Determinants of regional inequalities in under-five mortality in Uganda: evidence from 2011 Uganda Demographic and Health Survey.

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ABSTRACT

Background: Uganda has one of the highest under-five mortality rates in sub-Saharan Africa, 1 in every 11 children born in the country dies before the age of five. Despite the fact that enormous progresses have been made in reducing under-five mortality rates since 1990, the pace is still slow and further aggravated by significant regional inequalities. Thus, understanding the factors that explain those regional differences are vital in designing appropriate interventions for the betterment of child well-being in country. The objective of the study is to examine the effects of individual and household factors on regional inequalities in under-five mortality in Uganda.

Method: Binary logistic regression is modeled using the 2011 Uganda Demographic and Health Survey, and restricted to 28,609 children born to 8,674 women who had at least live-birth between 2006 and 2011. Four separate models of under-five deaths were fitted as a function of region of residence, individual, household and a fully-fledged model incorporating all variables.

Results: The result shows that the risk of under-five deaths differs significantly across regions in Uganda, with Southwest region (OR: 2.017; 95% CI: 1.671-2.435) having the highest risks of deaths compared to Kampala City. Individual variables (birth interval, birth order, contraceptive use, maternal age and maternal education) and household factors (wealth index, ethnic affiliation of mothers, household floor material, children ever born, place of residence) are the main predictors of regional inequalities in under-five mortality in country. The risks of under-five deaths are lower for children whose mothers had secondary or higher education (OR: 0.77; 95% CI: 0.635-0.944) and children born in a rich household (OR: 0.83; 95% CI: 0.711-0.968).

Conclusion: The individual and household determinants are key contributors to the regional inequalities in under-five mortality in Uganda. Basing on the study findings, policies aimed at reducing the risks of under-five deaths should be tailored to cater for regional disparities.

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AIDS	Acquired Immunodeficiency Syndrome
ANC	Antenatal Care
CIA	Central Intelligence Agency
CMC	Century Month Code
CSPro	Census and Survey Processing System
HIV	Human Immunodeficiency Virus
LML	Log minus Log Plot
PRB	Population Reference Bureau
U5MR	Under-Five Mortality Rate
UBOS	Uganda Bureau of Statistics
UDHS	Uganda Demographic and Health Survey
UNICEF	United Nations Children's Fund
WHO	World Health Organization
UAC	Uganda AIDS Commission
MOH	Ministry of Health
MFPED	Ministry of Finance, Planning and Economic Development
MDG	Millennium Development Goals
MICS	Multiple Indicator Cluster Survey
ICF	International Classification of Functioning

CHAPTER 1: INTRODUCTION

1.1 Background

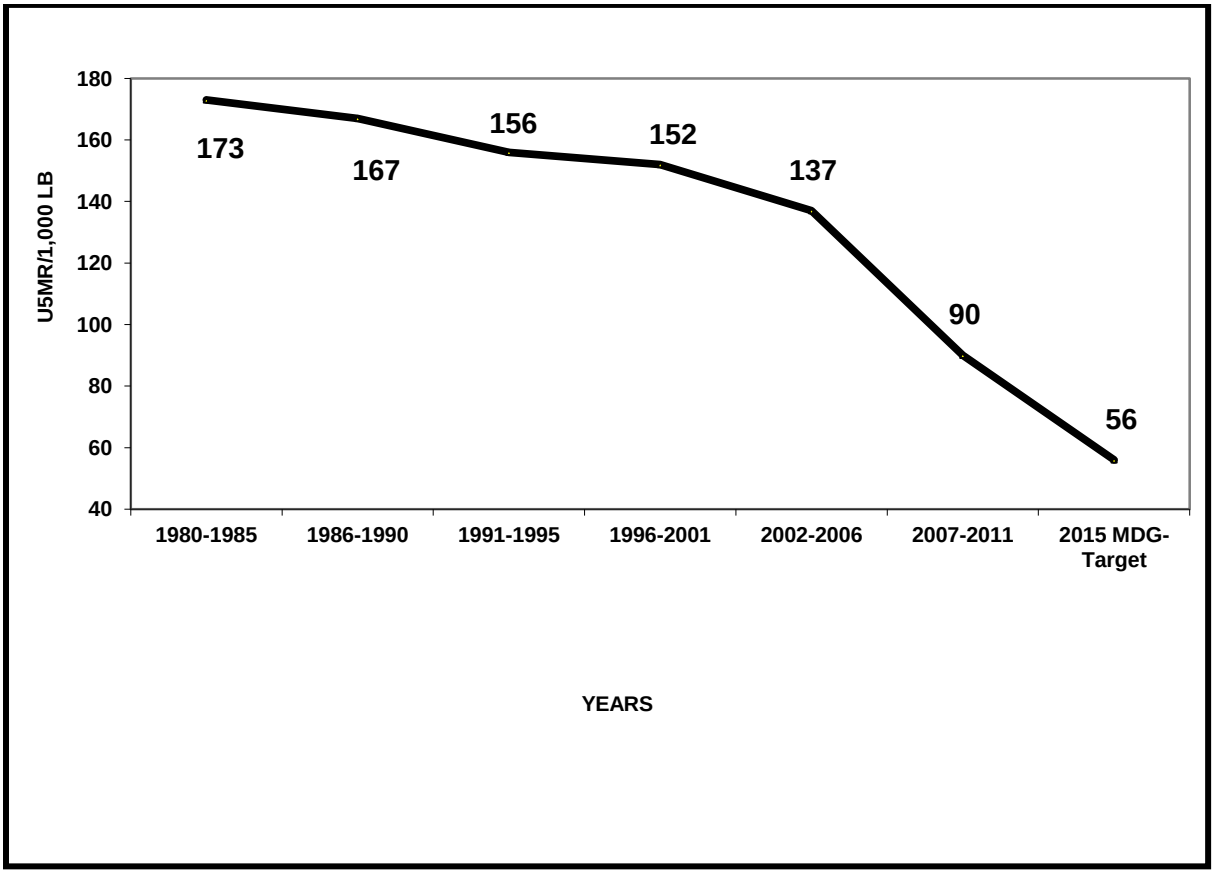
Under-five mortality rate is an important indicator of child well-being, health and nutrition status, coverage of child survival interventions, and comparison of the social and economic development among countries of the world (UNICEF, 2014). The public health practitioners and international development agencies are working tirelessly to reduce under-five mortality to an acceptable level across the globe as their priority and therefore, its inclusion in the United Nation's Millennium Development Goals (MDG4) is one such strategy (Mutunga 2007 & Assi Kouame, 2014).

According to UNICEF (2014), 6.3 million under-five deaths worldwide were registered in 2013 (17,260 deaths per day) and developing countries were reported to be having the biggest share of this figure. Generally, there has been an observed decline in global under-five mortality rates from 90 deaths per 1,000 live births in 1990 to 46 deaths per 1,000 live births in 2013. The reduction is unevenly distributed across nations of the world with Oceania and sub-Saharan Africa having less than 50% decline compared to other regions of the world during the period (UNICEF, 2014 & Assi Kouame, 2014). Under-five mortality is still unacceptably very high in Sub-Saharan Africa despite the fact that enormous progresses have been made in reducing it since 1990; therefore, the progress still remains insufficient to meet the target for United Nations Millennium Development Goal 4. For instance, sub-Saharan Africa combined had the world's highest rate of under-five mortality of 92 deaths per 1,000 live births, which was estimated to be about 15 times the current average rate in developed countries (UNICEF, 2014). Assi Kouame (2014) cited unequal distribution of healthcare services, different levels of economic development, geographical disparities, ethnic differences and scientific advancements among the reasons why sub-Saharan African and other developing countries lag behind in reducing their under-five mortality rates. As a consequence, regional approach should be adopted within each country to study those factors fueling under-five deaths by isolating them such that appropriate interventions can be developed and executed.

Uganda has one of the highest under-five mortality rates in sub-Saharan Africa with 90 deaths per 1,000 live births. This implies that about 1 in every 11 children born in the country dies before the age of five and 33% of these children die before reaching their first birthday (UBOS & ICF International, 2012 & Mbonye et al., 2012). Figure 1 shows a declining trend in under-five mortality rates in Uganda from as high as 173 deaths in 1980 to 90 deaths per 1,000 live births in 2011, but a lot still needs to be done if the target for Millennium Development Goal 4 is to be achieved. The United Nation's Millennium Development Goal number four (4) seeks to reduce under-five mortality rate by two thirds between 1990 and 2015 among the member states. This means that for Uganda to achieve its target, under-five mortality rate must reduce to 56 deaths per 1,000 live births by the close of 2015, which may not be feasible for the country to realize it (UBOS & ICF International, 2012). According to Uganda's Ministry of Finance, Planning and Economic Development report (2013), the progress on achieving MDG 4 requires

an average reduction in the rate of under-five deaths of 2.7% each year. The actual observed declining rate is lower than the required, for instance in the 11 years between 1995 and 2006, the declining rate was calculated to be only 1.2% per year. The World Bank (2014) reported on a recent figure of 66.1 deaths per 1,000 live births in 2013 and we are left with just 1 year to judge ourselves on the 56 deaths per 1,000 live births in 2015 target, which may not be reached.

Figure 1: Trends in Under-Five Mortality Rates in Uganda, 1980-2011 and target for 2015



Sources: *Derived from UDHS, 1995, 2001/2, 2006 and 2011.*

The slow pace in the reduction of under-five mortality rates in the country is aggravated with substantial regional differences. For instance, under-five mortality rate ranges from as low as 65 to 153 deaths per 1,000 live births in Kampala City and Karamoja region, respectively. Thus, the under-five mortality rate in Karamoja region is more than 2 times that of Kampala City (UBOS & ICF International, 2012). In addition, Uganda has one of the highest population growth rates in Africa (3.4% per annum) with a total fertility rate of 6.2 children per woman. This translates to a huge childhood population of 6.6 million according to the provisional results of the 2014 population and housing census in Uganda. Thus, out of the 35 million Ugandans in 2014, under-five children population accounted for 20% and variations in population densities across regions

of the country ranging from 46 to 523 people per square kilometer in Karamoja and Southwest regions of Uganda, respectively. Variations in poverty indicators, population densities (pressure), total fertility rates, and healthcare services distribution, level of development, ethnicity, norms and cultural (traditional) practices are thought to have significant influence on the risks under-five deaths across the ten statistical regions in Uganda. Therefore, in order to reduce under-five mortality in this country, understanding the factors that explain the regional differences are vital so that interventions pertinent for a particular region can be planned for and executed to respond to the needs and aspirations of each of these regions (UBOS, 2014; Assi Kouame, 2014).

1.2 Study objectives and research questions

1.2.1 Objective of the study

The broad objective of this study is to investigate whether there are significant inequalities in under-five mortality across regions in Uganda, and to establish whether individual and household level characteristics are predictors of regional inequalities in under-five mortality in country.

1.2.2 Research questions

The study attempts to answer the main research question, "what are the determinants of regional inequalities in under-five mortality according to the individual and household level characteristics in Uganda?

1.2.3 Sub-questions

To fully address the broad question stated above, answering the following sub-questions was deemed necessary:

1) What significant differences exist in under-five mortality across the regions in Uganda?
2) What are the individual level determinants responsible for the differences in under-five mortality across the regions in Uganda?
3) What are the household level characteristics accountable for the differences in under-five mortality across the regions in Uganda?

1.3 Scientific and societal relevance of the research

1.3.1 Scientific relevance of the research

Many studies conducted in Uganda have given little or no attention to the determinants responsible for the differences in under-five mortality across the regions of the country, and this research is therefore expected to contribute to the understanding of those factors. For instance, the recent study by Zhang et al. (2013) focused on trends in child mortality and associated risk

factors in a cohort of children in rural south-west Uganda, while Nankabirwa et al. (2011) examined perinatal mortality in eastern Uganda without comparison to other regions of residence. According to Uganda Bureau of Statistics (2014), over 80% of the Ugandan population live in rural areas which are characterized by different physical and structural settings, including the resources that are available within the locality and the social and political contexts related to the effectiveness and welfare of the population. The country is composed of many ethnic groups with diverse norms and cultural practices, varied level of economic growth and development including access and quality of services rendered to the population, which have either a direct or indirect impact on the risk of child survival across region of residence.

The focus on the disparities in under-five mortality across the regions is unique in the sense that it has got more to explore, focusing on people's way of life, the tradition, norms, religion, households, homes and families in which children are raised (Adedini et al., 2015). The review of literature suggest that there are certain salient issues worth discovering responsible for these inequalities in the different regions of the country which has got impact on the overall risk of dying before the age of five in Uganda. This is the first study conducted in Uganda to examine the effects of individual and household determinants on the risks of under-five mortality across the regions in the country, which is the focus of this research.

1.3.2 Societal relevance of the research

The benefits accruing from this research could be of particular help to the society as a whole because understanding the factors that explain the regional differences are vital so that interventions pertinent for a particular region can be customized to respond to the needs and aspirations for each region. The findings from this research could also be advantageous to the government, not only for the demographic assessment of the country's population policies and interventions, but also in the design and evaluation of health policies and programmes that go hand in hand in improving the health status of the population as whole.

1.4 Structure of the paper

This paper has been organized into five (5) major chapters. Chapter one contains the following sub-sections: information on the background to the research, statement of the research problem, the research objectives and research questions. Chapter two in particular contains information about the theoretical framework and relevant theory to the research, literature reviews, the conceptual framework, the research hypotheses, and operational definition concepts used in the study. Chapter three describes the data and the methods used extensively in this research. The major sub-sections are: study design used, description of study area, description of data, operationalization variables, reflections on data quality, ethical considerations and description of the method of data analysis. Chapter four contains the results/findings of the research with detailed explanatory analysis. Finally, chapter five consists of conclusion and discussion, the limitations of the research and recommendations for policy makers and further research.

CHAPTER 2: THEORETICAL FRAMEWORK

2.1 Theory

Many scholars have studied what drives under-five mortality in both developing and developed countries of the world, and posited that they are linked with socioeconomic status, environmental factors and demographic variables (Sastry, 1994). For instance, Pool (1982) developed a conceptual framework which helped him to analyze non-Maori mortality in New Zealand. Specifically, he singled out ethnicity, religion, healthcare system (infrastructure, vaccination and other healthcare services), environment, water, hygiene and sanitation, and grouped them under macro-micro level and intermediate variables. One of the renowned writers, Galster (2012) worked on community level characteristics and observed that there is a relationship between residential environment and the health implications of individual adults and children residing in such environment. On another note, Diez et al. (2001) in their separate study emphasized that physical environment and social characteristics of the community where a person resides were among the factors that may affect health and health-related behaviour. Mosley and Chen (1984) in their analytical framework however, established a relationship between child survival and determinants at individual, household and community levels. The theoretical framework formulated by Mosley and Chen (1984) formed the foundations for under-five mortality studies, which has been adopted by demographers, epidemiologists and social scientists because it is considered to be the most comprehensive, in-depth and systematic in analyzing the risk of childhood death before the age of five years (Rusicka, 1989 & Sastry, N., 1994).

