

**SCHOOL OF PUBLIC HEALTH
COLLEGE OF HEALTH SCIENCES
UNIVERSITY OF GHANA**

**FACTORS INFLUENCING INFANT MORTALITY IN MONTSERRADO
COUNTY, REPUBLIC OF LIBERIA**

BY

NICHOLAS N.C. BLIDI

(10509104)

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DECLARATION

I, Nicholas N.C. Blidi hereby declare that apart from references to other people's publications, which have been duly acknowledged, this thesis is a result of my independent ideas, thought and deliberations. I further declare that this thesis has not been submitted for the award of any degree at this institution and other universities elsewhere.

NICHOLAS N.C. BLIDI

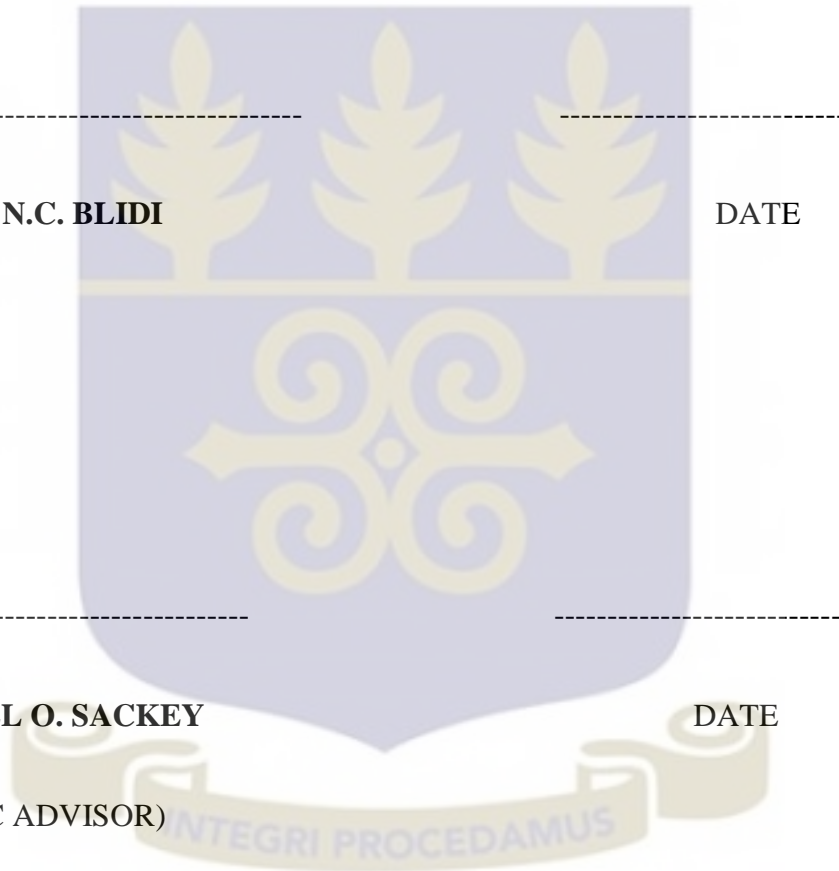
(STUDENT)

DATE

DR. SAMUEL O. SACKEY

(ACADEMIC ADVISOR)

DATE



DEDICATION

This research is dedicated to my country, family, friends both home and in the diaspora. Also to my assistants who supported me in the processes of collecting, compiling and analyzing the work in order to provide the best findings and recommendations. Your services are invaluable and I salute all of you.



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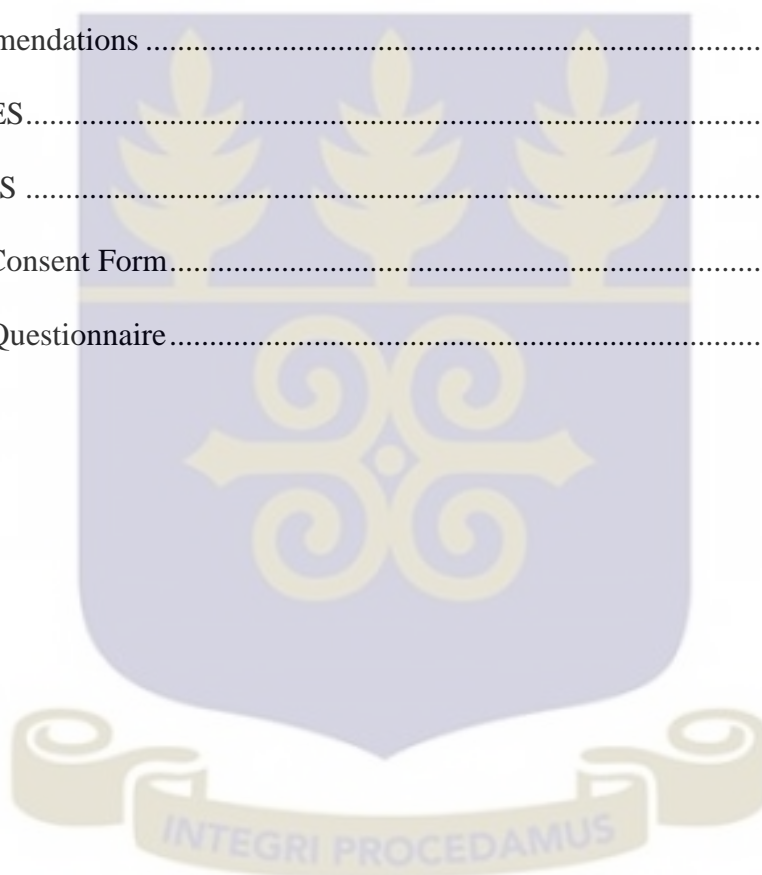
I am also obliged to extend sincere thanks and appreciation to my parents, Mr and Mrs Elias T. Blidi; though I lost my mom (Jeannetta T. K. Blidi) along this academic journey, for the moral, spiritual and financial support. To my siblings Rose, Keturah and Grace Blidi, my two loving kids Nicholas and Nicole Blidi; I am happy that you stood by me. To my mates, all residents of cohort (VIII), Ghana Field Epidemiology and Laboratory Training Program (GFELTP), I thank you for the support you extended me especially during my bereavement. Lastly, I commend the able faculty of the Department of Applied Epidemiology and Disease Control (AEDC), School of Public Health for their support and knowledge impartation while I navigate the waters of intermittent academic turbulence; I am so grateful that I came to the University of Ghana.

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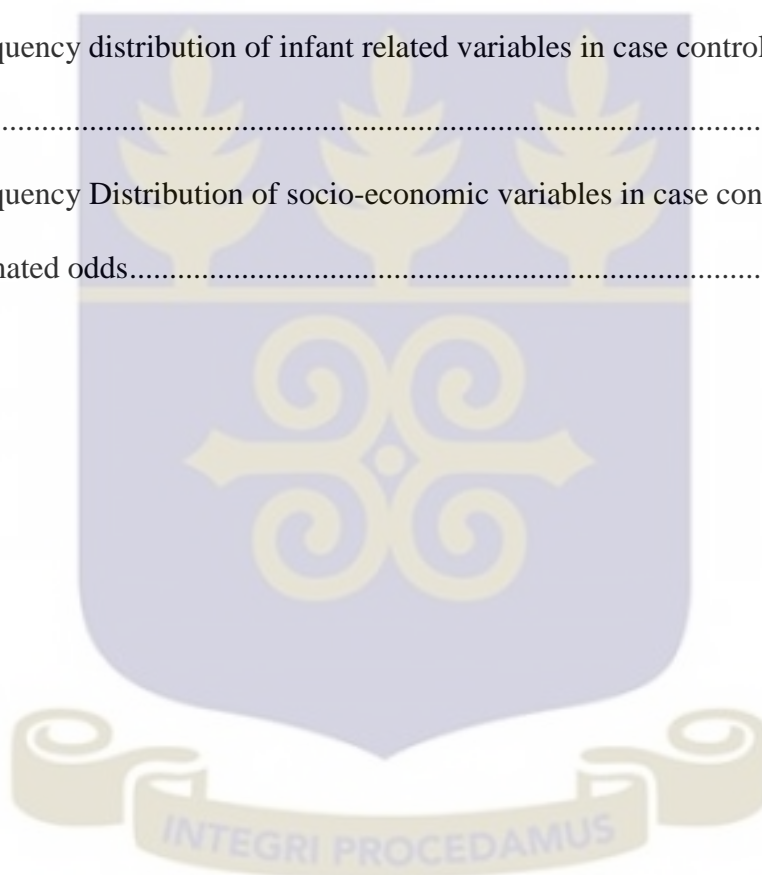
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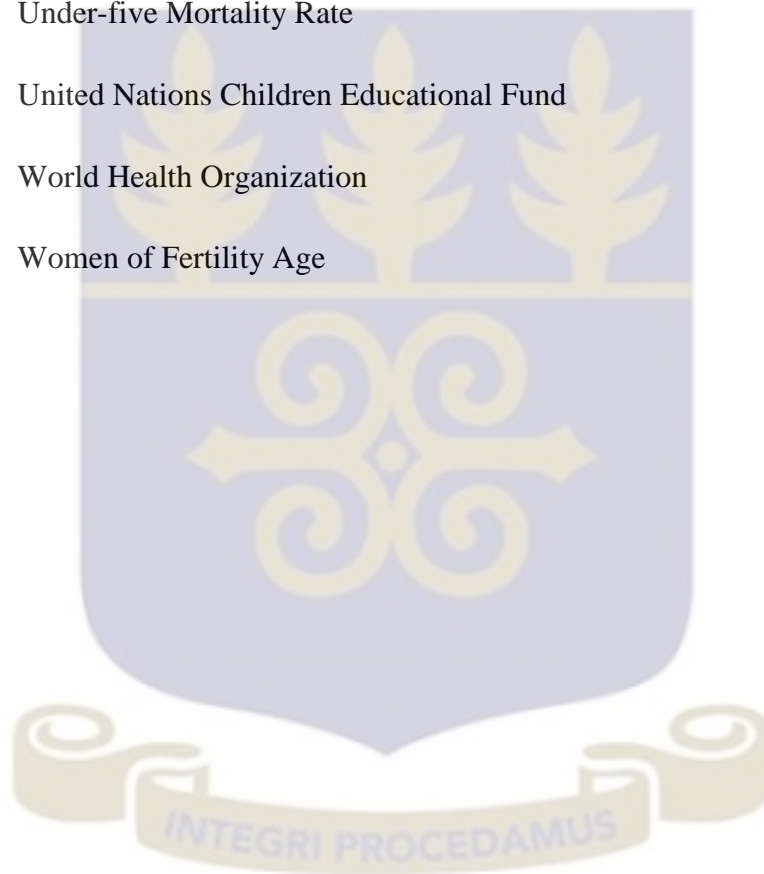


LIST OF ACRONYMS



ANC –	Antenatal Care
CI –	Confidence Interval
CM –	Certified Midwife
EBF –	Exclusive Breast Feeding
ECOSOC –	Economic and Social Council
EmONC –	Emergency Obstetric and Neonatal Care
ENAP –	Every Newborn Action Plan
EPI –	Expanded Program on Immunization
FP –	Family Planning
GHO –	Global Health Observatory
HALE –	Healthy Life Expectancy
HCF –	Health Care Facility
HLPF –	High Level Political Forum on Sustainable Development
HMIS –	Health Management Information System
IMCI –	Integrated Management of Childhood Illness
LBW –	Low Birth Weight
LDHS –	Liberia Demographic Health Survey
LLIN –	Long Lasting Insecticide Net
MDG –	Millennium Development Goal
OR –	Odds Ratio
ORS –	Oral Rehydration Salt
OECD –	Organization for Economic Co-operation and Development

OWG –	Open Working Group
PNC –	Post Natal Care
SDSN –	Sustainable Development Solution Network
SGA –	Small Gestational Age
TBA –	Traditional birth Attendant
TTM –	Trained Traditional Midwife
UFMR –	Under-five Mortality Rate
UNICEF –	United Nations Children Educational Fund
WHO –	World Health Organization
WIFA –	Women of Fertility Age



DEFINITION OF TERM

INFANT – Is a child zero to less than one year, preferably eleven months

INFANT MORTALITY – Is the number of deaths of infant less than one (1) year old in a given period, usually a year per 1000 live births in the same year. Included is the total death rate and death by sex and this is often used as an indicator of the level of health in a country.

VACCINE PREVENTABLE DISEASE – Are disease that can be prevented, especially in children by administering live and potent vaccines

NEONATAL MORTALITY – Is a newborn death occurring within 28 days postpartum

PERINATAL MORTALITY – Is a late fetal death (22 weeks gestation to birth) or death of a newborn up to one week postpartum



ABSTRACT

Introduction: Liberia's infant mortality rate is 69.1 per 1000 births, one of the highest in the world. Moreover, in Liberia, about 40,000 children die before attaining the age of five years. Mortality is a major determinant of a country's productivity; hence, when nothing is done the future is at stake.

Methods: This facility based unmatched case control study covered 103 infants who died age less than one year within 17 health care facilities in Montserrado County, Liberia, between the period July 2015 to February 2016. For each case, two controls were selected. The data was collected through reviewing infants' records in the health care facilities and conducting face to face interview with mothers.

Results: 58(56.31%) of the deaths were girls and 45 (43.69) were boys. The leading causes of deaths associated with medical factors were pneumonia 26(25.2%), neonatal sepsis 18(17.5%), diarrhea 17(16.5%) and malaria 15(14.6%). The study showed that parity, birth spacing, distance to health care facility, age of the mother at the time of child's birth, place of delivery and mothers' education were significant determinants of infant mortality.

Conclusion: Adequate attention should be given to the infantile period as well as care for all infants. National government through health care authorities should place special emphasis on those factors that influence infant mortality and how they can be reduced.

Keywords: Infant; infant mortality rate; socio-demography; Montserrado County, Liberia.

CHAPTER ONE

INTRODUCTION

1.1 Background

The Sustainable Development Goals (SDGs) which have replaced the Millennium Development Goals were created to improve the health and wellbeing of people worldwide. Its third goal, specifically SDG 3.2 is to end preventable deaths of newborn and children under five years of age, with all countries aiming to reduce neonatal mortality to at least as low as 12 per 1000 live births and under five mortality to at least 25 per 1000 live birth by the year 2030; an initiative the MDGs was expected to be achieved by 2015. Infant Mortality Rate is the number of infants under one year old who died per 1000 live births. It is also used as an indicator to measure the level of health in a country. The world Infant Mortality Rate is 49.9 per 1000 (WHO 2014) while under five mortality is 73.7 per 1000 (WHO 2014). However, there are challenges in the reporting system of most WHO countries with regards to infant mortality and thus it is difficult to compare across countries. The WHO recommends that all children who show signs of life should be recorded as live births. Many countries are yet to abide by this standard; hence, they are artificially lowering their infant mortality rate relative to those countries which follow the set criteria.

