND DEMOGRAPHIC VARIABLES				
Mothers' age at first birth (MAAFB)	**n= 11,612**	**n= 15,187**	**n= 29,455**	**N = 42,127**
Mothers age (9-14) years (PrematureMothers)	15.08	10.51	12.23	12.67
Mothers aged (15-25) years (Youngmothers)	82.77	86.74	85.36	83.46
Middle age mothers(26-30) years (MidMothers)	1.91	2.38	2.09	3.36
Late mothers (31-39) years (LateMothers)	0.24	0.37	0.32	0.52
Number of births in the last five years(MNOBIL5Ys)	**n= 11,612**	**n= 15,187**	**n=29,455**	**N = 42,109**
No births in last 5 years (No_births)	26.77	33.57	32.09	33.76
At most two births (Max2_births)	63.78	59.92	61.13	59.11
Three to four births (3-4_births)	9.45	6.51	6.78	7.14
Mother's Current Age (MCA)	**n= 11,612**	**n=15,187**	**n=29,455**	**n=42,126**
Teenage Mothers	2.92	2.43	2.60	2.41
Mothers_ in_ their 20s	28.46	25.36	26.49	26.76
Mothers in their_ Mid-30s	26.96	24.97	23.13	22.44
Mothers Above 35 years	41.66	47.24	47.77	48.39
Duration of breastfeeding (DOBF)	**n= 2,227**	**n= 1,122**	**n= 5,645**	**n= 8,147**
Never Breastfed Baby (NBFB)	5.39	8.20	10.42	7.40
Breastfed Baby For up to Six Month (BFBF6M)	7.90	8.82	5.93	6.20
Breastfed child for above six months (BChFM6M)	86.71	82.98	83.65	86.40
Type of Birth(TOB)	**n= 3,349**	**n=2,299**	**n= 8,125**	**n= 11,671**
Normal birth	82.74	81.91	80.98	79.42
Preceding birth interval (precd_birth_intls)	**n=8,746**	**n = 11,291**	**n=21,806**	**n= 31,008**
Proceeding Birth interval (0-12) months (Predbirth0:12ms)	4.52	3.50	3.40	3.91
Proceeding Birth interval (13-24) months (Predbirth13:24ms)	32.07	30.95	29.96	28.37
Proceeding Birth interval(25 to 328) months (Predbirth25:328ms)	63.41	65.56	66.63	67.72
Sex of Child (SoCh)	**n=11,612**	**n= 15,187**	**n=29,455**	**n=42,107**
Female	49.23	49.82	49.54	49.33
Male	50.77	50.18	50.46	50.67
Mothers Who Received Tetanus inject before birth (MWRTIBB)	**n=3,349**	**n= 2,300**	**n= 5,313**	**n= 7,618**

	72.95	71.83	73.42	79.97
SOCIO-ECONOMIC VARIABLES				
Mother's current marital Status (MCMS)	**n= 11,612**	**n= 15,187**	**n=29,455**	**n= 42,106**
Never Married Mother (NMM)	2.66	3.36	2.00	3.77
Married And Once Married Mother (MAOMM)	94.59	91.82	93.13	92.06
Mother Currently Living Alone (MCLA)	2.75	4.82	4.87	4.17
Place of deliver (POD)	**n=3,349**	**n= 2,296**	**n=8,091**	**n= 11,562**
Delivered At Home(DAH)	30.19	39.59	39.92	36.53
Delivered In A Hospital(DIH)	68.80	59.71	59.43	62.74
Delivered Neither At Home Nor Hospital(DNAHNH)	1.02	0.70	0.65	0.73
mother's level of education(MLOE)	**n= 11,612**	**n= 15,187**	**n= 29,455**	**n= 42,110**
No Education (NEdu)	46.72	36.14	30.51	29.65
Primary Education (PEdu)	34.89	39.90	44.89	42.96
Secondary And Higher Levels Of Education (SAHEdu)	18.39	23.96	24.60	27.39
Type Of Place Of Residence(TOPOR)	**n= 11,612**	**n= 15,187**	**n= 9,455**	**n= 42,110**
Urban	49.35	41.06	39.40	39.72
Partner With Source of Income (PWSOI)	**n= 11,612**	**n=15,187**	**n=29,455**	**n=42,112**
Has source of income	52.26	77.83	74.24	76.32
Partner's Level of education (PLOE)	**n= 11,612**	**n= 14,549**	**n=27,298**	**n=40,219**
Partners Without Education (No_education)	45.90	36.01	27.85	27.91
Partners With Primary Education (PWP_Education)	28.74	32.63	36.06	34.97
Partners With Secondary & Higher Education (PWSAH_Education)	25.36	31.36	36.09	37.12
Mother's religion (MReligion)	**n= 11,612**	**n= 15,182**	**n= 29,424**	**n= 41,964**
Catholics And Protestants (Christians)	68.08	69.40	69.26	69.86
Muslim Religion (Muslims)	19.45	21.54	20.42	23.11
Other Religions (Religion)	12.47	9.06	10.32	7.03
Househod_income_level (wealth score)	**n= 11,574**	**n= 14,368**	**n=27,979**	**n=40,393**
First Two Quartiles (Poor_Income_Home)	36.25	37.07	42.84	45.03
Third Quintile (Average_Income_Home)	17.98	17.86	23.15	22.13
Last Two Quintiles (Above_Average_Income)	45.78	45.07	34.00	32.83
Mother's Access To Mass Media (MATMM)	**n= 11,612** 16.75	**n= 14,842** 22.96	**n=29,455** 18.03	**n= 42,146** 22.20
Children living with Their Mothers (ChLWTMs)	**n= 8,439** 87.50	**n= 12,840** 73.36	**n=24,988** 69.82	**n= 36,288** 70.52

Note.N_T represents the total number of observations made in each of the four DHS datasets considered. The total number of cases considered for each variable is represented by n. Each variable is fully described with its acronyms enclosed in parenthesis. The numeric values indicate the percentage of respondents having a certain characteristics, experience or belonging to a given level of analysis.

As can be inferred from table 6 and 11, the results of the univariate analysis are against the claim that the health status of the Cameroonian population has not experienced any significant improvement across the four surveys. In the case of Type of Personnel Provided Prenatal Care to mothers (TPPPrNaC), we observed different trends for the four categories considered. For medical

doctors (RPrNaCFrDr), we noted an increasing trend on average, 10.87 in 1991, 14.87 in 1998, 11.42 in 2004 and 17.69 in 2011. Besides, we found that changes between all successive surveys were statistically significant. For Prenatal nurse/midwife (RPrNaCFNoM), the trend decreased across the four surveys, 78.55 for 1991, 77.14 for 1998, 76.36 for 2004 and 67.91 for 2011. In addition, changes between successive surveys were all significant. For auxiliary midwifes, on average, the pattern increased from, 9.58 in 1991, 7.04 in 1998, 11.73 in 2004 and 14.14 in 2011. The changes between all successive surveys were found to be significant. Finally, the trend in traditional practitioners (RPrNaCFTBA) decreased; 1.01 in 1991, 0.95 in 1998, 0.49 in 2004 and 0.26 in 2011. However only the change between 1998 and 2004 was found to be statistically significant.

Regarding the type of personnel sought during delivery (TPSDD), the trend was inconsistent in in the four categories and across the four surveys. For medical doctors (RAFMDrDD), the trend was found to generally increase; 4.50 % in 1991, 8.46 in 1998, 5.40% in 2004 and 10.60% in the 2011 dataset. Moreover, changes between successive surveys were found to be significant in this category.

For nurses/midwifes (RAFNMWDD), the trend was relatively stable in the first two surveys and progressively dropped subsequently; 73.69 in 1991, 73.71 in 1998, 70.35 in 2004 and 62.14 in 2011. Nevertheless, the changes between successive surveys for this category were found to be significant across all the surveys except for the change between 1998 and 2004.

For auxiliary midwifes (WDBAuMw), the trend increased on average; 9.30 in1991, 7.54 in 1998, 10.56 in 2004 and 14.34 in 2011, and changes between all successive surveys were significant. Finally for traditional practitioners(WDBTBAT), the trend fluctuated; 12.50 in 1991, 10.29 in 1998, 13.68 in 2004 and 12.91 in 2011, and only the change between 2004 and 2011 was insignificant.

Concerning the number of women who had adequate antenatal visits (MWHANV) during pregnancy, we noted the following increasing trend; 79.46 in 1991, 80.40 in 1998, 84.19 in 2004 and 86.94 in the 2011 dataset. All successive changes were significant except between 1991 and 1998.

Regarding the number of children who received adequate vaccination after births (ChWRAV), we noted that the trend decreased in the first two surveys before subsequently increasing; 34.63% in 1991, 28.17 in 1998, 38.40 in 2004 and 46.22 in 2011 dataset. All changes between successive surveys were significant.

Type of places consulted by children during episodes of diarrhea (TOPCDEOD), showed different trends across the different categories examined. For children who did not consult (ChWEODNC), the trend progressively decreased across the four surveys; 63.44 in 1991, 62.56 in 1998, 58.57 in 2004, and 38.80 in 2011. Nevertheless, the changes between all successive surveys were statistically insignificant except for the change between the 2004 and 2011. For children consulted in other private sectors (ChWEODCIOPS), the trend increased on average; 15.81% in 1991, 5.64 in 1998, 17.96 in 2004 and 28.63 in 2011, and successive increments between surveys were significant. The number of Children who consulted the medical private sector (ChWEODCIMPrS) increased as follows; 5.14 in 1991, 11.54 in 1998, 8.48 in 2004 and 8.89 in 2011. Except for the change between 2004 and 2011, all changes between successive surveys were statistically significant. Finally children who consulted medical public institutions (ChWEODCIMPuS) had an undulating trend; 15.61 in 1991, 20.26 in 1998, and 14.98 in 2004 and 23.68% in 2011.Nonetheless, the difference between all successive surveys were statistically significant except the change between 1991 and 1998.

Regarding medically treated children (MTAFD), the trend increased between the first two surveys and dropped subsequently from; 85.97 in 1991, 88.72 in 1998, and 67.75 in 2004 and 71.92% in 2011. However, with the exception of the change between 1991 and 1998, all other successive changes were statistically significant.

