UNIVERSITY OF GHANA

COLLEGE OF HEALTH SCIENCES

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PATTERNS IN NEONATAL MORTALITY RATES AND THEIR DETERMINANTS IN SELECTED HIGH PREVALENT WEST AFRICAN COUNTRIES

BY

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DECLARATION

I, Mawusi Sika Markwei, hereby declare that, this work is a product of my own original research towards the award of a Master of Health Informatics Degree. All ideas, quotes and arguments from other sources as well as secondary data have been clearly referenced. This work has neither in part nor in full been presented for the award of any kind of degree or certificate before to any University here in Ghana or elsewhere.

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DEDICATION

To my mum for every sacrifice made in caring for my son whilst I was away in school and to my son, Carl Hans. You will always be loved.

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I thank God for the grace and strength to successfully finish this work

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LIST OF ACRONYMS

ANC – Antenatal care

CHO – Community Health Officer

DHS – Demographic and health survey

IMNCI – Integrated Management of Neonatal and Childhood Illnesses

Kg – Kilograms

KMC – Kangaroo mother care

NM – Neonatal mortality

NMR – Neonatal mortality rate

SDG – Sustainable Development Goals

TBA – Traditional birth attendant

ABSTRACT

Neonatal deaths place a significant burden on women, families and the health system as a whole. Neonatal mortality rates appear to be declining but still contribute a higher percentage of under-five mortality rates.

The study aimed at determining patterns of neonatal mortality and their associated determinants in six selected high prevalent countries in West Africa.

Data for this study was drawn from Demographic and Health surveys for six selected West African countries over not less than three survey years with a total sample of 230,035. All study variables were extracted from the women and children's data sets. Separate analyses were conducted on data for each country as well as the pooled dataset accounting for weights through the survey data analysis functions. Adjusted and unadjusted Logistic regression analyses were performed to determine associations between neonatal mortality and independent variables. Also, Pearson Chi 2 test of association was used to determine significance of variations in NM trends in the countries.

The study revealed that significant variations exist in NM trends in the selected high prevalent countries. There was a general decline over all the survey years in all countries with the exception of Benin. Also, birthweight was found to be consistently associated with NM in Benin and Ivory Coast in all survey years.

Increasing child survival is intricately linked with reducing NM rates especially in Africa and more so as SDG 3 aims at a reduction to 12 per 1000 live births by 2030. There should be continuous in-service training for front line staff for effective management of neonatal emergencies especially in the rural areas.

CHAPTER ONE

INTRODUCTION

1.1 Background to the Study

According to the World Health Organisation, neonatal period refers to the period from birth to 28 days. Thus, neonatal mortality is the risk of dying within the first 28 days of life. In the year 2017, 2.5 million children died in the first month of life translating to approximately 7,000 neonatal deaths everyday across the world and a global neonatal mortality rate of 18 deaths per 1,000 live births (IGME, 2018a)

Child mortality rates have reduced globally over the years, however, decline in neonatal mortality rates have been slow from 37 per 1000 live births in 1990 to 18 per 100 live births in 2017 (51%) compared to mortality among children aged 1-59 months (63% decline) with the highest rates in sub-Saharan Africa and South Asia at 27 deaths per 1000 live births(Hug, Alexander, You, & Alkema, 2019). Nigeria ranks second to India with the highest number of neonatal deaths. These deaths have been linked inextricably to poor quality antenatal care, unavailability of skilled attendant at birth and post-partum care. In 2017 alone, approximately 1,100 babies were born in Benin daily. Out of this number, it was estimated that 35 of them would die each day before reaching their first month of birth. According to WHO, the top three causes of neonatal mortality include low birth weight, neonatal sepsis and asphyxia. Quality and accessible health care is therefore essential.

Neonatal deaths place a significant burden on women and families and the health system as a whole. Safe motherhood is critical to saving newborns. Research has shown that a significant number of neonatal deaths could be prevented if all women received good quality antenatal and postnatal care as well as skilled attendant at birth.

The need to bring an end to preventable childhood deaths has been acknowledged by the global

community thus making it an essential part of the Global Strategy for Women's, Children's, and Adolescent's Health (2016–2030) and the Sustainable development goals (SDGs). The quest to achieve the ambitious child survival goals will necessitate making sure that there is universal access to safe, effective good quality, affordable healthcare for all women, adolescents and children.

1.2 Problem Statement

According to the WHO, 5.4 million children died before reaching their fifth birthday globally. Out of this number, 2.5 million of them died within the first month of life in 2017, accounting for 46% of all under-five deaths which increased from 41% in 2000. The risk of mortality in children is highest in the first month of life. Majority (98%) of these deaths are said to occur in developing countries mostly in Africa and South Asia and are mostly as a result of preventable causes (IGME, 2018b).

Increased neonatal mortality is a problem of public health concern. Thus concerted efforts are being made globally to help reduce the high rates. This is visible in the Millennium Development Goal (MDG) 4 which targeted a reduction in childhood mortality by 75% and subsequently the Sustainable Development Goal (SDG) 3 which aims at a reduction in neonatal mortality within all countries to at least 12 deaths per 1000 live births by 2030.

Africa accounts for 11% of the total world population. However, 25% of the world's neonatal deaths occur in Africa with 75% of the highest risk countries located on the African continent. Despite the general decline in neonatal mortality rates globally, most African countries still record high mortality rates above the global estimation of 18 deaths per 1000 live births (IGME, 2018a). The proportion of children under five who die in West Africa increased from 30% in 1990 to 50% in 2017 and is expected to increase even further in the next few decades. It is estimated that in Africa, 1.16 million babies die within the first 28 days of life and up to half

of this number, die on their day of birth(Lawn Joy, Mongi Pyande, 2010). African countries especially those with huge populations over the last ten years have either experienced static neonatal mortality rates or have made very minimal progress at reducing them while others have made considerable progress although slow.

Over the years the focus of global child programs have primarily been on causes such as Malaria, vaccine preventable conditions, Pneumonia and Malaria which are usually responsible for deaths in babies after the first four weeks of life. These programs have succeeded to some extent in reducing deaths after the first month and within the first year of life leaving out deaths occurring within the neonatal period. This has accounted for the increasing proportion of neonatal deaths in under-five mortality of up to 40%, which is likely to increase if action is not taken to reduce neonatal deaths. There is therefore the need for more interventions targeted at babies who die within the neonatal period and thus the need to explore differences in neonatal mortality trends in West African countries with emphasis on those countries with the highest neonatal mortality rates.

1.3 Research Questions

1. What are the variations in neonatal mortality trends among selected high prevalent countries in West Africa?
2. What factors are associated with neonatal mortality among selected high prevalent countries in West Africa?
3. What are the consistent factors associated with neonatal mortality over different DHS survey periods within selected high prevalent countries?

1.4 Objectives

1.4.1 General Objective

To determine the patterns of neonatal mortality and their associated determinants in the selected high prevalent West African countries.

1.4.2 Specific Objectives

1. To determine variations in neonatal mortality trends among selected high prevalent West African countries
2. To determine whether factors associated with neonatal mortality differ among selected high prevalent West African countries
3. To assess consistent factors associated with neonatal mortality for different DHS survey periods within selected high prevalent countries.

4.3 Significance of the study

Findings from this study may prove useful to relevant stakeholders in public health for the review of old interventions and development of new community based strategies aimed at reducing neonatal mortality.

In addition, findings will also help in the development of country-specific child survival programs which will equip countries to better achieve SDG goal three by 2030 as prevailing conditions differ from country to country.

4.4 Organization of chapters

This study is organized as follows:

Chapter two (2) consists of review of relevant literature and similar studies conducted in the area of neonatal mortality. Chapter three (3) highlights the methodology employed in the study with descriptions of the research design, study population, profile of the study area and the process analysis. In chapter four (4), the results of the study are presented in detail. Chapter five (5) details discussion of the findings and comparison with other studies. The final chapter six (6) consists of the conclusion and recommendations.

CHAPTER TWO

LITERATURE REVIEW

2.1 Introduction

Neonatal mortality continues to be a burden in healthcare delivery globally with sub-Saharan Africa contributing a greater portion in the global prevalence. As a reflection of its importance in global health, many studies have been conducted, all geared towards suggesting measures to help reduce this scourge to the barest minimum if not entirely eliminated. In the light of the above, this chapter seeks to review selected studies relating to neonatal mortality.

Over the years, there have been numerous strategies rolled out to address this with significant decrease in ratios yet progress has been slow in some countries with neonatal mortality rates still much higher than the MDGs and subsequently the SDGs (Golding et al., 2017).

The death of a neonate can be linked to different factors ranging from socio-economic, clinical, environmental, cultural and governmental issues. Timing of these deaths is grouped into early days of birth; that is one to seven days (early neonatal death) and eight to twenty-eight days (late neonatal death) (Grady et al., 2017). A research carried out by Lawn, Cousens, & Zupan, (2005), indicated that most early neonatal deaths occurred on first day of life compared to death among babies beyond 24hrs of life. That notwithstanding, death among babies beyond 28 days but before their first birthday is unacceptably high especially in sub-Saharan Africa (Baqui et al., 2016; Susuman, Chialepeh, Bado, & Lailulo, 2016).

2.2 Neonatal mortality in the West African sub region

Within the West African sub-region, some countries have been identified as high prevalence countries in terms of neonatal mortality. Countries such as Benin, Cote d'Ivoire, Mali, Ghana, Nigeria and Niger are known to have high prevalence of neonatal mortality. These countries have similarities in socio-economic factors, religion and education which could be considered

in addressing the neonatal mortality issues in the sub region. Studies show that 5.2 per 1000 live birth pre-discharged babies, end in early neonatal deaths in Ghana. Guinea has the lowest pre-discharged early neonatal death with a ratio of 1.8 per 1000 live birth. The Gambia has the highest with 8.8 per 1000 live birth. Niger, Senegal and Togo 3.7, 6.3 and 4.9 per 1000 live births respectively (Bailey et al., 2017).

2.3 Factors associated with neonatal mortality

2.4 Economic factors

Neonatal mortality has significant link with the social status of the mother and or the immediate family the baby is born to. The wealth status of the family contributes greatly to the survival of the newborn. According to Neupane & Doku (2014), parent's wealth determines the environment the new born is kept in the early days of life. In countries where there are no policies to cater for the health needs of the newborn, economic hardship is a barrier for parents to afford the cost of caring for the newborn, thus neonatal mortality are higher. It is also known that neonatal death among mothers with lower wealth index are higher compared to mothers who fall within higher levels of wealth index (Kumar, Dandona, Chaman, Singh, & Dandona, 2014; Mohamoud, Kirby, & Ehrenthal, 2019). In a wealth based study conducted by Bado & Appunni (2015) among women who belonged to the poorest wealth index quintile, Nigeria recorded 31.4% under five mortality followed by Cote d'Ivoire with 30.4% and Ghana recorded 36.4% . Several factors of the health of the neonates are also linked to whether the parents are working or not. Research has shown that neonates with fathers not working have increased odds of neonatal death (OR=1.8 (95% CI 1.30, 3.0) compared to working fathers. Again, wealth index already identified to be associated with neonatal mortality is linked to the occupational status of the parents of the neonates (Upadhyay et al., 2012). Poor environment is usually associated with poverty and neonates born to such environment are susceptible to neonatal sepsis which is identified as one of the leading causes of death among neonates (Enyuma,

Ekanem, Udo, & Asindi, 2015). A study conducted in Ghana found APGAR score and neonatal age as being associated with neonatal mortality with 17.5% neonates dying as a result of neonatal sepsis (Adatara et al., 2018; Manortey et al., 2011). Generally, economic activities and improved healthcare delivery are relatively better in the urban areas compared to the rural settings of many low income countries. Most health professionals and specialists are sited in the urban communities to the detriment of those who live in the rural areas. This phenomenon tends to have a negative impact on the survival of the neonates (Mohamoud et al., 2019). The availability of certain services in the urban areas improves in the survival of the neonates. A study by Mohamoud et al., (2019) reveals that odds of mortality among term infants increase with rurality.

2.5 Maternal factors

Maturity of the mother is important when it comes to the survival of the newborn. In most cases, stages of labour are unacceptably delayed due to immaturity of mother. Cephalopelvic disproportion when undetected early can prolong second stage of labour which can have diverse effect on the both neonate and the mother. Younger mothers tend to experience more neonatal death compared to older women (Coulibaly et al., 2016). Okawa et al., (2015) argues that maternal age less than 20 years, lower educational levels and fewer ANC visits contribute to neonatal mortality. The health of a neonate is stretched to the peak at delivery as a result teenagers put their new borns in danger.

Undoubtedly, education in countries with high prevalence of neonatal mortality is low compared to countries with low prevalence. The educational level of mothers has significant impact on the survival of the neonates in low income countries. According to Kumar et al., (2014) mothers with no education have 1.15 odds of neonatal deaths (95% CI 0.86, 1.53) compared to mothers with any some level of educational. Knowledge acquired in school, print or electronic media and other sources, aid women in the response to danger signs in their

neonates. Countries with lower levels of education for women in their reproductive age have relatively higher prevalence in neonatal mortality.

2.6 Religion

Religion is an important aspect of life among most Africans. Decisions relating to health are taken with recourse to their belief and faith in their religious doctrines. Some individuals refuse certain health interventions and treatment on religious bases. The West African sub-region has religions ranging from Christianity, Islam, Traditional religion and others. A study conducted in Bangladesh revealed that 89.78% of neonatal death occur among Muslims compared to non-Muslims (Maniruzzaman et al., 2018). Another study suggested that sometimes lifesaving decisions have to be taken against the belief of Jehovah Witnesses, with regards to neonates (Sauer & Marc-Aurele, 2016).

2.7 ANC

For appropriate prognosis and interventions to be put in place to avert complications before and after delivery, pregnant mothers must regularly visit the ANC for thorough examination and treatment with regards to pregnancy related complications. According to Arunda, Emmelin, & Asamoah (2017), mothers who neither attended ANC nor received Tetanus toxoid vaccination had increased odds of neonatal mortality, OR=4.0 (95% CI 1.7, 9.1) of experiencing neonatal mortality.

Early reporting of conception to the health professional is key in prevention of pregnancy related complications. Studies have indicated that mothers' educational level and wealth index affect the timing of their first ANC attendance. Women with higher educational level are more likely to initiate early ANC attendance compared to uneducated women AOR=11.40 (95% CI 5.05, 25.73) (Paudel, Jha, & Mehata, 2017). Dorji et al., (2019) argued that multigravida mothers appeared to have late booking of ANC. The study further revealed that rurality and

mothers with primary educational levels is associated with late ANC attendance (after 12 weeks). A study conducted in Ghana indicated that 4 or more ANC visits reduced preterm delivery (Aseidu et al., 2019; Dorji et al., 2019).

2.8 Skilled attendant at birth

Assisted delivery by a skilled attendant is considered one of the factors that is associated with the reduction of neonatal mortality. The West African sub region is known to have Traditional Birth Attendants (TBAs) assisting deliveries. Most TBAs are untrained and cannot identify complications through prognosis. They rely mainly on herbs and unsterilized instruments for delivery. According to Moyer, Dako-Gyeke, & Adanu (2013), most countries in West Africa were reported to have relatively lower percentages of skilled attendants at birth from 2003 to 2008; Benin - 76.2%, Burkina Faso - 39.7%, Ghana - 57.8%, Guinea - 30.5%, Mali - 28.8%, Niger - 18.8%, Nigeria - 36.1% and Senegal - 47.2%. These figures are commensurate with early neonatal mortality in these countries. An improvement in the percentages for skilled attendants were estimated between 2010 to 2013 from a study conducted by Amouzou, Ziqi, Carvajal–Aguirre, & Quinley (2017) with Benin - 80.9%, Burkina Faso - 65.9%, Guinea - 45.3%, Senegal - 65.1% and Cote d'Ivoire - 59.4%. Most countries in the West African sub region have improved on the percentage of skilled attendant at birth. Despite these increases, the sub region is unlikely to achieve the target relating to neonatal mortality in SDGs unless unprecedented efforts are applied to accelerate progress (United Nations, 2017).

2.9 Place of delivery

The health facility is generally the ideal place to deliver a baby. This will enable health professionals to keep an eye on both the mother and the newborn during the perinatal period. In this manner, emergencies and complication resulting from the delivery can be identified in time and appropriately dealt with. However, within the sub-Saharan Africa region, economic

constraints and some cultural practices prevent some mothers from delivering at the health facility. This phenomenon contribute to some mothers acquiring the services of traditional birth attendants (TBAs) (Amouzou et al., 2017; Moyer et al., 2013; United Nations, 2017). A research conducted in 2016 on facility-based delivery estimated that 85% of deliveries are more likely to occur in the health facility from 2010 compared to deliveries which occurred in the 1990s (Doctor, Nkhana-Salimu, & Abdulsalam-Anibilowo, 2018). According to Nesbitt et al., (2016), distance to health facility contributes to the woman's decision to seek care from a health facility. In effect mothers who live far away from health facility are unlikely deliver in the health facility

2.10 Birth weight

It is known that low birth weight is associated with preterm which is one of the leading causes of neonatal mortality globally (WHO, 2012). A study conducted in Burkina Faso estimated that neonatal mortality rate among low birth weight babies was 53 per 1000 live birth which was much higher than that of the general population. The study further revealed that Hazard Ratio among preterm was estimated at 8 times compared to normal weight babies (Coulibaly et al., 2016). A study conducted in Ghana confirmed higher neonatal mortality among preterm babies with low birth weight. In consistency with the above, results from a study conducted in Nigeria showed that all neonates with extremely low birth weight who experienced hyperthermia resulted in death within 8 hours after birth (Amadi et al., 2015).

CHAPTER THREE

METHODOLOGY

This section provides details about how the research problem was investigated, the research design employed, study population, source of data, data collection tool and the research techniques that were used in processing and analysing the data obtained.

3.1 Source of data

This study was conducted with secondary data obtained from the DHS program, an international USAID funded project which provides technical assistance and support needed in implementing population and health surveys in several countries across the world. It is a nationally representative household survey which provides vast information and impact evaluation indicators in several areas including maternal and child mortality, reproductive health, HIV, family planning, fertility preferences and nutrition. The surveys are in two main categories; the Standard and Interim DHS. The Standard DHS involves large sample sizes ranging from 5,000 to 30,000 households and are typically conducted every five years for comparison over time. For Interim DHS, smaller sample sizes are used and information is collected on key performance monitoring indicators but may not include all impact evaluation indicators such as mortality rates. In addition, they are conducted between rounds of standard DHS and have shorter questionnaires.

A data request and short research proposal was submitted to the official DHS website. The request was approved and dataset was provided via email within two working days. Data was obtained on all six countries for all available survey years.

3.2 Sample design

The DHS employs a stratified two-stage sample design with the aim of estimating key indicators both at the national level as well as the rural and urban areas of the countries

involved. The first stage involves the selection of clusters made up of enumeration areas or primary sampling units which is usually drawn from the most recent census data. At the second stage, a sampling frame is made up of all households to allow for equal chances of selection and to make the data obtained nationally representative. Households to be included in the survey are randomly selected from the sampling frame.

In the selected households, only individuals between the ages of 15-49 years who were either permanent residents or stayed over the night before the survey were eligible to be interviewed and have their anthropometric measurements taken.

3.3 Study area

The West African sub region is made up of 16 countries located on the western side of the continent. For the purposes of this study, only six West African countries were selected based on their most recent neonatal mortality prevalence. All countries in West Africa were listed in order of those with the highest prevalence. Out of these, five countries were selected based on availability of DHS data with the aim of comparing those countries with the least prevalent country. Although, Ghana did not have the least prevalence of neonatal mortality, it was included because the researcher wanted to compare the situation in the high prevalent countries to that of Ghana to determine the existence of any differences.