Worldwide, about 4.6 million (74% of all under-five deaths) occur within the first year of life (Global Health Observatory, 2013). The risk of a child dying before one year of age was highest in WHO, Africa Region (60 per 1000 live births); about five times higher than that of WHO European Region (11 per 1000 live births). However, global infant deaths have reduced from estimated 63 deaths per 1000 live births in 1990 to 34 deaths per 1000 live births in 2013 (Global Health Observatory –GHO, 2014). Also annual infant death has

reduced from 8.9 million to 4.6 million. The Global Health Observatory revealed that addressing inequality in Reproductive, Maternal, Newborn and Child Health (RMNCH) intervention is crucial in curbing infant and maternal mortalities. The 2010 and 2012 Millennium Development Goals summit under the auspices of the United Nations have placed serious emphasis on child survival and have developed such parallel programs like “Every Woman Every Child and Child Survival Call to Action” respectively. However, the MDGs 4 is embedded in the Sustainable Development Goals three (SDG 3) which is now focused on sustaining progress being made from 1990-2015 and to push forward for improvement in infant and child health in the next generation.

1.2 Problem Statement

Liberia’s infant mortality rate is high and stands at 69.1 per 1000 live births and Montserrado County which host about percent of the County’s population also stand at 54 per 1000 live births (LDHS 2014); one of the highest in the Global community. Moreover, about 40,000 children died before 5yr, thirty-five (35%) of these children died before one year (1yr) and another fifteen percent (15%) of the deaths occurred post neonate (National Strategy for Child Survival in Liberia 2008-2011). This means that out of the five percent (5%) under one population, nineteen percent (19%) is being lost and also approximately one percent of the total population is being lost every five years (Liberia Investment Plan 2015).

There are a number of factors influencing infant mortalities and these ranges from medical associated conditions to socio-demographic and economic and political factors which have also been worsen by the recent Ebola Virus Outbreaks which began in mid-2014 (World Bank 2015). Currently and even before, the country is struggling with its health system – lack of sufficient and qualifies health practitioners, availability of specialized services and

facilities are among the many issues that are tackled on a very small scale with respect to the urgency of infant survival. Also the absence of empirical statistical findings that point out to specific issues and challenges confronting the health system apropos to infant survival is a challenge to combating infant mortality. If nothing is done, the country stands the risk of losing a productive future population and human resource – replacement will not be seen and our population pyramid will become unfavorable. This study seeks to provide a way forward to help reduce infant mortality and to generate other relevant information for specific intervention in Liberia, beginning with Montserrado County.

1.3 Conceptual framework

The conceptual frame work developed by Mosley and Chen (2008) and Desta (2011) has found to be applicable in the context of the study. The framework attempts to explain the influence of various factors on infant mortality. The outcome that an infant will ‘die or live’ depends on socio-demographic including maternal factors as well as medically associated factors affecting the infant health. Factors like mother age, occupation, income and marital status have been found to be significant predictors of infant mortality according to research. For instance, an uneducated mother may have serious difficulty in handling the health of her baby since she might not be aware or fully cognizant of childhood illness and dangers signs of childhood illness. On the other hand, a mother who is educated and gainfully employed has the advantage to seek adequate health care in order to support and sustain the health of her baby. High education of a mother also imply improved decision making power especially with regards to antenatal and post natal visits and preference of delivery facilities. Worldwide, socio-demographic characteristics have been recognized to influence health care use both in developing and developed countries. The model demonstrates how age of a mother can influence her infant health. However, this can be discussed in two folds. Age of the mother on one hand is view as accumulation

of experiences on the use of timely and appropriate health services – especially with regards to adult women (25 years and above). Whereas, on the other hand younger mothers are inexperienced and may solely rely on others especially family members to make decisions or provide instructions for the health of the infant. Parity, and birth spacing or interval are also significant predictors of infant mortality according to studies conducted. A mother who has given birth for the first time or who has a first baby is likely to lose the infant due to perhaps limited experience and handling of the infant care in the midst of childhood illness; a woman who delivers with interval less than twenty four months were likely to experience infant mortality. The rural and urban settings are also significant determinants of infant mortality. This is parallel to access to health care taking into account the distance covered in order to access quality health care services, time and means of attaining the service. Medical conditions like pneumonia, diarrhea, neonatal sepsis and malaria have been reported by international health regulatory bodies (WHO, UNICEF, Global Health Observatory) to have significant relationship with infant mortality. The introduction of the recent pneumonia conjugate vaccines (PCV) has also been a consolidated global effort to reduce infant and child mortality caused by pneumonia (UNICEF 2011). Moreover, infants born with low birth weight are normally susceptible to varieties of predisposing factors and conditions that can be life threatening. Globally 10 million infants and children die each year before their 5th birthday. About 99% of these deaths occur in developing countries (WHO 2014). Infant mortality is the death of a baby before his or her first birthday and infant mortality rate is the estimate of the number of infant deaths for every 1000 live births. The major causes are malaria, diarrhea, pneumonia and vaccine preventable diseases (example, Pneumonia) among others. However, there are factors contributing to infant mortality, which may include low income

status of parents, access to safe drinking water and environmental sanitation, malnutrition and parents' level of education (WHO 2014).

The conceptual framework

Model of the Conceptual framework

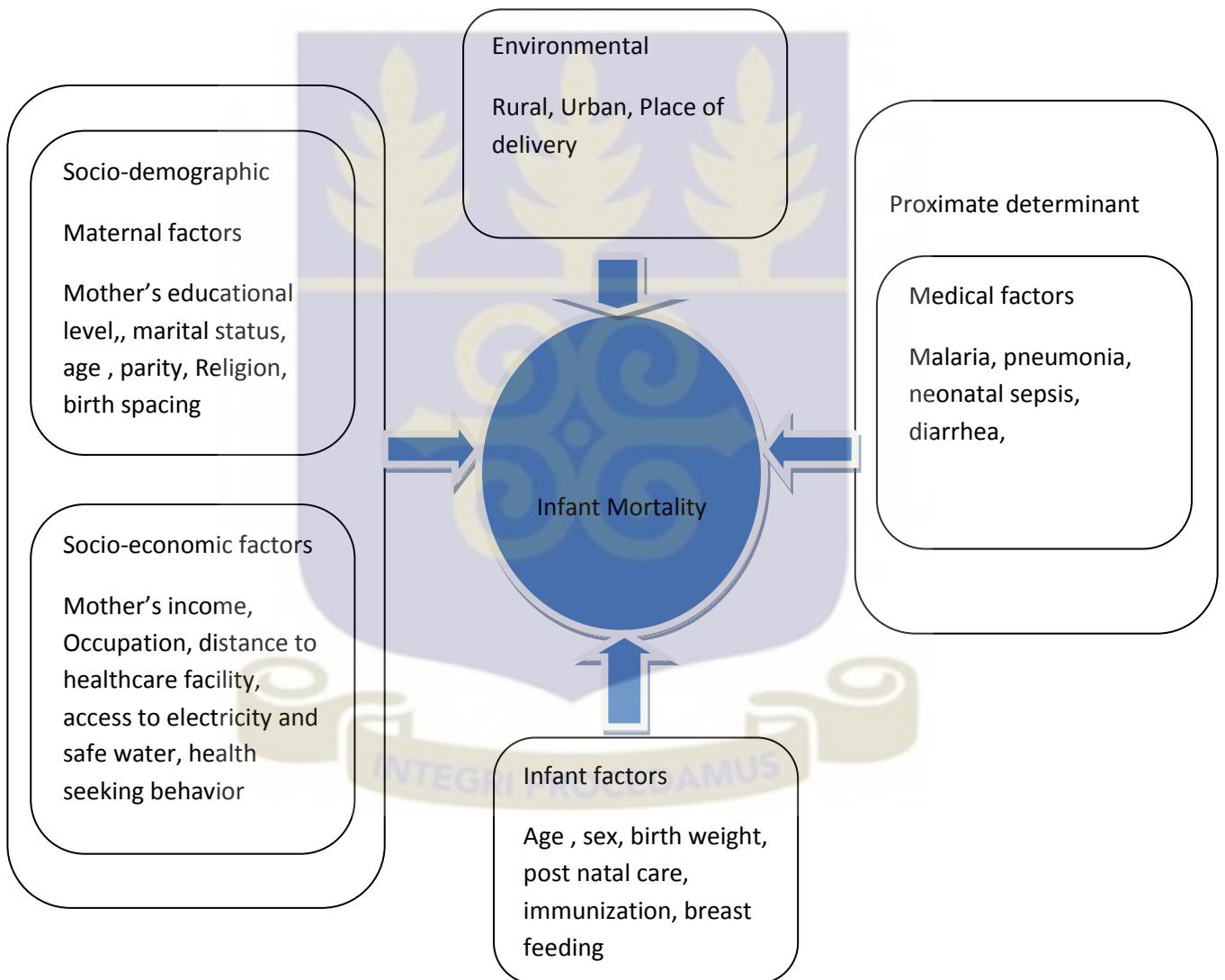


Figure 1.0 Conceptual Framework adapted based on Mosely and Chen theoretical model

This model is supported by a number of empirical study models in developing countries. For instance, Cramer (1987) has developed a conceptual model of infant mortality, based on this conceptual model, his objective used a causal modeling approach in order to detect direct and indirect effects of the socio-economic factors. He limited his conceptual framework on the indicators he has access to (birth and infant death records from single live births in California - 1978). Moreover he considered that maternal age, marital status, race and education (socio-economic factors) influence birth order, birth weight and prenatal care (intervening variables which finally influence the infant mortality). Sharma (1998) limited the conceptual framework to the available variable of interests. Accordingly, the conceptual framework was comprised of two social factors (maternal education and marital status) and several proximate determinants (health care, gestation duration, birth weight, maternal age, birth intervals and intergenerational risk). Analyzing infant survival in the Czech Republic, Rychtat'y'kov'a and Demko (2001) highlight also the direct and indirect mechanisms through which socio-demographic factors (maternal age, birth order, marital status, maternal education and region of living) influence infant mortality. Their framework was made of three main components: the proximate determinants (biological determinants), the background determinants (the mother's social, demographic and economic characteristics) and the community factors (the characteristics of the community in which the mother and the child live). The model must of course simplify the reality in order to highlight the main relevant causal mechanisms and make the model testable. It must also be independent upon the indicators which will be used later on in order to estimate causal effects.

1.4 Justification

Infant mortality takes away society's potential physical and human capital (WHO 2014). The Infant mortality rate is one of the many indicators used to monitor achievements

towards the Sustainable Development Goal Number Three (SDG 3; 3.2) (UN 2015). In Africa, children, under-five are increasingly concentrated in Sub-Saharan Africa and Southern Asia, while the proportion in the rest of the world dropped from 32% to 18% (Global Health Observatory 2013).

Liberia is among the world's highest number of infant mortality. The current infant mortality rate is 69.1 per 1000 live births a figure that is far exceeding the Global average. This presupposes that Liberia requires a robust step forward from studies and recommendation to alleviate or minimize higher infant mortality. In 2010, about 15% of the all children die before reaching their first birthday (CMAJ.JAMC.2010). Preventable diseases like malaria, pneumonia, and diarrhea are among the leading killers of children. In Liberia, malnutrition and respiratory tract infection kill thousands of children each year. Nearly 40% of the children under-five years suffered from stunting as a result of malnutrition and about 40% of the population does not have access to safe drinking water. Also about 75% of the populace do not have adequate sanitary environment (UNICEF.org/info by country/Liberia 2013.). Hence this study from findings shall:

- Provide empirical information on factors influencing infant mortality in Montserrado County, Liberia
- Information based on findings from the study will be used for strategy development and planning for appropriate intervention that will reduce infant mortality
- Based on findings and recommendations, there shall be lobby by the Ministry of Health and the Ministry of Gender, Development and Social Welfare, Liberia resource allocations that will target awareness through media education,

community engagement as well as construction of specialized facilities and training of personnel.

1.5 Objectives

1.5.1 General

To assess and or determine factors contributing to infant mortality in Montserrado County

1.5.2 Specific

- To determine infant medical factors associated with infant mortality in Montserrado County
- To determine the maternal socio-demographic factor influencing infant mortality in Montserrado County
- To determine socioeconomic factors influencing infant mortality in Montserrado County

1.5.3 Research Question

Basically, this research shall endeavor to answer two major questions which include the following.

Are there medical causes that influence infant mortality in Liberia?

What are the maternal socio-demographic factors and socioeconomic factors influencing infant mortality in Montserrado County?

CHAPTURE TWO

LITRATURE REVIEW

This chapter presents related relevant literatures on factors influencing infant mortality.

2.0 Global Burden of Infant mortality

Since 1990, the under-five mortality (UFM) rate has dropped by forty-seven percent (47%). About seventeen thousand (17,000) fewer children are dying each day, 6.6million under 5 children in 2012-mostly from preventable diseases. However, about 10 million lives have been saved through measles vaccination since 2000 (WHO 2014).

In sub-Saharan Africa, one in ten children dies before age five, more than15 times the average for developed regions. Gains have been made in child survival since 1990, making it possible to increase child survival for future generations worldwide. The mortality rate for children under five dropped by 47 percent- from 90 deaths per 1000 live births in 1990 to 48 in 2012. Despite this accomplishment, more rapid progress is needed to meet the 2015 target of two-thirds reduction in U5mortality. In 2012, an estimated 6.6million children-18000 a day- died from mostly preventable diseases. These children tend to be among the poorest and most marginalized in society. Increasingly, child death is concentrated in the poorest regions- sub-Saharan Africa and Southern Asia accounting for 5.3million (81 percent) of the 6.6million deaths in children under five worldwide. In some areas, half the children suffer from chronic malnutrition and many are anemic and vitamin A-deficient (UNICEF 2010). Extreme inequalities, lack of services, and poor roads and school make grim prospects for children. Rural families are now getting assistance from the MDG-Fund for Farmers-field schools, a program that provides training on agricultural and management technique to farmers to improve their children's health and nutrition.

In 2006, approximately 10 million children under-five died worldwide, with a daily rate of 26,000 deaths and this data was used by UNICEF for every country in the world. The rate is expressed as the number of children dying before their fifth birthday per 1000 live births. Of the 10 million, 4 million died within the first month of life, a half of these died within 24 hours of birth. Many of these deaths are related to the lack of adequate medical and nursing intervention at the time of birth. Accordingly, for every newborn that dies, another 20 suffer birth injuries, complications arising from preterm birth or other neonatal conditions. Moreover, in developing countries, one quarter of pregnant women do not receive even a single visit of a skilled health attendant. Only 59% of birth takes place with the assistance of skilled attendant. And only have taken place in a health facility. Whilst there has been some reduction in child mortality rates, progress in any region of the world has been negligible (Infant Mortality Rates Still High, Barry Mason – UNICEF, 2008).

One of the Millennium Development Goals set by the UN in 2000 was to reduce the under-five mortality rate by two-third by 2015 now SDG 3. Amongst the regions in Africa with inadequate progress towards this goal are Sub-Saharan Africa, Eastern Africa and Southern Africa, whilst the regions of West and central Africa are the most challenged to progress. The report further noted that Sub-Saharan Africa remains the most troubling geographic area. 1 in every 6 children dies before age five. Almost half of all deaths of children under-five occurred in Sub-Saharan Africa (UNICEF 2010 Report). At the time of the report, were 27 countries that have registered scanty progress since 1990 or have an under-five mortality rate that is stagnant or higher than it was in 1990. The region as a whole only managed to reduce child mortality at an average annual rate of 1 % from 1990-2006, and will require double digit reduction during each of the remaining years now extended by the Sustainable Development Goals Three (SDG 3.2).