Concerning the type of places consulted by children during episodes of fever/cough (TOPCDEOFC), we noted an inconsistent trend across the four categories. For children who never consulted any facility (ChWEOFCNC), we found an undulating trend across the four surveys; 48.22% in 1991, 51.18% in 1998, 37.45% in 2004 and 43.33% in 2011. Notwithstanding, all successive

changes were significant. In the case of ChWEOFCCIOPS, trend was found to be increasing; 12.35% in 1991, 14.00% in 1998, 19.28% in 2004 and 22.82 in 2011. For this category, all the increments except between 1991 and 1998 were significant. For children consulted in medical private sector (ChWEOFCCIMPrS), the trend increased steadily from; 13.71% in 1991, 14.00% in 1998, 17.69% in 2004 and15.47 in 2011.With the exception of the change between 1991 and 1998 all other subsequent changes were significant. Finally children consulted in a medical public sector (ChWEOFCCIMPuS), had an undulating trend across the four surveys; 25.72% in 1991, 20.82% in 1998, 25.59% in 2004, 18.38% in 2011, with significant changes between successive surveys in all cases except for the 1991 and 1998 surveys.

The sources of household drinking water (SOHhDW), showed different trends across the different categories considered. Households that used pipe borne water (UPipeBWS) showed a decreasing trend; from 43.27% in 1991 to 39.22% in 1998, 32.08% in 2004 to 32.42% in 2011. All successive changes were significant except between 2004 and 2011. Households that used well water supplies (UWWS) showed an increasing trend; 22.66% in 1991, 26.67% in 1998, 34.07 in 2004 and 37.62% in 2011. All successive differences were statistically significant except between 2004 and 2011. Households that used surface water (USWS) showed an initial increase which later dropped from 31.98% in 1991 to 32.84% in 1998, and 32.92% in 2004 to 28.55% in 2011.Only the change between 2004 and 2011 was significant. Households that used bottled water (UBW) have a decreasing trend; 1.65 in 1991 to 1.21 in 1998, and 0.20 for 2011, and all successive changes were significant. Finally households that used other sources of water (UOSWS), had an alternating trend pattern. The trend initially decreased before subsequently increasing from; 0.44 in 1991to 0.06 in 1998, 0.93 in 2004 to 1.22 in 2011, besides all successive changes were significant.

The trend of the type of household toilet facilities (TOHhTF) fluctuates across the four categories considered. Households that used flush toilets (UFlushT) decreased trend; 7.72 in 1991 to 7.57 in 1998, 5.57% in 2004 to 7.14% in 2011. All changes between successive surveys were statistically significant except between 1991 and 1998. For households that use pit toilet facilities

(UPT), we noted an increasing trend; 81.21% in 1991 to 83.85% in 1998, 86.52% in 2004 to 85.02% in 2011.All successive changes are statistically significant. Finally households that used inadequate toilet facilities (UInATF), showed a decreasing trend; 11.07% in 1991 to 8.58% in 1998, and 7.91% in 2004 to 7.83% in 2011. All successive changes were statistically significant except the change between the 2004 and 2011.

Considering mothers' age at first birth (MAAFB), we found a non-consistent trend in the different age groups across the four surveys. For premature mothers, we noted an initial drop followed by a slight upward trend; from 15.08 in 1991 to 10.51 in 1998, and 12.23 in 2004 to 12.67 in 2011. Besides, all successive changes were significant except between the 2004 and 2011. For young mothers, we noted an undulating trend across the surveys; from 82.77 in 1991 to 86.74 in 1998, and 85.36 in 1998 to 2004 and 83.46 in 2011. All the changes between successive surveys were found to be significant. For middle age mothers, the trend increased with the following pattern; 1.91 for 1991 to 2.38 in 1998, 2.09 in 2004 and 3.36 in 2011. Nonetheless all successive changes in these categories were found to be significant. Finally, with respect to late mothers, the trend increased; 0.24 in 1991 to 0.37 in 1998, and 0.32 in 2004 to 0.52 in 2011, and only the change between the 2004 and 2011 are found to be significant.

Mothers' number of birth in the last five years (MNOBIL5Ys), exhibits different patterns in the four categories considered. For mothers with no births, we noted an increasing trend; from 26.77 in 1991 to 33.57 in 1998, and 32.09 in 2004 to 33.76 in 2011. Besides, all changes between successive surveys were found to be statistically significant. For mothers with at most two births, the trend alternated across the four surveys; from 63.78 in 1991 to 59.92 in 1998, and 61.13 in 2004 to 59.11 in 2011. Also, all successive changes between surveys were significant. Finally for mothers with three to four births, the trend was found to be decreasing ; from 9.45 in 1991 to 6.51 in 1998, and 6.78 in 2004 to 7.14 in 2011. In addition only the change between 1991 and 1998 was found to be statistically significant.

Concerning mothers of different current age groups (MCA), we noticed an inconsistent pattern across the four categories considered. For teenage mothers, the trend undulated ; from 2.92 in 1991 to 2.43 in 1998, and 2.60 in 2004 to 2.41 in 2011. In addition, only the change between 1991 and 1998 was significant. For mothers in their 20s we noted the following trend; from 28.46 in 1991 to 25.36 in 1998, and 26.49 in 2004 to 26.76 in 2011. Only the change between 1991 and 1998 was found to significant. For mothers in their mid-30s; the trend decreased across the four surveys, and all successive changes were significant. Finally, for mothers above 35 years, the trend was increasing; from 41.66 in 1991 to 47.24 in 1998, and 47.77 in 2004 to 48.39 in 2011, only the change between 2004 and 2011was significant.

Regarding the duration of mothers' breastfeeding period (DOBF), we note an inconsistent trend across the three categories considered. The trend increased for women who never breastfed (NBFB) from 5.39 in 1991 to 8.20 in 1998, and 10.42 in 2004 to 7.40 in 2004 dataset. Besides, all successive changes between surveys were statistically significant. Women who breastfed for up to six months (BFBF6M), showed an undulating trend across the four surveys; from 7.90 in 1991 to 8.82 in 1998, 5.93 in 2004 to 6.20 in 2011. And only the change between 1998 and 2004 was significant. Mothers who breastfed for above six months (BChFM6M), shows an inconsistent trend; 86.71 in 1991, 82.98 in 1998, 83.65 in 2004, and 86.40 in 2011. All successive changes were significant except between 1998 and 2004.

Regarding the type of birth (TOB), we note a slightly decreasing trend across the four surveys; 82.74 in 2004, 81.91 in 1998, 80.98 in 2004 and 79.42 in 2011, and only the decrease between 2004 and 2011 was found to be statistically significant.

Regards mothers' preceding birth intervals (precd_birth_intls), the trend decreased in the first two categories but subsequently increased. For mothers with 0-12 month interval, the trend followed the following pattern; 4.52 in 1991 to 3.50 in 1998, to 3.40 in 2004, and 3.91 in 2011. Only the decrease between 1998 and 2004 was insignificant. For mothers in the 13-24 months interval, the

pattern reduced across the four surveys; 32.07 in 1991, 30.95 in 1998, 29.96 in 2004 and 28.37 in 2011. Only the change between the 2004 and 2011 was significant. Finally for mothers with 25-328 month intervals, we noted the following increasing trend; 63.41 in 1991, 65.56 in 1998, 66.63 in 2004, and 67.72 in 2011. Moreover, the increments between successive surveys were significant except between 1998 and 2004 surveys.

The sex of children (SoCh) displayed a fairly stable trend among male and female children. In the female sex, we noted the following pattern; 49.23 in 1991, 49.82 in 1998, 49.54 in 2004 and 49.33 for 2011. Only the change between 2004 and 2011 was statistically significant.

Mothers' vaccination status, is found to have an increasing trend; for mothers' who had received adequate tetanus injections before birth (MWRTIBB) the trend increased with the following pattern; 72.95 in 1991, 71.83 in 1998, 73.42 in 2001 and 79.97in 2011. Nevertheless only the increment between 2004 and 2011 is significant.

With respect to mothers' current marital status (MCMS), we noted an inconsistent trend amongst the three sub-categories considered. For never married women (NMM), we noted an undulating trend of; 2.66 in 1991, 3.36 in 1998, 2.00 in 2004, and 3.77 in 2011. In addition, all successive changes between surveys were significant. For married and once married women (MAOMM), we also noted the following alternating trend; 94.59 in 1991, 91.82 in 1998, 93.13 in 2004, and 92.06 for 2011. And changes between all successive surveys were significant. Finally, the trend for mothers currently living alone (MCLA) increased; from 2.75 in 1991 to 4.82 in 1998, and from 4.87 in 2004 to 4.17 in 2011. For this category, all successive changes were significant except between 1998 and 2004.

Mothers' place of delivery (POD) displays inconsistent pattern across the four categories studied. For women who delivered at home (DAH), we noted an increasing trend; 30.19 in 1991, 39.59 in 1998; 39.92 in 2004 and 36.53 in 2011. All successive changes were significant except between 1998 and 2004. Regarding women who delivered in hospital (DIH), the trend decreased as from; 68.80

in 1991, 59.71 in 1998, 59.43 in 2004 and 62.74 in 2011. Successive changes were significant except between 1998 and 2004. Lastly, for mothers who neither delivered at home nor in a hospital (DNAHNH), the trend decreased as from; 1.02 in 1991, 0.70 in 1998, 0.65 in 2004 and 0.73 in the 2011, and all changes were insignificant.

Considering mothers' level of education (MLOE), besides mothers' with no education (NEdu), which showed a decreasing trend, the other categories displayed an increasing trend. Women with no education decreased as follow; 46.72 in 1991, 36.14 in 1998, 30.51 in 2004, and 29.65 in 2011. All successive changes were significant. Mothers' with primary education(PEdu) showed an increasing trend; 34.89 in 1991, 39.90 in 1998, 44.89 in 2004 and 42.96 in 2011, successive changes between surveys were statistically significant. Finally, for mothers with Secondary or Higher Levels of Education (SAHEdu) we note an increasing trend; 18.39 in 1991, 23.96 in 1998, 24.60 in 2004 and 27.39 in 2011. All changes between surveys were significant except between1998 and 2004.

Children's type of place of residence, displayed a slightly decreasing trend across the four surveys with the following pattern for those in urban areas; 49.35 in 1991, 41.06 in 1998, 39.40 in 2004 and 39.71 in 2011. In addition, changes in all successive surveys were statistically significant.

Partners' source of income (PWSOI) is found to have an increasing trend across all the four survey. For partners with a source of income we noted an increasing trend; 52.26 in 1991, 77.83 in 1998, 74.24 in 2004, and 76.32 for the 2011 dataset. And all successive changes between surveys were statistically significant.