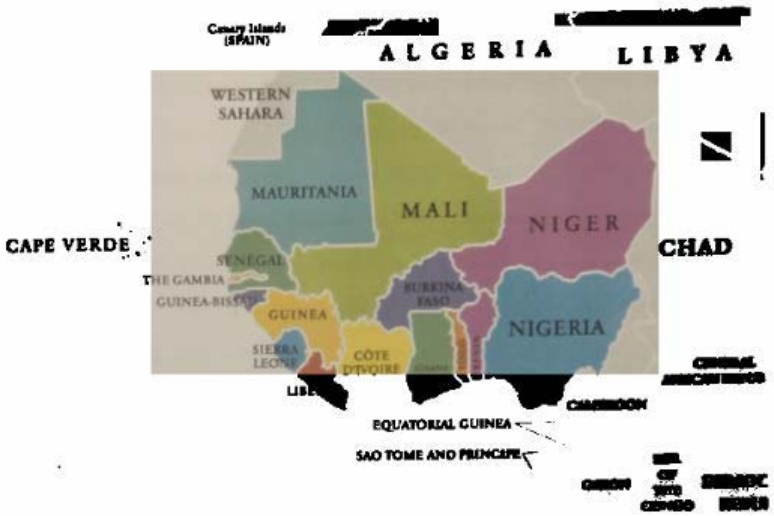


Figure 1: Map of West Africa

(Adopted from https://mapscompany.com/collections/west-africa)

3.4 Data variables

3.4.1 Dependent variable

The dependent variable for this study was neonatal mortality which is defined as death within the first 28 days of life. It was coded as a binary outcome. A code of "1" was assigned to children who experienced neonatal mortality and "0" assigned to those who did not.

3.4.2 Independent variables

The ages of respondents were recorded in the DHS in five year group categories from 15-49 years. Place of residence was recoded as urban or rural categories, level of education recoded

as 'no education', 'primary', 'secondary' or 'higher' education and wealth index recoded in four categories as 'poorest', 'poorer', 'middle', 'richer' and 'richest'.

Other independent variables used were recoded for analysis as follows; this study combined all forms of Christian denominations such as 'Anglican', 'Methodist', 'Protestant', 'Evangelical', 'Catholic' and 'Presbyterian' into 'Christian'. Other categories of religion are 'Islam', 'Traditional', 'Others' and 'None'. With respect to occupation of respondents, responses such as 'sales', 'clerical', 'agricultural employees, employers' 'skilled, unskilled manual', 'services' were grouped into 'Working, otherwise 'Not working'. Responses for place of delivery such as 'CHPS', 'health centre', 'health post', 'government, private hospital', and 'mobile clinic' were combined into 'Hospital facility'. 'Respondent's, other homes' were also combined into 'Home' otherwise 'Others'. Birthweight of babies born to respondents were recorded in kilograms (kg) which was for this study grouped into three categories; 'Low' (below 2.5kg), 'Normal' (2.5-4.5 kg), 'Above normal' (above 4.5 kg) and 'Not weighed at birth' (babies who were not weighed at birth). Responses for the month in which respondents attended ANC for the first time was recorded in months. This was recoded into four categories 'First trimester' (0–3 months), 'Second trimester' (4–6 months), 'Third trimester' (7–9 months) and 'After third trimester' (first attendance after 9 months). 'Doctor assisted', 'Nurse/midwife assisted', 'CHO assisted' and 'TBA assisted' deliveries were combined into 'Skilled attendant at birth' which is a binary outcome coded '0' (No) and '1' (Yes).

3.5 Data collection tool

The DHS employs the use of structured questions as an interview guide for collection of data. Four model questionnaires are used to collect data namely household, women's, men's and biomarker questionnaires. This study utilised the women's survey in which data was collected from all eligible women between the ages of 15 and 49 concerning topics such as demographic

characteristics, birth history, child mortality, knowledge and use of contraception, fertility preferences, ANC, delivery, PNC breastfeeding, infant care practices amongst others.

3.6 Statistical analysis

For each of the selected high prevalent countries, analysis was conducted on each survey year for individual countries and the pooled data set using Stata 14. Consideration was made for the sample weight using survey analysis functions. Frequencies, percentages and odds ratios were reported at a 5% level of significance. Pearson Chi-square test of independence was also conducted to determine association between frequencies of neonatal mortality in different survey years within each country.

Logistic regression analysis is used to determine association between a binary outcome and one or more independent variables which may be categorical or ordinal in nature. The goal of logistic regression is to find the best fitting model to describe the relationship between the outcome and independent variables (Liu, 2017).

Simple and multiple logistic regression analysis was done to determine the association between neonatal mortality and independent variables. For simple logistic regression, crude odds ratios were reported with their 95% confidence intervals and level of statistical significance. Adjusted odds ratios and their 95% confidence intervals and level of statistical significance were reported for multiple logistic regression analysis

Separate analysis was conducted for DHS data sets obtained for the various countries using Stata version 14 accounting for weights through the survey data analysis functions. Data was also entered into Microsoft Excel for the generation of various tables. Bivariate logistic regression was conducted for each survey year of the various countries as well as for the combined data set to determine association between the neonatal mortality and each of the independent variables. Multiple logistic regression analysis was also conducted to determine

adjusted odds ratios with their confidence intervals for each survey year and the combined years for individual high prevalent countries.

CHAPTER FOUR

RESULTS

4.1 Introduction

In this chapter, findings on distribution and trends of neonatal mortality, bivariate and multivariate logistic regression analyses in the selected high prevalent countries are presented.

4.2 Distribution of neonatal mortality

From the pooled data set, it was observed that in Benin, neonatal mortality was least in 1996 compared to the other survey years. With respect to age, babies born to women within the 45-49 age group experienced the least number of neonatal deaths over all the survey years being 3% in 1996 and 18% in 2017/18. In 1996, women aged between 25-29 years accounted for the highest percentage of neonatal mortality (20.11%) whilst women between 40-49 years accounted for the least percentage of 3.12%.

Neonatal deaths were found to be highest among babies born to mothers without any education with the least occurring among mothers with secondary education in each of the survey years with the exception of 2017/18 where mothers with higher education recorded the least percentage (1.03%) of neonatal mortality. Christian mothers recorded the highest (41.95%) of neonatal deaths in 1996 with an increase to 45.05% in 2017/18 survey year which was still the highest compared to other religions. Working mothers recorded a higher percentage of neonatal mortality than mothers who did not work which was consistent in all the survey years. In 2017/18 survey year, a higher percentage of 84.63% neonatal deaths occurred in babies delivered in health facilities than those delivered at home and places other than a health facility. These results are presented in Appendix 1 table 1.

Babies born to Ivorian mothers within 20-24 years experienced the highest percentage of neonatal deaths in all survey years with the least being within the 45-49 age group from the pooled data set. Mothers with higher education recorded the least of neonatal deaths; 1.17%

and 1.81% in 2006 and 2017/18 survey years respectively with uneducated mothers recording 64.25% and 63.81% in those same years respectively.

A higher percentage of working mothers (77.97%) lost their babies in the neonatal period compared to those who were not working (22.03%) in all the survey years put together. Also, women who delivered in health facilities recorded more neonatal deaths with the least of 62.37% in 1998/99 and highest of 78.84% in 2017/18 survey year as shown in Appendix 2 table 1.

Generally in Ghana considering the various age groupings, neonatal mortality was least among babies born to mothers within 15-19 years (3.07%) in the pooled data closely followed by 45-49 years with 3.51%. Percentage was however high in women within 30-34 years (23.44%). The results showed that in terms of education the highest percentage of neonatal deaths occurred in babies whose mothers have had secondary education (40.09%) in the pooled data. Christian mothers experienced more neonatal deaths (75.69%) than all the other religious groupings likewise working mothers (85.92%). Percentage of neonatal deaths which occurred during home deliveries decreased from 54.35% in 1998 to 17.95% in 2014 whilst that of health facilities increased from 40.22% in 1998 to 80.75% in 2014. These results are presented in table 4.1.

From the pooled data set, there was an increase in neonatal mortality in Mali amongst babies born to mothers aged between 30-34 years from 15.18% in 1995/96 to 16.17% in 2012/13 survey years whilst that of mothers aged between 15-19 years decreased from 17.89% to 11.27% in the same period. Babies born to uneducated mothers accounted for 82.07% of neonatal deaths in 1995/96 whilst women with higher education accounted for 0.44% in the same year. Also, 93.46% of neonatal deaths were experienced by babies of Islamic mothers followed by other religions - 2.89%, Traditional - 1.99% and Christians - 1.66% in the pooled data set. In 1995/96 survey year, 71.2% of neonatal deaths were accounted for by babies born

to working mothers and 28.8% by babies of non-working mothers. This was however reversed in 2012/13 survey year where 29.74% was accounted for by babies of working mothers and 70.26% for babies of non-working mothers. Mothers belonging to the 'poorest' and 'poorer' wealth index class recorded the same percentage (23.53%) of neonatal deaths in 1995/96 survey year. These results are displayed in Appendix 3 table 1.

In Nigeria, the highest percentage of neonatal deaths was accounted for by babies of mothers within 25-29 years for each survey year as well as for the pooled data with the least being mothers within 45-49 years. Uneducated mothers also experienced the highest percentage of 52.26% as opposed to mothers with primary, secondary or higher education as 23.78%, 20.37% and 3.59% respectively in the pooled data. Muslim mothers lost more babies to neonatal mortality than Christians, Traditionalists and those who did not belong to any religious affiliation. Home deliveries accounted for more neonatal deaths with 70.12% in 2003 and 60.37% in 2013 while hospital deliveries recorded 27.63% and 34.78% in the same survey years respectively as presented in Appendix 4 table 1.

In Niger, with the exception of 2006 survey year where the highest percentage of neonatal deaths was accounted for babies of mothers between 25-29 years, babies of mothers between 20-24 years accounted for the highest percentages in the rest of the survey years as well as the pooled data set with 24.55%. Babies of uneducated mothers also experienced more neonatal deaths than mothers with primary, secondary or higher education. Home deliveries accounted for more neonatal deaths (77.73%) than deliveries conducted in the health facilities (13.18%) in the pooled data set. Babies not weighed at birth also experienced more neonatal deaths than those with low and normal birth weight as presented in Appendix 5 table 1.

Table 4 Distribution of neonatal mortality in Ghana

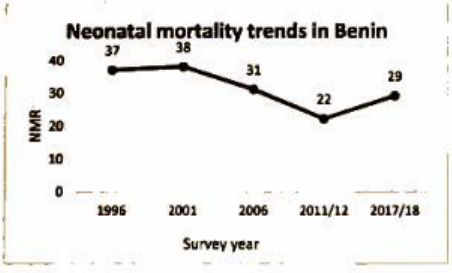
Variable	1998	2003	2008	2014	Total
Age					
15-19	3(2.93)	7(4.35)	3(3.45)	3(1.7)	16(3.07)
20-24	26(26.39)	25(15.15)	18(20.01)	27(16.44)	96(18.54)
25-29	18(18.43)	32(19.97)	17(17.99)	32(18.89)	98(18.98)
30-34	16(16.15)	42(26.2)	21(23.02)	42(25.22)	121(23.44)
35-39	23(23.34)	26(16.22)	17(18.95)	45(26.8)	111(21.45)
40-44	12(12.2)	19(11.65)	9(10.27)	17(10.12)	57(11.02)
45-49	1(0.56)	10(6.45)	6(6.31)	1(0.83)	18(3.51)
Level of education					
No education	37(37.69)	56(34.54)	32(34.99)	41(24.59)	166(32.01)
Primary	25(26.12)	49(30.32)	23(25.27)	38(23.04)	136(26.29)
Secondary	33(34.41)	55(33.72)	36(39.01)	84(50.2)	208(40.09)
Higher	2(1.79)	2(1.42)	1(0.72)	4(2.17)	8(1.61)
Religion					
Christian	74(75.85)	126(77.67)	57(61.93)	136(81.23)	392(75.69)
Islam	8(7.83)	24(14.78)	18(19.8)	28(16.8)	78(15.01)
Traditional	7(6.77)	6(3.71)	6(7.03)	2(1.26)	21(4.09)
Others	0(0)	0(0)	0(0)	0(0)	0(0)
None	9(9.55)	6(3.84)	10(11.24)	1(0.71)	27(5.21)
Occupation					
Not working	15(15.85)	20(12.21)	13(14.4)	24(14.68)	73(14.08)
Working	82(84.15)	142(87.79)	78(85.6)	142(85.32)	444(85.92)

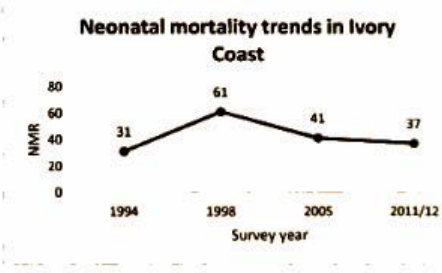
Distribution of neonatal mortality in Ghana continued

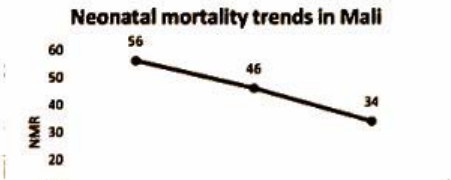
Variable	1998	2003	2008	2014	All years
Wealth index					
Poorest	32(32.9)	36(21.89)	24(25.98)	40(23.91)	131(25.33)
Poorer	16(16.11)	37(23.08)	14(14.97)	33(19.52)	99(19.19)
Middle	28(28.57)	40(24.86)	25(26.81)	27(16.19)	120(23.11)
Richer	13(13.82)	22(13.37)	17(18.54)	34(20.46)	86(16.65)
Richest	8(8.6)	27(16.81)	13(13.7)	33(19.92)	81(15.72)
Timing of 1st ANC attendance					
1st trimester	36(44.18)	43(61.68)	18(45.98)	43(72.23)	140(56.04)
2nd trimester	38(46.99)	26(37.74)	21(54.02)	16(27)	101(40.72)
3rd trimester	7(8.83)	0(0.59)	-	0(0.78)	8(3.23)
After 3rd trimester	-	-	-	-	-
Place of delivery					
Home	49(54.35)	60(36.91)	35(37.59)	30(17.95)	174(33.96)
Health facility	36(40.22)	77(47.18)	55(60.3)	134(80.75)	303(59.23)
Others	5(5.43)	26(15.9)	2(2.1)	2(1.31)	35(6.82)
Skilled attendant at birth					
No	42(42.94)	36(22.39)	25(27.49)	13(7.85)	116(22.47)
Yes	55(57.06)	126(77.61)	67(72.51)	154(92.15)	402(77.53)
Birth weight					
Low	0(0)	2(1.4)	5(5.39)	10(5.76)	17(3.3)
Normal	2(2.63)	6(3.94)	10(10.71)	22(13.24)	41(7.97)
Above normal	-	-	-	-	-
Not weighed at birth	87(97.37)	154(94.66)	77(83.91)	135(81)	453(88.73)

4.3 Neonatal mortality trends

Neonatal mortality trends in the selected high prevalent countries are presented in Fig 4.1. It can be observed that neonatal mortality rates in Benin increased slightly from 37 per 1000 live births in 1996 survey year to 38 per 1000 live births in 2001 after which the rates declined steadily to 22 in 2011/12 and then increased to 29 deaths per 1000 live births. In Ivory Coast, neonatal mortality rates in 1994, stood at 31 after which there was a sharp increase to 61 per 1000 live births and then a gradual decline to 37 deaths per 1000 live births as at 2011/12 survey year. For Ghana, there was an increase in neonatal mortality rates from 30 in 1998 to 43 in 2003. This declined steadily to 30 deaths per 1000 live births in 2008 and then to 29 deaths per 1000 live births in 2014. There was progressive decrease in neonatal mortality rates in Mali from 56, then to 46 and subsequently to 34 deaths per 1000 live births in 1995/96, 2006 and 2012/13 survey years respectively. In 2003, neonatal mortality rates increased to 46 from 42 in 1990 in Nigeria. There was however a decline to 39 in 2006 and then to 37 per 1000 births in 2012. Neonatal mortality rates in Niger experienced a steady decline from 40 to 39 deaths per 1000 live births. The rates declined again to 33 and further to 24 per 1000 live births in 2006 and 2012 respectively.







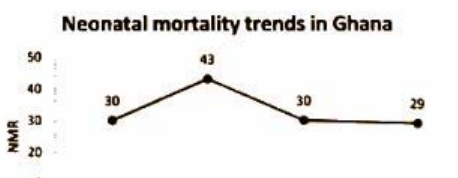
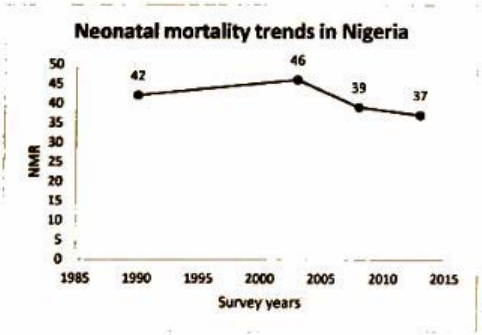
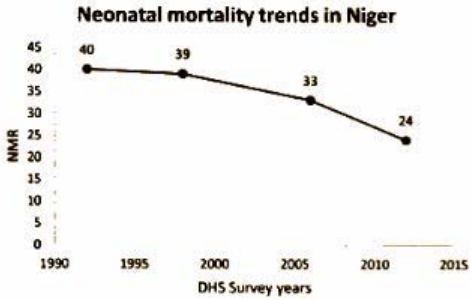


Figure 2: Neonatal mortality trends across survey years for each country





Neonatal mortality trends across survey years for each country continued

4.4 Association between neonatal mortality and survey years

A Pearson Chi-square test of independence was done to determine association between frequencies of neonatal mortality in different survey years within each country. The results indicated a significant variation in the neonatal mortality rates in each of the selected high prevalent countries. Also, from the pooled data set, the variation in neonatal mortality across countries was found to differ significantly from the other [Chi (5) =219, P<0.001

4.5 Bivariate analyses of neonatal mortality and independent variables

Simple logistic regression analysis was conducted to determine association between neonatal mortality and independent variables for each survey year in the selected high prevalent countries.