2.1.1 Henry Mosley and Lincoln Chen (1984) conceptual model

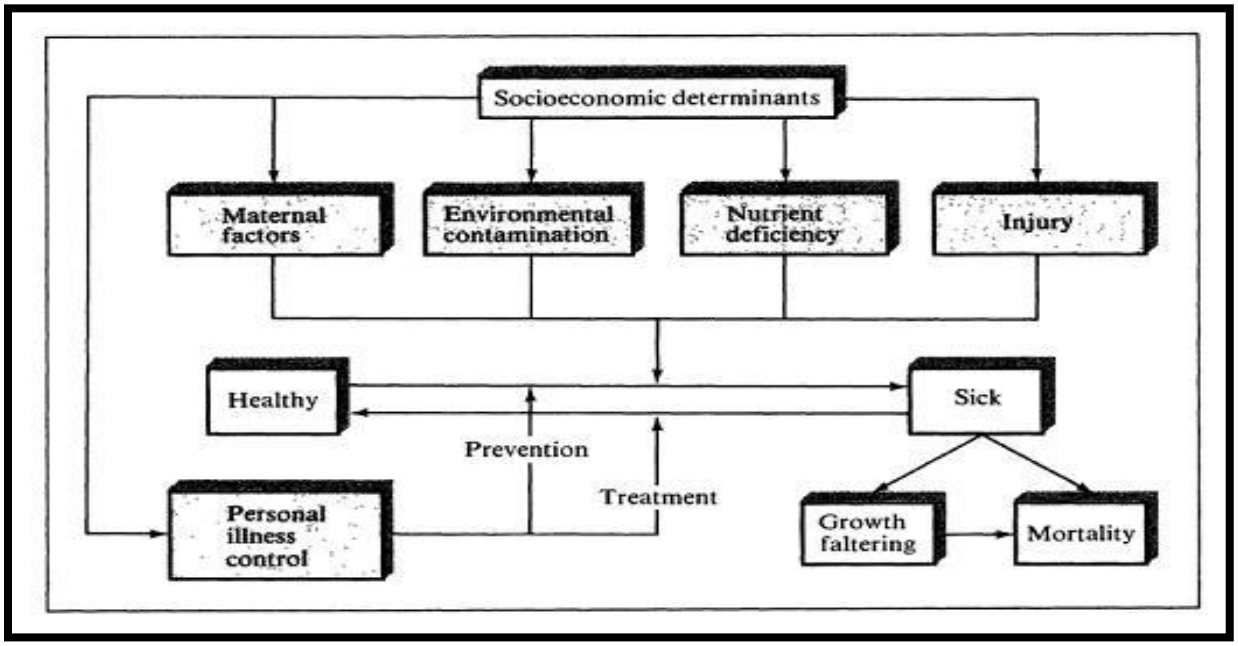
Mosley and Chen (1984) in their influential and widely cited work developed a set of proximate determinants (or intermediate variables) and categorized them into five classes: (1) maternal factors, (2) environmental contamination, (3) nutrient deficiency, (4) injuries, and (5) personal illness control (prevention and treatment). They posited that the socio-economic factors that influence child health and survival operate through each of these sets of proximate determinants as illustrated in figure 2.

2.1.2 The proximate determinants (or intermediate variables)

Maternal factors

Mosley and Chen (1984) identified three key components of maternal factors in their work: age at birth, parity and birth interval which has influence on what comes out as a result of the pregnancy through the health of the mother. The interactions between these maternal variables when combined can produce total effects that endanger the life of a child. According to UNICEF (1990), the concept of child spacing is so paramount for child survival because too young, too old, too frequent, or too many pregnancies can increase the risks for child deaths. These variables can be measured directly from the interview questions relating to maternal birth records embedded in the 2011 UDHS questionnaires.

Figure 2: Henry Mosley and Lincoln Chen (1984) conceptual framework for the study of child survival in developing countries.



Source: Mosley and Chen (1984).

Environmental contamination factors

Environmental contamination factors as described by Mosley and Chen (1984) constitutes one of the major routes through which contagious diseases are spread to infect the child or mother through air, water, food, sanitation and hygiene, dirty fingers, skins, soils, animals or vectors. They emphasized airborne diseases, water borne diseases spread through contaminated food or water with pathogens (germs), vector borne diseases spread via insects like mosquitoes, and transmission from animals to human being (zoonosis) among others which can increase the risk of infections. The information for these variables may be obtained from children's data with record for every child of eligible women, born in the last five years preceding the 2011 Uganda Demographic and Health Survey.

Nutrient deficiency

Mosley and Chen (1984) also argued in their model that the amount of energy that food produce in the human body in terms of calorie, proteins, vitamins and minerals intake are important for the child and the mother. During pregnancy and lactation periods, these nutrients are needed because it has impacts on child's weight at birth and growth, thus, studying nutritional aspect of child and mother form an integral part of child survival. The nutritional status of the child is adeptly covered in the demographic and health survey (UDHS).

Injury

Injury as an integral part of the proximate determinant developed by Mosley and Chen (1984) is concerned with accidents which can be as a result of fire (burns), motor or machine accident (physical), food or gas poisoning and child sacrifices through killing a child to offer rituals to gods among others.

Personal illness control

On personal illness control, Mosley and Chen (1984) posited that personal preventive measures and health seeking behaviour in terms of medical treatment are paramount for a child and her mother. The utilization of health services such as immunization, antenatal care visits, postnatal care, health facility delivery and seeking therapeutic treatment for malaria and diarrhea are important to be considered in reducing the risk of a child dying before the age of five years. The data on personal illness control are also adeptly covered in the 2011 Uganda Demographic and Health Survey.

2.1.3 The socio-economic determinants

Mosley and Chen (1984) socio-economic determinants of child survival operate through the proximate determinants as discussed earlier, and are grouped into three broad categories of factors: individual, household and community.

Individual-level variables

The individual-level variables include the following: educational level, health, norms and attitudes, which affect the child through mother's health seeking behaviour and health care practices such as antenatal visits, nutrition, breastfeeding patterns and disease treatment. Hygiene and sanitary practices, cultural practices and traditions and sex preference also affect child survival through proximate determinants.

Household variables

On the level of household variables, Mosley and Chen (1984) noted that household income/wealth index are among the characteristics that affect child health and survival through the quantity and quality of food, water, clothing/bedding, housing conditions, means of transportation. Other characteristics like hygiene and preventive care, sickness care, access to information on proper nutrition, contraceptive methods and immunization are among the household factors pertinent to child survival study. These are quite the best variables available in the demographic and health survey datasets (UDHS).

Community level factors

Community level factors as identified by Mosley and Chen (1984) include environmental situations such as climate, soil, rainfall, temperature, altitude and seasonality. Additional factors categorized as community level factors are political economy which encompass among others

physical infrastructure like railroad, roads, electricity, water, sewerage system, organization of food production, and also political institutions. Finally, Mosley and Chen (1984) emphasized the organization of people, institutions, and resources that deliver health care services to meet the health needs of the target populations among the major community factors. The environmental variables form an important part of community level factors and to this effect, source of drinking water, type of toilet facilities and type of sanitation are also considered under this area though they cal as well be categorized under household variables.

The analytical framework that was developed by Mosley and Chen (1984) for the study of child survival clearly provides the understanding of the numerous factors that pose a great threat to child survival in developing countries (Sastry, 1994). Thus, motivated by the theorem, this research seeks to examine the extent to which factors at individual and household level influence regional inequalities in under-five mortality in Uganda.

2.2 Literature review

There are many studies that have been extensively conducted on under-five mortality in both developed and developing countries using quite different categories and/or sources of data, frameworks, measurements, and statistical techniques which are presented in this section. The relevant literatures used to inform the study were gathered from different sources including but not limited to: the journal of biosocial science, Google search engine, access to several articles that were made available by the population research centre (PRC) of the University of Groningen and access to past PhD and master theses through the library of the University of Groningen among others. The review was focused basically on the available literature on socio-economic status, demographic factors, environmental factors and medical care determinants of infant mortality, child mortality as well as child survival in sub-Saharan Africa and around the globe. Therefore, for the study of the individual and household determinants of under-five mortality across the regions in Uganda, quite a variety of literatures were reviewed as enumerated in the subsequent paragraphs.

The global understanding of under-five mortality plays an integral part and lays concrete foundations for its study in developing or countries in the world. In reviewing literatures on under-five mortality, it was found out that over 10 million children worldwide die each year before celebrating their fifth birthday, and majority of these deaths occur in poor countries. About 50 percent of these deaths are accounted for by just six countries and 90 percent are accounted for by 42 countries, of which 40 percent occur in sub-Saharan Africa and 1 in 3 occur in South Asia (Black et al, 2003 & Adedini, 2013). A recent estimates by UNICEF (2014) registered 6.3 million global under-five deaths in 2013, and according to the report, malaria, diarrhoea and pneumonia were cited among the leading causes of death. Sub-Saharan Africa combined had the world's highest rate of under-five mortality of 92 deaths per 1,000 live births, which was estimated to be about 15 times the current average rate in developed countries (UNICEF, 2014). Although a lot has been gained substantially in reducing under-five mortality worldwide, the progress still remains insufficient in sub-Saharan Africa which is the major contributor to global under-five deaths (Adedini, 2013).

Galster (2010) worked on community characteristics and observed a relationship between residential environment and the health implications of individual adults and children residing in such environment. He outlined 15 potential causal relationship pathways between community characteristics, individual behavioral and health outcomes which he grouped them into four broad categories: social interactive, environmental, geographical, and institutional. His work provided an updated, international review of empirical studies related to neighborhood effect mechanisms on under-five mortality. Diez-Roux et al. (2001) emphasized physical environment and social characteristics of the community where a person resides among the factors that may affect health and health-related behaviour. Sandhya (1991) on his study on the effect of cultural practice on child mortality in rural India emphasized socio-cultural factors like caste (social groupings and practice), type of family, education and occupation of parents, socio-economic status of the family, child birth practices, pre-natal care and the type of medical attention at the time of birth as the main determinants of the level of infant mortality in India.

Other studies conducted in Africa were also reviewed and found to be very useful in understanding the context of under-five mortality especially in sub-Saharan Africa. In one such study, Akuma (2013) examined the effects of the selected socio-economic, demographic, cultural and environmental factors on infant mortality in the high and low mortality regions in Kenya. He pointed out the following as his key findings: - *Mother's occupation* is associated with regular incomes and better standard of living, thus, lowers the risk of infant death. On the *mothers' education level*, he argued that the educational attainment of mothers is inversely related to infant mortality. He posited that "the risk of infant death varies with the level of education". The *preceding birth intervals* were also found to have significant affect on infant mortality in the high mortality region. Closely spaced children increase the risk of infant death in the high mortality region. Other factors like *geographic area of residence, the type of marital union* that closely relate to cultural and religious factors have also been found to have some effects in infant mortality in Kenya. However, his results indicated that mothers' age at first birth, religion and ethnicity were found to have no predictive effects on infant mortality in both regions (Akuma, 2013). The mother level factors like the age of the mother and the wealth index were associated with risk neonatal mortality in Ghana while child level factors; size of child, sex of child and whether the child was a twin or not were not significant as causing neonatal mortality (Kwara, 2012). However, he found that the environmental level factors like the region (site of delivery) of the respondent and place of residence were insignificant.

Adebayo (2014) in his study on under-five mortality and its determinants in Nigeria also concluded that a female child have lower risk of dying before age five relative to a male child (HR 0.834, 95% C.I; 0.742 – 0.938). A child with a very small size at birth has higher risk of dying before fifth birthday compared with a child who has an average size at birth (HR 1.407, 95% C.I; 1.119 – 1.769). A child whose mother's age at birth (20-24) have a lower risk of under-five mortality relative to a child whose mother's age at birth was under 20 (HR 0.694, 95% C.I; 0.561 – 0.859). Child who had a postnatal check-up has a lower risk of under-five mortality compared with a child who did not receive it (HR 0.692, 95% C.I; 0.587 – 0.815).

Antai (2011) in his study on regional inequalities in under-five mortality in Nigeria focused more on the patterns of under-5 mortality cluster within families and communities. His findings were

as follows: risks of under-5 deaths are higher for children of mothers residing in the South-South (Niger Delta) region (HR: 1.30; 95% CI: 1.76-2.20) and children of mothers residing in communities with a low proportion of mothers attending prenatal care by a doctor (HR: 1.36; 95% CI: 1.15-1.86). Mothers' education cross-level interactions and community prenatal care by a doctor was associated with a more than 40% higher risk of dying (HR: 1.41; 95% CI: 1.21-1.78). He then suggested that more focus should be put on community-level interventions aimed at increasing maternal and child health care utilization and improving the socioeconomic position of mothers.

Adedini et al. (2015) concluded that community-level variables and individual level factors are important determinants of infant/child mortality in Nigeria. Among the individual variables studied included child's sex, birth order, birth interval, maternal education, maternal age and wealth index. For community variables, they posited that region, place of residence, community infrastructure, community hospital delivery and community poverty level are important factors. The findings concluded that community-level characteristics are important in explaining regional variations in child mortality than individual-level factors. The results of this study emphasized the importance of looking beyond the usual influence of individual factors in dealing with regional variations of infant and child mortality in Nigeria.

Lawrence (2000) indicated that short birth intervals are common in Sub-Saharan Africa where levels of unmet need for birth spacing and failure to avoid mistimed pregnancies remain unacceptably very high. The findings from this study agreed with earlier studies that the occurrence of unplanned pregnancies have to be drastically reduced if under-five mortality and maternal mortality Millennium Development Goal is to be achieved.

Assi Kouame (2014) studied determinants of regional disparities in under age five mortality in Cote d'Ivoire. The proportion of mothers with a least a secondary education was associated with under-age five mortality risk (OR=0.99, CI=0.98-0.99). There was no significant association between child mortality and the other selected community factors included in the study. This study reveals a significant variation of underage five mortality rate across region in Cote d'Ivoire. Other factors based on child, mother and household level factors were also considered. The findings of this study suggest a need for further exploration of the factors that can explain those differences.

Defo (1996) studied regional (areal) and socio-differentials in infant and child mortality in Cameroon and found out that ethnicity measures custom, way of life and feelings and other practices and behaviors that have a direct or indirect impact on health. He noted that some ethnic groups within Cameroon have cultures that put into effect breastfeeding for a period of three or more years and during this period, natural sterility in terms of breast feeding can delay conception and in many instances, sex abstinence is equally enforced which leads to longer birth intervals. The findings from this study seem to suggest that variations in ethnicity have significant effect on variations in infant mortality, which is a motivation for my proposed study.