Regarding partners' level of education (PLOE), we generally observed an increasing trend in all the categories except for partners' with no level of education. Fathers with no level of education showed the following increasing trend; 45.90 in 1991, 36.01 in 1998, 27.85 in 2004 and 27.91 in 2011. In addition all successive increments were significant. For partners' with only primary education the trend decreased thus; 28.74 in 1991, 32.63 in 1998, 36.06 in 2004, and 34.97 in 2011. And all successive increments were significant. Finally, partners with secondary or higher levels of education

showed an increasing pattern; 25.36 in 1991, 31.36 in 1998, 36.09 in 2004, and 37.12 in 2011. All successive increments were found to be statistically significant.

Mothers' religious affiliation portrayed different trends across the four subcategories considered. For Christian mothers, the trend was almost stable; 68.08 in 1991, 69.40 in 1998, 69.26 in 2004 and 69.86 in 2011, and only the change between 1991 and 1998 was significant. For Muslim mothers, the trend undulated across the four surveys; 19.45 in 1991, 21.54 in 1998, 20.42 in 2004 and 23.11 in 2011, and all changes between successive surveys were significant. Finally, mothers affiliated to other religions also showed an alternating trend; 12.47 in 1991, 9.06 in 1998, 10.32 in 2004, and 7.03 in 2011, with all successive changes being significant.

Household income level showed an increasing trend in all the three categories except for the above average income level. Poor income homes displayed an increasing trend; 36.25 in 1991, 37.07 in 1998, 42.84 in 2004 and 45.03 in 2011, and all successive increments were significant except between 1991 and 1998. The average income homes showed an alternating trend; 17.98 in 1991, 17.86 in 1998, 23.15 in 2004 and 22.13 in 2011. Except the changes between 1991 and 1998, all other successive changes were significant. Finally average income homes showed a decreasing pattern; 45.78 in 1991, 45.07 in 2004, 34.00 in 2004, and 32.83 in 2011, with all successive changes were significant except for the first two successive surveys.

Mothers' access to mass media (MATMM), displayed an increasing trend; 16.75 in 1991, 22.96 in 1998, 18.03 in 2004, and 22.20 in 2011, in all cases changes between successive surveys were significant.

Children living with their mothers (WChLW) display a decreasing trend; 87.50 in 1991, 73.36 in 1998, 69.82 in 2004 and 70.52 in 2011, and all the successive changes were significant.

Results of Assumptions Test Conducted

Although the Kaplan–Meier curve (KM) and goodness-of-fit (GOF) tests were both used to check the proportionality assumption, only the results of the GOF test are reported in table7.

Table 7: Results of the Proportional-Hazards Assumption Test for the 1991 dataset

	rho	chi2	df	Prob>chi2
TPPPrNaC	0.03282	0.16	1	0.6861
TPSDD	0.04249	0.26	1	0.6087
MWHANV	-0.12190	1.10	1	0.2951
ChWRAV	-0.00504	0.00	1	0.9547
TOPCDEOD	-0.05557	0.39	1	0.5307
TOTAFD	-0.06294	0.33	1	0.5661
TOPCDEOFC	-0.19094*	5.60	1	0.0179
SOHhDW	0.14984	2.93	1	0.0869
TOHhTF	0.08497	1.10	1	0.2932
MAAFB	-0.04090	0.15	1	0.7004
NOBITL5Ys	0.02882	0.07	1	0.7932
MCA	-0.22629*	4.92	1	0.0265
DOBF	-0.00106	0.00	1	0.9894
TOB	-0.01161	0.02	1	0.9024
precd_birt~s	0.03581	0.18	1	0.6747
SoCh	0.09123	0.80	1	0.3710
MWRTIBB	-0.04266	0.13	1	0.7201
MCMS	-0.04800	0.26	1	0.6128
POD	0.07503	0.48	1	0.4865
MLOE	-0.03586	0.15	1	0.6949
TOPOR	-0.24605*	6.45	1	0.0111
PWSOI	-0.17850	4.34	1	0.0371
PLOE	-0.03757	0.14	1	0.7044
MReligion	-0.11939	1.52	1	0.2173
MROR	0.00695	0.01	1	0.9276
wealthindex	-0.11815	1.58	1	0.2081
MATMM	0.19206	5.46	1	0.0194
WChLW	0.03830	0.17	1	0.6843
Global test		29.18	28	0.4033

The test results shows that TOPCDEOFC, MCA, TOPOR, PWSOI and MATMM are significant Hence violating the PH assumptions. The rest of 23 covariates pass the test.

Table 8: Results of the Proportional-Hazards Assumption Test for the 1998 Dataset

	rho	chi2	df	Prob>chi2
TPPPrNaC	0.03811	0.28	1	0.5991
TPSDD	0.00609	0.01	1	0.9348
MWHANV	-0.15916	3.96	1	0.0467
ChWRAV	0.04045	0.30	1	0.5817
TOPCDEOFC	0.10343	2.03	1	0.1544
SOHhDW	0.08202	1.21	1	0.2710
TOHhTF	0.02372	0.12	1	0.7308
MAAFB	0.02497	0.13	1	0.7186
NOBITL5Ys	-0.04228	0.29	1	0.5929
MCA	0.09788	1.80	1	0.1793
TOB	0.03402	0.23	1	0.6280
DOBF	0.06193	0.69	1	0.4050
precd_birt~s	-0.09183	1.35	1	0.2460
SoCh	0.02093	0.09	1	0.7669
MWRTIBB	-0.12930	2.78	1	0.0955
MCMS	0.06083	0.60	1	0.4401
POD	0.05824	0.62	1	0.4294
MLOE	-0.00921	0.02	1	0.8989
TOPOR	-0.15038	3.33	1	0.0682
PWSOI	0.04867	0.41	1	0.5223
PLOE	-0.18132	6.39	1	0.0115
MReligion	0.06572	0.70	1	0.4019
MATMM	-0.01803	0.06	1	0.8138
WChLW	-0.06000	0.55	1	0.4565
MROR	0.08857	1.39	1	0.2388
Wealthindex	-0.04904	0.38	1	0.5382
Global test		32.68	26	0.1717

*Note.**P < .05, **P < .01, and ***P < .0001. The test results shows that TOTAFD and TOPCDEOD are omitted and PLOE is significant implying that PLOE violets the PH assumptions.
The remaining 24 out of the 28 variables pass the ph assumptions.

Table 9: Results of the Proportional-Hazards Assumption Test for the 2004Dataset

	rho	chi2	df	Prob>chi2
TPPPrNaC	-0.07495	1.00	1	0.3177
TPSDD	-0.04317	0.31	1	0.5794
MWHANV	-0.04156	0.21	1	0.6448
ChWRAV	0.12183	2.31	1	0.1284
TOPCDEOD	-0.16123	5.37	1	0.0204
TOTAFD	0.10911	2.35	1	0.1253
TOPCDEOFC	0.04461	0.36	1	0.5475
SOHhDW	0.07181	0.79	1	0.3744
TOHhTF	-0.09943	1.86	1	0.1731
MAAFB	0.10106	1.59	1	0.2075
NOBITL5Ys	-0.00039	0.00	1	0.9962
MCA	0.03007	0.15	1	0.7006
DOBF	0.03441	0.25	1	0.6167
TOB	0.00909	0.01	1	0.9149
precd_birt~s	-0.06481	0.68	1	0.4080
SoCh	-0.00767	0.01	1	0.9196
MWRTIBB	0.12263	2.15	1	0.1421
MCMS	0.12676	2.97	1	0.0849
POD	-0.04828	0.33	1	0.5645
MLOE	-0.10833	1.84	1	0.1746
TOPOR	-0.03909	0.25	1	0.6179
PWSOI	0.14016	3.77	1	0.0521
PLOE	-0.08887	1.21	1	0.2714
MReligion	0.07226	0.92	1	0.3385
MROR	0.06464	0.71	1	0.4008
MATMM	0.12856	2.87	1	0.0902
WChLW	-0.19800	4.72	1	0.0298
Wealthindex	-0.08491	1.17	1	0.2801
Global test		31.43	28	0.2982

*Note. *P < .05, **P < .01, and ***P < .0001. The test results show that TOPCDEOD and WChLW is Significant indicating that they violet the PH assumptions. The remaining 26 out of the 28 variables considered do not suggest any violation of the ph assumptions.*

Table 10: Results of the Proportional-Hazards Assumption Test for the 2011Dataset

	rho	chi2	df	Prob>chi2
TPPPrNaC	0.02446	0.16	1	0.6850
TPSDD	0.02045	0.13	1	0.7176
MWHANV	-0.13993*	4.63	1	0.0313
ChWRAV	0.07508	1.46	1	0.2274
TOPCDEOD	-0.04713	0.63	1	0.4267
TOTAFD	0.01147	0.03	1	0.8521
TOPCDEOFC	-0.04500	0.58	1	0.4447
SOHhDW	-0.09059	2.48	1	0.1151
TOHhTF	-0.16026*	6.10	1	0.0136
MAAFB	-0.11575	2.72	1	0.0989
NOBITL5Ys	0.02450	0.18	1	0.6677
MCA	-0.03991	0.45	1	0.5003
DOBF	0.13648*	5.49	1	0.0191
TOB	-0.01975	0.11	1	0.7380
precd_birt~s	-0.02401	0.16	1	0.6849
SoCh	-0.00391	0.00	1	0.9486
MWRTIBB	-0.00037	0.00	1	0.9948
MCMS	-0.17958***	11.86	1	0.0006
POD	0.01110	0.04	1	0.8439
MLOE	0.01773	0.09	1	0.7588
TOPOR	0.11904	3.79	1	0.0516
PWSOI	0.09744	2.86	1	0.0909
PLOE	0.04071	0.53	1	0.4655
MReligion	0.03413	0.34	1	0.5589
MROR	-0.18885**	10.31	1	0.0013
MATMM	-0.04851	0.66	1	0.4162
WChLW	-0.00609	0.01	1	0.9087
wealth_index	-0.03267	0.28	1	0.5975
global test		52.70	28	0.0032

*Note. *P < .05, **P < .01, and ***P < .0001. The test results shows that TOHhTF, DOBF, MCMS, TOPOR PWSOI and MROR is significant indicating that they violet the PH assumptions. The rest(22 out of the 28) Variables considered do not suggest any violation of the ph assumptions.*

Results of Hypotheses Tests

Table 11shows the results of Pearson chi2 (1) test which sought to determine whether the change in the covariates between successive surveys is statistically significant at an alpha level of 0.05. As can be inferred from the Table, only the-values for one degree of freedom have been reported in the table. All results with P-values < 0.05 are accepted, implying the difference between successive years is statistically significant otherwise, the difference is not considered to be significant.