In Benin, mothers within all other age groups were less likely to experience neonatal mortality compared to mothers between the ages of 15-19 years and most of these associations were significant in 1996, 2001 and 2006 survey years. In 2012/13 and 2017/18 survey years, mothers aged between 45-49 years were more likely to lose their babies within the neonatal period compared to the other age groups. Over all the survey years, mothers within the ages of 20-49 years had reduced odds of neonatal mortality compared to those within 15-19 years and four of these five-year age groups had significant association; 20-24 years (OR=0.76, 95% CI 0.06, 0.97), 25-29years (OR=0.59, 95% CI 0.46, 0.75), 30-34 years (OR=0.64, 95% CI 0.50, 0.12) and 35-39 years (OR=0.73, 95% CI 0.57, 0.95). Level of education of the mothers was found to have significant association with neonatal mortality. Babies whose mothers had secondary education had 97% reduced odds of neonatal mortality (OR=0.3, 95% CI 0.11, 0.81) and those with primary education had 27% increased odds of neonatal mortality (OR=1.27 95% CI 1.01, 1.61) in 2001 and 2008 respectively. There was a significant association (OR=1.43, 95% CI 1.02, 2.03) and (OR=1.26 95% CI 1.08, 1.46) between neonatal mortality and mothers who did

not belong to any religion for 2017/18 survey year and combined years respectively compared to Christians. Working mothers were found to have decreased odds of neonatal mortality for 2001 survey year but vice versa for the other survey years compared to non-working mothers. This association was found to be significant only for 2011/12 survey year (OR=1.5 95% CI 1.14, 1.97). There was an association wealth index and neonatal mortality. Significant of these associations were mothers who belonged to the "poorer" and "richer" categories being more likely to lose their babies within the neonatal period (OR=1.72, 95% CI 1.24, 2.39) and (OR=1.62, 95% CI 1.15, 2.28) respectively. Babies delivered in health facilities experienced reduced odds of neonatal deaths in all the survey years compared to babies delivered at home except for 2017/18 survey year where the likelihood increased (OR=1.17, 95% CI 0.85, 1.61). However, this increase was not significant. Babies delivered in places other than health facilities were more likely to experience neonatal deaths compared to babies born at home over all the survey years with the exception of 1996. There was a statistically significant increase in odds from (OR=4.78 95% CI 2.11, 10.79) in 2006 to OR=11.11 95% CI 5.16, 23.9). Generally, the likelihood of neonatal deaths in Benin with delivery conducted by a skilled attendant across the survey periods was reduced. This association was found to be significant during 2006 (OR=0.73 95% CI 0.59, 0.91), 2011/12 (OR=0.62 95% CI 0.44, 0.86) and combined years (OR=0.78 95% CI 0.68, 0.88). Babies with normal birth weight were found to be less likely to experience neonatal deaths compared to low birth weight babies across all the survey years and this was significant. These results are presented in Appendix 1 table 2.

In Ivory Coast, mothers within the age bracket of 25-29 years and 30-34 years were less likely to lose their babies to neonatal mortality across all survey years. This was found to be significant for 25-29 age group in 1994 (OR=0.41, 95% CI 0.22, 0.78 P<0.01) and in 2005 for the 30-34 age group (OR=0.37 95% CI 0.15, 0.90 P<0.05). In 1998, babies born to mothers who belonged to the "middle" and "richest" categories of wealth index experienced significant

reduced odds (OR=0.35, 95% CI 0.17, 0.71) and (OR=0.35 95% CI 0.19, 0.64) respectively. In 1994, babies born mothers delivered by skilled attendants had 56% increased odds of neonatal deaths compared to babies born to mothers who were delivered at home and this association was found to be significant (OR=1.56 95% CI 1.02, 2.37). Babies with normal birth weight were less likely to die within the neonatal period in 1994 (OR=0.17, 95% CI 0.09, 0.32 P<0.001), 1998 (OR=0.28, 95% CI 0.13, 0.61 P<0.01) and 2005 (OR=0.28, 95% CI 0.13, 0.61 P<0.01) compared to babies with low birth weight and this association was significant as presented in Appendix 2 table 2.

Association between age and neonatal mortality among Ghanaian mothers was not significant across most survey years except in 2014 when babies born to mothers within 35-39 years were more likely to experience neonatal mortality compared to babies born to mothers between 15-19 years. Mothers' place of residence, occupation, wealth index and skilled attendant at delivery were not significantly associated with neonatal deaths. In 2003, babies born to mothers with primary education had 56% increased odds of neonatal deaths compared to mothers without any formal education (OR=1.56, 95% CI 1.03, 2.36) and this was found to be significant. For mothers who delivered in the health facility, there was a significant increase in the odds of neonatal mortality (OR= 1.66, 95% CI 1.09, 2.52) in 2008. Normal birth weight was also found to be negatively associated with neonatal deaths and this association was significant in most survey years. These results are presented in table 4.2

In Mali, compared to mothers between the ages of 15-19 years, there was significant negative association between age and neonatal mortality in 1995/96 survey year for all age groups. Again there was a negative association between age and neonatal mortality in 2006 but this was only significant for 20-24 years (OR=0.62 95% CI 0.44, 0.86), 25-29 years (OR=0.49 95% CI 0.35, 0.69) and 35-39 years (OR=0.55 95% CI 0.38, 0.79) respectively.

Mothers with secondary education compared to those without education were less likely to lose their babies within the neonatal period and this was consistent throughout all the three survey years. However, it was only significant in 1995/96 survey year (OR=0.54 95% CI 0.31, 0.93). Muslim mothers had two times higher odds of experiencing neonatal mortality compared to Christian mothers in 1995/96 and this was found to be statistically significant. (OR=2.45 95% CI 1.23, 4.87). Working mothers in 1995/96 significantly had 36% increased odds of neonatal mortality compared to non-working mothers (OR=1.36, 95% CI 1.1, 1.67). Normal birthweight was found to be negatively associated (OR=0.42 95% CI=0.23, 0.77) with neonatal mortality across all survey years. This association was however found to be significant in 2006 survey year as presented in Appendix 3 table 2.

There was negative association between neonatal mortality and age of Nigerian mothers. This association was found to be significant in 2008 and 2013 survey years for 20-24, 25-29, 30-35 and 35-39 age groups. Compared to mothers without any education, those who had secondary or higher education had reduced odds (OR=0.79, 95% CI 0.67, 0.94) and (OR=0.68, 95% CI 0.47, 0.99) respectively from the pooled data set. There was a consistent positive association between a mother's place of residence and neonatal mortality which was significant for 2003 (OR=1.59, 95% CI 1.16, 2.19), 2008 (OR=1.31, 95% CI 1.12, 1.53) and 2013 (OR=1.32, 95% CI 1.13, 1.53). In 1990, babies born to Muslim women had 44% increased odds of neonatal mortality compared to those born to Christian mothers and this was significant. The results also showed that a mothers' occupation, trimester of pregnancy in which she first attended ANC for the first time and whether her delivery was conducted by a skilled attendant or not did not have any significant association with neonatal mortality in all the survey years.

There was no significant association found between delivery at the health facility and neonatal mortality compared to those who delivered at home in all the survey years. However, delivery at places other than the health facility increased the odds of neonatal mortality to more than 4

times (OR= 4.94, 95% CI 3.53, 6.92) compared to delivery conducted at home. These results are presented in Appendix 4 table 2.

In Niger, compared to babies born to mothers between the ages of 15-19 years, mothers within the other age groups had reduced odds of neonatal mortality, some of which were significant especially in 2003 where for instance 30-34 age group had 71% reduced odds (OR= 0.29, 95% CI 0.17, 0.51). The association between mothers' level of education and wealth index was found to be insignificant. In 1990, children born to working mothers were more likely to experience neonatal deaths (OR=1.21, 95% CI 0.92, 1.58). However, in 2013 children born to working mothers were less likely to experience neonatal deaths compared to non-working mothers and this was found to be significant (OR=0.6, 95% CI 0.44, 0.83). Babies born to mothers who attended ANC for the first time during the third trimester of pregnancy were found to be three times (OR=3.11, 95% CI 1.52, 6.37) more likely to die within the neonatal period compared to women who attended ANC for the first time in the first trimester of pregnancy. The odds of neonatal mortality among babies born to mothers who delivered in the health facility increased significantly from 37% reduced odds (OR=0.63, 95% CI 0.43, 0.93) in 1990 to more than two times higher odds (OR=2.52 95% CI 1.63, 3.88) in 2013. Normal birth weight was found to have significant negative association with neonatal mortality in all the survey years. These results are presented in Appendix 5 table 2.

Table 5: Crude odds ratios of neonatal mortality in Ghana

Variable	1998	2003	2008	2014	All years
	OR 95% CI	OR 95% CI	OR 95% CI	OR 95% CI	OR 95% CI
Age					
15-19	Ref	Ref	Ref	Ref	Ref
20-24	1.47 [0.39, 5.51]	0.63 [0.25, 1.58]	1.19 [0.33, 4.31]	2.07 [0.69, 6.16]	1.16 [0.66, 2.03]
25-29	0.83 [0.22, 3.18]	0.59 [0.24, 1.43]	0.74 [0.2, 2.71]	1.61 [0.54, 4.78]	0.85 [0.49, 1.49]
30-34	1.03 [0.26, 4.01]	0.92 [0.38, 2.23]	1.32 [0.37, 4.7]	2.17 [0.73, 6.51]	1.25 [0.71, 2.19]
35-39	1.84 [0.49, 6.92]	0.73 [0.29, 1.85]	1.28 [0.36, 4.63]	3.15 [1.05, 9.48]*	1.47 [0.83, 2.6]
40-44	1.66 [0.41, 6.69]	1.11 [0.4, 3.12]	1.56 [0.39, 6.16]	2.55 [0.77, 8.39]	1.56 [0.85, 2.88]
45-49	0.23 [0.02, 2.34]	1.31 [0.44, 3.95]	2.33 [0.5, 10.83]	0.7 [0.14, 3.42]	1.36 [0.65, 2.86]
Level of education					
No education	Ref	Ref	Ref	Ref	Ref
Primary	1.32 [0.77, 2.28]	1.56 [1.03, 2.36]*	0.95 [0.53, 1.7]	1.29 [0.76, 2.18]	1.29 [1, 1.65]
Secondary	0.87 [0.53, 1.43]	1.11 [0.73, 1.7]	0.91 [0.54, 1.51]	1.17 [0.75, 1.82]	1.01 [0.8, 1.27]
Higher	1.98 [0.41, 9.45]	1.53 [0.35, 6.61]	0.27 [0.04, 2.03]	0.54 [0.19, 1.52]	0.66 [0.33, 1.32]
Place of residence					
Urban	Ref	Ref	Ref	Ref	Ref
Rural	1.61 [0.9, 2.89]	1.3 [0.86, 1.98]	1.15 [0.72, 1.84]	1.01 [0.68, 1.5]	1.21 [0.97, 1.51]
Religion					
Christian	Ref	Ref	Ref	Ref	Ref
Islam	0.62 [0.31, 1.24]	0.74 [0.47, 1.17]	1.18 [0.68, 2.06]	0.92 [0.58, 1.45]	0.87 [0.67, 1.12]
Traditional	0.66 [0.28, 1.53]	0.51 [0.21, 1.25]	1.87 [0.78, 4.46]	0.27 [0.08, 0.92]*	0.66 [0.42, 1.05]
Others	-	-	-	-	-
None	1.01 [0.52, 1.98]	0.85 [0.41, 1.75]	1.98 [0.99, 3.97]	0.2 [0.04, 0.92]*	0.96 [0.65, 1.4]
Occupation					
Not working	Ref	Ref	Ref	Ref	Ref
Working	0.86 [0.48, 1.56]	0.95 [0.56, 1.61]	0.7 [0.37, 1.34]	1.25 [0.76, 2.06]	1.01 [0.76, 1.33]

Note. P<0.05=*, P<0.01=**, P<0.001=***, OR = crude odds ratio, P = probability value, CI = confidence interval

Crude odds ratios of neonatal mortality in Ghana continued

Variable	1998	2003	2008	2014	All years
	OR 95% CI	OR 95% CI	OR 95% CI	OR 95% CI	OR 95% CI
Wealth index					
Poorest	Ref	Ref	Ref	Ref	Ref
Poorer	0.61 [0.32, 1.15]	1.24 [0.76, 2.01]	0.66 [0.33, 1.32]	0.86 [0.52, 1.41]	0.86 [0.66, 1.14]
Middle	1.14 [0.66, 1.98]	1.51 [0.94, 2.44]	1.42 [0.77, 2.6]	0.76 [0.44, 1.32]	1.15 [0.88, 1.5]
Richer	0.65 [0.33, 1.3]	0.93 [0.52, 1.67]	0.95 [0.49, 1.82]	1.01 [0.53, 1.93]	0.89 [0.64, 1.25]
Richest	0.52 [0.23, 1.15]	1.33 [0.73, 2.41]	0.94 [0.46, 1.95]	1 [0.55, 1.84]	0.97 [0.69, 1.36]
Timing of 1st ANC attendance					
1st trimester	Ref	Ref	Ref	Ref	Ref
2nd trimester	0.94 [0.58, 1.52]	0.65 [0.38, 1.12]	1.69 [0.86, 3.33]	0.77 [0.41, 1.44]	0.98 [0.74, 1.3]
3rd trimester	1.37 [0.57, 3.34]	0.12 [0.02, 0.85]*	-	0.3 [0.04, 2.22]	0.85 [0.4, 1.82]
After 3rd trimester	-	-	-	-	-
Place of delivery					
Home	Ref	Ref	Ref	Ref	Ref
Health facility	0.93 [0.59, 1.47]	1.3 [0.9, 1.88]	1.19 [0.76, 1.86]	1.66 [1.09, 2.52]*	1.22 [0.99, 1.5]
Others	3.45 [1.27, 9.33]*	2.5 [1.41, 4.43]**	2.79 [0.59, 13.18]	5.68 [1.58, 20.43]**	3.24 [2.09, 5.04]***
Skilled attendant at birth					
No	Ref	Ref	Ref	Ref	Ref
Yes	0.79 [0.51, 1.21]	0.97 [0.63, 1.5]	1.07 [0.66, 1.73]	1.33 [0.71, 2.5]	0.98 [0.77, 1.23]
Birth weight					
Low	Ref	Ref	Ref	Ref	Ref
Normal	0.12 [0.03, 0.41]**	0.24 [0.04, 1.31]	0.23 [0.07, 0.8]*	0.24 [0.09, 0.64]**	0.25 [0.13, 0.5]***
Above normal	-	-	-	-	-
Not weighed at birth	-	1.98 [0.48, 8.19]	1.18 [0.41, 3.36]	2.1 [0.9, 4.91]	1.78 [0.98, 3.23]

Note. P<0.05=*, P<0.01=**, P<0.001=***, OR = crude odds ratio, P = probability value, CI = confidence interval

4.6 Multiple logistic regression analyses of neonatal mortality and independent variables

Multiple logistic regression analysis was conducted to determine the effect of other factors in neonatal mortality.

After adjusting for all other variables, age was found to be negatively associated with neonatal mortality especially in the 1996 survey year where this association was significant for all age groups except 45-49 age group among mothers in Benin. In 2006 survey year, mothers within 30–34 years had 62% reduced odds (AOR=0.38, 95% CI 0.18, 0.8) compared to mothers between 15–19 years. Mothers with primary education had significant increased odds (AOR=2.30, 95% CI 1.53, 3.46) and (AOR=1.72 95% CI 1.10, 2.70) of neonatal mortality in 2006 and 2017/18 survey years respectively compared to uneducated mothers. Also, working mothers were found to have significant increased odds of neonatal mortality compared to non-working mothers in the 2011/12 (AOR=1.94 95% CI 1.24, 3.02) and combined survey years (AOR=1.47, 95% CI 1.13, 1.19). The odds of neonatal mortality was found to be increased (AOR=1.97 95% CI 1.07, 3.61) among mothers who belonged to the 'middle' quintile of wealth index compared to those in the 'poorest' quintile in 2006 survey year. In addition, 'richer' mothers also had significant increased odds (AOR=2.59, 95% CI 1.33, 5.02) in 2017/18 survey year. With respect to ANC attendance, odds of neonatal mortality was found to be decreased in mothers who visited ANC for the first time in the third trimester of pregnancy in 1996 and 2001 survey years. The results also showed that mothers who delivered in the health facility had increased odds of neonatal mortality in 1996 and 2017/18 survey years. In addition, mothers who had skilled attendant at birth were three times more likely (AOR=3.04, 95% CI 1.15, 8.03) to lose their babies in the neonatal period in 2001 compared to those who did not. Babies with normal birth weight had significant reduced odds of neonatal mortality in all the survey years.

Ivorian mothers aged between 30-34 years were found to have significant reduced odds (AOR=0.36, 95% CI 0.14, 0.91) compared to mothers between 15-19 years in the 2011/12 survey year after adjusting for all other variables. In 1994 survey year, mothers with primary and higher education were found to have increased odds of neonatal mortality compared to uneducated mothers. In 1994 and 1998, babies with normal birth weight had reduced odds (AOR=0.14, 95% CI 0.07, 0.27) and (AOR=0.28, 95% CI 0.13, 0.60) respectively compared to low birth weight babies.

After adjusting for other factors, the results showed that in Ghana, compared to uneducated mothers, mothers who have had primary and secondary education had higher odds of neonatal mortality in 2003 and 2014 survey years respectively. Also pertaining to wealth index, mothers belonging to 'richest' wealth index were found to have significant higher odds (AOR=3.8, 95% CI 1.16, 12.45) , (AOR=5.74, 95% CI 1.27,25.98) of neonatal mortality compared to mothers of 'poorest' wealth index in 2003 and 2008 survey years respectively. Mothers who attended ANC for the first time in their third trimester of pregnancy had significant reduced odds (AOR=0.09, 95% CI 0.01, 0.71) of neonatal mortality in 2003. Babies delivered in the health facility had higher odds of neonatal mortality compared to babies delivered at home and this was significant in 2008 and 2014 survey years. Normal birth weight babies were found to have reduced odds of neonatal mortality compared to low birth weight babies in 1998 and 2014 survey years.

In Mali, results showed that compared to mothers between 15-19 years, mothers within all other age groups had significant reduced odds of neonatal mortality in 1995/96 survey year with the exception of those within 45-49 years which was not significant. Babies born to mothers with higher education were found to have higher odds (AOR=6.98, 95% CI 1.64, 29.71) and (AOR=13.47, 95% CI 2.75, 65.91) of mortality within the neonatal period in 1995/96 and 2006 survey years respectively. In addition, babies born to mothers in rural areas

experienced significant reduced odds of neonatal mortality compared to those in the urban areas in 1995/96 survey year. In 2006 survey year, mothers in 'middle' wealth index class had 48% reduced odds (AOR=0.52, 95% CI 0.27, 0.99) whilst those who delivered in health facilities had 64% increased odds (AOR=1.64 95% CI 1.05, 2.55) of neonatal mortality. Babies not weighed at birth had increased odds (AOR=5.00, 95% CI 1.92, 13.01) of neonatal mortality in 1995/96 survey year.

Nigerian mothers within other age groups had significant reduced odds of neonatal mortality especially in the 2013 and combined survey years compared to mothers between the 15-19 years age bracket. Odds among mothers with higher education was also found to be increased (AOR=4.6, 95% CI 1.24, 16.97) compared to uneducated mothers in 2003. In relation to religion, mothers belonging to Islamic and traditional religion in 1990, had higher odds compared to Christians. Mothers in the 'middle' and 'richest' classes of wealth index had significantly higher odds (AOR=4.22, 95% CI 1.84, 9.65) and (AOR=2.91, 95% CI 1.22, 6.96) respectively of neonatal mortality in the 1990 survey year. Babies who were delivered in health facilities had 57% increased odds (AOR=1.57 95% CI 1.11, 2.22) of mortality within the neonatal period in 2008 survey year compared to those who were delivered at home. Babies with normal birthweight also had significant reduced odds of neonatal mortality in 1990, 2008 and 2013 survey years.

In Niger, babies born to mothers in other age groups compared to those within 15-19 years had significant reduced odds of neonatal mortality in the combined survey years. In 2013 survey year, babies born to mothers living in the rural areas as well as those who had their first ANC attendance in the third trimester of pregnancy had significant increased odds of neonatal mortality (AOR=3.12, 95% CI 1.04, 9.34) and (AOR=2.18, 95% CI 1.03, 4.65) respectively. With respect to place of delivery, babies born in health facilities compared to those born at home had significant increased odds (AOR=2.34, 95% CI 1.05, 5.23) in 2003 and

(AOR=18.17, 95% CI 5.96, 55.38) in 2013 survey year. In addition, normal birth weight babies had significant reduced odds of neonatal mortality in 1990 and 2003 survey years as well as in the combined years.