On the other hand, many studies conducted in Uganda found out that child mortality was associated with low parental education. According to Kaharuza et al. (2001) in their study of

child mortality in rural Uganda found that children born to uneducated parents had a doubled risk of not celebrating their second birthday. It was three times more likely for a child to die in the neonatal period than in the first year of life. Child mortality risk decreases by every year of education attained by mothers and fathers. Parity, residence and marital status were not associated with excess risk of child mortality. Seasonal mortality followed the El Nino rainfall pattern, signifying that water, sanitation and environment were big factors in driving mortality up. Geographical differences in child mortality were found to be statistically significant.
Other studies conducted in Uganda on the causes of child mortality also cited improvement in immunizations for childhood diseases, health care services behaviour by mothers, use of candles as a source for lighting as factors have significant reductions in under-five mortality rates while households with higher birth order of more than 5 children, fathers with primary level of education were associated with higher child mortality (Ssewanyana and Youngerb, 2007; Venanzio et al. 1992). They also found out that nutritional status of children in the rural areas and other socioeconomic determinants are predictors of child mortality in South-Western Uganda. Some of these individual and household level characteristics were considered in the current research notably: birth order, father's educational level, access to electricity, immunization breastfeeding and place of residence of the mother.

Nutrient deficiencies in terms of *size of a child at birth, anaemia, and iron deficiency* played a major role in causing growth faltering in children in Uganda (Otikal, 2009). Otikal (2009) posited that *immunization* through *polio vaccination* is associated with growth faltering and under-five mortality. Higher infant and mortality in Uganda is also associated with *teenage pregnant mothers* compared to women aged 20 year or more, higher infant and mortality is related to *women delivering at home* than women who gave birth in a health facility, and higher infant and mortality for children whose mothers *did not sleep under a mosquito net* (Nankabirwa et al., 2011, Zhang et al., 2013). Women living in *urban slums* had a higher risk of losing their babies than those in rural areas On another note, reduction in the risk of child mortality was associated with *vaccination, birth in a health facility, exclusive breastfeeding for 6 months, 2–3 years since the previous sibling's birth, maternal vital status, and negative mother and child HIV serostatus*.

Ayiko et al. (2009) posited that HIV/AIDS and armed conflicts and war led by Kony's Lord Resistant Army in Uganda were major contributing factors to the high levels of under-five mortality in Uganda. The declining trend observed (Ayiko et al., 2009) was due to improved child health strategies, robust program on the reduction of mother to child transmission of HIV, peace talks to resolve conflicts, the effect of universal primary and secondary education and poverty reduction programs in the north were among the prominent factors. The study therefore alluded that more studies should be conducted to assess the effects of contextual determinants of under-five mortality in Uganda if the country is to close on to achieve the Millennium Development Goal number four (4) target.

2.2.1 Reflection on the literature reviewed

In view of the researches conducted on infant and child mortality in the world (globally), Africa and Uganda in particular, under-five deaths is still persistently high in sub-Saharan Africa countries averaging 92 deaths per 1,000 live births. The question that we need to ask ourselves is that 'what has worked and what has not worked well?' We need a coordinated and concerted effort in terms of policy interventions in order to reduce under-five deaths to an acceptable level. The reviewed literature posited that parity, birth interval and age at birth have a big impact on under-five mortality. Increasing the preceding birth of more than 24 months is associated with lower under-five mortality risk compared to birth interval of less than 24 months. Similarly, the effects of the number of living children that the mother had were positively associated with under-five mortality. The highest levels of infant mortality occurred in households with no access to safe water, no access to toilet facility, no access to radio (information) and no access to electricity. Furthermore, children born to mothers who were illiterate had 4 times the chance of dying before the age of five years relative to those mothers who were literate and had at least secondary education level. This therefore means that maternal education is just not an indicator of human index development and standard of living but also has a significant influence on child survival. In addition, other factors that were found to be associated with the risk of under-five mortality were: parental occupation, region of residence, marital status, religion affiliation of the mother, ethnicity, wealth index, size of the child at birth, sex of child, place of delivery, place of residence, breastfeeding pattern, immunization, use of insecticide treated nets and high prevalence of HIV among women of reproductive age (15-49).

The literature review also revealed that there is no study conducted in Uganda in regards to the determinants that explain differences in under-five mortality across the regions in the recent past, which the current study will try to fill this void. This study in particular attempts to examine and compare whether there exists significant differences in under-five mortality across regions in Uganda, and whether individual and household level characteristics explained those differences.

2.3 Conceptual framework

The derivation of the conceptual framework as presented in figure 3 was guided by the review of relevant literatures as well the theoretical framework. Mosley and Chen (1984) analytical framework for the study of child survival in developing countries as earlier on mentioned in figure 2, was also immensely used to inform this conceptual model for the study of individual and household determinants of under-five mortality in Uganda between 2006 and 2011. The conceptual framework indicates the linkages between the socioeconomic factors, the independent or explanatory variables and the outcome variable.

Socioeconomic factors

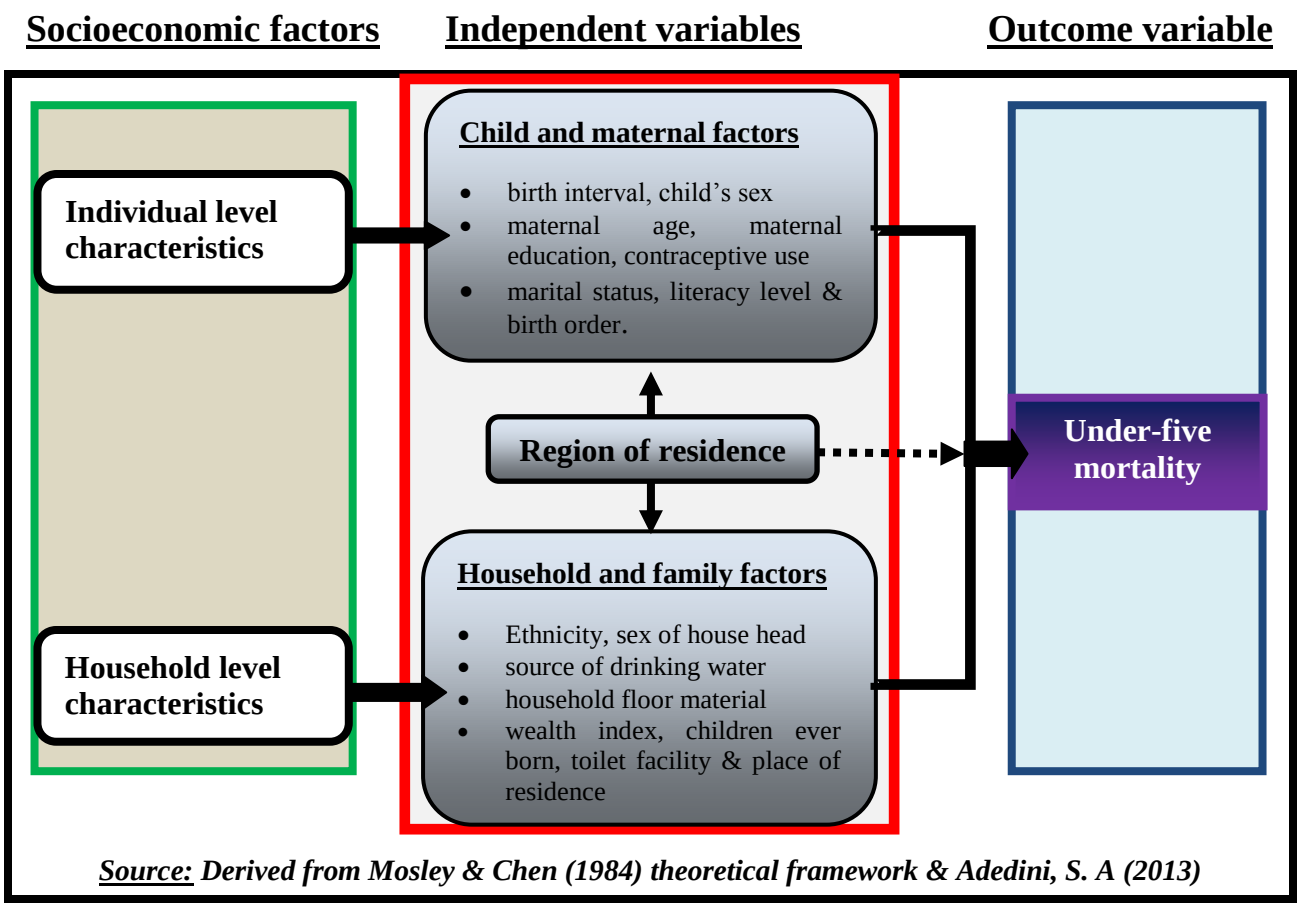
The socioeconomic determinants which are given in-depth considerations for the purpose of this study are categorized into two main groups: individual and household level characteristics. They thus operate through the child/mother and household/family factors of the independent variables

(figure 3) to exert influence on the outcome variable in the presence of the region of residence, the pivotal factor (the primary explanatory variable).

Independent variables

The independent variables in the conceptual framework comprise of the child/mother level factors, region of residence and household/familial factors. Region of residence is the primary independent variable, the central focus in the model linking the child/maternal and household/family factors to the outcome variable (under-five mortality).

Figure 3: Conceptual framework showing the relationship between individual and household level characteristics and regional under-five mortality



The linkages between the independent variables and the outcome variable operate through four branches (indicated by arrows in figure 3). Link 1 goes through region of residence (the primary independent variable) direct to under-five mortality to examine whether there exist significant variations in under-five mortality across regions in Uganda. Link 2 is the second branch that connects region of residence to under-five mortality via child/maternal factors, thus, used to

investigate whether individual variable can partly explain the differences in under-five mortality across regions in Uganda. In the third link, region of residence connects to under-five mortality through household/family factors to establish whether household variables have significant effects on the risk of under-five deaths across the regions in Uganda. Finally, the fourth link incorporates all the independent variables including region of residence, child/maternal factors and household/family factors, to ascertain whether individual and households factors combined can explain the inequalities in under-five mortality across the regions in Uganda.

At the individual level characteristics, the following variables were considered for further analysis: birth interval, child's sex, maternal age at birth, maternal education, contraceptive use, current marital status, literacy level of the mother and birth order. On the other hand, the household level characteristics given due attention as cited in the conceptual model were ethnic affiliation of the mother, sex of household head, household source of drinking water, household floor materials, wealth index, children ever born, household type of toilet facility and place of residence.

The outcome variable

The outcome variable considered for the purpose of this study is the risk of dying before the age of five (under-five mortality), figure 3. This is defined as the probability of dying between birth and exactly five years (0-59 months). Considering the four branches of the set of independent variables described earlier, the risk of dying before the age of five (outcome variable) can be affected by the individual and household level characteristics across the regions in Uganda.

2.4 Statement of hypotheses

The study hypotheses were formulated basing on the theoretical framework, review of relevant literatures and the derived conceptual framework. Therefore, the following specific hypotheses apply:

1. The risk of under-five mortality differs significantly across regions in Uganda.
2. The differences in under-five mortality across regions in Uganda are explained partly by individual level determinants. This will be tested by the following specific hypotheses:
   - The risks of dying are higher for closely spaced children of less than 24 months, children of 6 or more birth order, children of mothers with did not use contraceptive, children of mothers who are widowed or separated and children whose mothers are illiterate.
   - Lower risks of under-five deaths are associated with female children, children whose mothers are aged 25-34 and children of mothers with primary education or secondary and higher education attainment.
3. The inequalities in under-five mortality across regions in Uganda are explained partly by household level determinants. This will be tested by the following specific hypotheses:
   - Higher risks of under-five deaths are associated with children whose mothers are affiliated to Nilo-Hamites ethnic group, children born in a household with unsafe source

of drinking water, children born in a household made up of earth material, children of mothers with total children ever born 6 or higher or 4-5 and children of mothers resident in rural areas.

- The risks of under-five deaths are lower among children born in a rich household compared to those children born or raised in a poor household.

CHAPTER 3: DATA AND METHODS

3.0 Introduction

This chapter presents the description of the study design and description of the dataset, description of the study area, description of data, elaborate description on the study population and the selection of the sample study, Operationalization of the study variables, a brief explanation on the quality of the data and ethical considerations undertaken. Finally, a detailed account on the type of statistical analysis is also documented.

3.1 The study design

This is a quantitative study. Both the descriptive and analytical approaches to data analysis were utilized to study the effects of selected variables on the risk of dying before the age of five in Uganda. Descriptive analysis of data employed helped the researcher to describe, show or summarize data in a way that meanings can be drawn out of them. Analytical approach was basically used to identify and quantify associations, test hypotheses, and to determine whether an association exists between exposure and outcome variable. The study used a secondary data obtained from the birth recode of the 2011 Uganda Demographic and Health Survey (UDHS). This is a cross-sectional study which was implemented by the Uganda Bureau of Statistics from May through December with support from the MEASURE DHS and it is conducted after every five years. The 2011 UDHS is the fifth comprehensive survey conducted in Uganda as part of the worldwide Demographic and Health Surveys project, designed as a follow-up to the 1988/89, 1995, 2000-01 and 2006 Uganda DHS surveys (UBOS & ICF International, 2012).

3.2 Description of the dataset

The 2011 Uganda Demographic and Health Survey (UDHS) used four types of questionnaires: the Household Questionnaire, the Woman's Questionnaire, the Maternal Mortality Questionnaire, and the Man's Questionnaire. These questionnaires were jointly developed with technical support from the ICF for the MEASURE DHS project and by UNICEF for the Multiple Indicator Cluster Survey (MICS) project. This was intended to reflect the population and health issues that are relevant to Uganda. Various stakeholders, ranging from the government ministries and agencies to non-governmental organizations and development partners were involved to discuss the questionnaires in a series of meetings. The questionnaires were pre-tested before administering to the respondents (UBOS & ICF International, 2012).

The Household Questionnaire provided information on a list of members in the household and their socio-demographics data including the household's dwelling unit, such as the source of water, type of toilet facilities, materials used for the floor of the house, ownership of various durable goods, and ownership and use of mosquito bed nets. The Woman's Questionnaire was used to collect information from all eligible women age 15-49, and provided information on: birth history and childhood mortality, family planning, antenatal, delivery, and postnatal care,

breastfeeding and infant feeding practices, vaccinations and childhood illnesses, marriage and sexual activity, maternal health, nutrition, and many more indicators. The women questionnaire was used for this study. The Maternal Mortality Questionnaire collected data on maternal mortality using the Sibling Survival Module (commonly referred to as the 'Maternal Mortality Module'). Finally, the Man's Questionnaire collected information similar to that in the Woman's Questionnaire but was a bit shorter (UBOS & ICF International, 2012).