Table 11: Results of the hypothesis test (association between variables in successive years)

	Δ1991/1998	**Δ1998/2004**	**Δ2004/2011**
Covariates	**P-value**	**P-value**	**P-value**
RPrNaCFrDr	0.038	0.000	0.000
RPrNaCFNoM	0.028	0.000	0.000
RPrNaCFAMW	0.002	0.000	0.000
RPrNaCFTBA	0.828	0.041	0.053
RAFMDrDD	0.006	0.000	0.000
RAFNMWDD	0.000	0.510	0.000
RAFAuMWDD	0.000	0.004	0.000
TADel	0.001	0.000	0.532
MWHANV	0.385	0.000	0.000
ChWRAV	0.000	0.000	0.000
ChWEODNC	0.788	0.167	0.000
ChWEODCIOPS	0.000	0.000	0.000
ChWEODCIMPrS	0.000	0.044	0.153
ChWEODCIMPuS	0.071	0.015	0.000
TOTAFD	0.222	0.000	0.014
ChWEOFCNC	0.000	0.000	0.000
ChWEOFCCIOPrS	0.436	0.000	0.000
ChWEOFCCIMPrS	0.806	0.024	0.014
ChWEOFCCIMPuS	0.010	0.004	0.000
SOHhDW1	0.000	0.000	0.340
SOHhDW2	0.000	0.000	0.000
SOHhDW3	0.141	0.858	0.000
SOHhDW4	0.003	0.007	0.000
SOHhDW5	0.000	0.000	-
TOHhTF1	0.659	0.000	0.000
TOHhTF2	0.000	0.000	0.000
TOHhTF3	0.000	0.017	0.543
MAAFB1	0.000	0.000	0.080
MAAFB2	0.000	0.000	0.000
MAAFB3	0.009	0.046	0.000
MAAFB4	0.064	0.426	0.000

NOBITL5Ys1	0.000	0.002	0.000
NOBITL5Ys2	0.000	0.000	0.000
NOBITL5Ys3	0.000	0.111	0.063
MCA1	0.013	0.285	0.122
MCA2	0.000	0.010	0.429
MCA3	0.000	0.000	0.030
MCA4	0.000	0.288	0.107
DOBF1	0.002	0.024	0.000
DOBF2	0.360	0.000	0.524
DOBF3	0.004	0.579	0.000
TOB	0.409	0.333	0.006
precd_birth_intls1	0.000	0.651	0.002
precd_birth_intls2	0.088	0.066	0.000
precd_birth_intls3	0.002	0.050	0.009
SoCh	0.342	0.581	0.003
MWRTIBB	0.354	0.151	0.000
MCMS1	0.001	0.000	0.000
MCMS2	0.000	0.000	0.000
MCMS3	0.000	0.809	0.000
POD1	0.000	0.779	0.000
POD2	0.000	0.807	0.000
POD3	0.210	0.827	0.553
MLOE1	0.000	0.000	0.013
MLOE2	0.000	0.000	0.000
MLOE3	0.000	0.136	0.000
TOPOR	0.000	0.000	0.000
PWSOI	0.000	0.000	0.000
PLOE1	0.000	0.000	0.869
PLOE2	0.000	0.000	0.004
PLOE3	0.000	0.000	0.006
MReligion1	0.000	0.753	0.084
MReligion2	0.000	0.006	0.000
MReligion3	0.000	0.000	0.000
househod_income_level1	0.144	0.000	0.001
househod_income_level2	0.789	0.000	0.001
househod_income_level3	0.227	0.000	0.000
MATMM	0.000	0.000	0.000
WChLW	0.000	0.000	0.060

Results of Correlation Analysis

I. Results of Univariate cox regression for the 1991 dataset

Table 12a: Results of the crude models for the 1991 dataset

Variables	**HR**	**RSE**	**95% C.I.**
PUBLIC HEALTH VARIABLES			
ChWRAV	-.655976***	.0318292	.5964664 .7214228
DEMOGRAPHIC VARIABLES			
MAAFB			
Premature Mothers			
Young mothers	1.383986***	.0827295	1.230977 1.556013
Mid Mothers	1.197681	.1528972	.9325576 1.538177
Late Mothers	-.8800893	.2588832	.4944712 1.566435
NOBIL5Ys			
No_births			
At_Most_Two_births	13.34646***	.865658	11.75322 15.15568
Three_to_four_births	21.5749***	1.995282	17.99817 25.86243
DOBF			
NBFB			
BFBF6M	-.8058082	.1814529	.5182711 1.252871
BFBFM6M	-.5597699**	.1136374	.3760187 .8333159
Precd_birth_intls			
Predbirth0:12ms			
Predbirth13:24ms	1.062677	.1594164	.7919703 1.425914
Predbirth25:328ms	1.429948*	.2077327	1.075632 1.900977

SOCIO-ECONOMIC VARIABLES			
MCMS			
NMM			
MAOMM	-.8780416	.0692157	.7523418 1.024743
MCLA	-.6615257**	.0838206	.5160511 .8480097
MLOE			
NEdu			
PEdu	1.280379***	.0584306	1.170829 1.400178
SAHEdu	1.405594***	.0694787	1.275807 1.548585
PLOE			
No_education			
PWP_Education	1.077805	.051407	.9816152 1.18342
PWSAH_Education	1.250151***	.0580083	1.141473 1.369175
WChLW	1.676887***	.1139389	1.467802 1.915756

*Note.*P < .05, **P < .01, and ***P < .0001. HR= Hazard Ratio (relative risk), RSE= Robust Standard Error, 95% C.I. = 95% Confidence Interval.*

Table 12a shows the results of the main effects of each covariate considered in the univariate cox regression for the 1991 dataset. The result includes the hazard ratios (the exponents of the coefficient) and the associated statistics of each dummy variable created.

According to the results, children's vaccination status has a negative correlation with their survival probability. As the vaccination status of children changed not vaccinated to received adequate vaccination, the survival probability of the children decreased by 34.4% compared with those that were not adequately vaccinated.

Mothers' age at first birth (MAAFB) has a positive correlation with the survival chances of their children; when mothers' status changed from Premature to young mothers, the survival

probability of their children increased by 38.4%. The survival chances of children of middle age mothers and those of late mothers are not statistically significant.

Mothers' number of births in the last five years (NOBIL5Ys) positively correlates with the survival probability of their children. Amongst Children of mothers with different number of birth experiences with reference to children of mothers in their first birth experience, children whose mothers had three to four births had the highest survival chances, followed by those with at most two births. As mother's number of births increase from no previous births to three to four births, the survival chances of their children increased by 21.6 times; when NOBIL5Ys increased from No_births to at most two births, the survival chance of their children increased by 13.3 times.

Mothers' Duration of Breastfeeding period (DOBF) negatively associate with the survival probability of their children; as the duration of children's breastfeeding period improved from never breastfed (NBFB) to breastfed for more than six months (BFBFM6M), the survival probability of their children decreased by 40.0 %, and the survival chances of children breastfed for at most six months is not statistical significant.

Mothers' number of preceding birth intervals (Precd_birth_intls) has a positive correlation with the survival probability of their children; when mothers preceding birth intervals increased from Predbirth_0:12ms to 25-328ms, the survival probability of their children increased by 43%. The survival chance of those whose mothers observed 13 – 24 months was not statistically significant.

Mothers' current marital status (MCMS) is found to have a negative association with the survival chances of their children; as mothers marital status improved from never married (NMM) to currently living alone (MCLA), the survival probability of their children decreased by 33.8%. The survival probability of children from mothers with no marriage experience is statistically insignificant.

Mothers' level of education (MLOE) has direct correlation with the survival chances of their children. Among children of mothers of different levels of education compared with children of mothers with no education (NEdu), children whose mothers attained secondary or higher education had the highest survival probability. When mothers level of education improved from NEdu to secondary

and higher education (SAHEdu), the survival probability of their children increased by 59.4%, and when it increased from NEdu to PEdu the survival probability increased by 72%.

Similarly, Father's level of education (PLOE) has a positive association with the survival probability of their children; as fathers' level of education changes from no education to secondary or higher education (PWSAH_Education)), the survival chances of their children increased by 75%. However the survival chances of children whose parents attained primary education is not significant.

Whom children lived with (WChLW) in the first five years of their lives has a direct relationship with their survival probability; as children status improved from living with other relatives to living with their biological mothers, their survival probability increased by 67.7%.

Table 12c: Results of the Final Model with Interactions and Stratification Considered for the 1991 Dataset

_t	Haz. Ratio	Std. Err.	z	P>|z|	[95% Conf.	Interval]
ChWRAV	.6949822	.070428	-3.59	0.000	.56979	.8476813
2.NOBITL5Ys	3.910712	.5466825	9.76	0.000	2.973483	5.143351
MCMS						
1	.8010078	.1243843	-1.43	0.153	.5908239	1.085964
2	.5337354	.118716	-2.82	0.005	.3451419	.8253808
MLOE						
1	1.93455	.2697964	4.73	0.000	1.471871	2.542672
2	3.127608	.8402779	4.24	0.000	1.847245	5.295417
precd_birth_intls						
2	1.135528	.2159328	0.67	0.504	.7822268	1.648401
3	1.444273	.271106	1.96	0.050	.9996994	2.086552
WChLW	1.915053	.2608311	4.77	0.000	1.466381	2.501007
NOBITL5Ys_MLOE	.7041823	.0788897	-3.13	0.002	.5653596	.8770925
MLOE_ChWRAV	.8405261	.0656475	-2.22	0.026	.7212236	.9795633

Table 12c shows the existence of a negative relationship between the vaccination status of children (ChWRAV) and their survival chances after controlling the effects of other variables considered in the model. We observed that as the vaccination status of children improved (from not vaccinated to adequately vaccinated), the rate of survival of the children decrease by 48.4%.

Mother's number of birth in the last five years (NOBITL5Ys) has a positive relationship with the survival status of their children; as mothers' number of birth in the last five years improved from no birth to three to four births, the rate of children's survival increased by 4units.

Mothers' current marital status (MCMS) shows a negative relationship with the survival chances of their children.When MCMS is altered from never marriage (NMM) to once married (MAOMM), the survival rate of their children was not significant, and when mothers' marital status improved from (never married (NMM) to currently living alone (MCLA)), the survival rate of children decreased by 51.8%.