Table 6: Adjusted odds ratios for neonatal mortality among Ghana

Variable	1998	2003	2008	2014	All years
	AOR 95% CI	AOR 95% CI	AOR 95% CI	AOR 95% CI	AOR 95% CI
Age					
20-24	1.52 [0.34, 6.73]	0.4 [0.1, 1.6]	3.07 [0.33, 28.18]	1.35 [0.34, 5.42]	1.1 [0.53, 2.28]
25-29	0.92 [0.2, 4.16]	0.51 [0.14, 1.83]	2.01 [0.23, 17.46]	1.35 [0.34, 5.33]	0.9 [0.44, 1.85]
30-34	0.8 [0.16, 3.89]	1.08 [0.32, 3.68]	3.72 [0.45, 30.94]	0.65 [0.14, 3.03]	1.1 [0.53, 2.3]
35-39	2.15 [0.48, 9.58]	1.13 [0.3, 4.25]	2.38 [0.28, 20.58]	2.02 [0.49, 8.29]	1.7 [0.81, 3.57]
40-44	2.06 [0.43, 9.91]	0.8 [0.17, 3.68]	4.12 [0.42, 40.48]	2.5 [0.5, 12.44]	1.81 [0.81, 4.04]
45-49	0.33 [0.03, 3.81]	3.23 [0.73, 14.21]	6.36 [0.52, 77.2]	0.52 [0.07, 3.96]	2.06 [0.8, 5.34]
Level of education					
No education	Ref	Ref	Ref	Ref	Ref
Primary	1.21 [0.61, 2.41]	2.38 [1.01, 5.62]*	1.39 [0.53, 3.67]	1.6 [0.62, 4.16]	1.56 [1.03, 2.36]*
Secondary	0.72 [0.37, 1.41]	1.67 [0.68, 4.11]	0.78 [0.26, 2.33]	2.23 [1.05, 4.74]*	1.18 [0.78, 1.79]
Higher	5.65 [0.99, 32.22]	4.09 [0.69, 24.19]	1.19 [0.12, 12.09]	1.48 [0.26, 8.38]	2.07 [0.83, 5.16]
Place of residence					
Urban	Ref	Ref	Ref	Ref	Ref
Rural	1.15 [0.51, 2.58]	2.07 [0.89, 4.85]	1.4 [0.46, 4.25]	1.02 [0.34, 3.04]	1.38 [0.88, 2.15]
Religion					
Christian	Ref	Ref	Ref	Ref	Ref
Islam	0.74 [0.34, 1.57]	0.79 [0.31, 2.02]	0.7 [0.24, 2.07]	1.28 [0.68, 2.42]	0.9 [0.6, 1.34]
Traditional	0.23 [0.05, 1.12]	0.99 [0.27, 3.59]	3.03 [0.91, 10.06]	1 [0, 0]***	0.66 [0.32, 1.35]
Others	0 [0, 0]***	1 [0, 0]***	1 [0, 0]***	0 [0, 0]***	1 [0, 0]***
None	0.99 [0.41, 2.41]	0.53 [0.11, 2.43]	4.22 [1.38, 12.94]*	1 [0, 0]***	1.18 [0.63, 2.22]
Occupation					
Not working	Ref	Ref	Ref	Ref	Ref
Working	0.88 [0.44, 1.75]	0.76 [0.29, 1.97]	0.45 [0.16, 1.3]	1 [0.48, 2.08]	0.79 [0.53, 1.17]

Note. P<0.05=*, P<0.01=**, P<0.001=***, AOR = adjusted odds ratio, P = probability value, CI = confidence interval

Adjusted odds ratios for neonatal mortality in Ghana

Variable	1998	2003	2008	2014	All years
	AOR 95% CI	AOR 95% CI	AOR 95% CI	AOR 95% CI	AOR 95% CI
Wealth index					
Poorest	Ref	Ref	Ref	Ref	Ref
Poorer	0.88 [0.43, 1.81]	1.52 [0.62, 3.75]	1.32 [0.46, 3.83]	0.52 [0.2, 1.32]	0.91 [0.57, 1.43]
Middle	1.36 [0.67, 2.76]	1.92 [0.83, 4.46]	1.82 [0.49, 6.66]	0.57 [0.18, 1.87]	1.32 [0.81, 2.15]
Richer	0.97 [0.39, 2.42]	2.19 [0.79, 6.13]	3.58 [0.97, 13.25]	0.58 [0.13, 2.61]	1.32 [0.73, 2.41]
Richest	0.98 [0.3, 3.19]	3.8 [1.16, 12.45]*	5.74 [1.27, 25.98]*	0.6 [0.11, 3.4]	1.74 [0.85, 3.53]
Timing of 1st ANC attendance					
1st trimester	Ref	Ref	Ref	Ref	Ref
2nd trimester	0.99 [0.6, 1.63]	0.73 [0.42, 1.26]	1.83 [0.9, 3.72]	0.69 [0.35, 1.38]	0.93 [0.69, 1.24]
3rd trimester	1.41 [0.56, 3.56]	0.09 [0.01, 0.71]*	-	0.39 [0.05, 3.17]	0.78 [0.36, 1.69]
After 3rd trimester					
Place of delivery					
Home	Ref	Ref	Ref	Ref	Ref
Health facility	1.67 [0.84, 3.31]	1.71 [0.81, 3.62]	4.23 [1.77, 10.13]**	4.19 [1.83, 9.59]**	2.37 [1.62, 3.46]***
Others	3.37 [1.06, 10.74]*	1.24 [0.44, 3.46]	1 [0, 0]***	4.11 [0.26, 64.63]	2.44 [1.23, 4.84]*
Skilled attendant at delivery					
No	Ref	Ref	Ref	Ref	Ref
Yes	0.93 [0.49, 1.77]	1.01 [0.43, 2.37]	1.03 [0.43, 2.49]	0.73 [0.15, 3.55]	0.9 [0.6, 1.35]
Birth weight					
Low	Ref	Ref	Ref	Ref	Ref
Normal	0.09 [0.02, 0.38]**	0.17 [0.03, 1]	0.46 [0.05, 4.33]	0.24 [0.06, 0.96]*	0.28 [0.1, 0.74]*
Above normal	-	-	-	-	-
Not weighed at birth	-	1.45 [0.32, 6.55]	4.1 [0.54, 30.97]	2.23 [0.62, 8.07]	2.46 [1, 6.01]*

Note. P<0.05=*, P<0.01=**, P<0.001=***, AOR = adjusted odds ratio, P = probability value, CI = confidence interval

DISCUSSION

5.1 Variation in neonatal mortality trends within each country

The study revealed that there were significant differences in neonatal mortality trends in the selected high prevalent countries. In Benin, neonatal mortality rates increased significantly by 2.7% from 1996 to 2001. In 2006, there was an 18.4% decrease and a further 29% decline in 2011/12 survey year. Neonatal mortality rates then increased by 31.8% in 2017/18 survey year. This may be attributed to the 18% increase in population of Beninese from 2012 to 2018. In Ivory Coast, neonatal mortality rates increased significantly by 98% from 1994 to 1998 survey year. This may be attributable to the poor health care situation in the country as essential health care service is key in the management of complications that occur during the neonatal period such as resuscitation and temperature maintenance especially in the case of low birth weight babies (World Health Organization, 2016). Neonatal mortality rates then decreased in 2005 and 2011/12 survey year. Neonatal mortality rates in Mali decreased significantly by 18% from 1995/96 survey year to 2006 and then declined further in 2012/13 survey year. Although neonatal mortality rates are decreasing they are still high compared to the SDG target of at least 12 deaths per 1000 live births. A study conducted by Willcox et al. (2018) found out that mortality rates are still high among neonates in Mali mostly as a result of child neglect and malnutrition. In Ghana, neonatal mortality rates increased significantly from 1998 to 2003. This declined significantly by 30% in 2008 and subsequently declined marginally to 29 deaths per 1000 live births in 2014 survey year. Introduction of several programs aimed at improving maternal health and increasing child survival including the free maternal health care, introduction of the CHPS concept to allow for easy access to health care in communities could be responsible for the decline in neonatal mortality rates in Ghana. Another factor that could account for the decline is the use of the Integrated Management of Childhood and Neonatal Illness (IMNCI) framework in the management of neonatal and childhood deaths. In Nigeria,

neonatal mortality rates increased significantly from 1990 to 2003. In 2008 however, rates decreased by 15% and further declined marginally to 37 deaths per 1000 live births. High neonatal mortality rates in Nigeria may be attributable to the ever increasing population and poor health care system in the country. In Niger, neonatal mortality rates experienced marginal significant decrease from 1992 to 1998. Much progress was made as there was further significant decline in neonatal mortality rates from 2006 to 2010.

5.2 Factors associated with Neonatal mortality

The findings of the study reveal that different factors were associated with neonatal mortality in the selected high prevalent countries. In Benin, analysis of the five survey years (1996-2018) showed that factors such as level of a mother's education, occupation, wealth index, trimester in which ANC was commenced, place of delivery, and birth weight were significant in neonatal deaths. Mothers who have had primary education had 63% increased odds of losing their babies in the neonatal period compared to uneducated mothers. This is contrary to results from a study conducted using Malawi DHS by Makate & Makate (2016) in which primary education was negatively associated with significant percentage point reduction in infant and under-five mortality. Another study also reported decreased odds of under-five mortality for babies whose mothers have had secondary education (Akter et al., 2015). Maternal education has been interpreted as a predictor of living conditions including providing the mother with requisite information in areas such as child care, hygiene, etc. In spite of several reported benefits of maternal education in reducing child mortality, research carried out in India and Ethiopia have shown that primary education does not contribute significantly to infant survival (Kiross, Chojenta, Barker, Tiruye, & Loxton, 2019).

Working women and those belonging to middle and richer quintile of wealth index had 37% and 43% increased odds of neonatal mortality respectively in Benin. The situation was however different in Ivory Coast where mothers belonging to the middle quintile of wealth index had

45% reduced odds of neonatal mortality. This may be explained by the fact that these women live in better conditions and have better access to healthcare than those who belong to the poorest class. This is contrary to a similar study in Nigeria using DHS in which under-five mortality was found to be higher among poor working women (Biradar, Patel, & Prasad, 2019).

The place of birth of a baby is important in child survival. This is stressed with the UN Global Strategy for Women's, Children's and Adolescents' Health which recommends delivery in the health facility to ensure safe labour(WHO, 2018). Women who delivered in health facilities were found to have increased odds of neonatal mortality compared to those who delivered at home (AOR=1.78, 95% CI 1.22, 2.66). This may be attributed to the inadequate skills of front-line health workers especially in the rural areas and disparity in health services based on geographic location and wealth index (WHO, 2013). Results from study conducted in Ghana reveal that, higher proportions of facility births were not significantly linked with a reduction in early neonatal mortality. The study also revealed that although facility births were more in wealthier women, it did not account for lesser odds neonatal mortality among babies born to such women (Gabrysch et al., 2019a). This seems to suggest that facility births do not necessarily translate into increased child survival as some health facilities are not adequately equipped to provide emergency obstetric and newborn care.

Normal birth weight babies had 97% reduced odds of neonatal mortality in Benin with babies not weighed at birth having more than two times increased odds (AOR=2.13 95% CI 1.55, 2.92) compared to low birth weight babies, of which Coulibaly et al., (2016) reported similar findings in their study in Burkina Faso.

The study also found that wealth index and birth weight were significantly associated with neonatal mortality in Ivory Coast over four survey years (1994-2012). Babies born to mothers belonging to the middle quintile of wealth index had 45% reduced odds of neonatal mortality

with normal birthweight babies having 89% reduced odds of dying within the neonatal period This may be explained by the fact that these women live in better conditions making it easier to have better access to healthcare than those who belong to the poorest class. Low birth weight puts the baby at risk of infection which may result in death if not managed timely and skilfully (Coulibaly et al., 2016)

Level of education, place of delivery and birth weight in Ghana also for four survey years (1998-2014). A similar study conducted in Ghana revealed an inverse relationship between a mother's level of education and child survival (Buor, 2003).

Analysis for three survey years (1995-2013) in Mali showed that, mothers between 20-24years had 49% reduced odds of neonatal mortality and delivery in the health facility revealed increased odds of neonatal mortality (AOR=1.63, 95% CI 0.31, 0.86). This finding is congruent to findings in a study by Gabrysch et al (2019) which found out that babies who were delivered in health facilities did not necessarily experience less neonatal mortality rates. First ANC attendance during the second trimester also showed reduced odds of 27% as opposed to those who did so in the first trimester and the timing of first ANC attendance show significant association with neonatal mortality after adjusting for confounders.

This study revealed that in Nigeria, mothers with secondary education had decreased odds of neonatal mortality as was the result of a study by Akter et al. (2015). An educated mother is able to take better care of herself and the family because she has acquired some level of knowledge and can quickly identify any danger signs in the health of her baby. Education also affords a mother the understanding of the need for prompt medical care and therefore seeks medical care willingly than the uneducated (Ogunjuyigbe, Fasogbon, Odusina, & Shittu, 2017). Also, mothers without any religious affiliation and those who delivered in the health facility had increased odds of neonatal mortality In Niger, working mothers were found to have 60%

increased odds (AOR=1.6 95% CI 1.03, 2.48) of neonatal mortality and age was found to be inversely proportional to neonatal mortality.

Achieving SDG 3 which among other objectives aims at a reduction in neonatal mortality to at least 12 per 1000 live births by 2030 seems to be a daunting task especially in Africa neonatal mortality is associated with different factors within different countries.

5.3 Consistent factors over all survey years

The study also revealed that birth weight was consistently associated with neonatal mortality over all survey years for Benin and Ivory Coast. According to a study conducted by Coulibaly et al. (2016) mortality among neonates with low birth weight was high compared to those with normal birth weight. WHO estimates that low birth weight accounts for 60 to 80% of all neonatal deaths. It is therefore not surprising that neonatal mortality rates are high in Benin and Ivory Coast which also have birthweight being consistent in all survey years. Babies with normal birth weight had significant reduced odds of neonatal mortality. In Ghana, Mali, Nigeria and Niger however, no single factor was seen to be significantly consistent in all the survey years.

CHAPTER SIX

CONCLUSION/RECOMMENDATIONS

6.1 Conclusion

This study sought to determine the factors associated with neonatal mortality based on DHS data from six selected high prevalent West African countries. Findings from the study show that disparities in factors are associated with neonatal mortality in each country and birthweight. In Benin, babies of mothers who were working, educated, delivered in the health facility were more likely to experience neonatal deaths. In Ivory Coast, mothers in the middle quintile wealth index and babies with normal birth weight were less likely to experience neonatal deaths. In Ghana, a mother who has had primary education and delivered in the health facility as well as a baby not weighed at birth had increased odds of neonatal mortality while babies with normal birthweight were less likely to experience neonatal deaths. In Mali, a mother's place of delivery and a baby's birth weight increased the odds of neonatal mortality. In Nigeria, mothers who delivered in the health facility and those who did not belong to any religion had increased odds while babies with normal birth weight, mothers with secondary education and aged between 25-39 years had decreased odds of neonatal mortality. In Niger, working mothers had increased odds of neonatal mortality with normal birth weight babies and mothers between 20-39 years experiencing reduced odds of neonatal mortality.

6.2 Recommendations

Based on the findings of the study, there is the need for continuous in-service training for all health workers especially frontline staff including midwives to ensure the provision of the best possible health care provision of incentives for health staff who work in the rural areas to encourage others to accept postings to such areas after completion of their training. Health care facilities should also be well equipped to handle obstetric and neonatal emergencies when the

need arises. There should be intensified health education on the danger signs associated with the neonate and what to do in such situations and the education of the girl child.

More effort should be put in the prevention and management of low birth weight. Essential but inexpensive measures such as the use of Kangaroo mother care (KMC) should be used to increase survival of low birth weight babies. Also, effective monitoring of pregnant women during ANC with interventions such as immunisation, nutritional counselling, birth preparedness and complication readiness to help reduce incidence of pregnancy and childbirth complications.

6.3 Limitations of the research

Although more West African countries were found to have high neonatal mortality rates, only those with available DHS data were included in the study. Also, considering the survey years that were analysed some of them were older compared to other countries. In addition only countries with neonatal mortality rates higher than that of Ghana were included in the study.

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APPENDICES

APPENDIX 1: Neonatal mortality in Benin

Table 1: Distribution of neonatal mortality in Benin

Variable	1996	2001	2006	2011/12	2017/18	All years
Age						
15-19	18(16.89)	15(7.17)	25(5.15)	11(3.73)	17(4.17)	86(5.74)
20-24	18(16.38)	37(18.19)	117(23.65)	70(24.28)	87(21.52)	328(21.93)
25-29	22(20.11)	52(25.87)	156(31.69)	65(22.59)	96(23.69)	392(26.15)
30-34	20(18.04)	33(16.31)	78(15.73)	76(26.39)	106(26.32)	313(20.88)
35-39	18(16.73)	39(19.04)	75(15.27)	40(13.83)	52(12.97)	225(14.99)
40-44	10(8.72)	21(10.25)	31(6.26)	20(6.89)	28(6.84)	109(7.26)
45-49	3(3.12)	6(3.17)	11(2.26)	7(2.3)	18(4.49)	46(3.05)
Level of education						
No education	81(74.47)	148(73.11)	358(72.46)	207(71.79)	258(63.93)	1053(70.26)
Primary	21(19)	50(24.74)	107(21.7)	47(16.33)	92(22.71)	317(21.15)
Secondary	7(6.53)	4(2.16)	29(5.84)	34(11.88)	50(12.34)	124(8.31)
Higher	-	-	-	-	4(1.03)	4(0.28)
Religion						
Christian	46(41.95)	88(43.49)	226(45.91)	162(56.32)	182(45.05)	704(47.06)
Islam	20(18.28)	38(18.89)	130(26.36)	65(22.69)	145(35.96)	399(26.64)
Traditional	16(14.85)	23(11.4)	32(6.55)	9(3.03)	22(5.54)	103(6.87)
Others	-	1(0.59)	8(1.58)	5(1.72)	3(0.84)	17(1.15)
None	27(24.92)	52(25.64)	96(19.6)	47(16.24)	51(12.62)	273(18.27)
Occupation						
Not working	6(5.94)	24(11.75)	55(11.21)	78(26.94)	65(16)	228(15.21)
Working	103(94.06)	179(88.25)	438(88.79)	211(73.06)	339(84)	1270(84.79)