An understanding of making SDGs work where MDGs has lapsed (MDG 4 and SDG 3)

The United Nations system shall play an essential role in implementing the new sustainable development agenda for the world. Over the years since its existence, the United Nations has held a unique place in shaping the global multilateral system and has been in the business of setting universal norms and standards, has unparalleled convening powers, exhibiting legitimacy and neutrality, creating global knowledge and having a comprehensive mandate coupled with in-country presences worldwide; hence, the United Nations has already played an important role in helping to achieve the MDG agenda on many levels, e.g. by contributing directly with its operational activities, building capacity, gathering and assessing data, and by advocating for the agenda's implementation (World Bank 2015). A study conducted by Markus Loewe and Nicole Rappin in 2015 to assess the challenges of the United Nations and the processes of implementing the SDGs following the deadline of the MDGs revealed that in spite of a number of known weaknesses, the UN system is an asset that needs to be put to good use; it can be a motor for assisting countries in achieving their common national and collective Sustainable Development Goals. However, a universal sustainable development agenda with transformative ambitions presents unprecedented requirements to the international community, including the United Nations itself. In the United Nations Secretary-General's synthesis report, it was rightly stated that the international community at large needs to be made "fit for purpose" (WHO 2015). The UN faces the double challenge of tackling a stockpile of long-overdue reforms and getting into shape for overseeing and assisting in the implementation of the post-2015 agenda. The year 2015 can be monumental for addressing these challenges jointly. Member states should seize the opportunity to push for changes in the United Nations to avail them of a world organization that is better suited to the new demands. This will require changes in behavior and a serious look at the UN

system's functions, as well as its governance, funding, capacity and impact (. Such a reform effort should build on existing reform processes, both within the UN system itself as well as within intergovernmental bodies (Markus Loewe, Nicole Rippin 2015).

A look back at the MDG accountability framework

The Millennium Development Goal (MDG) accountability framework was characterized by shortcomings in both the monitoring and review processes. Monitoring is carried out by national statistics offices in cooperation with individual United Nation agencies and then compiled at central levels of the UN Secretariat. The MDGs accountability framework was susceptible to duplication, incoherence and poor description of responsibilities. In light of being fragmented, the system was lacking in quality and ownership (Markus Loewe, Nicole Rippins, 2015). Recent studies show that numerous developing-country statistical offices were unable to collect, analyze and disseminate data for MDG reporting. MDG statistics are often based on donor-funded surveys or modeling exercises. As a result, the MDG accountability framework continued to be inadequate in terms of promoting compliance for the development commitments agreed to by all states. However, the MDGs represent a step forward compared to the situation in the 1990s, especially in terms of creating greater transparency in development cooperation. Going forward, the post-2015 accountability framework should build on these experiences and design a monitoring system with clear lines of reporting (among UN agencies and other stakeholders). Calls for data revolutions and disaggregated statistics need to become rooted in discussions on how accountability to the agenda will be realized (Markus Loewe, Nicole Rippins, 2015). This requires balancing compliance and learning in a system that is inclusive to all different stakeholders and caters to their motivations and interests. The study recommended three components of post-2015 accountability tools or frame work that will be applicable for United Nations member states and has been consented to. The study further went on to

outline the key elements of post-2015 accountability Framework as follow. A central role should be played by the High-level Political Forum on Sustainable Development (HLPF), which was mandated to conduct regular reviews, starting this 2016, on the follow-up and implementation of sustainable development commitments and objectives, as well as those related to the means of implementation, within the context of the post-2015 agenda. This analysis mainly focuses on the HLPF but also sketches other potential forum for accountability. Despite the strong HLPF mandate, it is unclear how the reviews will be organized, how they will relate to other United Nations processes, what role key stakeholders other than governments (e.g. the private sector, civil society) will play and what level of ambition member states will show. The study also proposed a simple model for designing the post-2015 accountability mechanism around three key components: actors, linkages and ambition (Markus Loewe, Nicole Rippins, 2015). Component 1: Actors. The accountability framework should include three main actor groups: governments, the United Nations system and society. Governments will be responsible for implementing the new agenda with strong support from the UN system and broader society (non-governmental stakeholders, civil society organizations, philanthropic foundations, private sector, multi-stakeholder partnerships, etc.). The HLPF review will be a central place for bringing these three groups together. The HLPF review will be state-led, voluntary (while encouraging reporting) and provide a platform for partnerships. A key point, however, is that the accountability framework will be broader than just the HLPF review mechanism. The United Nations system – including all individual entities – shall provide additional opportunities for creating accountability that have to be linked to the overall accountability framework. Existing UN organs such as the General Assembly or the Economic and Social Council (ECOSOC) as well as thematic forum are already performing follow-up and review. Similarly, broader society and actors not participating in

the current post-2015 discussions should be engaged. Component 2: Inter linkages- Relations in the accountability framework are at least as important as individual elements. Organizing coherent lines of reporting and assigning responsibilities between elements of the framework will be the principal challenges. Inter linkages could be established in various forms, including joint meetings, reports and evaluations; harmonized operating cycles; joint governance structures; or shared thematic sessions. Further details should be discussed among member states. The study distinguished three broad types of linkages within the multi-layered accountability framework: between actors (UN system, governments, society), between levels of governance (national, regional, international) and between the post-2015 accountability framework and outreach to external actors. In linking different actors, a coherent engagement of the UN system is critical. The post-2015 agenda and accountability framework should set priorities for work areas of the whole system and individual United Nations entities. For example, ECOSOC's recent strengthening reform that moves the Council from "coordination" towards "management" of the United Nation system is capable of play a role in this regard (Markus Loewe, Nicole Rippins, 2015, WHO 2015). The same holds for ongoing UN reform processes for better connecting the normative work of the UN and its operational work at the country level. Next, each United Nations entity needs to be included through its governance structure. Governments play a crucial role on the Executive Boards of UN funds, programs and specialized agencies, for example. Finally, the UN Development Cooperation Forum, similar to other UN forum dealing with specific sectors, could organize accountability for the sector of development cooperation. For engaging non-governmental actors, the HLPF could work with the Sustainable Development in Action registry. The registry contains public and regularly updated information on multi-stakeholder partnerships and voluntary initiatives. Within the registry, there are several "Action Networks" – such as the

Secretary-General's Sustainable Energy for All, or Every Woman Every Child initiatives – that have set up their own accountability and review mechanisms (Markus Loewe, Nicole Rippins, 2015, WHO 2015). Going forward, the registry should be improved (e.g. through independent reviews, ex-ante goal definition and clear reference to specific SDGs). In addition, non-governmental actors should be invited to participate, also through formal roles, in the accountability framework at the national, regional and international levels. Linking different levels of governance – international to national – requires balancing global goals to foster global collective action and nationally set targets and indicators that reflect differentiated development priorities. There should be differentiated types of accountability, depending on the level of governance. For instance, strong accountability can be carried out at the national level, whereby parliaments, audit institutions and civil society actors could be the vehicles. At the regional level, peer-learning mechanisms could ensure an external and independent assessment of progress towards achieving the SDGs. Countries in the same region often share similar challenges and are likely to make greater progress by jointly addressing their problems. At the international level, there would be aggregated monitoring of global progress to identify implementation gaps and opportunities for collective action. Also, aggregated reporting will be presented in the Global Sustainable Development Report, which should link to different levels (regions, countries) and actors (governments, UN system, parliaments, non-governmental actors, and academia). Strong academic input for the report could guarantee higher quality and greater independence of the analysis. Lastly, the post-2015 accountability framework should involve external actors through clearly defined outreach efforts. Organizations and groups such as the G-20, the Organization for Economic Co-operation and Development (OECD), the BRICS countries, the World Trade Organization and development banks should engage in a formal manner (Markus Loewe, Nicole Rippins, 2015). In addition, the

study revealed that institutions addressing specific sectors, such as the Global Partnership for Effective Development Co-operation, could assume a formal role in supporting the achievement of the SDGs. Given the overall ambitious agenda, systemic issues in global governance, such as global trade and finance, inevitably need to be addressed by the accountability framework. Achieving the SDGs strongly relies on the actions of communities outside the post-2015 setting in the UN as well as within the UN's current sphere of influence.

Healthy lives and promotion of well-being for all at all age

In the SDG, this goal is about ensuring healthy lives and promoting well-being for all at all ages. The goal's focus on ensuring healthy lives rather than preventing diseases or infirmity is highly welcome, yet the level of ambition is likely unrealistic, given the current operationalization of the goal. Though ensuring healthy lives for all is clearly an aspiration for the long term, it is unachievable by 2030 and is not even aimed at by most of the targets of SDG 3. Also, the operationalization does not sufficiently reflect the comprehensiveness expressed in the tone of the goal, as many targets aim at combating specific diseases rather than promoting healthy lives. SDG 3 is among the most specific SDGs with a number of clear, measurable targets. It is a direct result of the fact that SDG 3 can build on experience with the MDGs, which had a very strong focus on health (MDGs 4, 5 and 6). Particularly in this regard, it is unfortunate that some of the main lessons learnt from the MDGs have not been accounted for (Markus Loewe, Nicole Rippins, 2015, WHO 2015). Clear examples are Targets 3.1, 3.4 and 3.6, which focus on global reductions only. Global targets not only risk masking significant variations in the starting conditions of countries but also risk being adopted at the national level, as experience with the MDGs has demonstrated. The SDSN suggestion for a disaggregation of global targets according to geographic location is a telling example of this.

Furthermore, a blind adoption of global targets at the national level is highly disadvantageous to countries with bad starting conditions. William Easterly's article "How the Millennium Development Goals Are Unfair to Africa" from 2009 is a prominent source in this regard. A positive feature of the goal is that the majority of targets apply to developing and developed countries alike, despite the goal's history with the MDGs. The importance of targets such as maternal, infant and child mortality justifies their inclusion, despite their greater relevance for developing countries (Markus Loewe, Nicole Rippins, 2015).

Finally, SDG 3 is complementary to a number of other goals. First, the implementation of social protection schemes required in SDG 1 includes health protection. Second, health is crucial for the ability to get educated (SDG 4). Third, safe drinking water and adequate sanitation and hygiene (SDG 6) contribute to limiting the spread of diseases. Fourth, employment and economic well-being (SDG 8) strengthen the possibilities for purchasing health care where it is not publicly provided. Fifth, SDGs 13, 14 and 15 – with their focus on ecosystem services and environmental well-being – complement SDG 3, at least indirectly. The goal is operationalized through nine targets and four suggestions for means of implementation. Most of the targets deal with health issues that are relevant for developing and developed countries alike. Most of the targets are very precise; the level of ambition, however, varies considerably between the targets (Markus Loewe, Nicole Rippins, 2015).

The target requires by 2030 to "reduce the global maternal mortality ratio to less than 70 per 100,000 live births" (WHO 2015). This is a welcome continuation of an important MDG target, yet two of the main lessons learnt from the MDGs have been disregarded. First, the global focus of the target will not prevent its translation into a goal adopted at the national level, as the suggestions of the SDSN for the disaggregation of the target plainly

demonstrate. But the simple adoption at the national level is highly unfair to those countries with challenging starting conditions. This weakness could easily be removed by adding “by reducing national maternal mortality ratios to less than x per 100,000 live births”; each country would then specify the target value, given the different starting conditions. Second, data on maternal mortality rates are highly unreliable. The SDSN mentions the problem that many developing countries lack a death (and often also birth) registration system, which makes it virtually impossible to derive a reliable number of maternal deaths. We urge calling for the implementation of death and birth registration systems as an important part of the data revolution. We also join the call of many health experts to use the MDG indicator “Proportion of births attended by skilled health personnel” in addition to maternal mortality rates because of the unreliability of the latter (Markus Loewe, Nicole Rippins, 2015).

To end preventable deaths of newborns and under-five children

The great importance of the target justifies its high level of ambition; however, it will be crucial to ensure that poor countries are not left alone with their limited resources to deal with this task. Target 3.2 is closely linked with Target 2.2 on ending all forms of malnutrition, as malnutrition is a frequent cause of death for newborns and under-five children. Target 3.3: The target requires by 2030 to “end the epidemics of AIDS, tuberculosis, malaria and neglected tropical diseases and combat hepatitis, water-borne diseases, and other communicable diseases”. The target is highly ambitious and seeks to include important diseases that have been neglected in the MDGs (WHO 2015). However, the list of communicable and non-communicable diseases mentioned by Targets 3.3 and 3.4 includes more than 25 diseases, and it would be far too costly to measure them all. This is probably the reason why the SDSN suggests only the three MDG indicators HIV, tuberculosis and malaria to capture Target 3.3. However, this concentration on a very

small sample of diseases directly leads to the same problems that the MDGs already had, whereby a defined set of health concerns attracted many resources, regardless of the dominant causes of illness and mortality in low- and middle-income countries (Markus Loewe, Nicole Rippins, 2015). Target 3.4 - The target requires by 2030 to “reduce by one-third pre-mature mortality from non-communicable diseases (NCDs) through prevention and treatment, and promote mental health and wellbeing”. Again, the global focus of the target will not prevent adoption at the national level, as again the suggestions of the SDSN for the disaggregation of the target according to geographic location plainly demonstrate. This weakness of the target could easily be removed by adding “by reducing national pre-mature mortality by x%”. However, the most serious problem of Target 3.4 is the same as the one explained in Target 3.3. Instead of trying to measure pre-mature mortality from non-communicable diseases and to develop an indicator for the promotion of mental health and well-being, it would be advisable to introduce a target on HALE (Markus Loewe, Nicole Rippins, 2015).