Mothers' level of education (MLOE) positively correlates with the survival chances of their children after adjustments. When mothers' level of education improved, from no education (PEdu) to primary education, the survival chances of their children increased by 91.5%, and when mothers' level of education improved (from no education to secondary or higher education), their children's survival chances improved by179%.

The preceding birth interval of mothers' is found to have a positive correlation with the survival chances of their children; as the preceding birth interval is altered from 0-12 to 25-328 months, holding all other variables in the model constant, children's rate of survival increased by 59.3%.

Whom children lived with (WChLW) at the earliest stage of their life positively correlate with their survival chances after adjustment. As children's status improved (from living with any other relatives to living with their biological mothers), their rate of survival increased by212%.

Table 13a: Results of the Crude Models for the 1998 Dataset

Variables	**HR**	**RSE**	**95% C.I.**
PUBLIC HEALTH VARIABLES			
ChWRAV	-.5297942***	.0280889	.4775049 .5878096
ENVIRONMENTAL VARIABLES			
SOHhDW			
UPipeBWS			
UWWS	1.145636**	.0498433	1.051995 1.247613
USWS	1.054403	.0426237	.9740858 1.141343
UBW	1.028119	.1668873	.7479526 1.413231
UOSWS	-.4080391	.235902	.1313989 1.267103
TOHhTF			
UFlushT			
UPT	1.220819**	.0745478	1.083113 1.376033
UInATF	1.375715***	.1146099	1.168465 1.619726
DEMOGRAPHIC VARIABLES			
MAAFB			
PrematureMothers			
Youngmothers	1.373433***	.0813599	1.22288 1.542522
MidMothers	1.218548	.1334418	.9831701 1.510278
LateMothers	1.222938	.2759107	.7858911 1.903034
NOBIL5Ys			
No_births			
At_Most_Two_births	12.20962***	.603689	11.08193 13.45206
Three_to_four_births	27.17996***	2.568486	22.58452 32.71046
MCA			
Teenage Mothers			
Mothers in their 20s	-.4646164***	.0320627	.4058393 .5319062
Mothers in their Mid-30s	-.2853794***	.0212919	.2465557 .3303164
Mothers Above 35 years	-.1236595***	.0093342	.1066539 .1433767
Precd_birth_intls			
Predbirth0:12ms			
Predbirth13:24ms	1.222976	.1853849	.9086327 1.646066
Predbirth25:328ms	1.435923*	.2118181	1.075394 1.917322

MWRTIBB	-.8974363*	.0475539	.808909 .995652
Place of Deliver (POD)			
DAH			
DIH	-.8745149*	.0423102	.7953987 .9615005
DNAHNH	-.7296028	.2124783	.4122832 1.291152
SOCIO-ECONOMIC VARIABLES			
MCMS			
NMM			
MAOMM	-.9002618	.0562334	.7965259 1.017508
MCLA	-.6810873***	.0614544	.5706883 .8128429
MLOE			
NEdu			
PEdu	1.077082	.0442011	.9938419 1.167294
SAHEdu	1.089015*	.0466021	1.001402 1.184293
TOPOR	1.153109***	.0387895	1.079535 1.231697
PWSOI	-.7616855***	.0292399	.7064792 .8212058
PLOE			
No_education			
PWP_Education	1.034203	.0456072	.948569 1.127569
PWSAH_Education	1.090662	.046078	1.003989 1.184818
MATMM	-.9246451*	.0361053	.85652 .9981886
WChLW	2.756709***	.1361065	2.502446 3.036806

*Note.*P < .05, **P < .01, and ***P < .0001. HR= Hazard Ratio (relative risk), RSE= Robust Standard Error, 95% C.I. = 95% Confidence Interval.*

Results of the Univariate Cox Regression 1998

According to Table 13a, children's vaccination status negatively associates with their survival probability. As the vaccination status of children improved (from not vaccinated to adequately vaccinated); the overall survival probability of the children decrease by 47%.

Source of household drinking water (SOHhDW) is found to have a positive correlation with the survival status of children within the household. When the source of drinking water changed from pipeborn water (UPipeBWS) to Well Water (UWWS), the survival chances of children within the household increased by 14.6%. The impact of the other sub-categories considered was not statistically significant.

In the same vein, Type of Household Toilet Facility (TOHhTF) is found to positively correlate with the survival probability of children within the household. As TOHhTF changed from inadequate toilet facilities (UInATF) to pit toilet facilities (UPT), children's survival chances increased by 22.1%, when TOHhTF changed from UFlushT to UInATF children's survival chances increased by 37.6%.

Mothers' Age at First Birth (MAAFB) positively correlates with the survival chances of their children. When MAAFB changed (from Premature to Young Mothers), children's survival probability increased by 37.3%. The survival chances of children delivered by middle age mothers (MidMothers) and late mothers (MidMothers) are not significantly different from those of premature mothers.

Mothers' Number of Birth in the last five years (NOBIL5Ys) showed a positive association with the survival probability of their children. Among the children of mothers with varied number of birth experiences compared with those whose mothers had no birth experience, children of mothers with three to four births were the most likely to survive. When NOBIL5Ys changed (from no birth to at most two births), the survival probability increased by 12.2 units, and when it increased (from no birth to three to four births) it increased by 27 times.

Mothers' Current Age (MCA) negatively correlates with the survival chances of their children. Among children of mothers of different current ages (MCA) compared with teenage mothers, children of mothers above 35 years were the least likely to survive, followed by those whose mothers were in

their mid-30s and those whose mothers were in their 20s. As MCA increased from Teens to the 20s, the survival chances of children decreased by 53.5%; when it increased (from teens to mid-30s) the survival chances decreased by 71.5%, and when it increased from teens to above 35, the survival probability decreased by 87.6%.

Mother's number of preceding birth intervals (Precd_birth_intls) is found to have a positive association with the survival chances of their children. As mothers' preceding birth interval improved (from most 12 months to 25-328 months), the survival probability of their children increased by 43.6%. The survival chance of their counterparts whose mothers observed 13 – 24 months is not significantly different from those of the reference group (0-12months).

Mothers' tetanus vaccination status before birth (MWRTIBB) showed a negative relationship with the survival status of their children. As mothers vaccination status changed (from not vaccinated to received adequate tetanus vaccination), the survival chances of their children decreased by 10%.

Children's place of delivery (POD) negatively correlates with their survival probability. When compared with children delivered at home, children delivered in a hospital had their survival probability decreased by 12.5%. The survival chance of child who were neither delivered at home nor in a hospital (DNAHNH) was statistically insignificant.

Mothers' current marital status (MCMS) negatively associates with the survival probability of their children. When MCMS changed (from never married to currently living alone), the survival chances of their children decreased by 31.9%, and the survival chance of those whose mothers had marriage experience was not significant.

Mothers' Level of Education (MLOE) shows a positive correlation with the survival chances of their children. As MLOE improved (from no education to secondary or higher levels of education), the survival chances of their children increased by 8.9%, and the survival chances of those whose mothers had attained primary education (PEdu) are statistically insignificant.

Children's Type of Place of Residence (TOPOR) showed a direct correlation with the survival probability of their children; as children's place of residence changed from urban to rural areas, their survival probability increased by 15.3%.

Fathers' source of income negatively correlates with the survival chances of their children; as the status of parents improved (from no income to income earner), the survival probability of their children decreased by 23.8%.

Mothers' access to mass media (MATMM) is found to have a negative association with the survival chances of their children. Children whose mothers had access to mass media had their survival probability decreased by 7.5%, compared with their counter parts whose mothers did not.

Finally, whom children lived with (WChLW) positively correlates with their survival chances. Children who lived with their biological mothers in the first five years of their existence had their survival probability increased by 2.8 percent compared with their counterparts that lived with other relatives over the same period of time.

Table 13c: Results of the Final Model Considered for the 1998 Dataset

_t	Haz. Ratio	Std. Err.	z	P>|z|	[95% Conf.	Interval]
ChWRAV	.5155555	.0332803	-10.26	0.000	.454285	.5850896
2.NOBITL5Ys	2.312809	.2218737	8.74	0.000	1.916381	2.791244
MCA						
2	.4462351	.0707879	-5.09	0.000	.32699	.6089659
3	.3356007	.0668383	-5.48	0.000	.227142	.4958478
4	.2328064	.0591589	-5.74	0.000	.1414798	.3830854
precd_birth_intls						
2	1.978555	.6096579	2.21	0.027	1.081595	3.619356
3	3.345852	1.191294	3.39	0.001	1.665082	6.723227
MWRTIBB	2.366362	.9401375	2.17	0.030	1.086189	5.155337
MROR						
2	.6738006	.0911215	-2.92	0.004	.5169149	.8783017
3	.4463629	.0898384	-4.01	0.000	.300863	.6622279
4	.3934676	.1063052	-3.45	0.001	.2317049	.6681633
1.WChLW	2.153722	.4242971	3.89	0.000	1.463853	3.168705
MLOE						
1	1.250195	.1226643	2.28	0.023	1.031481	1.515285
2	1.239592	.1375663	1.94	0.053	.9972745	1.540787
precd_birth_intls_MWRTIBB	.7373449	.1031104	-2.18	0.029	.5605812	.9698462
MCA_MROR	1.109877	.0351071	3.30	0.001	1.043158	1.180864

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The results of the comparative test between the adjusted model without interactions and the adjusted model with interactions for the 1998 dataset is significant with P- value > chi2 = 0.0005, indicating that the adjusted model with interactions better fits the dataset. The final model is hereby subsequently referred to as the final model, and its final evaluation shows that it fit the data very well.

According to Table 13ct, the survival status of children negatively correlates with the vaccination status of children (ChWRAV) after controlling for the effects of other variables in the model. According to this model, as the vaccination status of children change from no vaccination to adequately vaccinated, the rate of survival of the children generally decrease by 48.4%.

Mother's number of births in the last five years (NOBITL5Ys) is found to have a positive correlation with the survival status of their children after controlling for other variables in the model. As mothers' number of births in the last five years is altered from No_births to three_to_four_births; the rate of survival of their children increased by 2.31 survival chances (130%).

Mothers' current age (MCA) negatively correlates with the survival chances of their children. As MCA increased form the teens to the 20s, the survival chances of their children decreased by 48.4%; when it increased from teens to the Mid-30s, the survival chances of their children increased by 66.4%, and when it increased from Teens to above 35 years, the survival chances dropped by 76.7%.