The organization of the DHS dataset is mainly structured into seven, namely: households, the household members, women, men, births, children and couples recodes. For purpose of this study, the births recode (UGBR60FL) dataset for 2011 UDHS was chosen for this survey because it provides all the variables at individual and household level characteristics needed for the research (UBOS & ICF International, 2012).

3.3 Description of the study area

The study was conducted in Uganda as an area of focus. The republic of Uganda is a land-locked sub-Saharan country found in Eastern part of Africa as shown in figure 4. It is situated astride the equator, between latitudes 4°12'N and 1°29'S and longitudes 29°34'E and 35°0'E of Greenwich meridian. It is bordered by Kenya on the east, Tanzania on the South, Rwanda on the South-West, Democratic Republic of Congo on the West and South Sudan in the North. According to the 2014 census provisional results, the population of Uganda is estimated at 34,856,813 million people with a population growth rate of 3.03% per annum and sex ratio at birth of 94.5 males per 100 females. The life expectancy is estimated to be 52.72 years, with that of males being 51.66 years and females 53.81 years (UBOS, 2014; WPR, 2015).

Figure 4: Map of Uganda showing the DHS study area.

Source: UBOS & ICF International, 2012.

The age structure is skewed towards the younger generations with the 48.1% of Uganda's population being in the 0-14 year-old age group. About 25.1% of the population of Uganda is in the range of 25-64 year age group and 21.5% of the total population is dominated by the 15-24 year age group (UBOS, 2014; WPR, 2014).

Uganda has diverse ethnic groups which are composed of Baganda (16.9%), followed by the Banyangkole, Basoga and Bakiga tribes, which make up 9.5%, 8.4% and 6.9% respectively.

There are many other tribes in the country but they constitute a very small percentage of the total population. Uganda is basically a Christian country with Roman Catholic making 47.9% of the total population. Anglican, Muslim and Pentecostal believers represent 35.9%, 12.1% and 4.5% of the total population respectively (UBOS, 2014; WPR, 2015).

3.4 Description of data

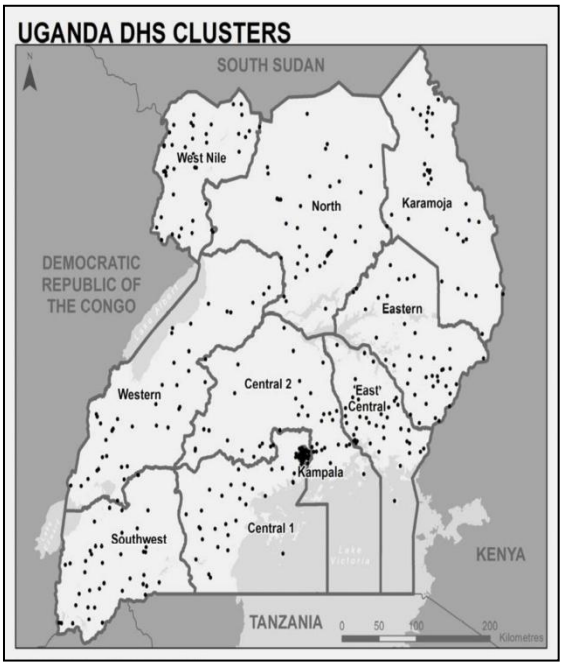
3.4.1 Method of data collection

The method of data collection for this study was secondary, based on the births recode dataset from the 2011 Uganda Demographic and Health Survey, extracted from the women questionnaire administered to a nationally representative sample of women in Uganda. The data are retrospective and covers a period of five years preceding the survey. The 2011 UDHS is the most recent survey conducted in Uganda (UBOS & ICF International, 2012).

3.4.2 Study population and sampling

The sample for the 2011 UDHS was drawn from the entire country as shown in figure 5 covering 10 statistical regions in order to provide population and health indicator estimates at the national and regional levels, including the urban and rural areas separately (UBOS & ICF International, 2012). The 10 statistical regions are: Kampala, Central 1, Central 2, East Central, Eastern, West Nile, North, Karamoja, Southwest and Western. The sample was selected in two stages. In the first stage, 404 enumeration areas (EAs) were drawn from among a list of clusters sampled for the 2009/10 Uganda National Household Survey (2010 UNHS). This was done to link the 2011 UDHS health indicators to poverty data from the 2010 UNHS, and the clusters for 2010 UNHS were selected from the 2002 Population Census sampling frame.

Figure 5: Map of Uganda showing DHS clusters.



Source: UBOS & ICF International, 2012**.**

In the second stage, households were purposively selected from a complete listing of households in each cluster (UBOS & ICF International, 2012). Thus, a nationally representative sample survey of 10,086 households with 9,247 women of reproductive age (15-49) and 2,573 men aged 15-54 was selected. The data used to estimate under-five mortality were collected in the birth history section of the Woman's Questionnaire of the 2011 UDHS. The birth history data were

collected from 9,247 women aged 15-49 years, and information on the sex of child, month and year of child's birth, child's survivorship status, child's current age and age at death if the child had dead were also included. The analysis of this study was restricted to 28,609 children born to 8,674 women who had at least birth between 2006 and 2011 (UBOS & ICF International, 2012).

3.5 Operationalization of variables

3.5.1 The outcome variable

The outcome variable for this study is the risks of dying before the age of five. The women were asked about the number of children they had and whether the children were alive or not. The question was, 'Is child alive?' Yes or no answers were collected, which is a dichotomous dependent variable used. The most recent births between 2006 and 2011 were studied from birth to just before their fifth birthday (0-59 months). Analysis was child-based and restricted to the live births in the 5 years preceding the survey. Hence, all children born within the 5 years before the survey date were included in the analysis (UBOS & ICF International, 2012).

Table 3.1: Outcome variable definition and coding

Variable	Definition	Coding
Under-five mortality	Is the child still alive?	Survived (Yes) - 0 Dead (No) - 1

3.5.2 Independent variables

The independent variables selected for this study emanated from the individual and household level characteristics. This was made possible due to information gathered from different literatures and theoretical framework which were known to have significant influence on the risk of dying before the age of five. Region of residence is the primary independent (exposure) variable, which is coded in table 3.2.

Table 3.2: Region of residence definition and coding

Region of residence	The region where the child is born or raised	Kampala (1), Central 1 (2) Central 2 (3) East Central (4) Eastern (5) West Nile (6) North (7) Karamoja (8) Southwest (9) Western (10)

Therefore, the other selected independent variables as indicated in the conceptual framework are presented and defined in the subsequent section below.

3.5.2.1 Individual level characteristics

The exposure variables under individual level characteristics considered for this study were as follows: birth interval, child's sex, maternal age at birth, and maternal education, contraceptive use, and current marital status, literacy level of the mother and birth order.

Table 3.3: Variables definition and coding under individual level characteristics

Variable	Definition	Coding
Birth interval	Number of months between preceding birth and the birth of child in question	<24 months (1) 24 or more months (2)
Child's sex,	Sex of the child	Male (1), Female (2)
Maternal age	Age of mother at the time of child's birth	15-24 (1), 25-34 (2), 35 or more (3)
Maternal education	Highest educational level of the mother	None (1), Primary (2) Secondary or higher (3)
contraceptive use	contraceptive use	Yes (1), No (2)
Mother's marital status	Current marital status of respondent	Married (1) Widowed/separated (2)
Literacy	Whether the respondent can read the whole sentence or not	Illiterate (1), Literate (2)
Birth order	Ranking of child according to order of birth	First birth (1), 2-3 birth (2) 4-5 birth (3), 6 or more (4)

3.5.2.2 Household level characteristics

The household level characteristics given due attention as cited in the conceptual model were ethnicity, sex of household head, source of drinking water, household floor material, household wealth index, children ever born, type of toilet facility and place of residence.

Table 3.4: Variables definition and coding under household level characteristics

Variable	Definition	Coding
Ethnicity	State of belonging to a social group that has a common cultural tradition and norms	Bantu (1), Nilo-Hamites (2) & Other (3)
Head of household	The sex of household head	Male (1) Female (2)
Source of drinking water	Household source of drinking water	Piped/protected source (1) Unprotected source (2)
Household floor materials	Type of materials used for making the floor of a house	Earth (1) & cement/stones (2)
Wealth index	Wealth index of household where respondents lived	Poor (1), Middle (2) & Rich (3)
Children ever born	Total children ever born by respondent	1-3 children (1), 4-5 children (2) & 6+ children (3)
Toilet facility	Type of toilet facility in the household	Flush/covered pit latrine (1), Uncovered pit latrine (2) & No facility (3)
Place of residence	Household's type of place of residence	Urban (1), Rural (2)

3.6 Reflections on data quality

The Uganda Bureau of Statistics (UBOS) took a lead in the implementation of the 2011 UDHS and involved quite a number of organizations and individuals that contributed immensely to the success of the survey. Every single step was undertaken to ensure a coordinated effort to the successful implementation of the survey. A multi-sectoral Technical Working Committee chaired by the Ministry of Health (MOH) provided technical issues related to the survey including questionnaire design, quality control, training, and report writing among others (UBOS & ICF International, 2012). According to Adebayo (2014), several steps were taken by the MEASURE DHS, ICF International and other organizations in order to ensure the quality of the DHS data. The first step was to enter all copies of the questionnaires twice to avoid coding and data entry errors using the Census and Survey Processing System (CSPro), which facilitated data entering, editing, tabulating and dissemination.

The Demographic and Health Survey data coverage is very high; a representative sample of 10,086 households was selected. This covered all the ten (10) statistical regions of the country and data were collected from all the districts within the region (UBOS & ICF International, 2012). The household and individual response rates for the 2011 UDHS was very high. A total of 9,480 households were found to be occupied during data collection, and out of this, 9,033 households were successfully interviewed, giving a household response rate of 95 percent. In a similar manner, 8,674 women out of the 9,247 eligible women were interviewed successfully, thus, yielding a response rate of 94 percent for women. On a general note, the percentages of the missing cases were minimal and many variables have no missing cases, and those variables that have misses cases were less than 5 percent (UBOS & ICF International, 2012). Given the afore-mentioned reasons, it is worthwhile to conclude that the 2011 Uganda Demographic and Health Survey have good data quality to work with for the outcome of this study.

3.7 Ethical considerations

This study was based on secondary analysis of an existing dataset of the 2011 Uganda Demographic and Health Survey, and all ethical issues were taken care of by Uganda Bureau of Statistics (UBOS). Respondent's informed consent was sought before interviews commenced as provided for in front of the women questionnaire section 1 on the respondent's background. In addition, a rapport was built between the respondent and the interviewee through trust and confidentiality matters (UBOS & ICF International, 2012). Specifically, utmost care was taken by UBOS during data collection, organization, analysis and processing to produce the quality data worth using. In addition, permission was also obtained from MEASURE DHS (http://dhsprogram.com) that authorized the use of most needed datasets for this research, abiding by all the conditions and guidelines regarding the use of these datasets (UBOS & ICF

International, 2012). It is my sincere hope that, after the successful conclusion of this research, a copy will be sent to MEASURE DHS as requested by the Director.

3.8 Method of data Analysis

The outlay of this sub-section is used to describe the appropriate statistical methods and techniques pertinent in answering the research questions derived for this study in chapter one. The methods of data analysis were categorized into two main levels, namely: the descriptive analysis of data and multivariate analysis of data. The data used for analysis are drawn from the individual level characteristics, region of residence (primary variable) and household level characteristics. The individual level characteristics comprises of the child/mother level variables while the household level characteristics are basically the mother level characteristics, the homes and families where children are born and raised (figure 3).

3.8.1 Descriptive analysis

First, the descriptive statistics is used to describe a single variable in terms of the applicable unit of analysis and presented in percentages to show the distribution of the study sample by region of residence. Individual and household level variables selected for the study were presented separately to show how they are distributed at national and by region of residence. In the second part, the bivariate analysis of data was performed using cross-tabulation and Pearson's chi-squared test to examine the relationship between the outcome variable (the risks of under-five mortality) and the selected independent variables. This was performed to display differentiations of under-five mortality by selected variables under individual and household level determinants by region of residence. The chi–square statistic in particular was applied in testing the association between the two variables in the cross-tabulation tables by choosing an alpha level of 0.05. The observed significant level of $p<0.05$ indicated that there is an association between the outcome variable and independent variables, and where $p>0.05$ was regarded as no association between the variables in question. The bivariate analysis is so insightful in providing direction of data analysis at a higher level (Akuma, 2013).

3.8.2 Multivariate analysis of data

The binary logistic regression model was chosen for the multivariate analysis of data to examine the effects of individual and household level characteristics on under-five mortality across the regions in Uganda. The choice of the model was guided by the binary nature of the outcome variable, is child alive? (Assi Kouame, 2014). This is a discrete model with only two choices to make, thus, has a dichotomous dependent variable$\binom{0=alive}{1=dead}$. The age at death was restricted to 0-

59 months, based on live births in the 5 years preceding the 2011 Uganda Demographic and Health Survey.

Collinearity diagnostic test for all selected independent variables were first performed before building the model for factors of under-five mortality. The Tolerance and the Variance Inflation Factor (VIF) of the independent variables are the two statistics that are used for collinearity test. The Variance Inflation Factor (VIF) for each independent variable must be preferably less than 5 to indicate that there is no serious interaction (linear relationship) between the independent variables that might affect the results in the analysis (Kwara, 2012).

The binary logistic regression model is given by the following functions:

$$Logit = Log\text{-}odd = In(\frac{p}{1-p}) = a + ß_1 X_1 + ß_2 X_2 + ... + ß_k X_k + \epsilon \quad (1)$$

$$\text{Odds} = (\frac{p}{1-p}) = e^{a + ß1\ X1 + ß2\ X2 + ...+ ßk\ Xk + \epsilon} \quad (2)$$

$$\text{Probability, P(Y=1)} = (\frac{e^{a + ß1\ X1 + ß2\ X2 + ...+ ßk\ Xk + \epsilon}}{1 + e^{a + ß1\ X1 + ß2\ X2 + ...+ ßk\ Xk + \epsilon}}) \quad (3)$$

Where, P(Y=1) = Probability of under-five death,

e = Base of the natural logarithm (2.71828),

$ß_1, ß_2 ..... ß_k$ = Coefficients estimated from the data, and

$X_1, X_2 ..... X_k$ = Dependent variables.