Distribution of neonatal mortality in Benin continued

Variable	1996	2001	2006	2011/12	2017/18	All years
Wealth index						
Poorest	-	48(23.48)	92(18.62)	66(22.94)	67(16.56)	272(19.63)
Poorer	-	40(19.86)	102(20.62)	50(17.27)	109(26.97)	300(21.66)
Middle	-	62(30.69)	120(24.25)	57(19.89)	73(17.99)	312(22.47)
Richer	-	27(13.13)	108(21.9)	62(21.62)	100(24.77)	297(21.4)
Richest	-	26(12.84)	72(14.61)	53(18.27)	55(13.7)	206(14.84)
Timing of 1st ANC attendance						
1st trimester	31(42.19)	34(44.47)	85(53.8)	68(54.71)	97(62.47)	314(53.63)
2nd trimester	35(48.09)	39(50.96)	59(37.49)	47(37.92)	47(30.32)	227(38.75)
3rd trimester	7(9.72)	3(4.57)	14(8.71)	9(7.37)	11(7.21)	45(7.62)
After 3rd trimester	-	-	-	-	-	-
Place of delivery						
Home	38(36.7)	46(22.95)	124(25.2)	39(13.38)	50(12.49)	298(19.97)
Health facility	66(63.3)	150(74.77)	359(72.79)	238(82.56)	342(84.63)	1155(77.49)
Others	-	5(2.28)	10(2.02)	12(4.05)	12(2.88)	38(2.54)
Skilled attendant at birth						
No	40(36.51)	46(22.61)	112(22.71)	49(17.05)	78(19.42)	325(21.73)
Yes	69(63.49)	157(77.39)	382(77.29)	239(82.95)	326(80.58)	1173(78.27)
Birth weight						
Low	9(8.77)	20(10.22)	59(11.97)	25(8.6)	32(7.81)	145(9.73)
Normal	13(12.6)	42(21.35)	103(20.96)	45(15.6)	72(17.76)	276(18.52)
Above normal	-	1(0.53)	2(0.41)	5(1.83)	4(0.87)	12(0.8)
Not weighed at birth	82(78.64)	134(67.89)	329(66.65)	213(73.97)	297(73.56)	1056(70.95)

Table 2: Crude odds ratios of neonatal mortality in Benin

Variable	1996	2001	2006	2011/12	2017/18	All years
	COR 95% CI	COR 95% CI	COR 95% CI	COR 95% CI	COR 95% CI	COR 95% CI
Age						
20-24	0.27 [0.14, 0.54]***	0.49 [0.26, 0.94]*	0.89 [0.58, 1.39]	1.18 [0.63, 2.21]	1.05 [0.62, 1.77]	0.76 [0.60, 0.97]*
25-29	0.32 [0.17, 0.61]***	0.5 [0.27, 0.92]*	0.72 [0.47, 1.11]	0.65 [0.34, 1.22]	0.78 [0.46, 1.32]	0.59 [0.46, 0.75]***
30-34	0.38 [0.20, 0.75]**	0.46 [0.24, 0.87]*	0.49 [0.31, 0.77]**	0.96 [0.51, 1.81]	1.23 [0.73, 2.09]	0.64 [0.50, 0.82]***
35-39	0.47 [0.24, 0.92]*	0.75 [0.40, 1.42]	0.79 [0.50, 1.26]	0.85 [0.44, 1.67]	0.94 [0.53, 1.65]	0.73 [0.57, 0.95]*
40-44	0.68 [0.30, 1.52]	0.92 [0.45, 1.85]	0.75 [0.44, 1.29]	1.00 [0.47, 2.14]	1.19 [0.64, 2.22]	0.84 [0.63, 1.12]
45-49	0.82 [0.23, 2.91]	0.73 [0.29, 1.87]	0.74 [0.36, 1.53]	1.11 [0.44, 2.83]	1.91 [0.95, 3.82]	0.98 [0.68, 1.43]
Level of education						
No education	Ref	Ref	Ref	Ref	Ref	Ref
Primary	1.26 [0.76, 2.08]	1.38 [0.98, 1.92]	1.27 [1.01, 1.61]*	1.00 [0.71, 1.4]	1.29 [0.98, 1.69]	1.24 [1.08, 1.43]**
Secondary	1.44 [0.61, 3.38]	0.30 [0.11, 0.81]*	0.88 [0.60, 1.31]	1.13 [0.76, 1.67]	0.86 [0.61, 1.21]	0.86 [0.7, 1.05]
Higher	-	-	-	-	0.8 [0.31, 2.07]	0.35 [0.14, 0.88]*
Place of residence						
Urban	Ref	Ref	Ref	Ref	Ref	Ref
Rural	0.82 [0.54, 1.25]	1.27 [0.92, 1.76]	1.14 [0.94, 1.4]	0.86 [0.67, 1.11]	1.13 [0.9, 1.43]	1.09 [0.97, 1.22]
Religion						
Christian	Ref	Ref	Ref	Ref	Ref	Ref
Islam	0.78 [0.45, 1.34]	0.83 [0.56, 1.23]	1.16 [0.92, 1.45]	0.93 [0.69, 1.25]	1.18 [0.92, 1.5]	1.06 [0.93, 1.21]
Traditional	1.07 [0.59, 1.95]	1.34 [0.82, 2.2]	1.19 [0.82, 1.71]	0.55 [0.22, 1.36]	1.04 [0.65, 1.67]	1.12 [0.90, 1.40]
Others	-	1.21 [0.16, 9.06]	1.09 [0.51, 2.35]	0.84 [0.36, 1.96]	0.78 [0.24, 2.53]	0.89 [0.54, 1.47]
None	1.07 [0.66, 1.72]	1.39 [0.98, 1.98]	1.09 [0.85, 1.42]	1.16 [0.83, 1.60]	1.43 [1.02, 2.03]*	1.26 [1.08, 1.46]**
Occupation						
Not working	Ref	Ref	Ref	Ref	Ref	Ref
Working	1.33 [0.6, 2.95]	0.72 [0.47, 1.12]	1.24 [0.93, 1.65]	1.5 [1.14, 1.97]**	1.2 [0.89, 1.6]	1.38 [1.19, 1.6]***

Note. P<0.05=*, P<0.01=**, P<0.001=***, COR = crude odds ratio, P = probability value, CI = confidence interval

Crude odds ratios of neonatal mortality in Benin continued

Variable	1996	2001	2006	2011/12	2017/18	All years
	COR 95% CI	COR 95% CI	COR 95% CI	COR 95% CI	COR 95% CI	COR 95% CI
Wealth index						
Poorest	Ref	Ref	Ref	Ref	Ref	Ref
Poorer	-	0.89 [0.58, 1.37]	1.22 [0.91, 1.63]	0.78 [0.53, 1.14]	1.72 [1.24, 2.39]**	1.17 [0.99, 1.39]
Middle	-	1.4 [0.95, 2.07]	1.41 [1.06, 1.87]*	0.93 [0.65, 1.31]	1.16 [0.81, 1.66]	1.23 [1.04, 1.45]*
Richer	-	0.66 [0.4, 1.08]	1.31 [0.98, 1.76]	1.02 [0.71, 1.47]	1.62 [1.15, 2.28]**	1.2 [1.01, 1.44]*
Richest	-	0.85 [0.52, 1.41]	1.07 [0.77, 1.49]	0.89 [0.61, 1.31]	1 [0.67, 1.48]	0.96 [0.79, 1.16]
Timing of 1st ANC attendance						
1st trimester	Ref	Ref	Ref	Ref	Ref	Ref
2nd trimester	0.61 [0.37, 1.01]	0.98 [0.61, 1.59]	0.75 [0.53, 1.06]	1.04 [0.69, 1.58]	0.75 [0.52, 1.09]	0.87 [0.72, 1.04]
3rd trimester	0.40 [0.18, 0.88]*	0.37 [0.13, 1.06]	0.89 [0.46, 1.72]	0.97 [0.49, 1.89]	1.16 [0.57, 2.35]	0.83 [0.59, 1.16]
After 3rd trimester						
Place of delivery						
Home	Ref	Ref	Ref	Ref	Ref	Ref
Health facility	0.94 [0.63, 1.41]	0.98 [0.7, 1.37]	0.79 [0.64, 0.98]*	0.90 [0.62, 1.31]	1.17 [0.85, 1.61]	0.87 [0.76, 1]*
Others	1 [0, 0]***	1.62 [0.57, 4.65]	4.78 [2.11, 10.79]***	11.11 [5.16, 23.94]***	2.03 [0.99, 4.17]	2.76 [1.87, 4.07]***
Skilled attendant at birth						
No	Ref	Ref	Ref	Ref	Ref	Ref
Yes	0.75 [0.51, 1.12]	1.12 [0.8, 1.56]	0.73 [0.59, 0.91]**	0.62 [0.44, 0.86]**	0.96 [0.73, 1.26]	0.78 [0.68, 0.88]***
Birth weight						
Low	Ref	Ref	Ref	Ref	Ref	Ref
Normal	0.26 [0.11, 0.63]**	0.33 [0.19, 0.57]***	0.25 [0.17, 0.35]***	0.27 [0.16, 0.45]***	0.3 [0.19, 0.47]***	0.27 [0.22, 0.34]***
Above normal	1 [0, 0]***	0.38 [0.05, 2.89]	0.21 [0.05, 0.89]*	0.83 [0.31, 2.26]	0.48 [0.16, 1.44]	0.41 [0.22, 0.76]**
Not weighed at birth	1.27 [0.62, 2.59]	1.2 [0.73, 1.98]	0.99 [0.73, 1.32]	1.7 [1.09, 2.65]*	1.7 [1.17, 2.48]**	1.32 [1.1, 1.59]**

Note. P<0.05=*, P<0.01=**, P<0.001=***, COR = crude odds ratio, P = probability value, CI = confidence interval

Table 3: Adjusted odds ratios of neonatal mortality in Benin

Variable	1996	2001	2006	2011/12	2017/18	All years
	AOR 95% CI	AOR 95% CI	AOR 95% CI	AOR 95% CI	AOR 95% CI	AOR 95% CI
Age						
20-24	0.22 [0.1, 0.51]***	0.6 [0.2, 1.78]	0.75 [0.39, 1.47]	1.13 [0.45, 2.82]	0.99 [0.41, 2.39]	0.86 [0.57, 1.31]
25-29	0.26 [0.11, 0.6]**	1.07 [0.39, 2.95]	0.67 [0.35, 1.3]	0.47 [0.18, 1.22]	0.89 [0.36, 2.2]	0.7 [0.46, 1.07]
30-34	0.41 [0.18, 0.93]*	0.61 [0.19, 1.93]	0.38 [0.18, 0.8]*	1.01 [0.4, 2.5]	1.89 [0.78, 4.57]	0.85 [0.55, 1.3]
35-39	0.37 [0.15, 0.93]*	1.51 [0.52, 4.35]	0.92 [0.46, 1.87]	1.12 [0.43, 2.88]	1.85 [0.75, 4.6]	1.21 [0.79, 1.87]
40-44	0.79 [0.31, 2]	1.73 [0.55, 5.48]	0.68 [0.29, 1.64]	1.14 [0.39, 3.3]	1.98 [0.74, 5.3]	1.13 [0.69, 1.86]
45-49	1 [0, 0]***	1.21 [0.26, 5.71]	0.79 [0.25, 2.51]	0.96 [0.22, 4.16]	3.03 [1.02, 8.99]*	1.27 [0.69, 2.34]
Level of education						
No education	Ref	Ref	Ref	Ref	Ref	Ref
Primary	1.68 [0.84, 3.38]	1.52 [0.85, 2.72]	2.3 [1.53, 3.46]***	0.98 [0.57, 1.69]	1.72 [1.1, 2.7]*	1.63 [1.28, 2.08]***
Secondary	2.08 [0.62, 6.96]	0.21 [0.03, 1.56]	1.84 [0.9, 3.73]	1.23 [0.62, 2.45]	1.31 [0.74, 2.32]	1.2 [0.84, 1.72]
Higher	1 [0, 0]***	1 [0, 0]***	1 [0, 0]***	1 [0, 0]***	3.63 [1.02, 12.86]*	1.4 [0.46, 4.23]
Place of residence						
Urban	Ref	Ref	Ref	Ref	Ref	Ref
Rural	0.79 [0.43, 1.44]	1.04 [0.59, 1.81]	0.82 [0.56, 1.19]	0.82 [0.51, 1.33]	1.32 [0.85, 2.05]	1.01 [0.81, 1.27]
Religion						
Christian	Ref	Ref	Ref	Ref	Ref	Ref
Islam	0.68 [0.3, 1.52]	0.6 [0.3, 1.21]	0.93 [0.59, 1.47]	1.02 [0.62, 1.69]	0.8 [0.52, 1.24]	0.87 [0.68, 1.11]
Traditional	1.51 [0.7, 3.27]	1.06 [0.45, 2.52]	0.64 [0.3, 1.35]	0.67 [0.14, 3.17]	1 [0.44, 2.28]	0.84 [0.53, 1.34]
Others	1 [0, 0]***	1 [0, 0]***	1.08 [0.26, 4.56]	0.46 [0.1, 2.19]	1 [0, 0]***	0.47 [0.16, 1.35]
None	0.86 [0.46, 1.63]	1.07 [0.57, 2.02]	0.89 [0.52, 1.5]	1.13 [0.68, 1.88]	1.18 [0.67, 2.09]	1.03 [0.78, 1.36]
Occupation						
Not working	Ref	Ref	Ref	Ref	Ref	Ref
Working	1.4 [0.52, 3.73]	0.57 [0.28, 1.17]	1.75 [1, 3.09]	1.94 [1.24, 3.02]**	1.12 [0.67, 1.89]	1.47 [1.13, 1.91]**

Note. P<0.05=*, P<0.01=**, P<0.001=***, COR = crude odds ratio, P = probability value, CI = confidence interval

Adjusted odds ratios for neonatal mortality in Benin continued

Variable	1996	2001	2006	2011/12	2017/18	All years
	AOR 95% CI	AOR 95% CI	AOR 95% CI	AOR 95% CI	AOR 95% CI	AOR 95% CI
Wealth index						
Poorest	Ref	Ref	Ref	Ref	Ref	Ref
Poorer	-	0.74 [0.36, 1.53]	1.29 [0.67, 2.49]	0.8 [0.42, 1.51]	1.87 [0.96, 3.63]	1.13 [0.82, 1.56]
Middle	-	1.01 [0.51, 2.02]	1.97 [1.07, 3.61]*	0.89 [0.5, 1.6]	1.74 [0.87, 3.47]	1.37 [1.01, 1.86]*
Richer	-	0.47 [0.2, 1.11]	1.77 [0.96, 3.29]	1.03 [0.54, 1.97]	2.59 [1.33, 5.02]**	1.43 [1.04, 1.96]*
Richest	-	0.57 [0.2, 1.62]	1.17 [0.53, 2.59]	1.05 [0.48, 2.33]	1.77 [0.79, 3.97]	1.13 [0.75, 1.7]
Timing of 1st ANC attendance						
1st trimester	Ref	Ref	Ref	Ref	Ref	Ref
2nd trimester	0.61 [0.34, 1.09]	0.81 [0.49, 1.32]	0.74 [0.52, 1.05]	0.89 [0.57, 1.4]	0.78 [0.54, 1.14]	0.81 [0.66, 0.99]*
3rd trimester	0.41 [0.18, 0.94]*	0.3 [0.1, 0.89]*	0.9 [0.46, 1.75]	0.92 [0.46, 1.81]	1.09 [0.53, 2.23]	0.82 [0.57, 1.2]
After 3rd trimester						
Place of delivery						
Home	Ref	Ref	Ref	Ref	Ref	Ref
Health facility	3.21 [1.16, 8.9]*	1.41 [0.56, 3.53]	1.52 [0.67, 3.46]	1.29 [0.62, 2.71]	3.46 [1.44, 8.31]**	1.78 [1.2, 2.66]**
Others	-	1.05 [0.12, 8.99]	-	-	3.43 [0.66, 17.91]	1.57 [0.47, 5.23]
Skilled attendant at birth						
No	Ref	Ref	Ref	Ref	Ref	Ref
Yes	0.7 [0.24, 2.04]	3.0 [1.15, 8.03]*	1.12 [0.48, 2.61]	0.6 [0.3, 1.18]	1.19 [0.64, 2.22]	1.11 [0.78, 1.6]
Birth weight						
Low	Ref	Ref	Ref	Ref	Ref	Ref
Normal	0.26 [0.11, 0.65]**	0.4 [0.17, 0.97]*	0.32[0.17, 0.58]***	0.25[0.12, 0.52]***	0.26 [0.13, 0.5]***	0.3 [0.21, 0.42]***
Above normal	1 [0, 0]***	-	0.32 [0.04, 2.42]	0.86 [0.23, 3.28]	0.6 [0.16, 2.22]	0.57 [0.25, 1.29]
Not weighed at birth	2.13 [0.93, 4.89]	1.75 [0.76, 4.03]	2.19 [1.24, 3.86]**	2.26 [1.16, 4.42]*	2.31 [1.3, 4.13]**	2.13 [1.55, 2.92]***

Note. P<0.05=*, P<0.01=**, P<0.001=***, COR = crude odds ratio, P = probability value, CI = confidence interval

APPENDIX 2: Neonatal mortality in Ivory Coast

Table 1: Distribution of neonatal mortality in Ivory Coast

Variable	1994	1998/99	2005	2011/12	All years
Age					
15-19	23(19.32)	16(11.71)	24(15.9)	21(7.68)	84(12.35)
20-24	30(24.71)	38(27.8)	41(27.53)	72(26.26)	181(26.56)
25-29	20(16.14)	26(19.35)	37(25.2)	57(20.59)	140(20.55)
30-34	26(21.07)	21(15.21)	17(11.41)	44(15.91)	107(15.71)
35-39	14(11.85)	21(15.41)	18(12.3)	55(20.04)	109(15.97)
40-44	6(4.68)	11(7.86)	6(4.32)	21(7.75)	44(6.47)
45-49	3(2.23)	4(2.67)	5(3.33)	5(1.78)	16(2.38)
Level of education					
No education	78(64.25)	96(71.19)	92(61.96)	176(63.81)	442(64.95)
Primary	27(22)	34(25.46)	49(32.85)	72(26.21)	182(26.76)
Secondary	15(12.58)	5(3.34)	8(5.19)	22(8.17)	50(7.35)
Higher	1(1.17)	-	-	5(1.81)	6(0.94)
Religion					
Christian	38(31.17)	37(27.63)	66(44.38)	109(39.64)	250(36.77)
Islam	49(39.93)	50(37.09)	55(37.29)	112(40.74)	266(39.12)
Traditional	27(21.97)	48(35.28)	25(17.03)	39(14.29)	139(20.44)
Others	-	-	2(1.3)	15(5.33)	17(2.44)
None	8(6.93)	-	-	-	8(1.24)
Occupation					
Not working	26(21.62)	15(11.05)	38(25.39)	71(25.81)	150(22.03)
Working	95(78.38)	120(88.95)	110(74.61)	204(74.19)	530(77.97)

Distribution of neonatal mortality in Ivory Coast continued

	1994	1998/99	2005	2011/12	All years
Wealth index					
Poorest	24(19.58)	58(42.77)	36(24.34)	69(24.98)	186(27.42)
Poorer	28(22.81)	24(17.38)	35(23.56)	62(22.67)	148(21.83)
Middle	20(16.72)	15(10.88)	34(22.93)	42(15.11)	111(16.26)
Richer	30(24.65)	29(21.06)	11(7.72)	54(19.59)	124(18.2)
Richest	20(16.24)	11(7.91)	32(21.45)	49(17.65)	111(16.29)
Timing of 1st ANC attendance					
1st trimester	21(22.73)	31(29.1)	48(40.18)	34(31.42)	133(31.44)
2nd trimester	50(55.2)	65(61.06)	60(50.58)	60(55.49)	234(55.44)
3rd trimester	20(22.07)	10(9.84)	11(9.23)	14(13.09)	55(13.11)
After 3rd trimester	-	-	-	-	-
Place of delivery					
Home	63(53.2)	85(62.53)	47(38.65)	103(39.25)	298(46.68)
Health facility	56(46.8)	51(37.47)	75(61.35)	158(60.43)	339(53.18)
Others	-	-	-	1(0.33)	1(0.13)
Skilled attendant at birth					
No	32(26.09)	51(37.63)	55(37.4)	58(21.16)	196(28.85)
Yes	90(73.91)	84(62.37)	93(62.6)	217(78.84)	484(71.15)
Birth weight					
Low	18(33.58)	13(10.64)	31(17.64)	-	-
Normal	19(36.72)	20(16.43)	39(22.63)	-	-
Above normal	4(8.28)	3(2.68)	8(4.39)	-	-
Not weighed at birth	11(21.41)	85(70.24)	96(55.34)	-	-