2.1 Infant mortality in Africa, an overview

It can be established that climate on the African Continent does not only influence nutrition, but also the type of culture and the appearance or disappearance of certain infection. Information on infant and child deaths are not complete in term of sources. Most data emanate from vital statistics registration, which is inaccurate for rural areas. Recent data revealed much more for mortality 1-4 year than mortality before one year of age in many African Countries. The attributed causes are due to the fact that mortality rates are maintained throughout the second year of life on a large scale, mortality in East Africa is lower than mortality in West Africa. Data on infant mortality are available only in some African countries, notably Algeria, Senegal, Nigeria, and Mauritius. The main cause of deaths in Infant and child are infected and parasitic disease, especially enteritis, followed

by diseases of the respiratory tract. Diarrhea and rubella account for the greatest number of deaths. Infant mortality appears to be much higher in rural areas in most but not in all countries. Infant and child mortality is still alarming in Africa; it has however, decreased steadily (Cantrelle e tal, 2009). Again a compiled follow-up visits were conducted in Luknow City, india to evaluate differentials by socio-economic, demographic and health care characteristics of infant and their families. The analyses revealed that infant mortality is found to be inversely proportional related with caste status among Hindus, education of mother, parent's monthly income, and father's occupation. Infant mortality exhibits a J-shaped distribution in relation to maternal age at marriage. With respect to health care factors, antenatal care of mother was seen to have negative relationship with birth weights and feeding index of the child. Infant policy recommended for application and implementation includes family planning (Srivastava e tal 2008). Study conducted in China on information on levels, trend and determinants of infant and child mortality showed that male mortality was higher than female mortality in the neonatal and post neonatal period and at the ages of 1-5 years. Births weight, place of residence and mother education were found to be significant determinants of mortality; age of mother and parity were less important (Dankert e tal 2009). Though infant and child mortality has steadily reduced since 1967, yet fertility is still very high. Consanguineous marriages, short birth spacing and maternal education were paramount determinants to control infant and child mortality. However, short birth spacing and type of marriages are some important determinants of infant mortality than maternal education (Pederson, J.). Studies in Nepal which focused on the differentials analysis by education of parents and other family members, access to toilet, electricity and source of drinking water were considered. The analysis showed significant effects of education, access to toilet and electricity in lowering infant and child mortality. Also access to toilet and electricity are proxies for household

socio-economic status which suggests that education and household resources are complementary in lowering the infant and child mortality (Pant, P.D, 2001). It is evident that in south Asia women are the primary decision-makers regarding child health care, family health and nutrition. A proportional hazard models indicate that enhanced autonomy significantly decreases post-neonatal mortality. Enhanced household authority significantly decreases child mortality. Meanwhile, a simulation based on estimated effects of eliminating gender inequality suggests that achieving complete gender equality could reduce child mortality by nearly fifty percent and post-neonatal mortality by a third (Hassain e tal, 2010). A ten year statistics data was conducted on the basis of risk factor of infant mortality, in singleton and twin births. The analyses showed IMR 5.3 fold higher in twins than in singleton in 1999 but decreased to 3.9 – fold in 2008. The reduced risk of infant mortality in twins relative to singletons may be related partially, to survival rates, which is ameliorated after fetoscopic laser photocoagulation for twin – twin transfusion syndrome. The overall proportion of neonatal deaths among total infant deaths was 54% for singleton and 74% for twin. IMR decreased as gestational age (GA) rose in singleton, whereas the IMR in twins decreased as GA rose until 37 weeks and increased thereafter. Moreover, the IMR was significantly higher in twins than in singleton from the shortest GA (<24 weeks) to 28 weeks as well as ≥ 38 weeks. The IMR was significantly higher in the youngest maternal age group than in the oldest one, whereas the opposite was seen in twins. The lowest IMR in singleton was 1.1 per 1000 live births for ≥ 38 weeks of gestation and heaviest birth weight (≥ 2.009), while the lowest IMR in twins was 1.8 at 37 weeks and ≥ 2.000 g (Imaizumi e tal, 2010). Studies in vietnam conducted on infant neonatal and post-neonatal mortality showed comparable distribution by births order, maternal age, pregnancy interval, mother's education and urban-rural residence. The IMR were highest amongst first order birth, birth after an interval of less than 12 months, births

to illiterate mothers and to those age under twenty one (21) or over thirty five years (35yrs). Logistic regression analysis showed that the most significant predictor of infant mortality was residence in the province where over all infant mortality was over 40 per 1000 live births (Swenson et al, 2009). Also research examining determinants of infant mortality in Egypt with primary focus on the effect of household economic status and the availability of health service showed that certain features of the health system environment affect survival in the neonatal period. In early childhood, survival chances improve markedly as income increases and if the household depends almost exclusively on employment income. In infancy and in early childhood, mortality is strongly associated with region of residence and maternal demographic characteristics, and is weakly associated with parental schooling (Casterline et al, 2010)

Currently there have been some evidences of tremendous success in Sub-Saharan Africa that has only been barely recognized. Infant and under-five mortality has plummeted in some countries in the region in recent times. According to the WHO/MDGs, a two-third reduction from 1990-2015 would require an annual decline of 4.4 percent per year. In 20 countries (Senegal, Rwanda, Kenya, Uganda, Ghana, Zambia, Mozambique, Madagascar, Nigeria, Benin, Niger, Mali, Malawi, Guinea, Zimbabwe, Lesotho, Namibia and Liberia) for which data are available, 12 show rate of decline above the MDG rate. These include Senegal, Rwanda, Kenya, Uganda and Ghana. They have experienced an extremely large decrease or reduction within MDG 4 rate. However, this does not show that a particular country will meet the MDG. What is connotes is that the African Renaissance is bringing substantial benefits to the citizen of the continent and that hundreds of thousands of parents will be spared the anguish of loss of a child.

Moreover, Uganda in the 1990 revealed household survey data on U5 mortality at 200 per 1000 live births and even higher. Today Uganda is at 90 per 1000 live births. Ethiopia, the

second most populous country in Africa, U5MR fell from 123 to 88 per 1000 live births from 2005-2010. This reduction was analyzed from a case control study that also outlined significant expansion of malaria intervention (Artemisinin-based combination therapy and insecticide-treated nets) and improvement in sanitation as major contributing mechanisms to success. In Kenya, which had the fastest infant (under one) mortality in the late 1990s and early 2000s, has dropped 7.6% per year (Kenya Demographic Health Survey 2012).

Again the reduction is due to the huge increase in ownership of insecticide-treated bed nets (ITNS) which play a substantial role in reducing malaria deaths in a malaria high risk zone. It was entirely confined to postnatal mortality, since postnatal mortality was much higher in a malaria high risk zone in households without ITNs than households that own ITNs (Africa's Success Story: Infant mortality Down, Gabriel Denobynes and Rita Reinikka, 2012). Reports from Africa Key Facts and Figures for Child Mortality Newborn and Child Mortality Estimates Sub-Saharan Africa as having the highest risk of death in the first month of life and is among the regions showing the least progress. However, Sub-Saharan Africa has seen a faster decline in its under-five mortality rate, with the annual rate of reduction doubling between 1990–2000 and 2000–2011. Sub-Saharan Africa, which accounts for 38 percent of global neonatal deaths, has the highest newborn death rate (34 deaths per 1,000 live births in 2011).

Neonatal deaths there account for about a third of under-five deaths globally (1.1 million newborns die in the first month of life). Sub-Saharan Africa has reduced under-five mortality by 39% between 1990 and 2011. If current trends persist, 1 in 3 children in the world will be born in sub-Saharan Africa, and its under-five population will grow rapidly. The highest rates of child mortality are still in Sub-Saharan Africa—where 1 in 9 children dies before age five, more than 16 times the average for developed regions (1 in 152).

Under-five mortality rate in Africa (per 1,000 live births) declined from 163 in 1990 to 100 in 2011.

In Eastern and Southern Africa the decline was from 162 in 1990 to 84 in 2011. In West and Central Africa the decline was from 197 in 1990 to 132 in 2011. Eastern and Southern Africa have reduced under-five deaths by 48% from 1990 to 2011. Western and Central Africa have reduced under-five deaths by 33% from 1990 to 2011. Liberia, Rwanda, Malawi, and Madagascar are among the top ten countries with the greatest percentage decline in their under-five mortality rates from 1990-2011. The under-five mortality rates decreased in these countries by 67.5%, 65.4%, 63.6%, and 61.8% respectively. Causes of Death One of the major causes of under-five mortality is neonatal sepsis.

In 2010, fifteen percent (15%) of newborn deaths in Africa can be attributed to infections related to the delivery process. In sub-Saharan Africa, care-seeking for pneumonia has improved from 36% in 2000 to 46% in 2010 in rural areas, and from 49% to 52% in urban areas. Diarrhea causes about 11% of under-five deaths worldwide, with nine-tenths of these deaths occurring in Sub-Saharan Africa. Use of Oral Rehydration Salts (ORS), one of the three key interventions for diarrhea, has increased from 24% of children in sub-Saharan Africa receiving ORS in 2000 to 30% in 2011.

Also in 2011, Malaria accounted for a loss of nearly 500,000 lives of children under-five in the world with almost all of the deaths occurring in sub-Saharan Africa. In 2000, only 2% of children under-five in Africa slept under Insecticide Treated Nets (ITNs), this number increased dramatically to 38% in 2010. Tanzania, Niger, and Mali have increased ITN use to over 60%. 165 million children under 5 are stunted (low height for age) in their growth due to poor nutrition during the first 1,000 days of life. Stunting rates in sub-Saharan Africa have decreased from 47% in 1990 to 40% in 2011, yet the prevalence is

still high. Exclusive breastfeeding is a critical part of improving child survival and development.

Sub Saharan Africa has seen increases from 21% in 1995 to 33% in 2010 of infants under six months who are exclusively breastfed. The largest threat of maternal mortality occurs during labor, birth, and the 24 hours following birth. Many of the interventions known to save the lives of women and their newborns depend upon the presence of a Skilled Birth Attendant (SBA). In Africa, 48.4% of births in 2011 were attended by skilled health personnel. Millions of children die from diseases that can be prevented through vaccines. At 2011, African immunization coverage was estimated at 77%. The World Health Organization (WHO) estimates that 20% of under-five deaths—approximately two million deaths annually—could be prevented with existing vaccines. In 2010, 6% of under-five deaths in sub-Saharan Africa were associated with HIV. In some countries the rate is much higher, 28% in South Africa and 23% in Swaziland. In 2011, Swaziland, Botswana, and South Africa all achieved over 90% coverage of the most effective medicines for Preventing Mother-to-Child Transmission (PMTCT).

2.2 Infant Mortality in Liberia

Liberia is rated at number sixteen (16) of the Global Infant Mortality ranking, with 69.1 deaths per 1000 live births next to Equatorial Guinea and above Zimbabwe. The country's has a population of 4.1 million (July 2014 Established). The country's population growth rate is 2.5% and median age is 17.9years. – Female 18.1 years and male 17.7 years (July 2014 LDHS Established). The death rate is 9.9 per 1000; urban population is 48.2% of the total population. The mean age of mother at first birth is 19 years and the median age is 25-29 years among women. With respect to infant mortality (69.19 per 1000 live births), male is 73.46 deaths/1000 live birth and female is 64.79 deaths/1000 live births. The fertility rate, the total is 4.81 children born/woman, life expectancy is 58.21 years average.

In males, it is 56.56 years and the female is 59.9 years; Improve- drinking water source aggregate is 74.6% (Urban 86.8% & rural, 63%), improved sanitation aggregate is 16.8% (Urban 28.4% and Rural 5.9%) (July 2014 LDHS Established). Meanwhile, major infectious diseases include food or waterborne, bacterial and protozoan diarrhea, hepatitis and typhoid fever. Vector-borne diseases include malaria, dengue fever and yellow fever, water contact disease includes schistosomiasis, Aerosolized dust or soil contact disease includes Lassa fever and animal contact disease include rabies (WHO 2014).

Save The Children, an International Non-governmental Humanitarian Organization is working with women's groups, certified midwives and trained traditional birth attendants in Margibi County, one of Liberia's political sub-division. With funding from the European Union, the project focuses in areas associated with improving maternal and child survival. The country was able to achieve some reduction in the areas of maternal and child health, but with the introduction of the Ebola Virus Disease, infant mortality, maternal mortality alongside of actors of unskilled birth attendance have altered and worsened the gains made during the period.

While still high, U5MR has declined from 220 per 1000 live births in 1986 to 110 per 1000 live births in 2007. Concurrently, infant mortality rate has declined from 144 deaths per 1000 to 69.1 per 1000 live births in 2009. If progress should continue on reducing malaria prevalence, accelerating scale-up in the prevention and treatment of pneumonia and diarrhea, improvement in the newborn care and increase in birth spacing, Liberia will likely achieve SDG 3. Meanwhile, malaria prevalence in children has declined from 66% in 2005 to 32% in 2009. Full immunization coverage remains inadequate (51%) and HIV prevalence (1.5%) poses a potential threat to the population and the reduction of infant and child mortality in Liberia (Save the Children, January 2013- June 2014).

Liberia is among the many countries with challenges to attaining lower infant mortality rate, though in 2012 the country was believed to have attained some significant marks in the reduction of children less than five mortality. Liberia's infant mortality rate is among the highest in the world given 69.1/1000 live births (LDHS 2013). About 40000 children died before age five years, 29% occurred in the first month of life, 35% occurred during the post neo-natal period and the rest (26%) is during the period before five years of age. According to the National Strategy for Child Survival in Liberia (2008-2011 Guidelines), the goal was to reduce child mortality by 15% by 2015; however, only 6% was achieved. The priority is to make children healthy and free from all common childhood illnesses so that they survived. However, there have been challenges in areas like the use of Long Lasting Insecticide Net (LLIN), Effective Breast Feeding (EBF), and effective treatment of diarrhea, malaria and pneumonia cases. Moreover, the availability of Emergency management of Obstetric and New born Care (EmONC), provision of safe drinking water, nutrition, improved Maternal and Child Health Services (MCH) and basic skills of Integrated Management of Childhood Illness (IMCI) were major challenges (National Strategy for Child Survival in Liberia, 2008-2011).

The recent Ebola has created a huge challenge for the country's recovering health system. A recent survey conducted in the country on pre Ebola and the post Ebola status of the health system revealed that there is a critical need for health workforce and need for full employment in the health sector. About twenty-nine percent (29%) of the population lacks access to health care within five (5) km or a one hour walk and about sixty five (65%) of household walk to a health facility. Challenges with health infrastructure, availability of pharmaceutical products, health services and health financing are of major concern to the overall health system (Liberia Health Assessment 2015).

The World Bank has warned that infant and maternal mortality are expected to increase following the Ebola epidemic which claimed the lives of several health workers in the country (World Bank 2015). The ratio of doctors to patients before Ebola was 1 to 10000, hence; with the Ebola Virus Epidemic situation and crises which the country has embroiled, it can be inferred that infants' survival will be influenced. Moreover, the life expectancy of a child guarantees the future of any country. The Assistant Health Minister added that other trainings are necessary because since subsequent graduations, things have improved. He said Government has plans to include healthcare workers on the payroll, adding, "Discussions are ongoing and progress has been made." He disclosed that Non-Government Organizations are helping with payment, and requested for the listing of all graduates from Government health institutions for possible employment.