Note that,

If $ß < 0$: $e^{ß} < 1$: odds and probability P(Y = 1) become smaller

If $ß > 0$: $e^{ß} > 1$: odds and probability P(Y = 1) increase

If $ß >= 0$: $e^{ß} = 1$: odds and probability P(Y = 1) do not change

The effect sizes (the logit and the odds) as denoted in equations (1) and (2) were in particular used to explain the impact of independent variables on under-five mortality across regions in Uganda. The parameters of the model were estimated by using the Maximum likelihood method and goodness of fit tested using Hosmer-Lemeshow test.

Four models were fitted in the analysis of individual and household level characteristics:

Model 1: This is the un-adjusted model, fitted to show the association between the risks of under-five mortality and region of residence as the only explanatory variable. This was performed by using the binary logistic regression to find out whether the risk of dying before the age of five differs significantly across the regions of Uganda.

Model 2: In the second model, the likelihood of under-five mortality was modeled as a function of the mothers' region of residence and individual level determinants. Adding birth interval, child's sex, maternal age, maternal education, contraceptive use, current marital status, literacy level and birth order to model 1 is to ascertain whether accounting for individual determinants can explain the differences in under-five five mortality across the regions in Uganda.

Model 3: The third model was fitted to show the likelihood of under-five deaths as a function of the mothers' region of residence and household level variables only, to examine the impact of household level characteristics on under-five deaths, independently of all the other explanatory variables.

Model 4: This is the full model that incorporates all the selected variables under individual and household level characteristics in the presence of mothers' region of residence. This was added to determine whether accounting for individual and household determinants can explain the differences in under-five five mortality across the regions in Uganda.

The multivariate analysis was done using SPSS: IBM Corp. Released 2013. IBM SPSS Statistics for Windows, Version 22.0. Armonk, NY: IBM Corp.

CHAPTER FOUR: RESULTS

4.0 Introduction

The chapter presents the distribution of the study sample by selected individual and household level characteristics according to region of residence, the regional differentials of under-five mortality using chi-square test, and the results of the multivariate analyses categorized into four models. The multivariate analysis of the data was performed to answer the research sub-questions one (1), two (2) and three (3), which aims to examine whether there are significant inequalities in under-five deaths across regions, and whether individual and household level characteristics can explain those differences.

4.1 The descriptive analysis

The results of the descriptive statistics are presented in tables 4.1and 4.2 to show the percentage distribution of the study sample by Individual and household level characteristics according to region of residence.

4.1.1 The distribution of individual level characteristics by region of residence

The distribution of the study sample of the individual level characteristics is presented in table 4.1. The variables included in the analysis are: birth interval, child's sex, mother's current age, maternal education, contraceptive use, mother's marital status, literacy level and birth order. The result shows that there exist significant differences in the selected individual level characteristics across regions in Uganda ($p < 0.05$).

The result from the 2011 Uganda Demographic and Health Survey (UDHS) dataset shows that less than 1 in 3 children: Kampala (31.9%), Central 1 (35.4%), Central 2 (36.8%), East Central (36.9%), Eastern (32.3%), North (27.7%), Karamoja (39.9%), West-Nile (26.3%), Western (34.2%) and Southwest (33.8%) had preceding birth intervals of less than 2 years, while children delivered after 2 years preceding birth interval was highest in West-Nile (73.7%) and lowest in North (60.1). The percentage distribution of children by child's sex showed that male and female children were almost of the same proportion across the regions, 51% versus 49%. Table 4.1 further indicates that more than half of the children were born to mothers whose ages were 35+ years across the regions compared to mothers aged 15-24 or 25-34 years, except Kampala and Karamoja regions (41.6% & 48.0%), respectively.

On the other hand, there is varied proportion of children born to mothers who had no formal education across regions, ranging from as high as 74.3% in Karamoja to 3.2% in Kampala. Also, the highest proportion of the children ranging from 43.4% in Kampala City to 70.3% in Eastern Uganda belonged to mothers with primary level of education, and only less than 1 in 6 of the

children were born to mothers who had secondary or higher level of education, with the exception of Kampala (53.5%), Central 2 (25.6%) and Central 2 (22.7%).

With respect to contraceptive use, the analysis shows that more than 54% of the children are delivered to mothers who did not use contraceptive across the region. The highest proportion of such mothers was observed in Karamoja (94.6%), followed by West-Nile (84.5%) and lowest in Kampala (54.5%). In addition, most mothers were married across the regions in Uganda with over 70% while less than 1 in 5 mothers were either widowed/separated/single with the exception of Kampala, Central 1 & 2. Considering birth order, a child of birth order six or higher was highest in East Central (16.7%) and lowest in Kampala City (2.9%).

Table 4.1: The distribution of individual level characteristics by region of residence, Uganda DHS 2011.

Variable/ category	Uganda (%)	Kampala (%)	Central 1 (%)	Central 2 (%)	East Central (%)	Eastern (%)	North (%)	Karamoja (%)	West-Nile (%)	Western (%)	Southwest (%)
Region	100 (28609)	6.6 (1889)	8.6 (2467)	10.1 (2902)	11.8 (3367)	11.9 (3413)	10.1 (2879)	8.7 (2478)	10.3 (2938)	11.4 (3259)	10.5 (3017)
Birth intervals	***p<0.001***										
Less 24 months	33.5	31.9	35.4	36.8	36.9	32.3	27.4	39.9	26.3	34.2	33.8
24+ months	66.5	68.1	64.6	63.2	63.1	67.7	72.6	60.1	73.7	65.8	66.2
Child's sex	***p<0.05***										
Male	50.6	49.3	49.2	51.1	51.6	50.1	51.1	48.1	50.7	53.1	50.7
Female	49.4	50.7	50.8	48.9	48.4	49.9	48.9	51.9	49.3	46.9	49.3
Maternal age	***p<0.001***										
15-24	10.5	15.3	11.4	10.7	10.7	13.2	9.5	9.4	10.0	9.4	7.0
25-34	36.6	43.1	34.4	35.1	38.8	32.4	39.5	42.5	30.9	36.9	35.3
35+	52.9	41.6	54.2	54.2	50.5	54.4	51.1	48.0	59.2	53.7	57.7
Maternal education	***p<0.001***										
No education	24.9	3.2	13.1	14.5	15.3	16.9	24.8	74.3	31.0	28.5	27.6
Primary	59.3	43.4	61.2	62.8	68.3	70.3	65.7	23.3	61.1	60.0	62.6
Secondary+	15.8	53.5	25.6	22.7	16.4	12.7	9.5	2.4	7.9	11.5	9.8
Contraceptive use	***p<0.001***										
Yes	28.3	45.2	37.5	34.3	32.2	29.9	25.3	5.4	15.5	29.5	31.1
No	71.7	54.8	62.5	65.7	67.8	70.1	74.7	94.6	84.5	70.5	68.9
Current marital status	***p<0.001***										
Married	81.8	70.0	75.7	76.1	84.5	85.2	81.7	89.3	83.7	80.5	86.2

Variable/ category	Uganda (%)	Kampala (%)	Central 1 (%)	Central 2 (%)	East Central (%)	Eastern (%)	North (%)	Karamoja (%)	West-Nile (%)	Western (%)	Southwest (%)
Widowed/separated/ single	18.2	30.0	24.3	23.9	15.5	14.8	18.3	10.7	16.3	19.5	13.8
Literacy level	***p<0.001***										
Illiterate	62.6	23.0	41.8	48.9	65.6	71.7	74.0	93.0	79.7	60.5	54.5
Literate	37.4	77.0	58.2	51.1	34.4	28.3	26.0	7.0	20.3	39.5	45.5
Birth order	***p<0.001***										
First bord	41.3	60.0	42.9	40.6	37.2	39.3	40.0	39.6	41.1	40.6	39.4
2-3 bord	28.1	27.8	28.3	27.6	27.8	28.0	29.1	28.7	27.8	27.8	28.2
4-5 bord	17.2	9.3	16.0	17.7	18.5	17.9	18.1	17.9	18.1	17.0	18.2
6+ bord	13.4	2.9	12.8	14.1	16.5	14.8	12.7	13.8	13.0	14.5	14.2

Source: Calculated from 2011, UDHS raw data.

4.1.2 The distribution of household level characteristics by region of residence

The household level characteristics selected for analysis include: ethnicity affiliation of the mother, sex of household head, household source of drinking water, household floor materials, wealth index, children ever born, household type of toilet facility and place of residence of the mother. The descriptive statistics showing distribution of the study sample by household level characteristics (table 4.2 above), indicates that all the selected household level characteristics vary significantly across the regions in Uganda ($p < 0.001$).

Table 4.2 shows that most of the children born in the country are from households whose mothers are affiliated to Bantu speaking ethnic group except (49.3%), with highest proportion reported in Southwest (87.5%) and lowest in West-Nile (5.5%). Largely, there is high proportion of children whose mothers are of Nilo-Hamites in West-Nile (84.8%), North (80.6%) and Karamoja (66.2%) while the rest of the regions have less than 20% children whose mothers are affiliated to Nilo-Hamites. The percentage of children born to mothers living in households who lack access safe water for drinking ranged from 5.8% in Kampala to 61.1% in Southwest region. With respect to household floor material, the result shows that most of the children in Uganda (73.8%) are born to mothers who live in a household with floor material made of earth and highest in Karamoja region (95.7%).

In addition, the percentage of children born to mothers of poor households ranges from 0.3% in Kampala to 91.8% in Karamoja region, while majority of the rich households are found in Kampala City (97.9%) and lowest in Karamoja region (4.8%). Table 4.2 further shows that 3 in 5 children across the region are from households with children ever born of 6 or more children except Kampala City (22.6%); while only less than 3 in11 were children from households having 4-5 total number of children ever born, except Kampala (32.4%). The proportion of household with access to flush/covered pit latrine is lowest in Karamoja region (21.6%) and highest in Southwest region (93.3%. Finally, the result showed that more than 75% of the households were living in rural areas in all the regions except Kampala that is purely urban.

Table 4.2: The distribution of household level characteristics by region of residence, Uganda DHS 2011.

Variable/category	Uganda (%)	Kampala (%)	Central 1 (%)	Central 2 (%)	East Central (%)	Eastern (%)	North (%)	Karamoja (%)	West-Nile (%)	Western (%)	Southwest (%)
Ethnicity	***p<0.00***										
Bantu	49.3	66.0	66.6	61.8	65.6	33.0	8.3	7.2	5.5	71.3	87.5
Nilo-Hamites	26.0	19.5	11.7	9.7	8.2	13.2	80.6	66.2	84.8	7.8	0
Others	24.7	14.5	21.7	28.5	26.2	53.8	11.1	26.6	9.7	20.8	12.5
Sex of household head	***p<0.00 1***										
Male	69.9	62.3	65.1	67.8	70.4	78.8	73.4	63.1	70.2	69.3	72.6
Female	30.1	37.7	34.9	32.2	29.6	21.2	26.6	36.9	29.8	30.7	27.4
Source of drinking water	***p<0.00 1***										
Piped/protected source	72.8	94.2	48.7	65.0	87.6	86.9	80.3	87.2	74.4	59.7	38.9
Unprotected source	26.2	5.8	51.3	35.0	12.4	13.1	19.7	12.8	25.6	40.3	61.1
Household floor	***p<0.00 1***										
Earth	73.8	8.1	51.8	60.6	70.3	84.2	88.9	95.7	89.6	82.3	79.9
Cemented	26.2	91.9	48.2	39.4	29.7	15.8	11.1	4.3	10.4	17.7	20.1
Wealth index											
Poor	43.6	0.3	14.8	22.4	32.9	55.7	70.4	91.8	71.4	34.6	30.8
Middle	18.1	1.8	18.8	18.6	20.2	21.1	13.3	3.4	11.6	28.0	33.9
Rich	38.2	97.9	66.4	58.9	46.9	23.2	16.3	4.8	17.0	37.4	35.2
Children ever born	***p<0.00 1***										
1-3 children	18.9	45.0	21.1	17.6	14.1	15.8	16.9	16.5	18.1	19.1	15.4
4-5 children	22.9	32.4	26.7	22.2	19.8	22.7	22.4	22.7	21.9	21.3	22.0

Variable/category	Uganda (%)	Kampala (%)	Central 1 (%)	Central 2 (%)	East Central (%)	Eastern (%)	North (%)	Karamoja (%)	West-Nile (%)	Western (%)	Southwest (%)
6+ children	58.1	22.6	52.2	60.2	66.1	61.5	60.6	60.8	60.0	59.7	62.5
Type of toilet facility	***p<0.001***										
Flush/covered pit latrine	69.2	96.4	81.2	76.1	70.7	62.7	61.4	21.6	59.4	73.9	93.3
Uncovered pit latrine	17.1	3.0	14.5	20.0	22.6	20.8	20.7	5.4	27.1	23.4	4.4
No facility	13.7	0.6	4.3	3.8	6.8	16.5	17.9	72.9	13.5	2.8	2.3
Place of residence	***p<0.001***										
Urban	19.9	100.0	24.4	16.6	14.0	11.6	15.7	4.5	22.4	13.9	5.5
Rural	80.1	0	75.6	83.4	86.0	88.4	84.3	95.5	77.6	86.1	94.5

Source: Calculated from 2011, UDHS raw data.

4.1.3 Collinearity diagnostic test

A set of independent variables must be tested for collinearity before building the model for factors of under-five mortality. Table 4.3 shows the result of the Tolerance and the Variance Inflation Factor (VIF) statistics used for collinearity test for the independent variables that shall be employed for predicting factors that affect under-five mortality. The Variance Inflation Factor (VIF) for each independent variable is less than 5 as indicated in table 4.3 meaning that, there is no interaction (linear relationship) between the independent variables that might affect the results in the analysis(Kwara, 2012). This implies that all the independent variables selected to form part of this study are fit to be used in developing the model for under-five mortality in Uganda.

Table 4.3: Collinearity test of independent variables

Independent variables	**Collinearity Statistics**	
	Tolerance	**VIF**
Region of residence	.845	1.183
Birth intervals	.973	1.028
Sex of child	.999	1.001
Maternal age	.603	1.659
Maternal education	.546	1.830
Contraceptive use	.893	1.120
Marital status	.668	1.498
Literacy level	.600	1.667
Birth order	.752	1.330
Ethnicity	.865	1.156
Sex of household head	.675	1.482
Source of household drinking water	.930	1.075
Household floor material	.481	2.080
Wealth index	.422	2.367
Children ever born	.524	1.907
Household type of toilet facility	.781	1.280
Type of place of residence	.700	1.428
Average score	0.721	1.476

4.2 The differentials of under-five mortality in Uganda

This section presents differentials in under-five mortality by selected individual and household level characteristics according to region of residence. Cross tabulation was applied to examine the association between under-five mortality (outcome variable) and the selected independent variables. The results are presented in three parts: differentials of under-five mortality by region of residence, regional differentials of under-five mortality by individual level characteristics, and finally the regional differentials of under-five mortality by household level variables. The averages of each individual and household level variable were established to show the extent of variations in under-five mortality across the regions in Uganda.