Table 2: Crude odds ratios of neonatal mortality in Ivory Coast

Variable	1994	1998	2005	2011/12	All years
	COR 95% CI	COR 95% CI	COR 95% CI	COR 95% CI	COR 95% CI
Age					
20-24	0.68 [0.38, 1.2]	1.03 [0.47, 2.22]	0.55 [0.27, 1.12]	1.08 [0.56, 2.09]	0.82 [0.58, 1.14]
25-29	0.41 [0.22, 0.78]**	0.66 [0.29, 1.5]	0.56 [0.26, 1.19]	0.7 [0.35, 1.39]	0.58 [0.41, 0.83]**
30-34	0.78 [0.43, 1.41]	0.63 [0.27, 1.51]	0.37 [0.15, 0.9]*	0.74 [0.37, 1.46]	0.61 [0.43, 0.88]**
35-39	0.79 [0.4, 1.57]	0.96 [0.41, 2.27]	0.58 [0.27, 1.26]	1.57 [0.78, 3.17]	1.02 [0.71, 1.48]
40-44	0.76 [0.31, 1.89]	1.2 [0.42, 3.37]	0.54 [0.2, 1.46]	1.18 [0.56, 2.49]	0.92 [0.6, 1.42]
45-49	1.24 [0.34, 4.48]	1 [0.21, 4.85]	1.44 [0.47, 4.43]	0.91 [0.35, 2.39]	1.09 [0.6, 1.99]
Level of education					
No education	Ref	Ref	Ref	Ref	Ref
Primary	0.91 [0.58, 1.42]	0.84 [0.52, 1.35]	1.2 [0.73, 1.98]	1.01 [0.69, 1.47]	1.01 [0.8, 1.26]
Secondary	1.56 [0.85, 2.87]	0.43 [0.16, 1.15]	0.56 [0.2, 1.57]	0.9 [0.54, 1.5]	0.83 [0.59, 1.18]
Higher	4.91 [0.6, 39.91]	-	-	1.86 [0.64, 5.36]	1.05 [0.41, 2.72]
Place of residence					
Urban	Ref	Ref	Ref	Ref	Ref
Rural	0.76 [0.52, 1.1]	1.42 [0.97, 2.09]	0.9 [0.57, 1.44]	1.06 [0.77, 1.46]	1.02 [0.84, 1.24]
Religion					
Christian	Ref	Ref	Ref	Ref	Ref
Islam	1.37 [0.88, 2.14]	1.13 [0.67, 1.9]	0.84 [0.5, 1.4]	0.99 [0.71, 1.38]	1.04 [0.84, 1.29]
Traditional	1.21 [0.72, 2.03]	1.6 [0.92, 2.79]	0.92 [0.53, 1.58]	1.03 [0.62, 1.73]	1.2 [0.92, 1.56]
Others	-	-	0.92 [0.16, 5.43]	1.31 [0.69, 2.49]	1.25 [0.69, 2.24]
None	1.35 [0.61, 2.99]	-	-	-	0.92 [0.44, 1.92]
Occupation					
Not working	Ref	Ref	Ref	Ref	Ref
Working	1.24 [0.8, 1.91]	1.42 [0.73, 2.77]	1.2 [0.75, 1.91]	1 [0.69, 1.46]	1.18 [0.93, 1.49]

Note. P<0.05=*, P<0.01=**, P<0.001=***, COR = crude odds ratio, P = probability value, CI = confidence interval,

Crude odds ratios of neonatal mortality in Ivory Coast continued

Variable	1994	1998	2005	2011/12	All years
	AOR 95% CI	AOR 95% CI	AOR 95% CI	AOR 95% CI	AOR 95% CI
Age					
20-24	1.37 [0.57, 3.29]	1.59 [0.61, 4.13]	0.65 [0.29, 1.44]	0.61 [0.25, 1.53]	1.57 [0.81, 3.05]
25-29	1.05 [0.39, 2.83]	0.74 [0.27, 2.04]	0.56 [0.24, 1.34]	0.48 [0.18, 1.27]	0.84 [0.41, 1.72]
30-34	1.3 [0.48, 3.53]	0.78 [0.26, 2.28]	0.41 [0.15, 1.13]	0.36 [0.14, 0.91]*	0.97 [0.46, 2.05]
35-39	1.31 [0.44, 3.87]	1.58 [0.56, 4.43]	0.67 [0.27, 1.68]	0.95 [0.37, 2.41]	1.56 [0.73, 3.34]
40-44	0.4 [0.07, 2.48]	2.45 [0.69, 8.66]	0.78 [0.25, 2.38]	0.58 [0.21, 1.61]	1.84 [0.67, 5.11]
45-49	1.37 [0.13, 14.79]	1.04 [0.11, 9.78]	1.49 [0.38, 5.86]	0.79 [0.22, 2.82]	1.19 [0.2, 6.9]
Level of education					
No education	Ref	Ref	Ref	Ref	Ref
Primary	1.09 [0.55, 2.15]	0.93 [0.51, 1.7]	1.06 [0.6, 1.89]	0.92 [0.47, 1.79]	1.03 [0.65, 1.62]
Secondary	2.42 [1.09, 5.4]*	0.71 [0.23, 2.2]	0.51 [0.16, 1.58]	1.15 [0.5, 2.62]	1.4 [0.73, 2.69]
Higher	20.61 [2.24, 189.81]**	-	-	2.03 [0.44, 9.32]	4.06 [0.42, 39.18]
Place of residence					
Urban	Ref	Ref	Ref	Ref	Ref
Rural	0.77 [0.38, 1.56]	0.77 [0.37, 1.62]	0.65 [0.36, 1.2]	1.61 [0.81, 3.19]	0.78 [0.46, 1.31]
Religion					
Christian	Ref	Ref	Ref	Ref	Ref
Islam	1.49 [0.77, 2.87]	1.06 [0.6, 1.85]	0.62 [0.36, 1.06]	1.15 [0.68, 1.97]	1.27 [0.83, 1.94]
Traditional	0.77 [0.28, 2.13]	1.13 [0.59, 2.18]	0.78 [0.42, 1.43]	0.85 [0.39, 1.85]	1.1 [0.64, 1.88]
Others	-	-	1.16 [0.16, 8.18]	2.25 [0.83, 6.06]	-
None	1.26 [0.26, 6.19]	-	-	-	1.14 [0.24, 5.53]
Occupation					
Not working	Ref	Ref	Ref	Ref	Ref
Working	1 [0.53, 1.87]	1.12 [0.53, 2.36]	1.19 [0.71, 2.01]	0.85 [0.49, 1.49]	1.1 [0.68, 1.79]

Note. P<0.05=*, P<0.01=**, P<0.001=***, OR = crude odds ratio, P = probability value, CI = confidence interval

Table 3: Adjusted odds ratios of neonatal mortality Ivory Coast

Variable	1994	1998	2005	2011/12	All years
	AOR 95% CI	AOR 95% CI	AOR 95% CI	AOR 95% CI	AOR 95% CI
Wealth index					
Poorest	Ref	Ref	Ref	Ref	Ref
Poorer	0.84 [0.26, 2.69]	0.73 [0.34, 1.61]	1.28 [0.68, 2.42]	0.68 [0.33, 1.39]	0.75 [0.4, 1.43]
Middle	0.43 [0.13, 1.46]	0.5 [0.21, 1.15]	1.53 [0.78, 3.03]	0.97 [0.43, 2.22]	0.45 [0.22, 0.9]*
Richer	0.75 [0.23, 2.44]	0.95 [0.37, 2.45]	0.42 [0.14, 1.2]	1.52 [0.61, 3.78]	0.82 [0.4, 1.71]
Richest	0.71 [0.21, 2.36]	0.63 [0.23, 1.73]	1.56 [0.7, 3.5]	1.77 [0.69, 4.56]	0.63 [0.3, 1.34]
Timing of 1st ANC attendance					
1st trimester	Ref	Ref	Ref	Ref	Ref
2nd trimester	1.79 [0.92, 3.5]	1.1 [0.65, 1.87]	0.83 [0.47, 1.45]	1.26 [0.74, 2.15]	1.31 [0.86, 2]
3rd trimester	2.31 [0.98, 5.44]	0.51 [0.22, 1.19]	0.63 [0.28, 1.43]	1.38 [0.55, 3.44]	0.86 [0.47, 1.58]
After 3rd trimester					
Place of delivery					
Home	Ref	Ref	Ref	Ref	Ref
Health facility	1.16 [0.37, 3.62]	1.82 [0.66, 5]	0.94 [0.45, 1.95]	0.97 [0.52, 1.81]	1.71 [0.77, 3.8]
Others	-	-	-	0.41 [0.05, 3.2]	-
Skilled attendant at delivery					
No	Ref	Ref	Ref	Ref	Ref
Yes	1.62 [0.44, 5.95]	0.99 [0.41, 2.38]	1.06 [0.48, 2.35]	1.49 [0.72, 3.07]	1.04 [0.49, 2.21]
Birth weight					
Low	Ref	Ref	Ref	Ref	Ref
Normal	0.14 [0.07, 0.27]***	0.28 [0.13, 0.6]**	-	-	0.19 [0.12, 0.32]***
Above normal	2.19 [0.64, 7.49]	1.15 [0.31, 4.24]	-	-	1.58 [0.64, 3.91]
Not weighed at birth	1.92 [0.8, 4.63]	1.74 [0.7, 4.29]	-	-	1.82 [1.02, 3.26]*

Note. P<0.05=*, P<0.01=**, P<0.001=***, OR = crude odds ratio, P = probability value, CI = confidence int

Adjusted odds ratios for neonatal mortality in Ivory Coast continued

Variable	1994	1998	2005	2011/12	All years
	AOR 95% CI	AOR 95% CI	AOR 95% CI	AOR 95% CI	AOR 95% CI
Wealth index					
Poorest	Ref	Ref	Ref	Ref	Ref
Poorer	0.84 [0.26, 2.69]	0.73 [0.34, 1.61]	1.28 [0.68, 2.42]	0.68 [0.33, 1.39]	0.75 [0.4, 1.43]
Middle	0.43 [0.13, 1.46]	0.5 [0.21, 1.15]	1.53 [0.78, 3.03]	0.97 [0.43, 2.22]	0.45 [0.22, 0.9]*
Richer	0.75 [0.23, 2.44]	0.95 [0.37, 2.45]	0.42 [0.14, 1.2]	1.52 [0.61, 3.78]	0.82 [0.4, 1.71]
Richest	0.71 [0.21, 2.36]	0.63 [0.23, 1.73]	1.56 [0.7, 3.5]	1.77 [0.69, 4.56]	0.63 [0.3, 1.34]
Timing of 1st ANC attendance					
1st trimester	Ref	Ref	Ref	Ref	Ref
2nd trimester	1.79 [0.92, 3.5]	1.1 [0.65, 1.87]	0.83 [0.47, 1.45]	1.26 [0.74, 2.15]	1.31 [0.86, 2]
3rd trimester	2.31 [0.98, 5.44]	0.51 [0.22, 1.19]	0.63 [0.28, 1.43]	1.38 [0.55, 3.44]	0.86 [0.47, 1.58]
After 3rd trimester					
Place of delivery					
Home	Ref	Ref	Ref	Ref	Ref
Health facility	1.16 [0.37, 3.62]	1.82 [0.66, 5]	0.94 [0.45, 1.95]	0.97 [0.52, 1.81]	1.71 [0.77, 3.8]
Others	-	-	-	0.41 [0.05, 3.2]	-
Skilled attendant at delivery					
No	Ref	Ref	Ref	Ref	Ref
Yes	1.62 [0.44, 5.95]	0.99 [0.41, 2.38]	1.06 [0.48, 2.35]	1.49 [0.72, 3.07]	1.04 [0.49, 2.21]
Birth weight					
Low	Ref	Ref	Ref	Ref	Ref
Normal	**0.14 [0.07, 0.27]*** **	**0.28 [0.13, 0.6]** **	-	-	**0.19 [0.12, 0.32]*** **
Above normal	**2.19 [0.64, 7.49]**	**1.15 [0.31, 4.24]**	-	-	**1.58 [0.64, 3.91]**
Not weighed at birth	**1.92 [0.8, 4.63]**	**1.74 [0.7, 4.29]**	-	-	**1.82 [1.02, 3.26]***

Note. P<0.05=*, P<0.01=**, P<0.001=***, COR = crude odds ratio, P = probability value, CI = confidence int

APPENDIX 3: Neonatal mortality in Mali

Table 1: Distribution of neonatal mortality in Mali

Variable	1995/96	2006	2012/13	All years
Age				
15-19	129(17.89)	75(12.04)	37(11.27)	241(14.41)
20-24	181(25.11)	139(22.38)	80(24.27)	400(23.93)
25-29	150(20.8)	128(20.64)	85(25.65)	363(21.7)
30-34	110(15.18)	132(21.33)	53(16.17)	295(17.65)
35-39	82(11.36)	70(11.35)	43(12.95)	195(11.67)
40-44	49(6.76)	53(8.53)	21(6.37)	123(7.34)
45-49	21(2.91)	23(3.72)	11(3.32)	55(3.29)
Level of education				
No education	635(87.82)	542(87.43)	271(82.07)	1448(86.54)
Primary	69(9.5)	57(9.23)	41(12.38)	167(9.97)
Secondary	16(2.21)	17(2.78)	17(5.11)	50(2.99)
Higher	3(0.47)	3(0.55)	1(0.44)	8(0.49)
Religion				
Christian	8(1.1)	12(1.89)	8(2.47)	28(1.66)
Islam	689(95.56)	563(91.6)	304(92.33)	1556(93.46)
Traditional	0(0)	22(3.65)	11(3.27)	33(1.99)
Others	24(3.34)	18(2.87)	6(1.93)	48(2.89)
None	-	-	-	-
Occupation				
Not working	205(28.8)	463(74.73)	232(70.26)	900(54.17)
Working	506(71.2)	156(25.27)	98(29.74)	761(45.83)

Distribution of neonatal mortality in Mali continued

Variable	1995/96	2006	2012/13	All years
Wealth index				
Poorest	-	149(23.53)	74(22.08)	223(23.03)
Poorer	-	149(23.53)	62(18.51)	211(21.79)
Middle	-	129(20.44)	93(27.52)	222(22.9)
Richer	-	131(20.72)	61(18.15)	192(19.83)
Richest		74(11.78)	46(13.74)	121(12.46)
Timing of 1st ANC attendance				
1st trimester	74(43.69)	65(48.88)	54(51.85)	193(47.49)
2nd trimester	75(44.62)	51(38.34)	44(42.68)	171(42.05)
3rd trimester	20(11.69)	17(12.78)	6(5.47)	42(10.46)
After 3rd trimester	-	-	-	-
Place of delivery				
Home	445(64.31)	355(59.27)	149(45.24)	949(58.57)
Health facility	150(21.69)	238(39.64)	80(24.29)	468(28.85)
Others	97(14.01)	7(1.1)	100(30.47)	204(12.57)
Skilled attendant at birth				
No	391(54.11)	335(54)	116(35.1)	842(50.32)
Yes	332(45.89)	285(46)	214(64.9)	831(49.68)
Birth weight				
Low	12(1.8)	21(3.57)	10(3)	43(2.7)
Normal	51(7.4)	49(8.27)	25(7.76)	126(7.79)
Above normal	6(0.91)	2(0.41)	12(3.72)	21(1.29)
Not weighed at birth	618(89.9)	523(87.76)	281(85.53)	1422(88.22)

Table 2: Crude odds ratios of neonatal mortality in Mali

Variable	1995/96	2006	2012/13	All years
Age				
15-19	Ref	Ref	Ref	Ref
20-24	0.48[0.34, 0.66]***	0.62[0.44, 0.86]**	0.74[0.48, 1.15]	0.56[0.45, 0.69]***
25-29	0.37[0.27, 0.51]***	0.49[0.35, 0.69]***	0.58[0.38, 0.9]*	0.43[0.35, 0.53]***
30-34	0.32[0.23, 0.46]***	0.73[0.48, 1.12]	0.49[0.3, 0.78]**	0.47[0.36, 0.59]***
35-39	0.33[0.23, 0.47]***	0.55[0.38, 0.79]**	0.62[0.38, 1]	0.44[0.35, 0.56]***
40-44	0.39[0.27, 0.58]***	0.84[0.55, 1.26]	0.68[0.39, 1.2]	0.58[0.45, 0.74]***
45-49	0.52[0.31, 0.88]*	1.14[0.67, 1.94]	1.12[0.51, 2.45]	0.81[0.57, 1.13]
Level of education				
No education	Ref	Ref	Ref	Ref
Primary	0.83[0.59, 1.15]	0.89[0.65, 1.23]	1.44[1, 2.09]	0.97[0.8, 1.18]
Secondary	0.54[0.31, 0.93]*	0.65[0.38, 1.11]	0.74[0.43, 1.26]	0.6[0.44, 0.82]**
Higher	1.37[0.3, 6.35]	2.14[0.48, 9.54]	0.69[0.09, 4.99]	1.24[0.48, 3.18]
Place of residence				
Urban	Ref	Ref	Ref	Ref
Rural	1.1[0.86, 1.4]	1.5[1.06, 2.14]*	1.3[0.97, 1.76]	1.26[1.05, 1.5]*
Religion				
Christian	Ref	Ref	Ref	Ref
Islam	2.45[1.23, 4.87]*	1.34[0.78, 2.3]	1.76[0.78, 3.97]	1.87[1.27, 2.74]**
Traditional	-	1.38[0.66, 2.9]	2.4[0.82, 7.05]	1.83[1.04, 3.23]*
Others	1.86[0.83, 4.18]	2.16[1.02, 4.59]*	3.22[1.01, 10.25]*	2.18[1.33, 3.57]**
None	-	-	-	-
Occupation				
Not working	Ref	Ref	Ref	Ref
Working	1.36[1.1, 1.67]**	0.89[0.71, 1.11]	0.82[0.63, 1.06]	1.17[1.03, 1.32]*

Note. P<0.05=*, P<0.01=**, P<0.001=***, OR = crude odds ratio, P = probability value, CI = confidence interval

Crude odds ratios of neonatal mortality in Mali continued

Variable	1995/96	2006	2012/13	All years
Wealth Index				
Poorest	Ref	Ref	Ref	Ref
Poorer	-	0.99[0.76, 1.29]	0.83[0.57, 1.21]	0.94[0.76, 1.17]
Middle	-	0.84[0.63, 1.12]	1.27[0.89, 1.8]	0.98[0.79, 1.23]
Richer	-	0.88[0.6, 1.29]	0.82[0.56, 1.21]	0.86[0.65, 1.15]
Richest	-	0.58[0.41, 0.81]**	0.77[0.52, 1.15]	0.64[0.5, 0.83]**
Timing of 1st ANC attendance				
1st trimester	Ref	Ref	Ref	Ref
2nd trimester	0.93[0.6, 1.43]	0.77[0.52, 1.15]	0.84[0.55, 1.28]	0.86[0.67, 1.1]
3rd trimester	0.72[0.36, 1.45]	0.95[0.55, 1.64]	0.6[0.24, 1.5]	0.83[0.55, 1.24]
After 3rd trimester	-	-	-	-
Place of delivery				
Home	Ref	Ref	Ref	Ref
Health facility	0.88[0.69, 1.13]	0.8[0.65, 1]*	1.26[0.94, 1.7]	0.87[0.76, 1]
Others	0.88[0.64, 1.21]	1.05[0.42, 2.62]	0.76[0.58, 1.01]	0.71[0.58, 0.86]**
Skilled attendant at birth				
No	Ref	Ref	Ref	Ref
Yes	0.84[0.69, 1.01]	0.88[0.71, 1.08]	0.87[0.68, 1.12]	0.81[0.72, 0.92]**
Birthweight				
Low	Ref	Ref	Ref	Ref
Normal	0.79[0.39, 1.61]	0.42[0.23, 0.77]**	0.53[0.25, 1.12]	0.56[0.38, 0.83]**
Above normal	1.39[0.42, 4.63]	0.18[0.04, 0.83]*	1.86[0.74, 4.68]	0.85[0.46, 1.59]
Not weighed at birth	2.08[1.14, 3.8]*	1.34[0.79, 2.26]	1.97[1.04, 3.73]*	1.75[1.25, 2.46]**