2.3 Socio- demographic and economic factors influencing infant mortality

According to the World Health Organization (WHO), an important indicator of socio-economic development of a country is the infant as well as maternal mortality rates. It is generally observed that in developing countries both infant and maternal mortality rates are too high as compared to that of developed countries (WHO 2015). Specifically, infant mortality rate (IMR) serves as an excellent parameter of development and healthiness of a country or community (Romani et al 2009). Infant mortality is gaining much relevance as many social scientists have viewed that infant mortality rate is an excellent indicator of socioeconomic development and hence the international and most national governments have initiated robust efforts to reduce the IMR and to enhance the level of child survival. Infant mortality rate is affected by a large number of socio-demography and economic factors (Barman et al, 2009). Most social and economic development programs are enhancing the overall objective of improving the health status of the populations concerned. Good health is viewed not only as important in

its own right but also as having a significant instrumental purpose. Healthy populations are seen as having a greater potential for engaging in productive economic activity, thereby directly contributing to efforts designed to reduce poverty (Health Systems Trust, 1998; Malawi, 2002). In this light, infant and child survival take on a special relevance for families, communities and countries. The most common indicator of infant and child survival is a country's infant mortality rate (IMR). Any society in which this rate is relatively low is considered healthier than one in which the IMR is high. Moreover, the IMR is frequently used as an indicator of socioeconomic development, with low IMRs being associated with a higher level of socioeconomic development. Varieties of factors have been identified as influencing infant and child survival. First are the socioeconomic characteristics of the household in which a child is born. Pundits argue that higher family income, urban residence and greater educational attainment or achievement of the mother improve the chance that a child will survive the first year of life and beyond. Also adequate access to health care services and facilities, including ante-natal care, medical attendance at birth, and participation in immunization programs constitute a second set of factors frequently cited as contributing to a lower IMR. Another set of factors believed to be important for infant and child survival is the socioeconomic characteristics of the household in which the child is born. Infant and child mortality is also affected by sanitary provisions and facility. An outstanding sanitation facility is a primary health care mechanism to good health and also reduces morbidity. It is believed that both infant and child mortality increase when sanitary condition decreases (Romani e tal). Currently, the most powerful media and basic amenities of life and information is television. It plays a very strong role for mass media; it broadcasts some programs concerning public health awareness. If even an illiterate man watches these health-based programs, he will realize the importance of role of health and cleanliness. Study conducted to illustrate television is

mortality revealed that child mortality level is lower having TV than no TV (Romani e tal). The post-neonatal period and childhood (1-4 years), the pattern is reversed, with female death rates exceeding those for males. A preference for sons over daughter is seem to be stronger in some countries than others, example Bangladesh. Sons always get better care in terms of food, clothing and medical care than female children (Romani e tal). These differentials remain unchanged throughout their life. As regarding to the sex of child, it is seen that during neonatal period male mortality is higher than female (60.7% versus 39.3%), while child mortality level (48.1%) is lower than female child mortality level (51.9) (Mondal e tal, 2010). The odds ratio for the place of residence suggests that the risk of dying as neonatal, post-neonatal and child is lower in the suburban area than in rural area. For instance, the suburban areas experienced have 25.60% lower child mortality than the rural areas. It is believed that suburban areas are associated not only with better health services but also with better education and employment opportunities for women, suggesting a low risk experiencing infant and child death in the area. It has been frequently argued that mother's education is an important factor in explaining risk of infant and child mortality (Romani e tal, 2009). The study indicates that risk of neonatal and child mortality are lower among the women having secondary and higher education respectively than those having no education. Several hypotheses have been adverted to explain this association, it is postulated that maternal education inculcates modern health knowledge, beliefs and practices; improves the effectiveness of health behavior. Study also showed that the risk of neonatal death is lower among mothers who are working than those who are not working. A lower risk of infant mortality among the working mothers may be due to the fact that they might be well aware about immunization and several care during antenatal and postnatal visits (Mondal e tal). In Ethiopia, a study conducted on a reviewing maternal level of education, number of antenatal visits and proximity to a health

facility influenced infant mortality. Women with urban residence, primary and secondary-plus educational levels, four-plus ANC visits and proximity to health centers had higher odds of using skilled birth attendants though women with no complication had lower odds (Alemayehu et al 2015).

Research on individual and community determinant of neonatal mortality in Ghana also shows that infants of multiple gestation, neonates with inadequate birth spacing and low birth weight had a lower chance of surviving the neonatal period. Moreover, infants of grand multiparous mother and non-breastfed infants were more likely to die during neonatal life, whereas adequate utilization of antenatal, delivery and post natal health services reduce the likelihood of neonatal mortality. Also dwelling in a neighborhood with high socioeconomic deprivation was associated with neonatal mortality – Kayode et al 2014.

Additionally, a cross-sectional multivariable analysis on risk factors for post-neonatal, infant, child and under-five mortality showed that children born to mothers with no formal education was significantly associated with mortality for post neonatal care; Other significant factors included living in rural areas for children and poor household - Ezeh et al 2015.

2.4 Environmental Factors Influencing Infant Mortality

Studies conducted in Poland suggested that infant mortality was associated with industrial environmental conditions at the population level. The cumulative effect of the population characteristics, which are represented by factors such as “poor working environment” and “industrial pollution”, was related to higher infant mortality and might contribute to explaining the geographical variation in that mortality within a country. On the other side, the effect of the population characteristics, which are indicated by factors such as

“urbanization and employment in the service sector” and “economic wealth”, was small and not statistically significant. Strategies to improve working conditions and reduction of industrial pollution might contribute to a decrease in infant mortality, (Genowska e tal, 2015).

Also study conducted in Nigeria to assess the underlying structure of the sixty-five items for the socio-economic and environmental variables of mortality rates. The normality assumptions, as well as the linear relationships between pairs of variables, and the variables being correlated at a moderate level were checked. Eleven factors component was identified. The total variance explained is 90.38. The result shows that 30.8 per cent of the variance was accounted for by the first factor while the second and third factors accounted for 16.5 per cent and 15.3 per cent respectively. It is particularly instructive to note that more than 60 percent of the variance is accounted for by the first three factors. The first factor which seems to index household dwelling infrastructure had a very strong loadings on infant immunization, type of cooking fuel, type of main roofing material, floor material, method of solid waste disposal and refuse disposal facility as well as household monthly income. The second factor which seemed to index maternal education had high loadings on households’ sanitation facility, drinking water, access to electricity, maternal education and type of housing unit. “Type of housing” unit had its highest loading from the third factor which seemed to index income, but had a cross-loading factor over the maternal education factor. The fourth, fifth, and the seventh factor indexed unemployment/mud house, unhealthy household waste disposal and rich household respectively. Type of refuse disposal facility and method of solid waste disposal which had their highest loading factor in household environment factor also had a strong loading from the unhealthy waste disposal facility management factor (Mesike e ta, 2012).

2.5 Infant factors associated with mortality

World Health Organization (WHO) famous slogan is “Children's health is tomorrow's wealth.” The concern for children's health and survival finds expression in the continuous monitor by WHO of low birth weight (LBW) worldwide as a public health indicator (UNICEF and WHO, 2004). The World Health Organization has defined low birth weight at birth as less than 2, 500 grams (2.5 kilograms 5.5 pounds) (WHO, 1992). This practical cutoff for international comparison is based on epidemiological observations that infants weighing less than 2.5 kilograms are approximately 25 to 30 times more likely to die than infants with birth weight exceeding this cutoff, and it increases sharply as birth weight decreases (Chang, 2003). More than 20 million infants worldwide, representing 15.5 percent of all births, are born with low birth weight – 95.6 percent of them in developing countries <http://aps.journals.ac.za> African Population Studies Vol 25, 2 (Dec 2011)251 making low birth weight (LBW) an important infant health problem in many populations. The 2008 Nigerian Demographic Health Survey showed the incidence of low birth weight in Nigeria to be 14 percent (655 per 1,000), which however varies considerably across social and geographic areas (NPC & ORC Macro, 2009). At birth, fetal weight is accepted as an indicator that is directly related to the health and nutrition of the mother as well as an important determinant of the chances of the newborn to survive and experience healthy growth and development. From study, birth weight also showed a reverse social gradient such that increasing disadvantage is associated with decreasing birth weight (Wilcox, 1992; Berney et al., 2000). The prenatal period is one of the most vulnerable in the human life cycle. During this period, the mother serves as a gate-keeper and child health is dependent on whether she admits into her own system those elements that are relevant to a healthy pregnancy. These include adequate nutrition, timely medical care and adequate antenatal education to make informed choices on behalf of her unborn child. The effect of

low birth weight on infant mortality is not only additive but also interactive. The intensity level and triplicity of the contribution of low birth weight to infant mortality is higher in developing countries given that the survival of such infants is dependent on environmental sanitation, effective post-natal nutrition and rehabilitation, and the availability of medical care and services (Mondal, 2000). Low birth weight remains a public health problem in many parts of the world and is associated with a range of health problems, lasting disabilities and even deaths. One-half of low birth weight infants in industrialized countries are born pre-term (<37wk gestation), however, in the developing countries these children are born at term but are affected by intrauterine growth alteration and retardation that begin early in pregnancy (Ramakrishnan, 2004). Pregnancy risk factors are all the aspects of pregnancy that endanger the life of the mother and the baby. These factors may include poor nutrition of the woman, child spacing, maternal age (under 15 years and over 35 years), inadequate prenatal care, lifestyle behaviors (e.g. smoking, alcohol consumption, drug abuse and unsafe sex), overweight, obesity and poverty (Wardlaw & Kessel, 2002). BFS (1989) data showed that infant mortality is higher for boys than for girls, but child mortality is lower for boys (Kabir and Chowdhury 1993). D'Souza and Bhuiya (1982) and Chen et al (1981) showed from data obtained by the International Centre for Diarrheal Disease Research in Bangladesh (ICDDR, B) that during neonatal period, male mortality exceeds female mortality as a sex differential consistent with higher biological risks faced by male children. The post neonatal period and childhood (1-4 years), the pattern is reversed, with female death rates exceeding those for males. In Bangladesh mortality levels are generally favorable for male. A preference for sons over daughter is seem to be stronger. Sons always get better care in terms of food, clothing and medical care than female children. These differentials remain unchanged throughout their life. As regarding to the sex of child, it is seen that during neonatal period male mortality

is higher than female, while child mortality level is lower than female child mortality level (51.9%) (Mondal et al.). Two hundred fifty two findings is the large maternal and socio-economic disparities in the birth weight of infants; in line with this, many authors have highlighted the importance of considering social and class factors in addition to biological ones to explain LBW. These socioeconomic differences have been found in many countries, even in those where access to prenatal care is universal (Kramer et al., 2000). While it is important to describe the independent effects of different behavioral and socioeconomic risk factors, we must consider that these factors are not isolated events in women's lives, but are a part of many interrelated and complex behavior and environmental risks she encounter. Many of the known determinants of a baby's birth weight are not within a woman's immediate control. Clearly, the relationship between lifestyle risk factors and birth weight is complex and is affected by psychosocial, socioeconomic, and biological factors; it is also clear that birth weight outcomes are socially stratified. For many women in the developing world, economic, social and cultural factors make it difficult for them to obtain the necessary food and health care, which are closely interrelated. Some researchers consider that health, therefore, may be an important determinant of opportunities in life and this process termed 'selection by health', and suggest that health 'selects' people in different social strata (Wadworth, 1999). Some of the major determinants of birth weight in developing countries include maternal nutritional status at pregnancy, gestational weight gain in accordance with dietary intake, parental socioeconomic status, malaria, anemia, and chronic infections during pregnancy (Podja and Kelly, 2000; Koupilova et al., 2000; Kramer et al., 2001). Social demographers (Singh and Yu, 1996) have long emphasized the importance of "nonmedical" barriers behavioral, social, environment, and economic – to good or adverse birth outcomes. Likewise, people's health occurs within cultural systems that are concerned with broader

issues of well-being than addressed by the physician's concerns with disease and injury. Other environmental factors that have been identified include socio-cultural traditions and customs concerning pregnancy, access to good quality prenatal care, culturally embedded demands for unlimited numbers of children (Nwokocha, 2004). Most research on birth weight outcomes in Nigeria have focused mainly on identifying risk factors of clinical/medical importance. There are limited studies on socio-cultural risk factors, knowledge, beliefs and practices in relation to patterns of prenatal care seeking and maternal health behavior as it influences infant birth weight. This present study is therefore designed to investigate the influence of maternal and environmental factors on infant birth weight in the city of Ibadan. In particular, the influence of nonmedical factors, such as socio-cultural and environmental settings and nutritional practices during pregnancy, are held constant in examining the effect of the conventional maternal variables.

2.6 Medical factors Associated with Infant mortality

Most of the post-neo-natal deaths are due to communicable diseases of digestive and respiratory system such as Diarrhea and Pneumonia, etc. the adverse environmental factors including congestion, insanitation, lack of sufficient sun shine and fresh air. Death due to Pneumonia, fever, asthma, diarrhea and respiratory etc. diseases can be greatly reduced by timely treatment of infant and children. Therefore, treatment place is also an important for children survival status. Study showed that neonatal, post-neonatal and child mortality level differences experienced due to their treatment places. The result shows that both infant and child mortality is higher whose treatment places are traditional than doctor/nurse. Place of delivery is also an important determinant of child survival (Romani et al). For instance, Bangladesh, many children die owing to the lack of safe delivery facilities, untrained dais, relatives and neighbors attend most of the deliveries, a practice

that presents risk to both the mother and the newborn baby. It was evident from the result that survival is higher among children born in proper health facilities and attended by professional doctors than those born at home attended by untrained attendant (Romani e tal). It was clearly shown that neonatal, post-neonatal and child mortality was higher among women whose delivery places were home, post-neonatal and child mortality levels at home than those delivery places are Hospital (Romani e tal, 2009). These results may imply that more and better antenatal care services during pregnancy may increase the children's chances of survival. Study also showed that the percentage of neonatal, post-neonatal and child mortality levels are lower with visitation of health worker than none visitation of health worker (Mondal e tal, 2010). In Eastern and Southern Africa the decline was from 162 in 1990 to 84 in 2011. In West and Central Africa the decline was from 197 in 1990 to 132 in 2011. Eastern and Southern Africa have reduced under-five deaths by 48% from 1990 to 2011. Western and Central Africa have reduced under-five deaths by 33% from 1990 to 2011. However, Liberia, Rwanda, Malawi, and Madagascar are among the top ten countries with the greatest percentage decline in their under-five mortality rates from 1990-2011. The under-five mortality rates decreased in these countries by 67.5%, 65.4%, 63.6%, and 61.8% respectively. One of the major causes of under-five mortality is neonatal sepsis (WHO 2015). In 2010, fifteen percent (15%) of newborn deaths in Africa can be attributed to infections related to the delivery process. In sub-Saharan Africa, care-seeking for pneumonia has improved from 36% in 2000 to 46% in 2010 in rural areas, and from 49% to 52% in urban areas. Diarrhea causes about 11% of under-five deaths worldwide, with nine-tenths of these deaths occurring in Sub-Saharan Africa. Use of Oral Rehydration Salts (ORS), one of the three key interventions for diarrhea, has increased from 24% of children in sub-Saharan Africa receiving ORS in 2000 to 30% in 2011.

Also in 2011, Malaria accounted for a loss of nearly 500,000 lives of children under-five in the world with almost all of the deaths occurring in sub-Saharan Africa. In 2000, only 2% of children under-five in Africa slept under Insecticide Treated Nets (ITNs), this number increased dramatically to 38% in 2010. Tanzania, Niger, and Mali have increased ITN use to over 60%. 165 million children under 5 are stunted (low height for age) in their growth due to poor nutrition during the first 1,000 days of life. Stunting rates in sub-Saharan Africa have decreased from 47% in 1990 to 40% in 2011, yet the prevalence is still high. Exclusive breastfeeding is a critical part of improving child survival and development. (A Promise Renewed Progress Report 2012 : <http://apromiserenewed.org>.)