The mothers' preceding birth interval (precd_birth_intls) positively correlates with the survival chances of their children after adjustments. When mothers' preceding birth interval improved from 0-12 to 25-328months, their children's survival rate increased by 97.9%, and when it changed from 0-12 to 25-328 months it increased by 230%.

The vaccination status of children positively associates with the survival chances of their children after controlling the effect of other variables. As mothers vaccination status before birth (MWRTIBB) improved from no tetanus injection to received adequate tetanus injections, their children's survival rate increased by 136.6%.

The person whom the child lived with (WChLW) in the earliest stage of their lives positively associated with their survival probability. When children's status changed from living with other relatives to living with their biological mothers, their survival rate increased by 115.3%.

Mothers' level of education (MLOE) shows a positive correlation with the survival chances of their children after adjustments. As MLOE improved from no education to primary education, the survival chances of their children increased by 75%. However the survival probability associated with a change from no education to secondary or higher education is not statistically significant.

Results of Univariate Cox Regression Analysis for the 2004 Dataset

Table 14a: Results of the Crude Models for the 2004 Dataset

Variables	**HR**	**RSE**	**95% C.I.**
TOPCDEOFC			
ChWEOFCNC			
ChWEOFCCIOPS	-.9656171	.0503216	.8718583 1.069459
ChWEOFCCIMPrS	1.137955*	.0612403	1.024039 1.264542
ChWEOFCCIMPuS	1.132233**	.0540523	1.031097 1.243288
PUBLIC HEALTH VARIABLES			
ChWRAV	-.7509857***	.0181714	.7162017 .787459
ENVIRONMENTAL VARIABLES			
SOHhDW			
UPipeBWS			
USWS	1.049752**	.0166685	1.017586 1.082936
UBW	1.058227***	.0169342	1.025551 1.091943
UOSWS	-.9904107	.0646304	.8715037 1.125541
TOHhTF			
UFlushT			

UPT	1.025437	.0278954	.972195 1.081595
UInATF	1.122688**	.0400836	1.046811 1.204065
DEMOGRAPHIC VARIABLES			
MAAFB			
PrematureMothers			
Youngmothers	1.242453***	.0249599	1.194483 1.292349
MidMothers	1.729321***	.0822323	1.575431 1.898243
LateMothers	2.382109***	.268784	1.909487 2.971711
NOBIL5Ys			
No_births			
At_Most_Two_births	2.895277***	.0423764	2.813401 2.979536
Three_to_Four_births	4.281976***	.1208809	4.051489 4.525575
MCA			
Teenage Mothers			
Mothers in their 20s	-.2317421***	.0096904	.2135067 .251535
Mothers in their Mid-30s	-.0837325***	.0036311	.0769098 .0911604
Mothers Above 35 years	-.0253003***	.0011089	.0232176 .0275699
Precd_birth_intls			
Predbirth0:12ms			
Predbirth13:24ms	1.06077	.0473459	.9719171 1.157747
Predbirth25:328ms	1.323458***	.0574356	1.215541 1.440956
SOCIO-ECONOMIC VARIABLES			
MCMS			
NMM			
MAOMM	-.4650651***	.0207677	.4260915 .5076035

MCLA	-.4198369***	.022191	.3785203 .4656633
MLOE			
NEdu			
PEdu	1.059779***	.0160099	1.02886 1.091627
SAHEdu	1.291716***	.0221664	1.248993 1.3359
PLOE			
No_education			
PWP_Education	1.038429*	.0175458	1.004603 1.073394
PWSAH_Education	1.228647***	.0206353	1.188861 1.269764
Househod_income_level			
Poor_Income_Home			
Average_Income_Home	-.915572 ***	.0149812	.8866752 .9454105
Above_Average_Income	-.9565286 **	.0139605	.9295542 .9842858
1.WChLW	2.843335***	.0419016	2.762384 2.926658

*Note.*P < .05, **P < .01, and ***P < .0001. HR= Hazard Ratio (relative risk), RSE= Robust Standard Error, 95% C.I. = 95% Confidence Interval.*

As can be infer from Table 14a, the type of place mothers' consulted during episodes of fiver and cough (TOPCDEOFC) has a positive correlation with the survival probability of their children. As the mothers place of consultation changed from no consultation to consulted in a medical private sector, the survival chances of their children increased by 13.8%. When mothers' place of consultation changed from no consultations to consulted in the medical public sector, their children's survival probability increased by 13.2 %. However the survival probability of those whose mothers consulted in other private sector is not significant.

Children's vaccination status (ChWRAV) is found to negatively correlate with their survival probability. Adequately vaccinated children had their survival probability decreased by 24.9%, compared with children that were not adequately vaccinated.

Source of household drinking water (SOHhDW) positively correlates with the survival status of children within the household. When children's source of water changed from pipe borne water (UPipeBWS) to well water (UWWS), their survival probability increased by 5%; and it changed from well water to bottle water (UBW) children's survival probability increased by 6%.The survival chances of those who use other sources of water was not statistically significant.

The type of household toilet facility (TOHhTF) positively associate with the survival probability of children within the household. A change in toilet facility from flush toilet (UFlushT) to inadequate toilet facility (UInATF) leads to 12.3% increase in the survival chances of the residing children. And the survival chances of children from households that used pit toilet facility (UPT) is not statistically significant.

Mothers' age at first birth (MAAFB) is found to have a positive correlation with the survival probability of their children. The higher MAAFB the more likely the child is going to survive. As mothers' MAAFB changed from Premature to young mothers, the survival chances of their children increased by 24.2%. When it increased from Premature to middle age, the survival chances of their children increased by 73%, and finally when MAAFB increased from Premature to a late age, the survival probability of their children increased by 189%.

Number of birth in the last five years (NOBIL5Ys) has a positive correlation with the survival probability of their children. An increase in mothers' number of birth from no birth to at most two births is associated with 190 % increase in the survival probability of their children. And finally an increase from no births to three to four births), is associated with 328% increase in the survival probability of children.

Mothers' current age (MCA) negatively associates with the survival chances of their children; when mothers' age increased from the teens to the 20s, their children's survival probability decreased by 76.8%. When it increased from the teens to the middle 30s, the survival chances of their children decrease by 91.6%, and when it increased from the teens to above 35 years, children's survival probability decrease by 97.5%.

Mothers' preceding birth intervals (Precd_birth_intls) is found to directly correlate with the survival probability of their children. A change in mothers preceding birth from at most12 months to 25-328 months is associated with 67.7% increase in children's survival probability. The survival probability of children whose mothers' preceding birth interval falls between 13 to 24 months is statistically insignificant.

Mothers' current marital status (MCMS) negatively correlates with the survival chances of their children.When mothers' marital status changed from never married to married and once married the survival chances of their children decreased by 53.5%, and when it changed from never married to currently living alone, the survival chances of their children decreased by 50%.

Mothers' level of education (MLOE) positively associates with the survival chances of their children. When mothers' education improved from no education to secondary or higher levels of education, their children's survival chances increased by 29.2%, and when it increased from no education to primary education, children's survival chances increased by 6%.

Similarly as fathers' level of education (PLOE) improved from no education to secondary or higher education, the survival chances of their children increased by 22.9%, and when it increased from no education to primary education, and the survival chances of their children increased by 4%.

The household income level (househod_income_level) is found to have a negative relationship with the survival chances of their resident children. As the household income level improved from poor income to average income homes, the survival probability of resident children decreased by 8.4%, and when it improved from poor income to above average income homes), the survival probability decreased by 4.3%.

Finally, who child lived with at a tender age (five years and below) directly correlates with their survival probability. Children who lived with their biological mothers had their survival probability increased by 184%, compared with their counterparts that had lived with other relatives.

Table 14c: Results of the final model considered for the 2004 dataset

_t	Haz. Ratio	Std. Err.	z	P>|z|	[95% Conf.	Interval]
ChWRAV	.7212561	.0180452	-13.06	0.000	.6867413	.7575057
MAAFB						
2	1.168949	.0485264	3.76	0.000	1.077605	1.268035
3	1.541299	.1330077	5.01	0.000	1.301463	1.825333
4	1.793485	.3157692	3.32	0.001	1.270081	2.532586
2.NOBITL5Ys	.877106	.0318356	-3.61	0.000	.8168771	.9417758
MCA						
2	.4979959	.0217761	-15.94	0.000	.4570932	.5425586
3	.4176565	.0202976	-17.97	0.000	.3797099	.4593955
4	.3533702	.0184411	-19.93	0.000	.3190133	.3914273
MCMS						
1	.8385602	.0492434	-3.00	0.003	.747392	.9408492
2	.7853841	.0622722	-3.05	0.002	.6723436	.91743
MLOE						
1	1.097414	.0328332	3.11	0.002	1.034912	1.16369
2	1.103341	.0371867	2.92	0.004	1.032812	1.178687
1.WChLW	1.835832	.0841608	13.25	0.000	1.678074	2.008422

*Note.*P < .05, **P < .01, and ***P < .0001. HR= Hazard Ratio (relative risk), RSE= Robust Standard Error, 95% C.I. = 95% Confidence Interval.*

According to Table 14c, children's vaccination status (ChWRAV) has a negative correlation with their survival probability after controlling the effects of other variables in the model. As the vaccination status of children improved from no vaccination to adequately vaccinated, their rate of survival decreased by 27.9

Mothers' age at first birth (MAAFB) positively correlates with the survival probability of their children after adjustments. When mother's age at first birth increased from Premature to Youngmothers, the survival chances increase by 16.9%, when it changed from premature to middle

age, their children's survival chances increased by 54.1%, and when it improved from premature to late mothers, it increased by79.3%.

Mothers' Number of birth in the last five years (NOBIL5Ys) is found to negatively associate with the survival probability of their children; when NOBIL5Ys increased from no birth to three to four births, children's survival rate decrease by 12.3%.

Similarly, mothers' current age (MCA) shows a negative correlation with the survival chances of their children. When MCA improved formTeens to the 20s, the survival chances of their children decrease by 50.2%; when it changed from teens to the mid-30s, children's survival chances decreased by 58.2%, and when it increased form Teens to above 35, it decreased by 64.7%.

Likewise, mothers' current marital status (MCMS) negatively associated with the survival chances of their children. When it improved from never married to married and once married, children's survival rate decreased by 16.1%. And when it improved from never married to single mothers, the survival status of their children decreased by 21.5%.

Mothers' level of education (MLOE) has a positive correlation with the survival chances of their children; when it changed from no education (NEdu) to primary education (PEdu)), children's survival probability increased by 9.7%, and when it increased from NEdu to secondary or higher levels (SAHEdu), children's survival probability increased by 10.3%.