Note. P<0.05=*, P<0.01=**, P<0.001=***, OR = crude odds ratio, P = probability value, CI = confidence interval

Table 3: Adjusted odds ratios of neonatal mortality Mali

Variable	1995/96	2006	2012/13	All years
	AOR 95% CI	AOR 95% CI	AOR 95% CI	AOR 95% CI
Age				
15-19	Ref	Ref	Ref	
20-24	0.22[0.11, 0.43]***	0.64[0.32, 1.27]	0.66[0.31, 1.38]	0.66[0.4, 1.11]
25-29	0.19[0.1, 0.38]***	0.55[0.27, 1.1]	0.45[0.21, 0.96]*	0.51[0.31, 0.86]*
30-34	0.28[0.15, 0.54]***	0.88[0.45, 1.73]	0.6[0.27, 1.36]	0.79[0.47, 1.33]
35-39	0.15[0.07, 0.33]***	0.95[0.47, 1.91]	0.57[0.26, 1.27]	0.8[0.47, 1.36]
40-44	0.23[0.09, 0.54]**	1.54[0.73, 3.22]	1.09[0.48, 2.51]	1.4[0.81, 2.43]
45-49	0.5[0.16, 1.55]	2.2[0.88, 5.47]	0.91[0.2, 4.21]	1.66[0.77, 3.56]
Level of education				
No education	Ref	Ref	Ref	Ref
Primary	0.93[0.51, 1.7]	1.75[1, 3.08]	1.21[0.63, 2.34]	1.53[1, 2.34]
Secondary	0.93[0.38, 2.28]	1.31[0.54, 3.17]	1.12[0.54, 2.32]	1.34[0.77, 2.35]
Higher	6.98[1.64, 29.71]**	13.47[2.75, 65.91]**	1[0, 0]***	4.24[0.93, 19.29]
Place of residence				
Urban	Ref	Ref	Ref	Ref
Rural	0.35[0.2, 0.6]***	2.25[0.88, 5.78]	0.72[0.4, 1.32]	1.34[0.81, 2.24]
Religion				
Christian	Ref	Ref	Ref	Ref
Islam	1.37[0.45, 4.18]	1.37[0.5, 3.75]	1.26[0.41, 3.82]	1.34[0.64, 2.81]
Traditional	-	0.63[0.11, 3.67]	2.37[0.46, 12.11]	1.14[0.35, 3.69]
Others	0.53[0.11, 2.63]	0.67[0.12, 3.9]	2.65[0.43, 16.53]	1.32[0.37, 4.68]
None	-			
Occupation				
Not working	Ref	Ref	Ref	Ref
Working	1.37[0.87, 2.15]	1.09[0.72, 1.65]	0.99[0.64, 1.53]	1.01[0.75, 1.37]

Note. P<0.05=*, P<0.01=**, P<0.001=***, OR = crude odds ratio, P = probability value, CI = confidence interval

Adjusted odds ratios for neonatal mortality in Mali continued

Variable	1995/96	2006	2012/13	All years
	AOR 95% CI	AOR 95% CI	AOR 95% CI	AOR 95% CI
Wealth Index				
Poorest	Ref	Ref	Ref	Ref
Poorer	-	1.27[0.75, 2.15]	0.67[0.33, 1.37]	1[0.65, 1.53]
Middle	-	0.52[0.27, 0.99]*	0.79[0.39, 1.6]	0.63[0.39, 1.01]
Richer	-	0.65[0.35, 1.23]	0.65[0.29, 1.49]	0.67[0.41, 1.1]
Richest	-	1.54[0.52, 4.59]	0.82[0.34, 1.99]	1.11[0.57, 2.16]
Timing of 1st ANC attendance				
1st trimester	Ref	Ref	Ref	Ref
2nd trimester	0.92[0.57, 1.49]	0.73[0.49, 1.1]	0.75[0.48, 1.16]	0.73[0.54, 0.98]*
3rd trimester	0.72[0.34, 1.52]	0.84[0.47, 1.47]	0.49[0.19, 1.27]	0.7[0.43, 1.12]
After 3rd trimester	-	-		-
Place of delivery				
Home	Ref	Ref	Ref	Ref
Health facility	1.23[0.67, 2.23]	1.64[1.05, 2.55]*	1.77[0.91, 3.44]	1.63[1.13, 2.35]**
Others	1.4[0.75, 2.62]	1.69[0.35, 8.15]	1.2[0.63, 2.28]	1.27[0.82, 1.95]
Skilled attendant at birth				
No	Ref	Ref		
Yes	1.18[0.72, 1.92]	0.7[0.45, 1.09]	1.38[0.8, 2.38]	0.92[0.67, 1.25]
Birth weight				
Low	Ref	Ref	Ref	Ref
Normal	0.77[0.28, 2.14]	0.73[0.28, 1.93]	0.49[0.18, 1.32]	0.6[0.3, 1.2]
Above normal	3.56[0.75, 16.92]	-	1.8[0.52, 6.16]	0.97[0.33, 2.86]
Not weighed at birth	5[1.92, 13.01]**	1.97[0.8, 4.8]	2.33[0.9, 6.06]	2.09[1.1, 3.99]*

Note. P<0.05=*, P<0.01=**, P<0.001=***, OR = crude odds ratio, P = probability value, CI = confidence interval

APPENDIX 4: Neonatal mortality in Nigeria

Table 1: Distribution of neonatal mortality in Nigeria

Variable	1990	2003	2008	2013	All years
Age					
15-19	24(7)	25(8.62)	92(8.35)	90(7.64)	231(7.93)
20-24	87(25.15)	63(21.9)	232(21.03)	242(20.58)	623(21.42)
25-29	89(25.89)	68(23.76)	254(23.08)	298(25.37)	710(24.41)
30-34	62(17.92)	55(19.18)	208(18.87)	228(19.4)	553(19)
35-39	37(10.7)	51(17.57)	156(14.15)	173(14.71)	416(14.31)
40-44	35(10.17)	18(6.37)	108(9.77)	97(8.24)	258(8.86)
45-49	11(3.17)	7(2.6)	52(4.75)	48(4.06)	118(4.07)
Level of education					
No education	228(66.35)	161(55.86)	522(47.34)	609(51.87)	1520(52.26)
Primary	84(24.39)	69(23.99)	278(25.2)	261(22.22)	692(23.78)
Secondary	32(9.25)	46(15.85)	260(23.6)	255(21.71)	593(20.37)
Higher	-	12(4.3)	43(3.87)	49(4.21)	104(3.59)
Religion					
Christian	121(35.2)	95(32.87)	508(46.37)	416(35.59)	1140(39.36)
Islam	199(57.81)	176(61.05)	567(51.71)	741(63.49)	1683(58.11)
Traditional	14(4.17)	-	-	-	14(0.5)
Others	-	-	2(0.15)	0(0.03)	2(0.07)
None	10(2.81)	17(6.08)	19(1.77)	10(0.89)	57(1.97)
Occupation					
Not working	110(31.98)	114(39.69)	303(27.76)	381(32.39)	908(31.32)
Working	233(68.02)	174(60.31)	790(72.24)	794(67.61)	1991(68.68)

Note. P<0.05=*, P<0.01=**, P<0.001=***, OR = crude odds ratio, P = probability value, CI = confidence interval

Distribution of neonatal mortality in Nigeria continued

Variable	1990	2003	2008	2013	All years
Wealth index					
Poorest	58(16.79)	67(23.27)	284(25.75)	299(25.5)	708(24.34)
Poorer	74(21.62)	87(30.27)	277(25.16)	314(26.7)	753(25.87)
Middle	90(26.2)	62(21.51)	202(18.34)	204(17.41)	559(19.21)
Richer	63(18.22)	52(18.17)	178(16.14)	203(17.27)	496(17.04)
Richest	59(17.16)	20(6.79)	161(14.61)	154(13.12)	394(13.53)
Timing of 1st ANC attendance					
1st trimester	35(16.68)	19(27.95)	77(26.73)	99(29.73)	230(25.59)
2nd trimester	136(64.78)	36(54.67)	191(66.4)	195(58.3)	558(62.14)
3rd trimester	39(18.54)	12(17.38)	20(6.87)	40(11.97)	110(12.27)
After 3rd trimester	-	-	-	-	-
Place of delivery					
Home	197(58.56)	201(72.12)	631(60.69)	710(60.37)	1739(61.43)
Health facility	123(36.57)	77(27.63)	385(37.04)	409(34.78)	994(35.12)
Others	16(4.87)	1(0.25)	24(2.27)	57(4.85)	98(3.45)
Skilled attendant at birth					
No	149(43.14)	138(48.08)	435(39.45)	490(41.75)	1212(41.67)
Yes	196(56.86)	149(51.92)	667(60.55)	684(58.25)	1697(58.33)
Birth weight					
Low	-	1(0.29)	16(1.59)	19(1.65)	37(1.3)
Normal	7(2.1)	13(4.51)	58(5.64)	52(4.39)	129(4.59)
Above normal	-	**1(0.37)**	**5(0.51)**	**3(0.29)**	**10(0.34)**
Not weighed at birth	**329(97.9)**	**264(94.83)**	**950(92.25)**	**1103(93.67)**	**2645(93.77)**

Note. P<0.05=*, P<0.01=**, P<0.001=***, OR = crude odds ratio, P = probability value, CI = confidence interval

Table 2: Crude odds ratios of neonatal mortality in Nigeria

Variable	1990	2003	2008	2013	All years
	OR 95% CI	OR 95% CI	OR 95% CI	OR 95% CI	OR 95% CI
Age					
20-24	1.00 [0.55, 1.82]	0.84 [0.47, 1.5]	0.66 [0.51, 0.86]**	0.68 [0.51, 0.89]**	0.72 [0.6, 0.86]***
25-29	0.74 [0.42, 1.31]	0.63 [0.35, 1.12]	0.50 [0.38, 0.64]***	0.58 [0.44, 0.77]***	0.57 [0.48, 0.67]***
30-34	0.63 [0.36, 1.11]	0.79 [0.44, 1.45]	0.54 [0.41, 0.70]***	0.57 [0.43, 0.75]***	0.58 [0.49, 0.69]***
35-39	0.73 [0.40, 1.34]	1.06 [0.58, 1.94]	0.58 [0.44, 0.77]***	0.61 [0.46, 0.82]**	0.64 [0.54, 0.77]***
40-44	1.24 [0.62, 2.51]	0.72 [0.36, 1.44]	0.85 [0.63, 1.16]	0.73 [0.53, 1.02]	0.83 [0.67, 1.02]
45-49	0.83 [0.35, 1.93]	1.06 [0.43, 2.62]	0.91 [0.63, 1.31]	0.96 [0.64, 1.43]	0.93 [0.73, 1.2]
Level of education					
No education	Ref	Ref	Ref	Ref	Ref
Primary	0.92 [0.66, 1.27]	0.94 [0.66, 1.34]	1.07 [0.91, 1.25]	1.1 [0.92, 1.31]	1.05 [0.94, 1.16]
Secondary	0.78 [0.5, 1.23]	0.68 [0.46, 1.01]	0.93 [0.79, 1.1]	0.79 [0.67, 0.94]**	0.82 [0.74, 0.92]**
Higher	-	1.17 [0.56, 2.41]	0.7 [0.48, 1.01]	0.68 [0.47, 0.99]*	0.69 [0.54, 0.89]**
Place of residence					
Urban	Ref	Ref	Ref	Ref	Ref
Rural	1.09 [0.82, 1.45]	1.59 [1.16, 2.19]**	1.31 [1.12, 1.53]**	1.32 [1.13, 1.53]***	1.32 [1.2, 1.46]***
Religion					
Christian	Ref	Ref	Ref	Ref	Ref
Islam	1.44 [1.05, 1.98]*	1.04 [0.77, 1.41]	0.86 [0.76, 0.99]*	1.06 [0.92, 1.22]	1.01 [0.92, 1.1]
Traditional	**1.82 [0.95, 3.49]**	**-**	**-**	**-**	**1.57 [0.85, 2.92]**
Others	**-**	**-**	**1.03 [0.22, 4.84]**	**0.97 [0.12, 7.58]**	**0.97 [0.25, 3.71]**
None	**1.49 [0.57, 3.92]**	**5.68 [3.02, 10.7]*** **	**1.05 [0.66, 1.65]**	**1.00 [0.53, 1.89]**	**1.48 [1.09, 2.02]***
Occupation					
Not working	**Ref**	**Ref**	**Ref**	**Ref**	**Ref**
Working	**0.98 [0.72, 1.32]**	**0.82 [0.62, 1.09]**	**1.14 [0.99, 1.32]**	**0.88 [0.76, 1.02]**	**0.97 [0.88, 1.06]**

Note. P<0.05=*, P<0.01=**, P<0.001=***, OR = crude odds ratio, P = probability value, CI = confidence interval

Crude odds ratios of neonatal mortality in Nigeria continued

Variable	1990	2003	2008	2013	All years
	OR 95% CI	OR 95% CI	OR 95% CI	OR 95% CI	OR 95% CI
Wealth index					
Poorest	Ref	Ref	Ref	Ref	Ref
Poorer	1.22 [0.82, 1.82]	1.34 [0.92, 1.94]	1.00 [0.84, 1.19]	1.07 [0.89, 1.28]	1.08 [0.96, 1.21]
Middle	2.11 [1.26, 3.55]**	1.03 [0.68, 1.56]	0.85 [0.7, 1.03]	0.85 [0.69, 1.04]	0.97 [0.84, 1.11]
Richer	1.14 [0.73, 1.8]	0.94 [0.6, 1.47]	0.81 [0.66, 0.99]*	0.89 [0.72, 1.11]	0.89 [0.77, 1.02]
Richest	1.3 [0.87, 1.93]	0.38 [0.22, 0.68]**	0.77 [0.61, 0.96]*	0.72 [0.56, 0.91]**	0.76 [0.65, 0.87]***
Timing of 1st ANC attendance					
1st trimester	Ref	Ref	Ref	Ref	Ref
2nd trimester	1.27 [0.72, 2.24]	0.9 [0.45, 1.82]	1.04 [0.78, 1.39]	0.85 [0.64, 1.13]	1.00 [0.83, 1.21]
3rd trimester	1.42 [0.67, 3.03]	1.12 [0.46, 2.74]	0.59 [0.35, 1.01]	1.01 [0.65, 1.57]	1.01 [0.75, 1.38]
After 3rd trimester					
Place of delivery					
Home	Ref	Ref	Ref	Ref	Ref
Health facility	1.2 [0.84, 1.71]	0.77 [0.56, 1.06]	1.09 [0.95, 1.26]	1.02 [0.88, 1.18]	1.04 [0.94, 1.14]
Others	1.00 [0.51, 1.96]	0.62 [0.08, 4.77]	1.05 [0.64, 1.72]	4.94 [3.53, 6.92]***	1.88 [1.47, 2.42]***
Skilled attendant at birth					
No	Ref	Ref	Ref	Ref	Ref
Yes	1.23 [0.9, 1.68]	0.86 [0.65, 1.14]	1 [0.88, 1.14]	0.92 [0.8, 1.05]	0.97 [0.89, 1.06]
Birth weight					
Low	Ref	Ref	Ref	Ref	Ref
Normal	**0.3 [0.19, 0.47]*** **	**1.84 [0.37, 9.06]**	**0.31 [0.16, 0.59]*** **	**0.25 [0.12, 0.49]*** **	**0.32 [0.2, 0.51]*** **
Above normal	**0.48 [0.16, 1.44]**	**1.61 [0.14, 19.07]**	**0.36 [0.11, 1.15]**	**0.19 [0.05, 0.75]***	**0.30 [0.13, 0.68]** **
Not weighed at birth	**1.7 [1.17, 2.48]** **	**5.09 [1.2, 21.58]***	**1.00 [0.56, 1.79]**	**0.9 [0.48, 1.68]**	**1.12 [0.73, 1.7]**

Note. P<0.05=*, P<0.01=**, P<0.001=***, OR = crude odds ratio, P = probability value, CI = confidence interval

Table 3: Adjusted odds ratios of neonatal mortality in Nigeria

Variable	1990	2003	2008	2013	All years
	AOR 95% CI	AOR 95% CI	AOR 95% CI	AOR 95% CI	AOR 95% CI
Age	Ref	Ref	Ref	Ref	Ref
20-24	1.67 [0.66, 4.18]	0.72 [0.22, 2.35]	0.83 [0.47, 1.45]	0.41 [0.25, 0.67]***	0.73 [0.52, 1.03]
25-29	1.21 [0.53, 2.76]	0.62 [0.21, 1.81]	0.55 [0.32, 0.96]*	0.6 [0.37, 0.95]*	0.67 [0.49, 0.91]*
30-34	0.92 [0.39, 2.19]	0.51 [0.16, 1.67]	0.77 [0.44, 1.35]	0.49 [0.3, 0.8]**	0.63 [0.46, 0.86]**
35-39	1.19 [0.48, 2.96]	0.74 [0.25, 2.24]	0.64 [0.35, 1.15]	0.61 [0.37, 1.01]	0.68 [0.49, 0.95]*
40-44	2.03 [0.74, 5.58]	0.49 [0.12, 1.98]	1.15 [0.61, 2.16]	0.65 [0.36, 1.16]	0.94 [0.64, 1.37]
45-49	0.71 [0.18, 2.77]	0.69 [0.12, 3.99]	0.91 [0.42, 1.97]	0.88 [0.42, 1.82]	0.83 [0.52, 1.35]
Level of education					
No education	Ref	Ref	Ref	Ref	Ref
Primary	0.85 [0.54, 1.34]	1.44 [0.7, 2.97]	0.83 [0.58, 1.18]	1.22 [0.87, 1.7]	0.93 [0.74, 1.16]
Secondary	0.78 [0.39, 1.54]	0.98 [0.36, 2.65]	0.85 [0.59, 1.23]	0.85 [0.56, 1.29]	0.76 [0.59, 0.99]*
Higher	1 [0, 0]***	4.6 [1.24, 16.97]*	1.12 [0.6, 2.09]	1.38 [0.7, 2.71]	1.18 [0.78, 1.79]
Place of residence					
Urban	Ref	Ref	Ref	Ref	Ref
Rural	1.32 [0.79, 2.2]	1.7 [0.78, 3.71]	1.02 [0.74, 1.39]	1.15 [0.83, 1.6]	1.21 [0.99, 1.48]
Religion					
Christian	Ref	Ref	Ref	Ref	Ref
Islam	2.04 [1.3, 3.22]**	0.74 [0.34, 1.6]	0.7 [0.53, 0.94]*	0.85 [0.62, 1.15]	0.93 [0.78, 1.12]
Traditional	2.83 [1.18, 6.74]*	-	-	-	2.13 [0.96, 4.73]
Others	-	-	2.37 [0.53, 10.55]	-	2.33 [0.52, 10.49]
None	2.14 [0.58, 7.85]	5.03 [1.28, 19.72]*	1.88 [0.8, 4.39]	1.36 [0.4, 4.62]	1.91 [1.08, 3.4]*
Occupation					
Not working	Ref	Ref	Ref	Ref	Ref
Working	0.9 [0.6, 1.34]	0.88 [0.44, 1.75]	1.06 [0.78, 1.44]	0.78 [0.58, 1.05]	0.94 [0.77, 1.14]