Sub Saharan Africa has seen increases from 21% in 1995 to 33% in 2010 of infants fewer than six months who are exclusively breastfed. The largest threat of maternal mortality occurs during labor, birth, and the 24 hours following birth. Many of the interventions known to save the lives of women and their newborns depend upon the presence of a Skilled Birth Attendant (SBA). In Africa, 48.4% of births in 2011 were attended by skilled health personnel. Millions of children die from diseases that can be prevented through vaccines. At 2011, African immunization coverage was estimated at 77%. The World Health Organization (WHO) estimates that 20% of under-five deaths, approximately two million deaths annually could be prevented with existing vaccines. In 2010, 6% of under-five deaths in sub-Saharan Africa were associated with HIV infection. In some countries the rate is much higher, 28% in South Africa and 23% in Swaziland. In 2011, Swaziland, Botswana, and South Africa all achieved over 90% coverage of the most effective medicines for Preventing Mother-to-Child Transmission (PMTCT) (A Promise Renewed Progress Report 2012: <http://apromiserenewed.org>)

2.7 Maternal Factors influencing infant mortality

A study by Kazaura et al (2006) reported that several risk factors influence neonatal mortality. These include parity, maternal age, race, marital status, smoking, birth weight, gestation age, labor complications, antenatal care, previous unfavorable outcomes (e.g. stillbirth, neonatal deaths), maternal morbidity (e.g. malaria and HIV infection) and poor socio-economic conditions. Poor nutritional status during pregnancy has been associated with irreversible damage to the infant brain and central nervous system leading to poor brain development and intelligence. There is ample evidence that obesity and non-communicable diseases, for instance, cardiovascular diseases start early in childhood (Wardlaw & Kessel, 2002). The first category consists of those infants who die before they complete four weeks of life. The other category consists of those infants who die between 28 days and 365 days of their life. The rate based on the first period is known as the neo-natal mortality rate, while that on the second period is referred to as the post-neo-natal mortality rate. Factors, which affect fatal and neo-natal deaths, are primarily indigenous, while those which affect post-neo-natal deaths are primarily exogenous.

Endogenous Factors: The endogenous factors are biological factors related to the formation of the fetus in the womb. Among the biological factors affecting fetal and neo-natal infant mortality rates, the important ones are the age of the mother, the birth, prematurity, weight at birth and the fact of multiple births. It has been observed that fetal and neo-natal mortality rates are higher at the younger age of the mother (below 19), at first parity and for the first birth order. Up to the age of 29 of the mother these mortality rates declined and increase after it. The maturity of an infant is an important factor affecting neo-natal and infant mortality rates. Similarly, the weight of the baby at birth is also an important factor affecting neo-natal and post-neo-natal deaths. In 1950, low birth weight was in cause of two-thirds of all the neonatal deaths in USA. It was also found that

the changes of survival increased considerably with even a moderate increase in the birth weight – the optimum birth weight ensuring survival being 3,501 – 4,000 gms. The still birth rate and the neo-natal mortality rate are both very high in the case of multiple births. Endogenous factors are also known as genetic factors. Exogenous Factors: These include social, cultural, economic and environmental factors affecting infant mortality particularly during the post neo-natal period. One of the causes of high infant mortality in some countries is the lack of availability of medicine. The difference between infant mortality rates of legitimate and illegitimate birth is usually found to be quite marked. Illegitimacy is also an important factor contributing to a high infant mortality rate. A child conceived and born out of wedlock is generally unwanted both by the mother as well as society. One interesting feature of the role of endogenous and exogenous factors in determining infant mortality rates is worth noting. In countries where infant mortality rates are very low, a higher proportion of infant deaths occur during the neo-natal stage, because, being developed, they have been successful in almost completely eliminating the environmental factors responsible for such deaths. The main causes of infant mortality in these countries are mainly genetic or biological in nature. In countries where infant mortality rates are high, the majority of infant deaths occurs after the neo-natal stage and is due mainly to environmental factors (Barman et al, 2012).

CHAPTER THREE

METHODS

This study design is an unmatched Case Control. Data were collected from fifteen health care facilities in Montserrado County, Liberia and were analyzed to show associations between outcome and exposure variables.

Definition of Case and Control

- Case: Is a child whose mother is a resident of Montserrado County, age (0-11 months) and died between July 2015 – February 2016
- Control: Is a child whose mother is a resident of Montserrado County and who survived above 11 months between July 2015 – February 2016

3.1 Study Location/Area

The Study Area is the Montserrado County, one of the fifteen (15) political subdivisions of Liberia, and hosts the capital city Monrovia. The county comprises of seven health districts with 21 townships, seven cities, one borough and chiefdom. The County is also classified into rural and urban. This study was conducted in ten health facilities within the county, namely: Redemption Hospital, John F. Kennedy Memorial Hospital, James Davies Hospital, SOS hospital, Catholic Hospital, SDA Cooper Hospital, Benson Hospital, Clara Town Health Center, Nyehn health Center and Bensonville Hospital, MSF Pediatrics Hospital, Island Specialized Hospital, Cynthia Nelson Health Center, Kpallah Clinic and Bushrod Clinic. The County has about 400 health facilities and hosts the majority of the population (approximate 1.3 million) compared to other counties in the country. Moreover, the county has the highest number of deliveries hence the highest number of mortality. With respect to the rural-urban health care facility, the urban has a better advantage in terms of health facilities as well as health personnel. Most of the Country's

socioeconomic activities are conducted in the County since it hosts the political capital and better livelihood for many.

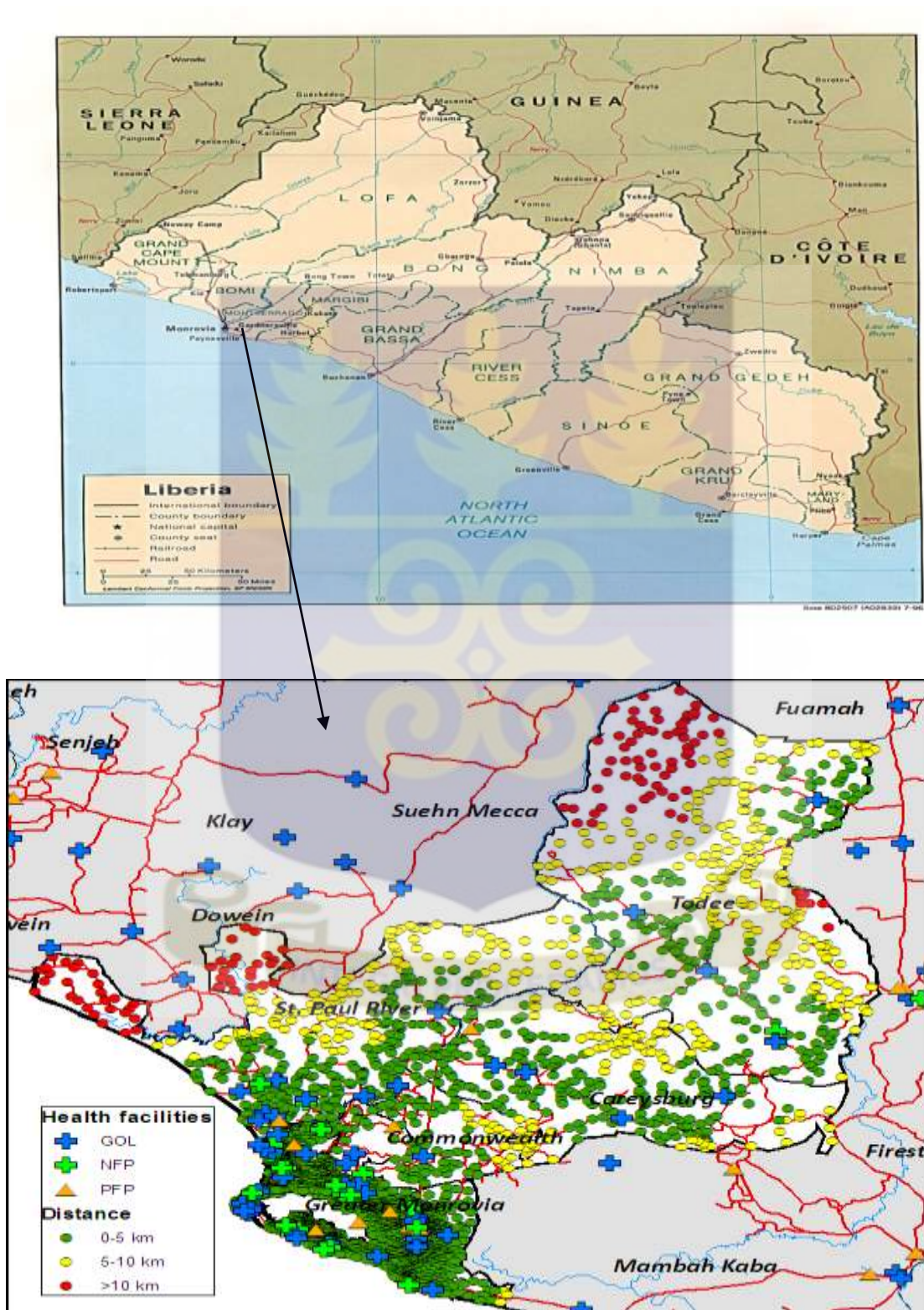


Figure 2.0: Liberia-Montserrado County (Top to bottom); Distribution of health facility by distance, location and ownership

3.2 Variables

Dependent Variable, Infant Mortality (measured as a binary variable)

Independent variables

Maternal demographic factors	Socio-Medical factors	Infant factors	Socioeconomic factors
Mother's age	Malaria	Age	Income
Parity	Pneumonia	Weight	Occupation
Birth spacing	Neonatal sepsis	Immunization status	Area of residence- Rural, urban
Mother's education	Diarrhea	Breast Feeding	Smoking
Birth order	Malnutrition		Access to electricity
Multiple gestation	Anemia		Access to safe drinking water
Place of delivery	Birth asphyxia		Religion
Distance to health care facility	Acute respiratory tract infection		Number of PNC visits
	Sudden Infant death, septicemia		
	Herbal intoxication,		
	Preterm		

Table 1.0 Distribution of Independent variable in case control

Variable	Operational Definition	Scale of Measurement	Source of Data
Age	<ul style="list-style-type: none"> Age of mother at last birthday Age of child during the study 	Continuous discrete in years	Client records/interview
Sex	Biological identity of infant	Binary (male, female)	Client records/interview
Education level	Highest formal education attained	Ordinal (None, primary, secondary, tertiary)	Interview
Parity	Number of children bore by mother	Ordinal (one, two, three, more than three)	Interview
Distance to health facility	Distance in kilometer from residence to health facility	Ordinal (less than 5 kilometer, 5 kilometer, more than 5kilometer)	Interview
Assess to electricity	Availability of lighting source	Binary (Yes, No)	Interview
Place of delivery	Area/place where mother delivers	Ordinal (home, clinic, health center, hospital)	Interview
Birth spacing	Interval for child bearing	Nominal (every year, every two year, every three year, every six year)	Interview
Religion	Faith based affiliation regarding God	Nominal (Christian, Muslim, none)	Interview
Birth weight	The weight of a child in either category (case/control)	Nominal (two kilogram, three kilogram, more than three kilogram)	Client records/interview
Marital status	Legal status	Nominal (married, cohabitating, single, divorce)	Interview

Table 1.1 Operational Definition of Socio-demographic characteristics

3.3 Study Population

The population under study includes all mothers whose infants fitted into the inclusion criteria. That meant an infant between 0 -11 months, born in Montserrado, survived or died between the periods July 2015 to February 2016.

3.4 Sampling Methods

A total of 700 cases records were made available from the fifteen health care facilities. 340(48.57%) were infant related deaths. Of those infant related deaths 215(63.23%) fitted into the inclusion criteria for the study. However, from those eligible for the study 103(47%) were selected by simple random sampling method. For each folder of a case, there was a death certificate filled and signed by a physician and that every folder contained information of the parents and or relative of the infant (s).With regards to the selection of control, there were 2000 folders available of which 600(30%) were suited for the study based on the inclusion criteria. From those suited for the study 206(34.33%) were selected based on simple random sampling methods for the purpose of the study.

3.5 Sample Size Determination

The sample size was generated using Epi Info StalCal software for Unmatched Case-Control. Below is the require measurements for generating the sample size. The assumptions of the sample size determination are based on literature and other background data like the Liberia Demographic Health Survey (LDHS) and the Liberia Investment Plan 2015.

- Cases to Control, assume an OR of ≥ 2 , with 80% power, 1 case to 2 controls
- Percent of controlling exposure is 50%
- Two sided confidence interval of 95%, Fleiss' sample size is 309

Cases were 103 and Controls were 206

3.6 Data Collection Techniques/Methods

Since the quality and classification of mortality data, especially infant mortality is treated with high level of circumspection and protocols, all research assistants were trained on how to conduct interview for the participants. Subjects participating in the study were provided knowledge of what the study is about and written consent was solicited. There were twelve (12) research assistants trained by the principal investigator and hired by the Japanese International Cooperative Agency (JICA) to provide support in the collection of data and to conduct interview for mothers from April 1- May 30, 2016. There were questionnaires available for interview for each infant mother in the study and each questionnaire for an interviewee were accompanied by consent that was filled by the interviewer/research assistant/principal investigator.

3.7 Inclusion Criteria

- Cases included records of mothers whose infants (0–11 months) have died and were residents of Montserrado County from July 2015 to February 2016.
- Controls included records of mothers whose infants survived above 0-11 months between July 2015 to February 2016

3.7.1 Exclusion Criteria

- Records of mothers whose infants (0-11 months) died before the study period or survived outside the study period and were residents of Montserrado County.

3.7.2 Quality Control

In order to maintain credibility and reliability of this study, research assistants included personnel with at least secondary education and knowledge on health. Moreover, these personnel were trained on how to collect data. Daily examination and conversation were done from questionnaires and data abstraction forms. Data handled by a research assistant

were cross-checked for consistency and completeness using source records. The principal investigator also double checked data gathered by the research assistants for the purpose of accuracy and vice versa. Pre testing of the questionnaire included random selection of health facilities (Redemption Teaching Hospital, Clara town health Centers, New kru Town Clinic) for the administrations of questionnaires in order to ascertain the understanding of each research assistants and to calculate the average time needed to interview a respondent. Also it was intended to create familiarity of the questionnaires.

3.8 Data Processing and Analysis

Quantitative data processing was done using Stata version (13) and Microsoft Excel 2007. Responses to the question were coded before data entry. Frequencies and percentages were run to determine the proportions. Cross tabulation (bivariate analysis) and logistic regression were used to determine the association between the dependent variable (infant mortality) and the factors that influenced infant mortality (independent variables). The results were presented using descriptive statistics.

3.9 Statistical Methods

Data Analysis

- Bivariate analysis was by percentage and frequency distribution
 - Summary statistics using logistic regression models were used to quantify the association
 - Odds ratio to determine significant association for outcome and exposure variables
- Categorical variables were presented with 95% confidence intervals. A p-value of less than 0.05 was considered significant. A logistic regression model was used to assess the association between independent and dependent variables.

3.10 Ethical Consideration/Issues

Ethical approval for the study was obtained from the Noguchi Memorial Institute of Medical Research (NMIMR) Ethical Review Committee and the University of Liberia Pacific Institute for Research Institutional review Board (UL-PIRE) following review of my study proposal. Permission was sought from the Ministry of Health Republic of Liberia and the health facilities authorities prior to data collection. The health facilities authorities were assured of maximum confidentiality, data safety and management and prudent data usage. The researcher guaranteed full protection of subjects and their participation during and after the collection of data. Participants were explained to and given the purpose of the research; also each participant was asked to consent by filling in a consent form.