4.2.1 Differentials of under-five mortality by region of residence

The differentials of under-five mortality rates (U5MR per 1000 live births) by region of residence are indicated in table 4.4. According to the results, there are indications of statistically significant variations in under-five mortality across all the 10 regions of the country ($p < 0.001$). As observed, under-five mortality rate was highest in the Southwest and West-Nile regions with 159 and 148 deaths per 1000 live births, respectively and lowest in Kampala with 85.8 deaths per 1000 live births.

Table 4.4: The differentials of under-five mortality rate (U5MR per 1000 live births) by region of residence

	Number of deaths	**U5MR (per 1000 live births)**
Kampala	162	85.8
Central 1	324	131.3
Central 2	351	121.0
East Central	386	114.6
Eastern	420	123.1
North	403	140.0
Karamoja	360	145.3
West-Nile	435	148.1
Western	458	140.5
Southwest	480	159.1
Uganda	**3779**	**132.1**
Pearson Chi-square = 82.972, degree of freedom (df) = 9 & p-value < 0.001		

Source: Calculated from 2011, UDHS raw data.

4.2.2 The differentials of under-five mortality rate according to individual level characteristics across region of residence

The result of the cross-tabulation showing differentials of under-five mortality rate according to individual level characteristics across region of residence is presented in table 4.4. The chi–square statistic in particular was applied in testing the association between the two variables in the cross-tabulation tables by choosing an alpha level of 0.05. The observed significant level of $p<0.05$ indicated that there is an association between the outcome variable and independent variables, and where $p>0.05$ was regarded as no association between the variables in question. The result indicated that under-five mortality varies significantly by individual level characteristics across the regions in Uganda (*p<.001).*

Table 4.5 indicated that under-five mortality rate was higher for males than for females' children in all the regions of Uganda, with Southwest region having the highest observed rate of 164.7 deaths per 1000 live births. With respect to birth order, the result showed that under-five mortality significantly increases with the increasing number of the child's birth order. For instance, higher under-five mortality was observed among children of mothers with 6 or more birth orders compared to children of mothers with first-birth order for all the regions in country ($p<0.001$). The under-five mortality rate by birth order was highest in Southwest region (159.1 per 1000), followed by West-Nile region (148.1 per 1000) and lowest in Kampala City (85.8 per 1000). Preceding birth interval also showed a significant variations in under-five mortality rates across all the regions of Uganda ($p<0.001$). The data indicated that more than 1 in 7 under-five deaths occurred among mothers with closely spaced children of less than 24 months. Further, the under-five mortality rate according to birth interval was highest in Southwest region (245.6 per 1000) and lowest in Kampala (65.7 per 1000).

On maternal education, the result revealed that education attainment of mothers was inversely related to under-five mortality. Thus, the higher the level of education the mother, the lower is the rate of under-five mortality across all the regions of Uganda. Higher under-five mortality rate was reported among women with no education compared to those with secondary or higher level of education across all the regions in Uganda. The result further showed that under-five mortality was significantly higher for children of older mothers (35 or more) than for the children of younger mothers aged (15-24 years) in all the 10 regions of the country ($p<0.001$) with highest observed figure reported in the North (178.9 per 1000).

Table 4.5: The differentials of under-five mortality rate (U5MR per 1000 live births) according to individual level characteristics across region of residence

Variable/category	Kampala	Central 1	Central 2	East Central	Eastern	North	Karamoja	West-Nile	Western	Southwest
Birth interval	***p<0.01***	***p<0.001***	***p<0.001***	***p<0.001***	***p<0.001***	***p<0.001***	***p<0.001***	***p<0.001***	***p<0.001***	***p<0.001***
Less 24 months	117.6	172.2	148.7	150.1	152.4	208.1	171.6	222.4	187.6	245.6
24+ months	74.4	100.2	96.5	80.5	96.0	105.2	112.1	114.5	102.4	103.1
Average	**88.2**	**125.7**	**115.7**	**106.2**	**114.3**	**133.4**	**135.9**	**142.9**	**131.5**	**151.3**
Child's sex	***p<0.001***	***p=0.93***	***p<0.05***	***p=0.20***	***p<0.05***	***p=0.23***	***p<0.05***	***p<0.05***	***p=0.19***	***p=0.39***
Male	107.296	131.9	132.1	121.5	133.3	147.6	157.9	159.6	148.1	164.7
Female	64.7858	130.8	109.3	107.3	112.8	132.0	133.6	136.1	132.0	153.3
Average	**85.7597**	**131.3**	**121.0**	**114.6**	**123.1**	**140.0**	**145.3**	**148.1**	**140.5**	**159.1**
Maternal age	***p<0.01***	***p=0.11***	***p<0.001***	***p=0.07***	***p<0.001***	***p<0.001***	***p<0.001***	***p<0.001***	***p<0.001***	***p<0.001***
15-24	65.7	117.4	67.7	91.4	57.9	84.2	106.8	61.4	81.4	103.8
25-34	67.6	115.4	91.3	105.7	94.9	103.0	116.7	125.7	114.7	138.0
35+	112.0	144.4	150.7	126.4	155.5	178.9	178.2	174.3	168.7	178.7
Average	**85.8**	**131.3**	**121.0**	**114.6**	**123.1**	**140.0**	**145.3**	**148.1**	**140.5**	**159.1**
Education level	***p<0.001***	***p<0.001***	***p<0.001***	***p=0.68***	***p=0.72***	***p<0.001***	***p<0.01***	***p<0.001***	***p<0.001***	***p<0.001***
No education	150.0	179.0	164.3	126.0	148.8	206.2	146.6	186.4	189.7	210.3
Primary	103.8	133.7	125.1	112.2	120.4	122.6	154.2	138.2	131.9	149.8
Secondary+	67.3	101.3	81.9	114.1	103.4	87.6	16.9	73.6	64.0	74.3
Average	**85.8**	**131.3**	**121.0**	**114.6**	**123.1**	**140.0**	**145.3**	**148.1**	**140.5**	**159.1**
Contraceptive	***p<0.001***	***p<0.001***	***p<0.001***	***p<0.05***	***p<0.05***	***p<0.001***	***p=0.11***	***p<0.05***	***p<0.001***	***p=0.37***
Yes	65.7	110.3	96.4	97.8	106.0	74.2	97.7	105.5	105.1	150.2
No	102.3	144.0	133.8	122.6	130.3	162.3	148.0	155.9	155.4	163.1
Average	**85.8**	**131.3**	**121.0**	**114.6**	**123.1**	**140.0**	**145.3**	**148.1**	**140.5**	**159.1**

Variable/category	Kampala	Central 1	Central 2	East Central	Eastern	North	Karamoja	West-Nile	Western	Southwest
Marital status	***p<0.001***	***p=0.12***	***p<0.01***	***p=0.30***	***p<0.05***	***p=040***	***p=0.12***	***p<0.05***	***p=0.17***	***p=0.12***
Married	68.8	125.3	112.8	112.2	118.6	137.4	141.4	142.3	136.4	154.9
Widowed/separated/single	125.4	150.0	146.8	128.1	148.5	151.5	177.4	177.5	157.7	185.1
Average	**85.8**	**131.3**	**121.0**	**114.6**	**123.1**	**140.0**	**145.3**	**148.1**	**140.5**	**159.1**
Literacy level	***p=0.28***	***p<0.01***	***p<0.01***	***p=0.22***	***p<0.05***	***p<0.001***	***p<0.05***	***p<0.001***	***p<0.001***	***p<0.001***
Illiterate	97.2	152.6	136.6	120.0	129.4	157.7	146.1	163.3	164.2	182.5
Literate	80.6	115.8	101.4	105.8	105.5	88.6	84.8	89.0	100.5	131.8
Average	**84.4**	**131.1**	**118.6**	**115.1**	**122.7**	**139.7**	**141.8**	**148.2**	**139.0**	**159.4**
Birth order	***p<0.001***	***p<0.001***	***p<0.001***	***p<0.001***	***p<0.001***	***p<0.001***	***p<0.001***	***p<0.001***	***p<0.001***	***p<0.001***
First bord	62.7	85.1	73.1	75.1	70.0	76.4	82.5	95.2	83.9	87.5
2-3 bord	97.1	156.2	111.1	122.7	117.0	133.5	147.9	167.9	146.6	167.1
4-5 bord	176.1	162.4	159.2	136.7	163.9	228.0	189.6	173.3	183.8	214.5
6+ bord	163.6	192.4	229.8	165.2	226.2	229.5	262.4	237.6	236.3	270.4
Average	**85.8**	**131.3**	**121.0**	**114.6**	**123.1**	**140.0**	**145.3**	**148.1**	**140.5**	**159.1**

Source: Calculated from 2011, UDHS raw data.

4.2.3 The differentials of under-five mortality rate according to household level characteristics across region of residence

The result of the cross-tabulation showing differentials of under-five mortality by household level characteristics according to region of residence is presented in table 4.6. The chi–square statistic in particular was applied in testing the association between the two variables in the cross-tabulation tables by choosing an alpha level of 0.05. The observed significant level of $p<0.05$ indicated that there is an association between the outcome variable and independent variables, and where $p>0.05$ was regarded as no association between the variables in question. The result indicated that under-five mortality varies significantly by individual level characteristics across the regions in Uganda (*p<.001).*

With regards to household's source of drinking water, the result as presented in table 4.6 indicated higher under-five mortality for children raised in households with unprotected source of drinking water (well/spring/river/stream) relative to children in households with piped/protected source of drinking water across the regions with highest rate observed in West-Nile region. Table 4.6 also showed that household with more total number of children ever born are prone to experience higher mortality relative to household with fewer total number of children ever born. The result shows that under-five mortality varies significantly by total number of children ever born across the regions in the country.

Regarding place of residence, higher under-five mortality rates was associated with being resident in rural areas relative children in the urban areas across the regions. This variable was found to be insignificant in Kampala, Eastern, North, Karamoja, West-Nile and Western regions of Uganda. Concerning household wealth index, the table showed that the poor the household, the higher is the rate of under-five mortality and it varies across the regions of Uganda. The households that had no access to pit latrine/uncovered pit latrine as a form of toilet facility were observed to be having higher under-five deaths relative to households that had a flush/covered pit latrine as a form of toilet facility across the regions in Uganda. A consideration of ethnic affiliation of the mother revealed that more under-five mortality is associated Nilo-Hamites ethnic group compared to Bantu or other ethnic groups across the region of residence.

Table 4.6: The differentials of under-five mortality according to household level characteristics across regions of residence in Uganda, five years period preceding the survey, Uganda DHS 2011.

Variable/category	Kampala	Central 1	Central 2	East Central	Eastern	North	Karamoja	West-Nile	Western	Southwest
Ethnic affiliation of mothers	***p=0.70***	***p=0.66***	***p=0.12***	***p=0.59***	***p=0.27***	***p=0.59***	***p<0.01***	***p=0.35***	***p<0.05***	***p=0.13***
Bantu	83.6	128.4	112.5	114.3	131.3	100.0	31.3	66.7	138.5	155.2
Nilo-Hamites	82.4	176.5	142.9	222.2	184.2	142.3	159.4	150.9	196.1	0
Others	98.9	140.7	140.3	114.6	117.9	122.6	112.5	125.9	126.7	186.2
Average	**85.8**	**131.3**	**121.0**	**114.6**	**123.1**	**140.0**	**145.3**	**148.1**	**140.5**	**159.1**
Sex of household head	***p=0.07***	***p=0.10***	***p=0.11***	***p=0.08***	***p=0.45***	***p=0.23***	***p<0.35***	***p=0.23***	***p=0.57***	***p=0.85***
Male	76.5	123.2	114.3	108.4	120.9	135.3	150.4	153.2	138.2	159.9
Female	101.0	146.5	134.9	129.4	131.2	152.9	136.6	136.0	145.7	157.0
Average	**85.8**	**131.3**	**121.0**	**114.6**	**123.1**	**140.0**	**145.3**	**148.1**	**140.5**	**159.1**
Source of drinking water	***p=0.68***	***p<0.01***	***p=0.13***	***p=0.67***	***p=0.08***	***p=0.72***	***p=0.73***	***p<0.01***	***p<0.001***	***p=0.12***
Piped/protected source	84.5	113.7	114.0	115.3	119.8	139.6	147.0	137.9	123.9	144.3
Unprotected source	96.2	147.4	133.7	122.5	149.4	145.4	139.7	177.9	165.2	166.3
Average	**85.2**	**131.0**	**120.9**	**116.2**	**123.7**	**140.8**	**146.1**	**148.1**	**140.5**	**157.7**
Household floor material	***p<0.001***	***p<0.05***	***p<0.01***	***p<0.01***	***p=0.39***	***p=0.15***	***p=0.22***	***p<0.001***	***p<0.001***	***p<0.001***
Earth	160.0	144.9	137.0	127.7	127.7	143.7	147.9	156.1	148.6	171.7
Cement/stones	80.2	117.6	97.4	88.9	107.8	113.6	104.8	80.3	98.9	100.2
Average	86.6	131.8	121.4	116.2	124.6	140.4	146.0	148.3	139.8	157.4
Wealth index	***p<0.05***	***p=0.31***	***p=0.13***	***p<0.05***	***p=0.39***	***p<0.001***	***p=0.16***	***p<0.05***	***p<0.001***	***p<0.001***
Poor	166.7	153.4	139.8	141.7	120.5	144.5	149.0	162.0	165.2	209.7
Middle	205.9	137.6	129.4	117.8	137.5	172.3	82.4	120.6	148.8	153.3

Variable/category	Kampala	Central 1	Central 2	East Central	Eastern	North	Karamoja	West-Nile	Western	Southwest
Rich	83.3	124.6	111.1	94.3	116.0	93.8	118.6	108.2	111.6	120.4
Average	85.8	131.3	121.0	114.6	123.1	140.0	145.3	148.1	140.5	159.1
Children ever born	***p<0.001***	***p<0.05***	***p<0.01***	***p<0.05***	***p<0.001***	***p<0.001***	***p<0.001***	***p<0.001***	***p<0.001***	***p<0.001***
1-3 children	61.2	103.8	66.7	88.2	68.6	80.1	78.4	73.3	75.6	70.8
4-5 children	85.0	117.0	80.6	99.1	99.5	109.9	110.1	135.3	116.9	137.0
6+ children	135.8	149.7	151.7	124.9	145.7	167.8	176.5	175.3	169.8	188.7
Average	85.8	131.3	121.0	114.6	123.1	140.0	145.3	148.1	140.5	159.1
Type of toilet facility	***p=0.52***	***p=0.30***	***p<0.05***	***p=0.48***	***p=0.10***	***p=0.15***	***p=0.70***	***p=0.15***	***p=0.33***	***p<0.05***
Flush/covered pit latrine	85.3	131.9	109.7	110.7	133.3	133.5	158.5	142.6	135.8	154.8
Uncovered pit latrine	89.3	115.3	162.3	119.9	104.3	136.8	142.9	168.6	156.6	224.8
No facility	181.8	173.1	145.5	135.1	115.5	167.3	143.8	131.4	125.0	246.4
Average	86.0	131.3	121.6	114.5	124.3	140.3	146.9	148.1	140.4	160.0
Place of residence	***p=0.88***	***p<0.05***	***p<0.01***	***p<0.01***	***p=0.27***	***p=0.84***	***p=0.09***	***p=0.45***	***p=0.54***	***p<0.001***
Urban	85.8	129.6	91.3	80.7	105.8	136.9	89.3	139.8	149.8	65.9
Rural	0.0	131.9	126.9	120.2	125.3	140.6	147.9	150.4	139.0	164.6
Average	85.8	131.3	121.0	114.6	123.1	140.0	145.3	148.1	140.5	159.1

Source: Calculated from 2011, UDHS raw data.