Finally who child lives with (WChLW) positively correlates with their survival chances; as children's status changed from living with other relatives to living with their biological mothers, their survival chances increased by 83.6%.

Results of Univariate Cox Regression Analysis for the 2011 Dataset

Table 15a: Results of the Crude Model for the 2011 Dataset

Variables	**HR**	**RSE**	**95% C.I.**
PUBLIC HEALTH VARIABLES			
TPPPrNaC			
RPrNaCFrDr			
RPrNaCFNoM	1.118745**	.037867	1.046935 1.19548
PrNaAuMW	1.179355***	.0532961	1.079389 1.288579
RPrNaCFTBA	1.157041	.2914023	.706273 1.895505
MWHANV	-.8884588**	.0313117	.8291604 .9519979
ChWRAV	-.7185905***	.0140219	.6916271 .7466052
TOPCDEOD			
ChWEODNC			
ChWEODCIOPS	-.9945587	.0525299	.8967518 1.103033
ChWEODCIMPrS	1.121814	.0897436	.9590158 1.312247
ChWEODCIMPuS	-.7425936***	.0456042	.6583809 .8375778
TOPCDEOFC			
ChWEOFCNC			
ChWEOFCCIOPS	-.9268079*	.0353971	.859964 .9988475
ChWEOFCCIMPrS	-.9809393	.0431068	.8999877 1.069172
ChWEOFCCIMPuS	1.109305 *	.0456608	1.023326 1.202508
ENVIRONMENTAL VARIABLES			
SOHhDW			
UPipeBWS			
UWWS	1.081938***	.0137754	1.055273 1.109277

USWS	1.060835***	.0144167	1.032951 1.089471
UOSWS	1.068448	.0535482	.9684852 1.178728
UBW	- .6820772**	.0876492	.5302142 .8774366
TOHhTF			
UFlushT			
UPT	1.092653***	.0219804	1.05041 1.136594
UInATF	1.169776***	.0321664	1.1084 1.234551
MAAFB			
Premature mothers(9-14)			
young mothers(15-25)	1.336711***	.0219074	1.294456 1.380346
Middle age mothers(26-30)	1.835839***	.059633	1.722603 1.956518
Late mothers(31-40)	2.080332***	.1570165	1.794265 2.412006
DEMOGRAPHIC VARIABLES			
NOBIL5Ys			
No_births			
At_Most_Two_births	3.184763***	.0387512	3.109222 3.26113
Three_to_Four_births	4.687845***	.1071794	4.482415 4.902691
MCA			
Teenage Mothers			
Mothers in their 20s	-.3057836***	.0107574	.28541 .3276116
Mothers in their Mid-30s	-.1260707***	.0045596	.1174435 .1353318
Mothers Above 35 years	-.0378245***	.0013623	.0352464 .0405911
Precd_birth_intls			
Predbirth0:12ms			
Predbirth13:24ms	-.9587844	.034099	.8942278 1.028002

Predbirth25:328ms	1.19475***	.0410199	1.116998 1.277914
SoCh	1.028074**	.0108106	1.007102 1.049482
SOCIO-ECONOMIC VARIABLES			
MLOE			
NEdu			
PEdu	1.070058***	.0137093	1.043523 1.097268
SAHEdu	1.280261***	.0179128	1.24563 1.315855
PWSOI	-.7850886 ***	.0097251	.7662572 .8043828
PLOE			
No_education			
PWP_Education	1.041303**	.0144976	1.013272 1.070109
PWSAH_Education	1.182929***	.0161176	1.15044 1.213628
MReligion			
Christians			
Muslims	1.042519 **	.013381	1.01662 1.069078
OReligion	- .9816578	.0208803	.9415744 1.023448
Househod_income_level			
Poor_Income_Home			
Average_Income_Home	-.9556548***	.0130904	.9303395 .981659
Above_Average_Income	-.9791515	.0117673	.9563574 1.002489
WChLW	2.864192***	.0351497	2.796122 2.933919

*Note.*P < .05, **P < .01, and ***P < .0001. HR= Hazard Ratio (relative risk), RSE= Robust Standard Error, 95% C.I. = 95% Confidence Interval.*

According to Table 15a, the type of personnel providing prenatal care to mothers (TPPPrNaC) is found to have a positive association with the survival chances of children. When type of personnel consulted changed from medical doctors to nurses and midwifes the survival chances of children

increased by 11.9 %, when it increased from medical doctors to auxiliary nurses, the survival chances increased by 17.9%. The survival chances of those whose mothers consulted traditional practitioners is found to be insignificant.

Mothers' antenatal visits (MWHANV) negatively correlates with the survival chances of their children; when mothers' received adequate vaccination, the survival chances of their children decreased by 11.2% compared with their counterparts whose mothers did not receive any vaccination.

Children's vaccination status (ChWRAV) is negatively correlates with their survival chances; as children's vaccination status improved from not vaccinated to adequately vaccinated, their survival probability decreased by 28.1%.

Type of places consulted during episodes of diarrhea (TOPCDEOD) positively correlates with the survival chances of children. Children who consulted in a medical Public Sector (ChWEOFCCIMPrS) had their survival probability decreased by 25.7%, compared with those who did not consult at all. The survival probabilities of the other categories were not statistically significant.

The type of place children consulted during episodes of fever and cough (TOPCDEOFC) correlates differently with their survival probability. When the type of place consulted changed from not consulted to consult in other private sector (ChWEOFCCIOPS), the survival probability of children decreased by 7.3%. However, when type of place consulted changed from no consultation to consulted in a medical public sector (ChWEOFCCIMPuS), children's survival probability increased by 10.9%. The survival chances of children who consulted in the medical private sector (ChWEOFCCIMPrS) were not statistically significant.

The source of household drinking water (SOHhDW) positively correlates with the survival status of children for most of the subcategories considered. A change from pipe born water (UPipeBWS) to well water supply (UWWS) is associated with 8.2% increase in survival probability. Similarly a change from pipe born water to surface water supply (USWS) is associated with 6.1% increase in survival probability. However, we noted that when the source changed from pipe born water to bottle water (UBW), the survival chances decreased by 31.8%.

The type of household toilet facility (TOHhTF) positively correlates with the survival probability of children within the household. As the type of household toilet facilities changed from flush toilet (UFlushT) to pit toilet(UPT), the survival chances of children increased by 9.3%, and when it changed from (UFlushT) to inadequate toilet facilities (UInATF) it increased by 17.0% .

Mothers' age at first birth (MAAFB) positively associate with the survival chances of their children. As mothers age improved from premature to late age, the survival chancesof their children increased by 108%; when it improved from Premature to middle age, the survival chances of children increased by 83.6%, and when it increased from premature to young mothers, children's survival chances increased by 33.7%.

Mothers' number of birth in the last five years (NOBIL5Ys) directly correlates with the survival chances of their children. As mothers' number of birth changed from no birth to at most two births, children's survival chances increased by 218%, and when it increased from no birth to three to four births, their survival chances increased by 368%.

Mothers' Current Age (MCA) negatively associates with the survival chances of their children. A change in mothers' current age from the teens to the 20s results to 69.4% reduction in the survival chances of their children. When it changed it from the teens to the mid-30s, children's survival chances reduced by 87.4%, and when it changed from teens to above 35 years it decreased by 96.2.

Mothers' preceding birth intervals (precd_birth_intls) positively associate with the survival chances of their children. As mothers' preceding birth interval increased from at most 12 months to 25:328 months, the survival probability of their children decreased by 19.5%. However, the survival chances of those whose mothers observed 13 to 24 months is statistically insignificant.

The sex of children (SoCh) has a positive correlation with their survival chances. A changed in the sex of a child from male to female is associated with 2.8% increase in their survival probability.

Mothers' Level of Education (MLOE) and Fathers' Level of Education (PLOE) both show a positive correlation with the survival chances of their children. A change in mothers' level of education from no education to secondary or higher education is associated with 28% increase in the survival

chances of their children, while a change from no education to primary education is associated with 7% increment. Likewise, as the fathers' educational attainment improved from no education to secondary or higher education, their children's survival probability increased by 18.3%, and when it improved from no education to primary education, the survival chances of children increased by 4.1%.

Father's source of income (PWSOI) negatively correlates with the survival chances of their children. A change in fathers' status from no source of income to income earner leads to 21.5% decrease in the survival probability of Children.

Mothers' religion (MReligion) shows a positive association with the survival chances of their children. A change in mothers' religion from Christian to Muslim is associated with 4% increase in the survival chances of their children. The survival chance of children whose mothers were of other religions is found to be statistically insignificant.

Household income level (Househod_income_level) negatively associates with the survival chances of their children.A unit change in household income level from poor income earner to average income earner results to 4.4 % decrease in the survival chances of children in the household. The survival chances associated with children who live in the above average income homes is statistically insignificant.

Finally, who children lived with (WChLW) after birth positively associates with their survival chances. Children living with their biological mothers in the earliest part of their lives are associated with 186% survival chances compared with those that lived with other relatives.

Table 15c: Results of the FinalModel Considered for the 2011 Dataset

_t	Haz. Ratio	Std. Err.	z	P>|z|	[95% Conf.	Interval]
ChWRAV	.7616609	.0281193	-7.37	0.000	.7084948	.8188166
MAAFB						
2	1.202	.0425107	5.20	0.000	1.121502	1.288275
3	1.366408	.0825924	5.16	0.000	1.213751	1.538265
4	1.651872	.203623	4.07	0.000	1.29733	2.103305
2.NOBITL5Ys	.8379668	.0239982	-6.17	0.000	.7922269	.8863475
MCA						
2	.5785923	.0222134	-14.25	0.000	.5366526	.6238096
3	.5078286	.0216686	-15.88	0.000	.4670863	.5521247
4	.4381971	.0200286	-18.05	0.000	.4006488	.4792643
MLOE						
1	1.082023	.0344825	2.47	0.013	1.016506	1.151763
2	1.233539	.0536258	4.83	0.000	1.132787	1.343251
PWSOI	.9233811	.0204432	-3.60	0.000	.8841701	.964331
1.WChLW	1.874516	.0737273	15.98	0.000	1.735443	2.024735
ChWRAV_MLOE	.9173985	.0248676	-3.18	0.001	.869931	.9674562

Stratified by MROR MCMS TOPOR

*Note. *P < .05, **P < .01, and ***P < .0001. HR = Hazard Ratio (relative risk), RSE= Robust Standard Error*.