3.11 Voluntary Written Informed Consent

As a rule of Thumb for ethical consideration, a well written informed consent stating the title and the purpose of the study were given to the subjects for their consent, in this case parents. In addition, detailed explanation of the essence of participation was emphasized. The consent form was attached to this proposal for approval of the Research Protocol and Ethical Review from Noguchi Memorial medical Institute and the University of Liberia-PIRE

3.12 Potential Risk

For mothers who lost their babies at a close interval of the research, the principal investigator was in charge to talk with her using some practical counseling skills in order to obtain information. In the event that the participant was in the confines of the health care facility, a psychosocial expert was contacted to assist in the interview of the participant

3.13 Pretest or Pilot Study

The questionnaires were tested to obtain understanding and the maximum time require for interview and to create some form of familiarity of the various section on the tool amongst the research assistants



CHAPTER FOUR

RESULT

From the data analysis, there were three hundred and nine (309) mothers who participated in the study, these include both cases and control. 48(46.6%) of the cases had birth weight below three kilograms, 55(53.4%); 20 (19.42%) of the cases did not breast feed as compare to 83(80.58%) who received breastfeeding; 22(21.36%) of the cases did not have any immunization at all, 78(75.73%) of the cases were partially immunized and 3(2.9%) of the cases were fully immunized; moreover, 10(9.71%) of the cases were identified as rural inhabitants and 93(90.29%) of the cases were urban inhabitants; among mothers who children died, 58(56.31%) were birthing every year; 48(46.6%) and 26(25.24%) of infants mothers were living five kilometers and above five kilometers from the health care facility; among mothers who lose their babies, 4 (3.88%) were between the ages of 15 – 19 years old, 29(28.16%) were between the ages of 20 – 24 years old; among mothers who infant died, 28(27.18%) had no formal education and 48(46.6%) were primary school dropped out; among the cases 55(53.4%) of mothers were petty trader, 23(22.33%) were house wife, 20(19.42%) were student and 5(4.85%) were well employed with private of public sector; 74(71.84%) of mothers who lose their infants did not have access to electricity compare to 29(28.16%) who had some sources of electricity; among the mothers who infant died, 76(73.79%) were Christian and 27(26.29%) were of the Islamic faith; 24(23.3%) of mothers who lose their baby had no post natal care visits and 16(15.52%) had had only one post natal visit at a health care facility

In this case control study, 103 were cases and 206 controls. Table 2.0 shows that out of these deaths cases 58(56.3%) were girls and 45(43.69%) were boys. As far as the place of delivery was concerned, 16(15.5%) happened at the home, 6(5.8%) occurred at the clinics, 11(10.67%) occurred at the health center and 70(67.97%) occurred in the hospital. Table 1 shows the frequency distribution of infant age in the analysis of mortality of the infant. From the table below, 15(14.6%) of the total deaths were within the first week of life, 25(24.3%) were within the neonatal period and 63(61.1%) were within the post neonatal period.

Outcome		Frequency	Percent
Death	<1week	15	14.6
	1-4weeks	25	24.3
	1-6months	39	37.9
	>6months	24	23.3
	Total	103	100.0
alive	<1week	23	11.2
	1-4weeks	52	25.2
	1-6months	64	31.1
	>6months	67	32.5
	Total	206	100.0

Tab. 2.0: Frequency Distribution of case and control

Figure 3.0 shows the frequency distribution of the various causes of death at the health care facilities. From the table, the leading causes of deaths were pneumonia 26(25.2%), neonatal sepsis 18(17.5%), diarrhea 17(16.5%), and malaria 15(14.6%). However, malnutrition 7(6.8%), birth asphyxia 5(4.9%), anemia 5(4.9%), septicemia 4(3.9%), sudden infant death 2(1.9%), acute respiratory tract infection 2(1.9%), herbal intoxication and preterm respectively were found to have contributed to infant mortality.

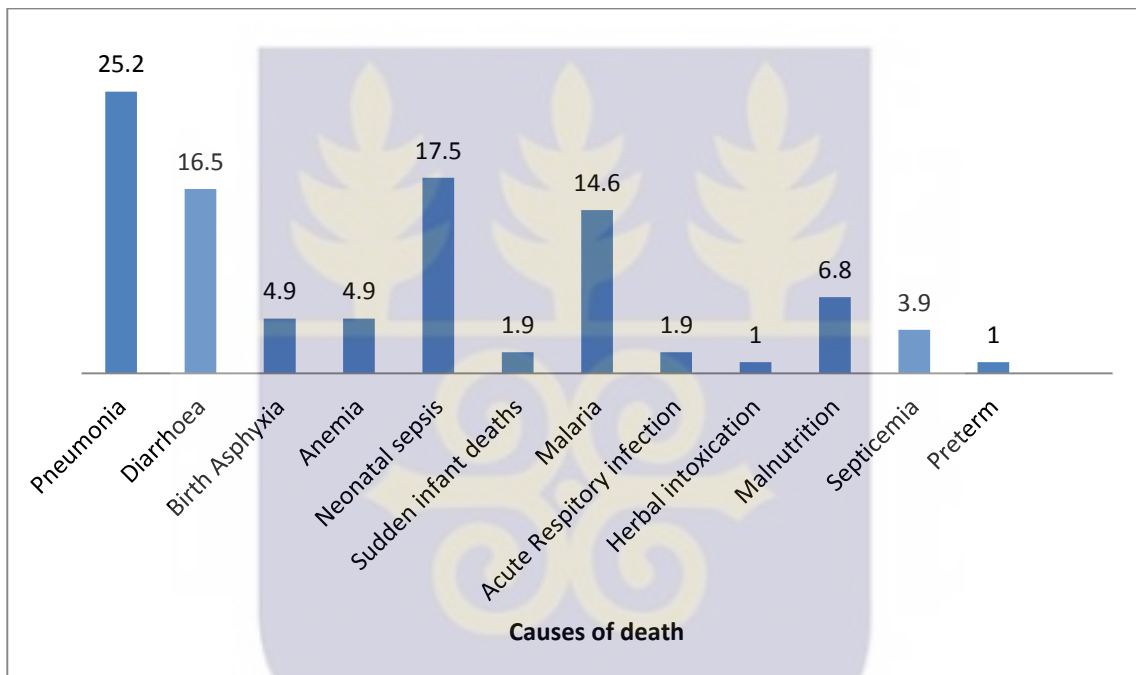


Figure 3.0 Distribution of causes of health facility deaths in case control study

Table 2.1 summarizes the effect of maternal socio-demographic factors on infant mortality; from the table, there were more mothers having at least two births in both case (55.6%) and control groups (56.3%); the percentage of women who give birth every year or less was higher among case group (56.3%) than control group (45.15%); the percentage of mothers who lived beyond five kilometers from a health care facility was higher among case group (25.24%) than control group (9.22%) and the percentage of mothers who dropped out of primary schools were higher among case group (46.6%) than

control group (34.47%). The table further shows that maternal socio-demographic variables like parity, birth spacing, and distance to health facility, age the mother at birth, place of delivery, mother educational level and birth order were significant. In this case control study, a para one mother or mother with first baby or infant [$p < 0.01$, CI 1.565 - 8.153] was 3.57 times more likely to lose her baby as compared to mothers of more than one parity; a mother who had a child at the interval of twelve month spacing [$p < 0.05$, CI 1.14 – 6.71] was 2.77 times more likely to lose her baby as compare to mothers who had birth interval twenty four months or more; mothers who lived five kilometers or above from a health care facility [$p < 0.05$, CI 1.34 – 5.27; $p < 0.01$, 2.15 – 9.14 respectively] were 2.65 and 4.44 times more likely to lose their baby during illness and emergency than those who live within less than five kilometers; also, infants born unto mothers ages 15 – 19 years [$p < 0.05$, CI 1.26 – 13.8] and 20 -24 years [$p < 0.05$, CI 1.23 – 4.76] were 4.12 and 2.41 times more likely to die than those born unto mothers age 25 years and above; infant born at home [$p < 0.01$ CI 0.133 – 20.46] were eight times more likely to die as compare to infants who were born in the hospital, clinic or health

Centers; a child who was born unto and uneducated mother [$p < 0.05$, CI 0.69 – 6.77] and a mother who was a primary dropped out [$p < 0.05$, CI 0.45 – 4.26] were 2.4 times and 1.38 times more likely to die than a child or infant born unto a mother who has attained

Secondary or tertiary education.

Variables	Case	Control	Odds	95 % CI		P-value
	Number (%)	Number (%)	Ratio	Lower	Upper	
Parity						
One	27(26.21)	75(36.59)	3.57143	1.56449	8.15291	0.00
Two	58(56.31)	114(55.61)	2.52709	1.17402	5.43961	0.02
Three	18(17.48)	14(6.83)	1			
Four	-	2(0.98)	1			
Birth spacing						
None	31(30.10)	4(1.94)	1			
Every year	58(56.31)	93(45.15)	2.77	1.14	6.71	0.02
Every two years	2 (1.94)	91(44.17)	1.45	0.62	3.39	0.39
Every three years	12(11.65)	5(2.43)	2.31	0.37	14.21	0.37
Every Six years	-	13(6.31)	1			
Distance to health facilities in km						
Less than 5km	29(28.16)	94(45.63)	1			
5km	48(46.60)	93(45.15)	2.65132	1.33451	5.26744	0.01
Above 5km	26(25.24)	19(9.22)	4.43557	2.15177	9.14333	0.00
Age of mother at birth						
15-19 years	4(3.88)	20(9.71)	4.16667	1.25805	13.8001	0.02
20-24 years	29(28.16)	84(40.78)	2.41379	1.22512	4.75578	0.01
25-29 years	45(43.69)	72(34.95)	1.33333	0.69717	2.54998	0.39
Above 30 years	25(24.27)	30(14.56)	1			
Place of delivery						
Home	16(15.53)	14(6.80)	8.0065	0.13324	20.4595	0.00
Clinic	6(5.83)	70(33.90)	0.60049	0.26017	1.38595	0.23
Health center	11(10.67)	71(34.40)	1.059	0.6002	1.8694	0.84
Hospital	70(67.97)	51(24.70)	1			
Mother education						
None	28(27.18)	58(28.16)	2.46	0.68832	6.77025	0.01
Dropped-out	48(46.60)	71(34.47)	1.38	0.44736	4.26284	0.04
High school	21(20.39)	68(33.01)	0.96	0.32956	2.9506	0.98
College	6(5.83)	9(4.37)	1			
Birth Order						
First	30(29.13)	77(37.38)	2.88	1.30442	6.39185	0.06
Second	55(53.40)	113(54.85)	2.3113	1.09558	4.87633	0.05
Third	18(17.48)	16(7.77)	1			

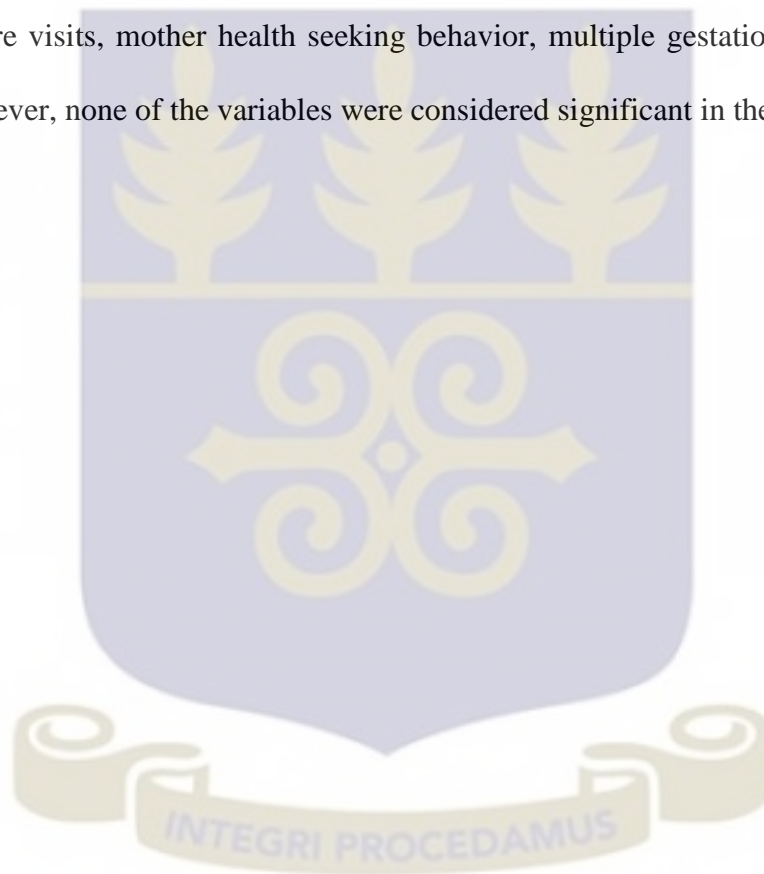
Tab. 2.1: Frequency Distribution of maternal related variables in case control and odds ratios

Table 2.2 shows the relationship of infant variable to mortality. It depicts that the percentage of low birth weight babies were higher among case group (46.6%) as compared to control group (31.07%); the percentage of infants who did not have any vaccination was also higher among case group (21.36%) than control group (11.65%); there were less cases fully immunized (2.91%) as compared to controls (9.22%); however, the sex of the child, breast feeding, and birth weight and immunization status were examined. Infant born with birth weight less than three kilograms [$p < 0.05$, CI 1.14 – 15.60] were 4.22 times at higher risk of dying as compare to those babies who attained three kilograms or more. However, sex of the infant, breast feeding, and immunization status were not significant determinants of infant mortality.

Variables	Case	Control	Odds	95 % CI		P-value
	Number (%)	Number (%)	Ratio	Lower	Upper	
Sex						
Female	58(56.31)	106(51.46)	0.82	0.51	1.32	0.42
Male	45(43.69)	100(48.54)	1			
Birth weight						
2-2.9 kg	48(46.60)	64(31.07)	4.22	1.14	15.60	0.03
3-3.9kg	49(47.57)	138(66.99)	2.00	0.53	7.48	0.30
>3.9 kg	6(5.83)	4(1.94)	1			
Breast feeding						
No	20(19.42)	21(10.19)	0.47	0.24	0.92	0.06
Yes	83(80.58)	185(89.81)	1			
Immunization status						
None	22(21.36)	24(11.65)	0.17	0.04	0.66	0.07
Partially Completed	78(75.73)	163(79.13)	0.33	0.09	1.15	0.08
Fully immunized	3(2.91)	19(9.22)	1			

Tab. 2.2: Frequency distribution of infant related variables in case control and estimated odds

Table 2.3 summarizes the socio-demographic determinants of infant mortality. It shows that most of the mothers were petty traders for both case (53.4%) and control groups (48.06%) though case group were higher; the percentage of lack of access to electricity was higher among case group (71.84%) than control group(62.14%); also, the percentage of lack of access to safe drinking water was higher among the case group (18.45%) as compared to the control group (10.6%); moreover, the table captured mother's income level in Liberian dollars, occupation, area of residence, access to electricity, number of post natal care visits, mother health seeking behavior, multiple gestation, religion of the mother. However, none of the variables were considered significant in the analysis.