4.3 Multivariate level analysis

The analyses of the effects of individual and household level characteristics on the risk of under-five mortality across the regions of Uganda are presented in this section using four different models. The models were fitted to examine the existence of significant differences in under-five mortality across regions in Uganda, and to ascertain whether individual and household level characteristics account for those differences. Binary logistic regression model was applied in order to assess the relevance and relative importance of each factor and under-five mortality by region of residence, table 4.7. The first model was fitted using region of residence as the only predictor variable and the risk of under-five deaths as an outcome variable (model 1). Models 2 and 3 (table 4.7) were fitted to examine whether accounting for individual and household level characteristics separately can reveal to what extend individual and household level determinants explain the differences in under-five five mortality across the regions in Uganda.

Model 1 (table 4.7) illustrates the impacts of region of residence as an independent variable on under-five mortality. Region of residence was included in the model as the only explanatory variable to find out whether the risks of dying before the age of five differ across the regions of Uganda. The result shows that the risk of under-five deaths differs significantly across all the regions of Uganda ($p<0.001$). Children born in all the other nine regions had significantly higher risks of under-five mortality compared with children born in Kampala City. For instance, the odds of under-five deaths was highest for children of mothers residing in Southwest region (OR: 2.017; 95% CI: 1.671-2.435), followed by West-Nile region (OR: 1.853; CI: 1.531-2.242) and lowest in East Central region (OR: 1.38; CI: 1.138-1.674) compared to children born in Kampala City. The Nagelkerke R squared indicates 0.016, thus, can be interpreted as the proportion of variance in under-five mortality explained by region of residence (the predictor).

In model 2 (table 4.7), the risk factors for under-five deaths by region of residence were controlled for individual level determinants and the findings revealed a decreased risk of under-five mortality in all the regions. For instance, the odds of under-five mortality for children in Southwest region reduced from 2.017 to 1.339 but remained significantly higher than the odds of under-five death in Kampala City ($p<0.05$). In addition, the parameters for all the other remaining regions became statistically insignificant at 5% level. Decreased risks of under-five deaths were also experienced in Central 1 (1.612 to 1.146), North (1.735 to 1.182), West-Nile (1.853 to 1.204) and Western (1.743 to 1.097) regions but they remained higher than that of Kampala City while the odds of under-five deaths in Central 2 (1.467 to 0.966), East Central (1.380 to 0.876), Eastern (1.496 to 0.976) and Karamoja (1.812 to 0.933) regions were lower than the odds of under-five deaths in Kampala City. The changes in the coefficients are indications that part of the disparities in under-five mortality across regions of Uganda shown in the un-adjusted model 1 (table 4.7) were attributed to by individual level characteristics. Comparing to model 1, it can be seen that the value of Nagelkerke R squared has increased to 0.172, meaning that about 17.2% variations in under-five mortality is explained by model 2 due to inclusion of individual level determinants.

The risks of deaths before the age of five by region of residence were also controlled for household level determinants as indicated in model 3 (table 4.7). After controlling for (incorporating) household level factors only in the model, the result revealed that the risk of under-five mortality reduced significantly but remained higher for children whose mothers reside in Southwest (OR: 1.31; 95% CI: 1.035-1.652) and Central 1 (OR: 1.23; 95% CI: 0.978-1.556) compared to children of mothers in Kampala City. Furthermore, reduced odds of under-five deaths were also observed in the other remaining seven regions, and they have all become insignificant compared to model 1. The changes in the odds of under-five deaths across the regions as a result of incorporating the household level determinants suggests that they partly explain some of the observed differences in under-five deaths indicated in the un-adjusted model 1. However, comparing to model 2, it can be seen that the value of Nagelkerke R squared has reduced to 0.130, meaning that about 11% variations in under-five mortality is explained by model 3 due to inclusion of household level variables.

All the selected individual and household level characteristics, including region of residence were incorporated into model 4 (table 4.7). The model was specifically fitted to ascertain whether accounting for individual and household level characteristics together can explain the differences in under-five five mortality across the regions. The result showed a decrease in the effect sizes to such a level that the odds of under-five mortality in all the regions became statistically insignificant in the fully fledged adjusted model 4. This is a clear indication that the effects of region of residence on the risk of under-five deaths were taken over due to the inclusion of individual and household level factors. The results of this model 4 indicate that individual level determinants such as birth interval, child's sex, maternal age, maternal education, contraceptive use, marital status and birth order, as well as household level factors like ethnic affiliation of the mother, household floor materials, wealth index, total number of children ever born and place of residence are important explanatory variables of regional inequalities in under-five mortality in Uganda. However, Nagelkerke R squared is 0.378, meaning that about 37.8% variations in under-five mortality is explained by model 4.

The risks of dying were higher for closely spaced children of less than 24 months (OR: 1.86; 95% CI: 1.708-2.029); children of 2-3 birth order (OR: 1.55; 95% CI: 1.379-1.733) or children of 4-5 birth order (OR: 1.80; 95% CI: 1.584-2.061) or children of 6 or more birth order (OR: 2.26; 95% CI: 1.956-2.614); children whose mothers did not use contraceptive (OR: 1.29; 95% CI: 1.1161-1.435); children whose mothers had divorced/separated/single (OR: 1.38; 95% CI: 1.202-1.576); children whose mothers are affiliated to Nilo-Hamites ethnic group (OR: 1.47; 95% CI: 1.207-1.790); children born in a household made up of earth material (OR: 1.25; 95% CI: 1.063-1.475); children ever bor 4-5 (OR: 1.28; 95% CI: 1.012-1.612) or children ever born 6 or higher (OR: 1.51; 95% CI: 1.189-1.919) and children of mothers resident in rural areas (OR: 1.27; 95% CI: 1.092-1.481). On the other hand, risks of under-five deaths were lower for female children (OR: 0.84; 95% CI: 0.744-0.917); children whose mothers were aged 15-24 (OR: 0.72; 95% CI: 0.538-0.965) or children whose mothers were aged 25-34 (OR: 0.86; 95% CI: 0.744-0.960); children of mothers with primary education (OR: 0.86; 95% CI: 0.744-0.961) and children born in a rich household (OR: 0.83; 95% CI: 0.711-0.968).

Table 4.7: The odds ratios and 95% confidence intervals showing association between region of residence and under-five mortality after adjusting for individual and household level characteristics

Variable/category	Model 1			Model 2			Model 3			Model 4		
	OR	C.I		OR	C.I		OR	C.I		OR	C.I	
Region (ref: Kampala)	***			***			**			**		
Central 1	**1.61*** **	1.321	1.967	1.15	0.892	1.472	**1.23***	0.978	1.556	1.17	0.876	1.556
Central 2	**1.47*** **	1.206	1.784	0.97	0.754	1.239	1.06	0.843	1.336	0.94	0.705	1.248
East Central	**1.38*** **	1.138	1.674	0.88	0.684	1.121	0.99	0.792	1.251	0.92	0.694	1.224
Eastern	**1.49*** **	1.236	1.810	0.98	0.762	1.249	1.02	0.804	1.281	0.96	0.719	1.28
North	**1.74*** **	1.431	2.103	1.18	0.923	1.515	0.84	0.642	1.091	0.80	0.574	1.11
Karamoja	**1.81*** **	1.489	2.204	0.93	0.716	1.215	0.93	0.711	1.224	0.74	0.523	1.037
West-Nile	**1.85*** **	1.531	2.242	1.20	0.939	1.544	0.87	0.67	1.135	0.79	0.565	1.092
Western	**1.74*** **	1.443	2.106	1.10	0.858	1.403	1.15	0.916	1.442	1.03	0.772	1.36
Southwest	**2.02*** **	1.671	2.435	**1.339***	1.05	1.708	**1.31***	1.035	1.652	1.27	0.947	1.691
Individual level characteristics												
Birth interval (ref: 24+ months)				**1.85 *** **	1.703	2.014				**1.86 *** **	1.708	2.029
Child's sex (ref: male)				**0.85 *** **	0.784	0.924				**0.84 *** **	0.774	0.917
Maternal age (ref: 35+)				***						**		
15-24				**0.60 *** **	0.475	0.769				**0.72***	0.538	0.965
25-34				**0.81 *** **	0.731	0.889				**0.86****	0.774	0.960
Maternal education (ref: no education)				**						*		
primary				**0.85 *** **	0.761	0.937				**0.86****	0.774	0.961
secondary+				**0.77****	0.635	0.944				0.87	0.703	1.075
Contraceptive use (ref: yes)				**1.35 *** **	1.22	1.495				**1.29 *** **	1.161	1.435
Marital status (ref: married)				**1.29 *** **	1.163	1.435				**1.38 *** **	1.202	1.576
Literacy (ref: literate)				**1.12***	0.998	1.26				1.05	0.925	1.18
Birth order (ref: first birth)				***						***		

Variable/category	Model 1		Model 2			Model 3			Model 4		
	OR	C.I	OR	C.I		OR	C.I		OR	C.I	
2-3 bord			**1.60 *** **	1.44	1.785				**1.55 *** **	1.379	1.733
4-5 bord			**2.01 *** **	1.777	2.261				**1.80 *** **	1.584	2.061
6+ bord			**2.39 *** **	2.087	2.744				**2.26 *** **	1.956	2.614
Household level characteristics											
Ethnicity (ref: others)						***			***		
Bantu						0.99	0.894	1.098	1.01	0.895	1.147
Nilo-Hamites						**1.39 *** **	1.187	1.627	**1.47 *** **	1.207	1.79
Sex of household head (ref: male)						**1.10***	1.015	1.187	0.97	0.86	1.086
Drinking water (ref: pipe /safe)						**1.12***	1.026	1.217	1.1	0.984	1.205
Household floor (ref: cement)						**1.25 *** **	1.095	1.435	**1.25** **	1.063	1.475
Wealth index (ref: poor)						***			*		
middle						**0.89***	0.806	0.991	0.93	0.82	1.051
rich						**0.79 *** **	0.697	0.899	**0.83***	0.711	0.968
CEB (ref: 1-3)						***			***		
4-5						**1.48 *** **	1.297	1.692	**1.28***	1.012	1.612
6+						**2.23 *** **	1.984	2.505	**1.51 *** **	1.189	1.919
Toilet facility (ref: flush /covered latrine)											
uncovered latrine						0.99	0.898	1.093	0.98	0.876	1.106
no facility						0.93	0.818	1.056	0.89	0.767	1.041
Place of residence (ref: urban)						**1.18****	1.039	1.334	**1.27****	1.092	1.481
Constant	**0.09 *** **		**0.07 *** **			**0.06 *** **			**0.04 *** **		
Chi-square (df)	*86.392 (9)*		*834.644 (21)*			*439.060 (21)*			*861.976 (33)*		
Pseudo R Square	*0.016*		*0.172*			*0.130*			*0.378*		
Hosmer-Lemeshow Test	*P=1.000*		*P=0.649*			*P=0.085*			*P=0.133*		

Source: Calculated from 2011 UDHS raw dataset.

CHAPTER FIVE: CONCLUSION AND DISCUSSION

5.1 Summary of the main findings and conclusions

The objective of this study was to investigate whether there are significant inequalities in under-five mortality across regions in Uganda, and to establish whether individual and household level characteristics are predictors of regional inequalities in under-five mortality in country.

The descriptive statistics showed that out of the total number of 28,609 children born five years preceding the 2011 Uganda Demographic and Health Survey, 3,779 children (13.21%) died before reaching their fifth birthday while a total of 24,830 children (86.79%) survived past the age of five. The study showed that under-five mortality rates were highest in the Southwest and West-Nile regions with 159 and 148 deaths per 1000 live births, respectively and lowest in Kampala with 85.8 deaths per 1000 live births. The majority of the under-five deaths occurred between age 0 and 24 months. The bivariate and multivariate analyses indicated that there were significant inequalities in under-five mortality across all the regions in Uganda. This is summarized in the subsequent sections below according to sub-research questions based on the results.

What significant differences exist in under-five mortality across the regions in Uganda?

Both the bivariate and multivariate analyses alluded that there were significant variations in under-five mortality across regions in Uganda. On the basis of bivariate analysis, the study found out that under-five mortality varies significantly according to individual and household level determinants across all the regions in Uganda ($p<0.05$). For instance, under-five deaths for children of 6 or higher birth orders ranges from as high as 270.4 to 163.6 deaths per 1000 live births in Southwest and Kampala City, respectively. Under-five mortality according to birth interval also significantly varied across all the regions ($p<0.05$), with West-Nile having the highest rate, 222.4 deaths per 1000 live births and lowest in Kampala City (117.6). Besides, inequalities in under-five mortality across regions of residence were evidenced according to maternal education, maternal age, ethnicity, total number of children ever born, wealth index, source of drinking water, type of toilet, contraceptive use, place of residence, maternal age, child's sex and household floor materials in Uganda. On average, there were higher proportions of under-five deaths for children whose mothers were resident in Southwest region compared with mortality experience of children in other regions and lowest in Kampala.

The result of the multivariate analysis (Model 1, table 4.7) shows that the risk of under-five deaths differs significantly across all the regions of Uganda ($p<0.001$). The risks of under-five deaths was highest for children of mothers residing in Southwest region (OR: 2.017; 95% CI: 1.671-2.435), followed by West-Nile region (OR: 1.853; CI: 1.531-2.242) and lowest in East Central region (OR: 1.38; CI: 1.138-1.674) compared to children born in Kampala City.

What are the individual level determinants responsible for the differences in under-five mortality across the regions in Uganda?