Note. P<0.05=*, P<0.01=**, P<0.001=***, OR = crude odds ratio, P = probability value, CI = confidence interval

Adjusted odds ratios for Nigeria continued

Variable	1990	2003	2008	2013	All years
	AOR 95% CI	AOR 95% CI	AOR 95% CI	AOR 95% CI	AOR 95% CI
Wealth Index					
Poorest	Ref	Ref	Ref	Ref	Ref
Poorer	2.22 [1, 4.94]	1.68 [0.63, 4.48]	1.16 [0.74, 1.82]	0.93 [0.6, 1.42]	1.28 [0.97, 1.68]
Middle	4.22 [1.84, 9.65]**	1.6 [0.58, 4.41]	0.83 [0.53, 1.32]	0.77 [0.5, 1.17]	1.27 [0.92, 1.76]
Richer	1.5 [0.66, 3.38]	1.39 [0.45, 4.34]	1.18 [0.74, 1.9]	0.93 [0.58, 1.5]	1.24 [0.92, 1.67]
Richest	2.91 [1.22, 6.96]*	0.83 [0.18, 3.91]	0.89 [0.49, 1.61]	1.04 [0.6, 1.77]	1.39 [0.98, 1.97]
Timing of 1st ANC attendance					
1st trimester	Ref	Ref	Ref	Ref	Ref
2nd trimester	1.2 [0.71, 2.05]	0.91 [0.43, 1.92]	1.06 [0.8, 1.42]	0.82 [0.61, 1.08]	0.99 [0.82, 1.19]
3rd trimester	1.34 [0.65, 2.8]	1.1 [0.43, 2.76]	0.58 [0.34, 0.99]*	0.9 [0.57, 1.42]	0.96 [0.71, 1.3]
After 3rd trimester					
Place of delivery					
Home	Ref	Ref	Ref	Ref	Ref
Health facility	1.87 [0.95, 3.7]	1.81 [0.8, 4.06]	1.57 [1.11, 2.22]*	1.39 [0.99, 1.93]	1.6 [1.28, 2]***
Others	0.92 [0.39, 2.2]	1 [0, 0]***	0.96 [0.39, 2.38]	0.75 [0.1, 5.78]	0.92 [0.53, 1.6]
Skilled attendant at delivery					
No	Ref	Ref	Ref	Ref	Ref
Yes	1.54 [0.89, 2.67]	0.95 [0.42, 2.16]	1.25 [0.83, 1.88]	1.23 [0.86, 1.74]	1.2 [0.95, 1.5]
Birth weight					
Low	Ref	Ref	Ref	Ref	Ref
Normal	0.17 [0.08, 0.36]***	2.82 [0.26, 30.24]	0.3 [0.13, 0.74]**	0.29 [0.1, 0.83]*	0.39 [0.2, 0.76]**
Above normal	-	-	0.68 [0.19, 2.46]	0.23 [0.03, 2.04]	0.49 [0.16, 1.46]
Not weighed at birth	-	6.34 [0.79, 50.88]	1.25 [0.54, 2.91]	1.46 [0.52, 4.09]	1.73 [0.91, 3.29]

Note. P<0.05=*, P<0.01=**, P<0.001=***, OR = crude odds ratio, P = probability value, CI = confidence interval

APPENDIX 5: Neonatal mortality in Niger

Table 1: Distribution of neonatal mortality in Niger

Variable	1992	1998	2006	2012	All years
Age					
15-19	31(12.16)	46(26.36)	30(10.42)	15(5.3)	121(12.2)
20-24	70(27.68)	46(26.84)	68(23.38)	60(21.51)	244(24.55)
25-29	62(24.57)	34(19.55)	57(19.57)	66(23.65)	219(21.99)
30-34	43(16.79)	19(11.02)	58(20.07)	51(18.27)	171(17.15)
35-39	28(11.2)	12(7.16)	48(16.61)	52(18.54)	141(14.13)
40-44	16(6.13)	11(6.25)	20(6.91)	27(9.59)	73(7.35)
45-49	4(1.45)	5(2.81)	9(3.04)	9(3.15)	26(2.63)
Level of education					
No education	236(93.16)	157(90.77)	262(90.58)	242(86.69)	897(90.18)
Primary	15(5.72)	11(6.26)	22(7.55)	28(10.2)	76(7.6)
Secondary	3(1.12)	5(2.97)	5(1.87)	8(2.98)	22(2.18)
Higher	-	-	-	0(0.13)	0(0.04)
Religion					
Christian	1(0.49)	2(1.41)	-	4(0.52)	-
Islam	247(99.02)	167(98.59)	280(99.63)	693(99.16)	-
Traditional	-	-	1(0.37)	1(0.15)	-
Others	1(0.49)	-	-	1(0.18)	-
None	-	-	-	-	-
Occupation					
Not working	**133(52.52)**	**72(41.75)**	**150(51.74)**	**227(81.39)**	**582(58.53)**
Working	**120(47.48)**	**101(58.25)**	**140(48.26)**	**52(18.61)**	**412(41.47)**

Distribution of neonatal mortality in Niger continued

Variable	1992	1998	2006	2012	All years
Wealth index					
Poorest	-	27(15.79)	60(20.61)	57(20.46)	145(19.43)
Poorer	-	54(30.97)	67(23.02)	65(23.06)	185(24.89)
Middle	-	38(22.11)	67(22.95)	57(20.26)	162(21.74)
Richer	-	37(21.31)	58(20.06)	59(20.94)	154(20.68)
Richest	-	17(9.81)	39(13.37)	43(15.29)	99(13.26)
Timing of 1st ANC attendance					
1st trimester	19(25.45)	22(38.93)	14(26.95)	29(26.15)	85(28.52)
2nd trimester	39(51.24)	25(44.6)	33(62.42)	76(67.41)	172(58.06)
3rd trimester	18(23.3)	9(16.48)	6(10.64)	7(6.44)	40(13.42)
After 3rd trimester	-	-	-	-	-
Place of delivery					
Home	225(88.98)	137(80.6)	242(83.7)	166(59.6)	769(77.73)
Health facility	27(10.52)	25(14.95)	43(14.97)	35(12.65)	130(13.18)
Others	1(0.49)	8(4.45)	4(1.33)	77(27.75)	90(9.09)
Skilled attendant at birth					
No	162(63.77)	96(55.42)	99(34.26)	91(32.47)	447(44.96)
Yes	92(36.23)	77(44.58)	190(65.74)	189(67.53)	548(55.04)
Birth weight					
Low	5(1.83)	5(2.97)	19(6.72)	13(4.61)	42(4.24)
Normal	7(2.75)	6(3.44)	15(5.16)	37(13.37)	65(6.57)
Above normal	0(0.11)	-	-	-	0(0.03)
Not weighed at birth	239(95.31)	159(93.59)	254(88.12)	229(82.02)	881(89.17)

Table 2: Crude odds ratios of neonatal mortality in Niger

Variable	1990	2003	2008	2013	All years
Age	OR 95% CI	OR 95% CI	OR 95% CI	OR 95% CI	OR 95% CI
15-19	Ref	Ref	Ref	Ref	Ref
20-24	0.73 [0.46, 1.17]	0.56 [0.37, 0.86]**	0.71 [0.43, 1.18]	1.10 [0.6, 2.00]	0.68 [0.53, 0.86]**
25-29	0.52 [0.32, 0.84]**	0.43 [0.27, 0.67]***	0.46 [0.27, 0.78]**	0.93 [0.52, 1.68]	0.49 [0.39, 0.63]***
30-34	0.53 [0.31, 0.88]*	0.29 [0.17, 0.51]***	0.67 [0.39, 1.13]	0.90 [0.49, 1.67]	0.51 [0.39, 0.66]***
35-39	0.58 [0.34, 1.02]	0.28 [0.15, 0.52]***	0.76 [0.44, 1.31]	1.43 [0.77, 2.66]	0.64 [0.49, 0.84]**
40-44	0.68 [0.34, 1.34]	0.63 [0.31, 1.28]	0.61 [0.31, 1.18]	1.59 [0.81, 3.12]	0.70 [0.51, 0.97]*
45-49	0.50 [0.17, 1.51]	0.95 [0.35, 2.59]	0.74 [0.32, 1.72]	1.44 [0.62, 3.37]	0.73 [0.46, 1.14]
Level of education					
No education	Ref	Ref	Ref	Ref	Ref
Primary	0.79 [0.47, 1.32]	0.7 [0.39, 1.23]	0.77 [0.48, 1.23]	1.03 [0.68, 1.56]	0.82 [0.64, 1.05]
Secondary	0.66 [0.24, 1.83]	0.96 [0.4, 2.33]	0.6 [0.26, 1.37]	0.73 [0.39, 1.36]	0.68 [0.46, 1.01]
Higher	-	-	-	0.44 [0.06, 3.23]	0.19 [0.03, 1.36]
Place of residence					
Urban	Ref	Ref	Ref	Ref	Ref
Rural	1.58 [1.19, 2.1]**	1.81 [1.19, 2.75]**	1.54 [1.09, 2.17]*	1.49 [1.04, 2.13]*	1.55 [1.3, 1.85]***
Religion					
Christian	Ref	Ref	Ref	Ref	Ref
Islam	0.93 [0.13, 6.82]	0.18 [0.05, 0.64]**	1.95 [0.27, 14.22]	-	0.83 [0.29, 2.35]
Traditional	-	-	-	-	0.38 [0.04, 3.56]
Others	0.91 [0.05, 15.18]	-	-	-	0.6 [0.06, 5.65]
None	-	-	-	-	-
Occupation					
Not working	Ref	Ref	Ref	Ref	Ref
Working	1.21 [0.92, 1.58]	1.00 [0.73, 1.36]	1.08 [0.81, 1.42]	0.6 [0.44, 0.83]**	1.05 [0.92, 1.21]

Note. P<0.05=*, P<0.01=**, P<0.001=***, OR = crude odds ratio, P = probability value, CI = confidence interval

Crude odds ratios of neonatal mortality in Niger continued

Wealth index					
Poorest	Ref	Ref	Ref	Ref	Ref
Poorer	-	1.35 [0.84, 2.16]	1.21 [0.78, 1.88]	1.12 [0.75, 1.69]	1.23 [0.95, 1.58]
Middle	-	1.37 [0.83, 2.27]	1.27 [0.82, 1.96]	0.96 [0.64, 1.45]	1.15 [0.89, 1.49]
Richer	-	1.35 [0.81, 2.25]	0.99 [0.64, 1.54]	0.95 [0.63, 1.42]	1.03 [0.8, 1.34]
Richest	-	0.67 [0.38, 1.17]	0.76 [0.48, 1.2]	0.84 [0.55, 1.29]	0.77 [0.59, 1.02]
Timing of 1st ANC attendance					
1st trimester	Ref	Ref	Ref	Ref	Ref
2nd trimester	1.35 [0.77, 2.39]	0.71 [0.39, 1.27]	1.24 [0.6, 2.57]	1.05 [0.63, 1.76]	1.01 [0.76, 1.36]
3rd trimester	3.11 [1.52, 6.37]**	1.2 [0.49, 2.95]	0.79 [0.26, 2.44]	0.61 [0.24, 1.54]	1.19 [0.77, 1.83]
After 3rd trimester					
Place of delivery					
Home	Ref	Ref	Ref	Ref	Ref
Health facility	0.63 [0.43, 0.93]*	0.85 [0.57, 1.26]	0.85 [0.6, 1.2]	2.52 [1.63, 3.88]***	1.04 [0.94, 1.14]
Others	1.18 [0.16, 8.82]	6.25 [2.78, 14.08]***	1.78 [0.62, 5.12]	1.34 [0.99, 1.8]	1.88 [1.47, 2.42]***
Skilled attendant at birth					
No	Ref	Ref	Ref	Ref	Ref
Yes	0.77 [0.59, 1.02]	0.73 [0.54, 1.00]*	0.96 [0.72, 1.29]	1.31 [1.01, 1.72]*	0.9 [0.78, 1.03]
Birth weight					
Low	Ref	Ref	Ref	Ref	Ref
Normal	0.14 [0.05, 0.42]***	0.17 [0.06, 0.47]**	0.19 [0.10, 0.38]***	0.39 [0.19, 0.79]**	0.25 [0.16, 0.37]***
Above normal	0.47 [0.05, 4.24]	-	-	-	0.07 [0.01, 0.49]**
Not weighed at birth	0.66 [0.27, 1.61]	0.84 [0.39, 1.79]	0.56 [0.33, 0.94]*	0.63 [0.34, 1.14]	0.66 [0.47, 0.91]*

Note. P<0.05=*, P<0.01=**, P<0.001=***, OR = crude odds ratio, P = probability value, CI = confidence interval

Table 3: Adjusted odds ratios of neonatal mortality in Niger

Variable	1990	2003	2008	2013	All years
	AOR 95% CI	AOR 95% CI	AOR 95% CI	AOR 95% CI	AOR 95% CI
Age					
20-24	1.15 [0.48, 2.71]	0.5 [0.22, 1.12]	0.49 [0.17, 1.46]	1.48 [0.47, 4.67]	0.51 [0.27, 0.97]*
25-29	0.89 [0.37, 2.12]	0.58 [0.27, 1.28]	0.31 [0.1, 0.96]*	1.35 [0.41, 4.42]	0.44 [0.23, 0.85]*
30-34	0.88 [0.32, 2.37]	0.17 [0.05, 0.62]**	0.56 [0.18, 1.76]	1.85 [0.56, 6.13]	0.36 [0.16, 0.8]*
35-39	1.75 [0.69, 4.47]	0.14 [0.04, 0.52]**	0.32 [0.09, 1.13]	3.09 [0.93, 10.31]	0.23 [0.1, 0.57]**
40-44	0.98 [0.23, 4.22]	0.87 [0.27, 2.77]	0.44 [0.1, 2.01]	3.76 [1.06, 13.3]*	0.55 [0.22, 1.38]
45-49	1 [0, 0]***	1.17 [0.2, 6.96]	0.24 [0.04, 1.31]	4.19 [1.07, 16.46]*	0.42 [0.13, 1.37]
Level of education					
No education	Ref	Ref	Ref	Ref	Ref
Primary	1.38 [0.74, 2.55]	0.87 [0.41, 1.84]	0.53 [0.2, 1.38]	1.48 [0.74, 2.95]	0.71 [0.39, 1.3]
Secondary	0.99 [0.35, 2.81]	2.73 [0.72, 10.33]	0.71 [0.23, 2.21]	1.11 [0.42, 2.97]	1.32 [0.54, 3.26]
Higher	1 [0, 0]***	1 [0, 0]***	1 [0, 0]***	1.44 [0.18, 11.68]	1 [0, 0]***
Place of residence					
Urban	Ref	Ref	Ref	Ref	Ref
Rural	0.98 [0.47, 2.05]	0.54 [0.28, 1.04]	2.11 [0.66, 6.81]	3.12 [1.04, 9.34]*	1.15 [0.54, 2.44]
Religion					
Christian	Ref	Ref	Ref	Ref	Ref
Islam	1 [0, 0]***	0.32 [0.06, 1.88]	1 [0, 0]***	-	1.24 [0.14, 10.66]
Traditional	0 [0, 0]***	0 [0, 0]***	1 [0, 0]***	-	1 [0, 0]***
Others	1 [0, 0]***	1 [0, 0]***	1 [0, 0]***	-	1 [0, 0]***
None	0 [0, 0]***	0 [0, 0]***	1 [0, 0]***	-	0 [0, 0]***
Occupation					
Not working	Ref	Ref	Ref	Ref	Ref
Working	0.66 [0.38, 1.15]	1.51 [0.82, 2.78]	1.48 [0.78, 2.82]	0.6 [0.36, 1.02]	1.6 [1.03, 2.48]*

Note. P<0.05=*, P<0.01=**, P<0.001=***, OR = crude odds ratio, P = probability value, CI = confidence interval

Adjusted odds ratios for Niger continued

Variable	1990	2003	2008	2013	All years
	AOR 95% CI	AOR 95% CI	AOR 95% CI	AOR 95% CI	AOR 95% CI
Wealth Index					
Poorest	Ref	Ref	Ref	Ref	Ref
Poorer	-	1.68 [0.44, 6.52]	0.78 [0.24, 2.54]	1.59 [0.76, 3.31]	1.14 [0.5, 2.62]
Middle	-	2.52 [0.65, 9.69]	1.11 [0.37, 3.27]	1.35 [0.64, 2.86]	1.48 [0.66, 3.32]
Richer	-	2.33 [0.6, 9]	1 [0.31, 3.2]	1.02 [0.48, 2.15]	1.48 [0.65, 3.35]
Richest	-	1 [0.25, 4.01]	2.29 [0.72, 7.23]	1.37 [0.51, 3.69]	1.66 [0.63, 4.37]
Timing of 1st ANC attendance					
1st trimester	Ref	Ref	Ref	Ref	Ref
2nd trimester	1.22 [0.68, 2.2]	0.71 [0.38, 1.31]	1.16 [0.53, 2.51]	1.16 [0.68, 1.96]	0.87 [0.54, 1.39]
3rd trimester	2.18 [1.03, 4.65]*	1.04 [0.41, 2.63]	0.68 [0.21, 2.19]	0.67 [0.26, 1.69]	0.8 [0.39, 1.64]
After 3rd trimester					
Place of delivery					
Home	Ref	Ref	Ref	Ref	Ref
Health facility	0.75 [0.33, 1.68]	2.34 [1.05, 5.23]*	1.44 [0.39, 5.29]	18.17 [5.96, 55.38]***	1.91 [0.92, 3.97]
Others	1 [0, 0]***	3.22 [0.65, 15.93]	1.72 [0.18, 16.07]	3.95 [2.15, 7.25]***	3.02 [0.75, 12.15]
Skilled attendant at delivery					
No	Ref	Ref	Ref	Ref	Ref
Yes	1.46 [0.73, 2.91]	1.06 [0.54, 2.06]	1.01 [0.45, 2.23]	0.98 [0.55, 1.74]	0.98 [0.59, 1.62]
Birth weight					
Low	Ref	Ref	Ref	Ref	Ref
Normal	0.14 [0.05, 0.41]***	0.2 [0.07, 0.58]**	0.55 [0.12, 2.45]	0.48 [0.16, 1.45]	0.3 [0.12, 0.73]**
Above normal	0.6 [0.06, 5.6]	1 [0, 0]***	1 [0, 0]***	1 [0, 0]***	1 [0, 0]***
Not weighed at birth	0.62 [0.21, 1.83]	1.65 [0.59, 4.56]	1.47 [0.37, 5.84]	2.02 [0.61, 6.67]	1.5 [0.66, 3.37]

Note. P<0.05=*, P<0.01=**, P<0.001=***, OR = crude odds ratio, P = probability value, CI = confidence interval