Variables	Case Number (%)	Control Number (%)	Odds Ratio	95 % CI		P- value
Income level(Lib. Dollars)						
500-1000	44 (42.72)	73(35.44)	1.12	0.61	2.04	0.71
1100-1750	30 (29.13)	86(41.75)	1.93	1.03	3.62	0.04
1800-2500	29(28.16)	43(20.87)	1			
> 2500		4 (1.94)	1			
Occupation						
House wife	23(22.33)	45(21.84)	1.22	0.35	4.17	0.32
Student	20(19.42)	54(26.21)	1.69	0.49	5.77	0.83
Petty trader	55(53.40)	99(48.06)	1.13	0.35	3.61	0.20
Employed	5 (4.85)	8(3.88)	1			
Area of Residence						
Rural	10(9.71)	16(7.77)	0.78	0.34	1.80	0.57
Urban	93(90.29)	190(92.23)	1			
Smoking						
No	102(99.03)	204(99.03)	1	0.09	11.16	1.00
Yes	1(0.97)	2(0.97)	1			
Access to Electricity						
No	74(71.84)	128(62.14)	0.64	0.38	1.07	0.09
Yes	29(28.16)	78(37.86)				
Access to Safe Drinking water						
No	19(18.45)	22(10.6)	0.53	0.27	1.03	0.06
Yes	84(81.55)	184(89.32)				
No. PNC visits						
None	24(23.30)	71(34.47)	1.71	0.98	2.98	0.06
Once	16(15.53)	26(12.62)	0.94	0.47	1.88	0.86
Twice	63 61.17	109(52.91)	1			
Health Seeking behavior						
Only when sick	54 (52.43)	104(50.49)	2.20	0.75	6.39	0.15
Once in a month	22(21.36)	78(37.86)	2.15	1.32	12.41	0.07
Every three months	19(18.45)	17(8.25)	1.02	0.31	3.42	0.97
Every six months	8(7.77)	7(3.40)	1.00			
Multiple gestation						
No	101(98.06)	200(97.09)	0.66	0.13	3.33	0.62
Yes	2(1.94)	6(2.91)	1.00			
Religion						
Muslim	27(26.21)	61(29.61)	1.18	0.70	2.01	
Christian	76(73.79)	145(70.39)	1			

Tab. 2.3: Frequency Distribution of socio-economic variables in case control and estimated odds

CHAPTER FIVE

DISCUSSION

In developing around the globe, less than one year old mortality is more than twenty percent of all deaths. About half of these deaths occurred in the first month after birth and a half of these in the first week of life (Global Health Observatory 2014, WHO 2015). In this case control study, out of the 103 cases of deaths under one year of age, 40(38.9%) were neonatal and 63(61.1%) were post neonatal mortalities. Moreover, with regards to the cause of death during the infantile period, the most important conditions were pneumonia, neonatal sepsis, diarrhea and malaria, and these are similar conditions accounting for under five deaths in developing countries in Africa (Africa Key Facts and Figure for Newborn and Child mortality, 2014). The study revealed that mothers' education was significantly associated with infant mortality. In that light, study conducted in India to evaluate socio-economic and demographic characteristics of infant and family, it findings confirmed that education of a mother, parents monthly income and occupation were significant determinants of infant mortality (Srivastava e tal). Birth weight, parity, age of mother at the time of child's birth were also significant predictors of infant mortality in the study. Again studies conducted on level, trend and determinants of infant mortality conducted showed that birth weight place of residence, mother education, age of mother at birth and parity were significant predictors of infant mortality (Dankert e tal).

Also in the study, short birth spacing or interval and parity and types of marriage were important predictors of infant mortality as compare to maternal education (Pederson, J 2010). Study in Vietnam conducted on infant, neonatal and post neonatal and post neonatal mortality showed significant association between birth order, maternal age, pregnancy interval, mother education and urban-rural residence and infant mortality

The study considered a number of independent variables to have influenced neonatal deaths. However, from the analysis, distance to health facility, place of delivery, mother age at child's births, parity, birth spacing and mother's educational status were significant and have greater influence on the mortality of infants. However, the study did not find mother occupation and income level as having significance to the determination of infant mortality. The findings are corroborated by empirical findings that revealed that infant and child mortality is determined by a number of socio-economic factors such as mother age at birth, birth order and birth interval and or spacing (Belo, 2002, Abimbola and Akanni, 2012). Kumar and File (2005) conducted a study in Ethiopia, using the Demographic and Health Survey (EDHS) to investigate predictors of child mortality [0-5 yrs] mortality, results revealed that birth interval, mother's standard of living and mother's education were significant determinants of mortality. As refuted in the study, mother's income and occupation, a meta-study by Charmabagwala e tal (2005) proved that income level of a mother or household is not a significant determinants of infant mortality most times. Again Goro (2007) DHS survey study in Ghana on the determinanats of infant mortality in three northern regions; using multivariate logistic regression model, it was revealed that mother's education, birth order and marital status were significant determinants for infant mortality. Other studies in Kenya by Hill (2001) found that mother education level and socio-economic status have significant impact on infant mortality. Sahn and Stifle (2003) used data from twenty (24) African countries, they found out that infant mortality in urban areas are lower juxtapose to rural setting. Study also showed there were three characteristics of fertility behavior that are associated with infant mortality. High mortality has been associated with being the first born and with higher order of birth, with having mother less than 18 years and with preceding birth interval shorter than 24 months (Shea O' Rustein, 2000). The study result showed low birth

weight as a significant predictor of infant mortality; hence, study conducted to determine maternal and environmental factors influencing infant mortality and low birth revealed that socio-economic, environmental and maternal factors were significant determinants of infant mortality and low birth weight. The study pointed out that marital status, educational qualification, types of housing facility, maternal age at birth, parity and gestational age were significant predictors (Uche C. Isiuge-Abanihe 2011) study conducted in Nepal on risk factors for early infant mortality showed that paternal and maternal education were significant determinant of infant mortality; also antenatal visit, history of prior miscarriage, still birth were also significant determinants of infant mortality (Katz et al). Study conducted on determinants of infant mortality showed that poverty, malaria, post natal care and breast feeding were major predictors of infant mortality (Bello et al). In all scientific writing cited in the study maternal socio-demographic factors (parity, birth spacing or interval, mother's age at birth, and maternal education, birth order) were all significant factors influencing infant mortality. Birth weight of infant and place of delivery were also significant predictors of infant mortality in the study. Hence, more attention need to be given these factors which will include education and physical and technical interventions to reduce infant mortality in Montserrado County, Liberia

CHAPTER SIX

CONCLUSIONS AND RECOMMENDATIONS

6.0 Conclusions

The study was determining the factors influencing infant mortality in Montserrado County. Meanwhile, specific objectives focused on determining medical factors associated with infant mortality, maternal socio-demographic factors and socio-economic factors that influence infant mortality in Montserrado County, Liberia. The study showed that among the many medical conditions associated with infant mortality, malaria, pneumonia, diarrhea and neonatal sepsis were the leading cause among infant. Moreover, mother's age at birth, mother's educational level, parity, birth spacing and place of delivery were found to be significant maternal socio-demographic factors associated with infant mortality. Birth weight was the only infant factors influencing infant mortality in Montserrado County for the study period.

6.1 Recommendations

Below is an outline of some recommendations derived from the analysis of the data;

- That the National Government of Liberia, through the Ministry of Health and the Ministry of gender and Social Welfare employ control measures which include broadcast education and counselling on infant mortality in Montserrado County
- More sophisticated hospital, specialized facilities be built by the Government of Liberia in collaboration with the Ministry of Health, and the provision of highly qualified medical personnel recruited trained and deployed so as to minimize mortality amongst infant.
- That the Ministry of Health ensure standard national protocols for the treatment of conditions like pneumonia, neonatal sepsis and diarrhea – leading cause of death in the study

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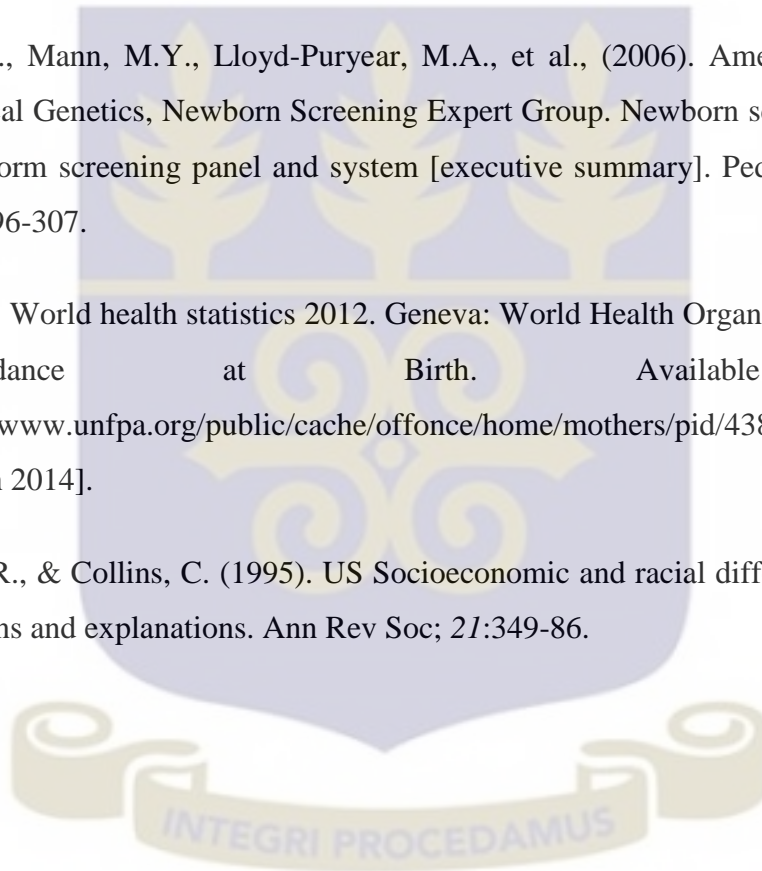
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APPENDICES

Appendix I

CONSENT FORM

Title: **Assessing Infant Mortality in Montserrado County, Liberia**

Principal Investigator: [Name] Nicholas N. C Blidi

Address: Department of Applied Epidemiology and Disease Control, School of Public Health, University of Ghana.

Cell numbers; +233540370816/+231886423194; Email: chachesko@gmail.com

General Information about Research

The overall objective is to assess factors that have influence on infant mortality. However, the study shall look at some of the medical causes of infant mortality, and the socio-demographic influences such as mother occupation, income level, health seeking behavior access to health facility and safe environment among other things, that can also contribute to the mortality of the infant. This study is expected to last for five months beginning October 2015 to February 2016. The study is facility based matched case control in ten health facilities. This means that for every recorded death (Case) of an infant, we will select two other infants who were born during that period and did not died.

A structure questionnaire will be used to gather information of cases and controls from mothers of these babies. Mothers are selected to respond to the questionnaires that have had or are having a child between the ages of 0- 11months within these facilities and community where they can be located. The mother socio-demographic information as explained above will be gathered using the questionnaires. The research will involve 309

participants, 103 cases and 206 controls. This has been generated by a statistical software called STAL cal in Epi Info version 7.

Possible Risks and Discomforts

There is no risk associated with this study. There might be some discomfort a mother might expressed because of bereavement she might be undergoing. However, the Investigator will work closely with the counseling and psychosocial units of the all the health facilities included in the study in order to obtain accurate and reliable information while providing psychological support for the mother

Possible Benefits

There are no physical benefits participating in the study. However, study is expected to benefit to an extent the unborn children who might be exposed to factors that will lead to death. Meanwhile, findings from the study will be shared with stakeholders including the Ministry of Health and Social Welfare for policy action and or recommendation.

Confidentiality

This study shall endeavor as much as possible to keep all participants privacy and maintain a high level of confidentiality. No All participants' information shall be kept confidential except duly sought consent from such participant. Moreover, this study is not intended to use the names of participants in its analysis. All information will be kept safe.

Compensation

It is expected that all participant will be duly explained to the essence of the research and as such there is no financial compensation allocated for any participants. However, moral supports and advocacy are obvious for bereaved mothers participating in the study.

Voluntary Participation and Right to Leave the Research

All participants are at liberty to withdraw from the study at anytime during the interview.

Each participant reserves the right to opt out or discontinue the interview.

Contacts for Additional Information

In the event of any query during the research, the principal investigator shall be the one to contact for clarity. Mobile numbers are: +231886423194/776664941

Your rights as a Participant

This research has been reviewed and approved by the Institutional Review Board of Noguchi Memorial Institute for Medical Research (NMIMR-IRB). If you have any questions about your rights as a research participant you can contact the IRB Office between the hours of 8am-5pm through the landline 0302916438 or email addresses: nirb@noguchi.mimcom.org



Consent Form

VOLUNTEER AGREEMENT

The above document describing the benefits, risks and procedures for the research title (*Assessing factors influencing Infant mortality in Montserrado County, Liberia*) has been read and explained to me. I have been given an opportunity to have any questions about the research answered to my satisfaction. I agree to participate as a volunteer.

Date Name and signature or mark of volunteer

If volunteers cannot read the form themselves, a witness must sign here:

I was present while the benefits, risks and procedures were read to the volunteer. All questions were answered and the volunteer has agreed to take part in the research.

Date Name and signature of witness

I certify that the nature and purpose, the potential benefits, and possible risks associated with participating in this research have been explained to the above individual.

Date Name Signature of Person Who Obtain

Appendix II

Questionnaire Form

Study Title: Assessing Factors Influencing Infant Mortality in Montserrado County, Liberia

Form Number _____

Interview Name: _____ Cell Number: _____

Date of Completion of the Form _____

Below are three sections: please record the data as per question in the space or options under various sections.

Infant Records

1. Child age in Months _____ less than one year old Child Sex Male Female
2. Child physical status Alive Deceased
3. If dead Cause of death Malaria Diarrhea Pneumonia
Neonatal sepsis Others specify Unknown
4. Birth Weight at the time of delivery (In Kg) _____
5. Birth Order 1st 2nd (Months apart) 3rd(Months apart)
6. Multiple Gestation: Yes No
7. Place Of delivery Home Clinic Hospital/health centers
8. Immunization Status None partially complete completed

9. Post natal care Yes No

Maternal Health Record

10. Age category 15 – 19 yrs 20 -24 yrs 25 – 29 yrs >30yrs

11. Breastfeeding Yes No

12. Health Seeking Behavior: Once in the Month Every three month
Every six Month Only when sick

13. Birth spacing: Every year every two year every three years
Every six years None

14. Parity One (1) Two (2) three (3)

15. PNC Visits Once Twice None

Socio-Economic/ demographic Status

16. Educational Level: dropped out High school College None

17. Marital Status: Married Divorced Single Cohabiting

Religion: Christian Muslim Others specify None

18. Occupation : Housewife Petty trader student Employed

19. Income level : 500LD – 1000 LD 1100 – 1750LD 1800LD – 2500 LD
>2500 LD

20. Area of Residence: Rural Urban

21. Do you smoke? Yes NO

22. Do you have Access to safe drinking water? Yes No

23. Do you have access to electricity? Yes No

24. What is the distance from your home to the health facility < 5km 5km
>5km