Results of the multiple regression analysis for the 2011 dataset

According to Table 15c, children's vaccination status (ChWRAV) positively correlates with their survival probability; as children's vaccination status improved from not vaccinated to adequately Vaccinated, their survival probability decreased by 23.3%.

Mothers' age at first birth (MAAFB) is found to positively correlate with the survival probability of their children; when MAAFB increased from premature to young mother, the survival probability of their children increased by 20.0%, when it increases from premature to middle age, the survival probability of their children increased by 36.5 %, and when it improved from premature to middle age, the survival probability increase by 64.6%.

Mothers' number of birth in the last five years (NOBITL5Ys) negatively associates with the survival chances of their children; as number of birth increased from no birth to three to four births, the survival probability of their children increased by 16.1%.

Mothers' current age (MCA) is negatively associated with their children's survival probability. When MCA increased form the teens to the 20s, the survival chances of the children decreased by 42.2%; when it increased from the teens to the Mid-30s, the survival rate of their children increased by 49.3%, and when it increased from teens to above 35 years, the survival chances increased by 56.2%.

Mothers' level of education (MLOE) positively correlates with the survival chances of their children; when mothers' educational attainment increased from zero to secondary or higher education, children's survival rate improved by 23.7%, and when it increased from zero to primary education the survival chances increase by 8.1%.

Fathers' source of income (PWSOI) negatively associates with children's survival chances; as children's fathers' source of income improves compared with those whose parents had no income, their survival probability decreased by 7.5%.

Whom child lives with (WChLW) positively correlates with their survival probability. Children living with their biological mothers' had their survival probability increased by 87.6% compared with those that lived with other relatives.

CHAPTER 5: Discussion

This section compares findings from datasets whose correlations are consistent in at least two out of the four data sets already outlined above. We first discuss the trends of childhood mortality indicators across the four surveys comparing the 1991 with 2011 datasets. Next, we discuss trends between successive pairs of surveys (1991/1998, 1998/2004, 2004/2011), and lastly we present some policy recommendations and conclusion.

5.1 Trend of Childhood MortalityIndicators Across the fourSurveys

Table 5 shows diverse patterns in the evolution of the different childhood mortality indicators across and between successive surveys. We observed a 3.2 point increment from 58.8 per 1000 live births in 1991 to 62 per 1000 live births in 1998; 0.9 point increment from 62.0 in 1998 to 62.9 in 2004, and 11.5 point reduction from 62.9 per 1000 livebirths in 2004 to 51.4 per 1000 live births in 2011. Conversely IMR improved by 7.4 points from 58.8 per 1000 live births in 1991 to 51.4 per 1000 in 2011. The general increment across the four surveys (between 1991 and 2011) is greater compared with the changes between pairs of successive surveys.

In the case of U5MR, we observed a net decline between the first two successive pairs of surveys followed by significant improvement in the third successive pair of surveys. This implies that U5MR experienced 17.7 point increment from 120.4 per 1000 live births in 1991 to 138.1 per 1000 live birth in 1998. It reduced by 3.1 points from 138.1 per 1000 live births in 1998 to 141.2 per 1000 live births in 2004). The trend further decreased by 1.1 point from 141.2 per 1000 live birth in 2004 to 117.2 per 1000 births in 2011. However, U5MR experienced a 3.2 point increment from 120.4 per 1000 live birth in 1991 to 117 per 1000 live birth in 2011. These improvements can largely be associated with the accumulated effects of different government policy actions implemented from the seven years that preceded each of the four survey conducted between1991 and 2011.

In the case of Neonatal mortality, we observed a slight increase in the trend between the first successive pair of surveys, and subsequently dropped in the later surveys. It initially increased by 0.3

point from 36.2 per 1000 live birth in 1991 to 36.5 per 1000 live births in 1998. The trend progressively dropped by 3.4 point from 36.5 per 1000 life birth in 1998 to 33.1 per 1000 life birth in 2004, and slightly dropped by 1.1 point from 33.1 per 1000 life birth in 2004 to 32 per 1000 life birth in 2011. Notwithstanding we noted a much more significant improvement across surveys: neonatal mortality dropped by 4.2 point from 36.2 per 1000 in 1991 to 32 per 1000 in 2011).

5.2 Comparing consistent findings between Successive Surveys

By comparing the final models of each of the four surveys (see table 12c, 13c, 14b and 15c), we conclude that the most consistent determinants of childhood mortality in Cameroon over the period considered include; children vaccination status (ChWRAV), mothers' number of birth in the last five years (NOBIL5Ys), mothers' current marital status (MCMS), mothers' level of education (MLOE), mothers' preceding birth interval, where the child is raised in the first five years of live (WChLW), mothers' current age (MCA), and mothers age at first birth (MAAFB).

By comparing successive pairs of surveys we noted that the vaccination status of children (ChWRAV) has a significant inverse relation with the survival chances of children in three datasets. Comparing the 1991 and 1998 surveys, the coefficient increased by 12.6% from 34.4% in 1991 to 47% in 1998, which indicates an increasing trend. However, the size of the coefficient decreased by 22.1 from 47% in 1998 to 24.9% in 2004, which implies a decreasing trend. Finally, the coefficient increased by 3.2% from 24.9% in 2004 to 28.1% in 2011, which also implies a decreasing trend. The above result indicates that the vaccination status of children is a significant predictor of children's survival rates. This observation agrees with the claim that immunization is amongst the most significant predictors of Neonatal, Post-natal, and Child mortality in the Rajshahi district of Bangladesh (Islam, Kamal, & Ali, 2009).

Number of births in the last five years (NOBIL5Ys) was found to have a positive correlation with the survival status of children in the 1991 and 1998 datasets. We noted 5.6 points increase in the

trend of the coefficient from 21.6 in 1991 to 27.2 in 1998 for mothers with three to four births. However, the trend dropped by 1.1 point from 13.3 in 1991 to12.2 in 1998.

Mothers' level of education (MLOE) positively correlates with the survival probability of their children in all the four datasets. Comparing the results of the 1991 and 1998 successive surveys, we not 4% drop in the coefficient from 40.6% in 1991 to 10% in 1998 for mothers' with secondary or higher education implying a decreasing trend; we also note a 19.2 % increment in the coefficient from 10% in 1998 to 29.2% in 2004 for mothers with secondary or higher education, which indicates an increasing trend. The results also show 1% increment in the coefficient from 6% in 2004 to 7% in 2011 for mothers with primary education, which implies a slight decrease in the trend. For mothers with secondary and higher education the trend dropped by 1.2% from 29.2% in 2004 to 28% in 2011. The above observation supports the claim that mothers' level of education is amongst the most significant determinants of child mortality in Cameroon (Akoto & Tambashe, 1991).

The coefficient of Who children lived with directly associates with the survival rate of children in all the four datasets studied. Between 1991 and 1998, the coefficient increased by 108% from 68% in 1991 to 176 in1998; it increased by 8% from 176% in1998 to184% in 2004, and finally increased by 2% from 184% in 2004 to 186% in 2011.

Mothers' preceding birth intervals positively correlates with the survival status of children in all the four datasets considered. The coefficient decreased by 0.6 from 43% in 1991 to 43.6% in 1998 for mothers in the 25- 328 months intervals; the coefficient decreased by 12.8 from 43.6% in 1998 to 32.3% in 2004 for mothers in the 25-328 months intervals, and decreased by 12.8 from 32.3% in 2004 to 19.5% in 2011 for mothers in the 25- 328 months intervals.

Mothers' current marital status (MCMS) had a negative association with the survival status of their children in three dataset (1991, 1998 and 2004). The estimated coefficient increased by 2% from 66.1% in 1991 to 68.1% in 1998 for mothers currently living alone, and finally increased by 2% from 68.1% in 1998 to 42% in 2004 for mothers currently living alone.

Mothers' age at first birth (MAAFB) positively associates with the survival chances of their children in all the four datasets. The estimated coefficient of MAAFB decreased by 1.1% from 38.4% in 1991 to 37.3% in 1998 for young mothers; it decreased by 13.1% from 37.3% in 1998 to 24.2% in 2004 for young mothers, and increased by 9.5% from 24.2% in 2004 to 33.7% in 2011) for young mothers. It further increased by 10.6% from 73% in 2004 to 83.6% in 2011 for Middle age mothers, and finally decreased by 30%, from 138% in 2004 to 108% in 2011 for late mothers.

5.3 Conclusion

In this study we attempted to evaluate the trend of childhood mortality indicators and the effect of its determinants across four successive waves of surveys using DHS data from 1991 to 2011. We used the survival model (life tables) to estimate the effects of childhood mortality and cox proportional hazard model to estimate the effects of each determinant on the survival chances of children across different age groups. Inferring from table 5, we conclude that the trend of childhood mortality indicators did not improve between the first successive surveys (between the 1991 and 1998), and (between 1998 and 2004 surveys). However the value of the indicators generally improved across the survey (between 1991 and 2011 for most indicators).

From the univariate analysis, we conclude that most of the individual determinants of childhood mortality have evolved positively and the changes between successive surveys were found to be statistically significant in most cases with a few exceptions as shown in table 11.

With reference to the results of the multivariate analysis (the crude and final models for each survey), we conclude that although most of the 28 determinants of childhood mortality considered for this study have had varied significant impacts on childhood mortality in Cameroon for the periods examined, only 8 of the 29 determinants had significant and consistent impacts in at least two of the four datasets after adjustments. Besides, the directions of the correlations were found to be consistent for almost all determinants, although the magnitude of their coefficients did not evolve in a consistent manner.

Policy Recommendations

We recommend the need for more consistent development policies and associated monitoring and evaluation plans in Cameroon. This may help Cameroon's government officials to constantly track the performance of important determinants of childhood mortality indicators and consider their effects when responding to its development needs and integrate them in their national development efforts in a more consistent and proactive manner.

The conception of development policies expected to influence childhood mortality indicators should precede the review of the performance of preceding sectorial policies to make corrective decisions is new policies that are expected to reduce childhood mortality. For instance, knowledge of the impact of health determinants and the impact of their interactions with one another may better inform national policies, as well as the budgeting and programing of national investments plans.

There is need for a timely and consistent formulation and subsequent implementation of development policies in a way that is consistent with national and international development goals. Considering that the impact of the determinants of childhood mortality indicators fluctuated from one survey period to another, such fluctuations should be periodically reviewed and given serious considerations when elaborating and implementing future national development policies.

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