After adjusting for the effects of individual level factors, the risk of under-five mortality reduced considerably across all the regions in Uganda. Coefficients for Southwest region remained significant while that of the other regions were statistically insignificant (model 2, table 4.7). The risks of under-five mortality were attenuated by the inclusion of individual level determinants. In this respect, the determinants responsible for the differences in under-five deaths can partly be explained by preceding birth intervals, child's sex, maternal age, maternal education, contraceptive use, current marital status, literacy level and birth order. The Nagelkerke R squared indicated that about 17.2% variations in under-five mortality is explained by model 2 due to inclusion of individual level determinants.

What are the household level determinants responsible for the differences in under-five mortality across the regions in Uganda?

Model 3 (Table 4.7) showed a reduction in the odds of under-five deaths in all the regions after adjusting for household level determinants only, but Central 1 and Southwest regions remained statistically significant while the other regions were insignificant. The changes in the odds of under-five deaths across the regions suggest that household level determinants partly explained some of the observed differences in under-five deaths across the regions in Uganda. The takeover effects can be attributed to ethnic affiliation of the mother, sex of household head, households' source of drinking water, household floor material, wealth index, total number children ever born and type of place of residence of the mother. Type of household toilet facility was found to be statistically insignificant for this study. On the overall, the Nagelkerke R squared showed that about 11% variations in under-five mortality is explained by model 3 due to inclusion of household level variables.

5.2 Discussions

The results of the bivariate and multivariate analyses indicated that under-five mortality varies significantly across region of residence in Uganda. The un-adjusted model showed that the risk of under-five deaths was twice as high for children of mothers living in Southwest while the other remaining regions also had significantly higher risks of deaths compared to children of mothers residing in Kampala City. After adjusting for individual level factors and also household level factors separately, the risks of under-five deaths were still higher for children of mothers living in Southwest and Central 1 regions compared to mothers residing in Kampala City. This study is consistent with the findings of other earlier researches conducted in sub-Saharan Africa where statistical associations were reported between under-five mortality and region of residence. A study by Macassa et al (2012) reported that children of mothers residing in the North and Central provinces had higher risks of child mortality than children whose mothers reside in the South region including Maputo province and Maputo City in Mozambique. Yet in a separate study by Antai (2011) and Assi Kouame (2014), higher risks of under-5 deaths were

also reported in the South-South region of Nigeria, and Nord, Nord Ouest and Ouest regions in Cote d'Ivoire, respectively. The findings from several studies from Kenya and Nigeria were also consistent with this finding that indicated statistically significant differences in infant and child mortality risk across regions of a country (Akuma, 2013 & Adedini, 2013).

After adjusting for the effects of individual and household level determinants in the final model, the effect sizes of under-five mortality reduced significantly and became statistically insignificant in all the regions (model 4, table 4.7). The findings from this study suggested that birth interval, child's sex, maternal age, maternal education, contraceptive use, marital status and birth order, as well as household level factors including ethnic affiliation of the mother, household floor materials, wealth index, children ever born and place of residence were the possible predictors of the regional inequalities in under-five mortality in Uganda. These findings were supported by many researchers in developing and other sub-Saharan African countries.

The results from this study showed that being married, having the preceding birth interval greater than or equal to 24 months, being a female child, using contraceptive, being of birth order 1-2 and maternal age of less than 35 years were associated with reduced risks of under-five deaths across the regions in Uganda. The findings were consistent with those conducted by Assi Kouame (2014) in Cote d'Ivoire, Macassa et al (2006) in Mozambique, Antai (2011) and Adedini et al. (2015) in Nigeria. In yet another finding, other factors such as female headed household, safe drinking water for the household, middle or rich household, 1-3 children ever born in a household and flush/covered pit latrine were found to be associated with reduced risks of under-five deaths, thus, one of the major contributors to regional under-five deaths in Uganda. Earlier researches conducted by Macassa et al (2012) in Mozambique, Assi Kouame (2014) in Cote d'Ivoire and Adedini et al. (2015) in Nigeria were consistent with this study.

The risks of dying were associated with children of mothers affiliated to Nilo-Hamites ethnic group, which is in agreement with study by Adedini et al. (2015) who found that children born in a community with mixed maternal ethnic affiliation had higher risks of infant and child mortality in Nigeria. Other studies conducted in Kenya and Mozambique came with a similar finding (Akuma, 2013 & Macassa et al., 2012). Children born in a household with floor made up of earth material were associated with higher risk of dying, which was also alluded to by Akuma (2013) who found that higher risk of under-five deaths was associated with children born in a household made up of earth material in Kenya. Regarding children ever born, this study found that the risk of under-five mortality increases with increasing number of children ever born in a family, which finding was consistent with other researchers in sub-Saharan Africa (Adedini et al., 2015). The finding regarding place of resident also agreed with the literature reviewed, for example, Adedini (2013) and Assi Kauame (2014) who found that children whose mothers reside in rural areas have higher risks of dying compared to their urban counterparts in Nigeria and Cote d'Ivore, respectively.

The finding of this research also found that the risk of under-five deaths varies significantly with maternal education across region of residence. The higher the level of educational attainment of

mothers the lower the risk of under-five mortality. This finding is consistent with other studies conducted in African countries which also confirmed that educational attainment of parents is inversely associated with under-five mortality (Caldwell, 1979; Mosley & Chen, 1984; Hobcraft, 1993; Antai, 2011 & Akuma, 2013). The bad cultural breakdown in the way children are nurtured, knowledge of better nutrition practices, better health seeking behaviour, increased income and other family resources that favour the child are some of the attributes causing the inverse association of education attainment and child mortality. The levels of economic and social development coupled with education attainment of mothers were among the causes of the geographical differences in infant mortality in Kenya and Nigeria (Akuma, 2013 & Antai, 2011).

Model 4 (table 4.6) showed that only 38% of the variations in under-five mortality is explained by the individual and household level characteristics which is an indication that there are some other important variables not considered for this study contributing immensely to the variations in the outcome variable. Antai (2011) in his work also argued that there are many factors responsible for risk of under-five deaths in Nigeria which he said cannot be covered in a single research. He posited that ;*"This may be associated with spatial inequality in social development in the community within regions, which may also be associated with population density, differential levels of regional development, political and religious situations, as well as varying economic resources. These factors reflect the situation in the South-South region of Nigeria, which is reported to suffer from deficient social infrastructure and services (schools, roads, electricity, and health services), high unemployment, social deprivation, and endemic conflict, in spite of the region accounting for more than 90% of Nigeria's proven gas and oil reserves and the nation's wealth. Geographically, the region is characterized by extensive mangrove forests and extensive networks of lagoons and swamps affected by environmental degradation from crude oil spillage and pollution. These conditions may be related with the increased risks of under-5 deaths for children in this region".* Page 7 paragraph 2 through to paragraph 1 of page 8.

Like in Nigeria, the observed regional inequalities in under-five mortality revealed by this study can also be associated with differences in economic development in the districts within those regions, political instability, population density, differences in resource endowment, HIV/AIDS infections and other morbidity related to deaths of children including malaria and diarrhea. The unequal socio-economic development in the country coupled with uneven distribution of basic infrastructure like health facilities, schools, road network and transportation play a big role in enhancing the child welfare (Ewbank et al., 1986 Brass & Jolly, 1993; UBOS & ICF International, 2012 & Macassa et al., 2012).

Malaria is the leading cause of under-five mortality and morbidity in Uganda with about 25% of all cases of under-five deaths recorded in the country (Kiwanuka, 2003; MOH, 2006 & WHO, 2011). Thus, it is a major contributor to the differences in under-five mortality within the different regions. Ssewanyanaa and Youngerb (2007) in their study in Uganda posited that the high Infant mortality being experienced in Southwest and Western regions were attributed to the lower level of protection against malaria coupled with two major malaria epidemics in the region over the years compared to other regions in the country. Malaria parasites, especially plasmodium falciparum have developed resistance to the most common anti-malarial drugs (chloroquine and sulphadoxine-pyrimethamine), and that this resistance according to studies

continues to rise affecting the entire country but more pronounced in Southwest, West-Nile, Western, Karamoja and Northern regions of Ugnada (Kiwanuka, 2003; MOH, 2006; Nuwaha, Babirye & Ayiga, 2011).

Women were found to be less likely to deliver in a health facility coupled with higher prevalence of child malnutrition in North and Western regions compared to other regions in Uganda. In addition, the study showed that there was low percentage of pregnant women getting Tetanus vaccination in West-Nile, Northern and Southwest regions vis-à-vis other regions (Nuwaha et al., 2011). All these are indirectly affecting child survival status and could advance some possible explanations for the inequalities in under-five mortality across the regions in Uganda.

In addition, Uganda's history has been marred by political instability and war. The period 1970 through the mid-2000s saw a chain of events leading to political instability and turmoil, ranging from the tyranny regime of Idi Amin from 1971 to 1979. The current leadership in Uganda came in power in 1986, which marked yet another onset of armed rebellion called the Lord's Resistance Army (LRA), under the leadership of General Joseph Kony which persisted up to 2006. This affected mostly northern and eastern Uganda while Allied Democratic Force (ADF) was terrorizing western region, persisting to date (UBOS & ICF International, 2012). This resulted into multiple socio-economic slowdowns, institutional decadence, and the collapse of the industrial sector. These factors culminated in weakening of the health status of the population, especially for those children under the age of five (Gideon, 1999). Throughout this period, Uganda experienced a slow and stagnated decline in under-five mortality especially in North, Eastern, West-Nile, Karamoja and Western regions. Thus, political instability and war has adeptly contributed to the high under-five rates in those regions of Uganda (Brass & Jolly, 1993; Ewbank et al., 1986; UBOS & ICF International, 2012).

HIV/AIDS have direct impact on infant and child mortality, through mother to child transmission, and an indirect cause because the family support network is destabilized when an adult is ill or dies of AIDS (Ssewanyanaa & Youngerb, 2007; UNAIDS, 2011). Uganda is seen as an example on how best to tackle the problem HIV/AIDS in Sub-Saharan Africa by reducing her prevalence rates from as high as 18% in 1993 to 6.4% in 2005. The success story in Uganda has been very disappointing currently because it has experienced a rise in prevalence rate from 6.2% in 2009 to 7.3% in 2011with 20-25% of infections are from mother-child transmission (UAC, 2011 & UAIS, 2011). The HIV/AIDS prevalence among women aged 15-49 years varies across the regions in Uganda with highest figure observed in central 1 (12.5%), followed by North (10.1%), Central 2 (9.7%), Kampala (9.5%), Western (9.1%), Southwest (9.0%), East Central (6.7%), Karamoja (5.3%), West-Nile (4.7%) and Eastern (4.4%). This suggests that the inequalities in under-five mortality observed across the region of residence can be partly explained high HIV/AIDS prevalence among women in Uganda, thus, babies get infected through mother-to-child transmission of HIV (Ssewanyanaa & Youngerb, 2007; UAIS, 2011).

5.3 Limitations of the research

Although the fitted multivariate models were able to help us in assessing the comparative importance of each of the individual and household level determinants selected for this research in explaining the risks of under-five deaths across the regions in Uganda, it cannot conclusively provide the final answer to our study for the following reasons:

1. It does not include variables such as community poverty indicators, proportion of community hospital delivery, immunization coverage in a community and proportion of mothers with secondary education or more in a community because data for these variables were not available in the dataset. These variables are adequately provided by population and housing census which data were not available for this research.
2. There were some important variables such as breastfeeding, number of antenatal visits, postnatal check up and immunization that were removed from the final analyses to minimize the biased effects in the estimated coefficients due to missing values of more than 50%.
3. The multivariate model used restricted the analysis to variables which quantitative in nature found in the 2011 Uganda Demographic and Health Survey, thus, triangulation of data were not applied to complement the quantitative data analysis.
4. The binary logistic regression applied cannot analyze time to an event because of its failure to account for censoring and time-varying covariates unlike in event history analysis models like the cox proportional hazard model and discrete-time models.

The analysis in the under-five mortality study could certainly have been taken further, for instance by developing a model using the 2014 Uganda Population and Housing Census data but the dataset has not yet been finalized and made available for academic work/research.

5.4 Recommendations

The result of this study shows that there exists a significant relationship between the risks under-five deaths and region of residence. The individual and household level determinants provided some of the explanations to the differences in under-five mortality across the regions in Uganda. In view of these findings, the following suggestions were put forward that could go a long way in providing information necessary for policy makers to design interventions that are child-based and also recommendations for further researches in Uganda.

5.4.1 Policy recommendations

Following the discussions above and findings from this study, it is clear that regional inequalities in under-five mortality is a big challenge in the execution of successful child-based programmes in the country. To address the inequalities, it is suggested that women empowerment and awareness creation among all women should be taken as a priority by policy makers. This can be done through sensitization of women about danger of closely spaced children of less than two years, teen age pregnancies and giving births at later ages, especially more than 40 years. A

deliberate effort should be made by policy makers to design curriculum to be taught in primary and secondary schools that addresses sex education and other health talks. On the other hand, government should increase access to girl child education and devise means to reduce high school dropout rates for them. This can be done through provision of wash rooms and sanitary facility in primary schools, and also by fighting some bad traditions within the society that looks at girls as brides to be married off at young ages. In addition, access to modern contraceptives should be made available and affordable by women of reproductive (15-49) to reduce the high unmet need for family planning and low contraceptive prevalence rate in the country. Attempt should be made to increase access to safe drinking water and improved household sanitation to an average resident in Uganda.

5.4.2 Suggestions for further research

It is recommended that further researches should be carried out to look at the effects of some risk factors that were not given due attention in this study. Factors such as community maternal level of education, average poverty level in the community, community hospital delivery, postnatal care for the baby after birth and distance to the nearest health facility. In addition, it is also recommended that another research be carried out using event history analysis (cox proportional regression or discrete-time analysis) which analyzes time to an event (under-five death) and caters for censoring and time-varying covariates using DHS or census data retrospectively. Finally, it is suggested that ethnicity disparities in neonatal, infant, child and under-five mortality in Uganda should also be studied for its effects of child survival.

5.5 Conclusion

This study is the first attempt conducted in Uganda to examine the effects of individual and household level factors on the risks of under-five deaths across regions in Uganda. The result of the study pointed out that there are significant inequalities in under-five mortality across regions in Uganda with Southwest region having the highest risk. Both individual and household level characteristics were found to be important in explaining in part the differences in under-five mortality across regions in Uganda. Therefore, birth interval, child's sex, maternal age, maternal education, contraceptive use, marital status, birth order, ethnicity, household floor material, children ever born and place of residence are important predictors of regional inequalities in under-five mortality in Uganda. The outcome of this study could be used to design interventions pertinent for a particular region, customized to respond to the needs and aspirations for each region.

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