FACTORS AFFECTING INFANT SURVIVAL IN HARGEISA DISTRICT, MAROODI JEEX REGION

BY

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DECLARATION

"This thesis is my original work and has not been presented for a master degree in any other University".

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DEDICATION

This thesis is dedicated to my dear wife Caroline Kananu Muthomi and my mother Margaret Kiruja.

ABSTRACT

Infant survival refers to a state of continuing to live or exist within the first year of life despite the difficult conditions, such as unhygienic conditions and infant complications. One of the significant indicators of infant survival is a country's infant mortality rate (IMR). According to UNICEF report of 2016, the global IMR is estimated at 32 per 1000 live births. In Sub-Saharan Africa the IMR is estimated at 58 per 1000 live births, whereas in Ethiopia it's estimated at 41 per 1000 live births. According to the MOH report of 2016, the IMR in Hargeisa, Somaliland, stands at 75 per 1000 live births. Among the factors that can affect infant survival include maternal factors such as high parity and short birth intervals; infant factors such as low birth weight and prematurity; and environmental factors such as untreated drinking water and poor sanitation. The general objective of this study was to investigate the factors influencing infant survival in Hargeisa District, Maroodi Jeex Region, Somaliland. The specific objectives were to determine the maternal factors influencing infant survival in Hargeisa, to determine the infant factors influencing infant survival in Hargeisa, to establish environmental factors influencing infant survival in Hargeisa, and to establish the relationship between maternal factors, infant factors, environmental factors and infant survival in Hargeisa. A comparative cross-sectional study of 210 mothers consisting of 105 cases and 105 controls was undertaken. A structured questionnaire was used. To test association between dependent and independent variables, Pearson's Chi-Square test was applied, while conditional logistic regression analysis was used to generate adjusted odds ratios of association. Findings suggest that on maternal factors, low level of education ($\chi 2=10.202$, df=3, p=0.017), low level of family income ($\chi 2=15.649$, df=3, p=0.001), short birth interval ($\chi 2=10.705$, df=5, p=0.030), high parity ($\chi 2=10.694$, df=2, p=0.005), and not attending antenatal care ($\chi 2=17.523$, df=2, p=<0.001) affected infant survival. On infant factors, only low birth weight ($\chi 2=20.500$, df=2, p=<0.001) was found to affect infant survival. Regarding environmental factors, only the source of drinking water from wells ($\chi 2=4.667$, df=1, p=0.031) affected infant survival. There was a negative significant association between not attending antenatal care visits (AOR = 3.779, 95% CI=1.133-12.609, p=0.031), birth weight below 1500gms (AOR = 1.175, 95% CI=0.338-4.084, p=0.001), and infant survival, and a positive significant association between secondary school level of education (AOR=0.390, 95% CI=0.153-0.996, p=0.049), parity of 1-3 (AOR=0.371, 95% CI=0.145-0.950, p=0.039) and infant survival. Strategies to reduce infant mortality should focus on the relevant predictors established in the models based on bivariate and conditional logistic regression analyses. The findings may help the Ministry of Health, policy makers and health related organizations to develop appropriate and cost effective programs such as health education programs targeting mothers on the importance of antenatal care visits, how to treat drinking water, and the importance of birth spacing methods to reduce high parity and short birth intervals, hence aid in improving infant survival.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

ABBREVIATIONS AND ACRONYMS

ANC: Ante-Natal Care

IMR: Infant mortality rate

MCH: Maternal Child and Health Centres

MNPD: Ministry of National Planning and Development

MOH: Ministry of Health

NN: Neonatal Mortality

PNN: Post-neonatal Mortality

SPSS: Statistical Software for Social Sciences

WHO: World Health Organization

OPERATIONAL DEFINITION OF TERMS

Child mortality: refers to the death of a child between the first and the fifth birthday.

Early neonatal death: A neonatal death occurring during the first seven completed days of life (0-6 days).

Environmental factors: These are external environment factors like the quality of water or sanitary facilities that might influence the health of the infant and lead to infants' death.

Infant factors: The infant factors are infant's characteristics which influence infant's health status and might contribute to infant's death such as low birth weight and prematurity.

Infant mortality rate: This is an estimate of the number of infant deaths for every 1,000 live births and it's often used as an indicator to measure the health and well-being of a nation.

Infant mortality: a death arising within the first year of life.

Infant outcome: the survival or death of an infant as a consequence following exposure to maternal related or infant related diseases or conditions.

Infant survival: the state of continuing to live or exist within the first year of life despite the difficult conditions.

Infant: is a child younger than 365 days of age.

Intervening variable: This is a hypothetical variable postulated to account for the way a set of independent variables control a set of dependent variables.

Late neonatal death: A neonatal death occurring after the seventh day but before the completion of the 28th day of life (7-28 days).

Live birth: Complete expulsion or extraction from its mother of a product of conception, irrespective of the duration of the pregnancy, which after such separation, breathes or shows any other evidence of life, such as beating of the heart, pulsation of the umbilical cord, or definite movement of voluntary muscles.

Maternal factors: The maternal factors are the mother's characteristics which might influence the formation of the fetus in the womb and lead to infant mortality such as maternal age, parity and birth interval.

Neonatal Mortality rate: The number of neonatal deaths during a given time period per 1000 live births during the same period.

Parity: The number of times that a woman has been pregnant and given birth to fetus with a gestational age of 24 weeks or more.

Post-neonatal mortality: a death arising after the 28th day but before completion of the first year of life.

Proximate factors: The maternal, infant, or environmental factors closest to causing infant mortality or infant survival.

Under-five mortality: the probability of dying between birth and the fifth birthday.

CHAPTER ONE: INTRODUCTION

1.1 Background Information

Although progress has been made to improve infant survival, it remains a major public health issue prioritized globally (Weldearegawi *et al.,* 2015). The most common indicator of infant survival is infant mortality rate (UNICEF, 2018). Infant mortality is any death of an infant before its first birthday, whereas infant survival is the state of continuing to live or exist past the first year of life despite difficult conditions (Bhutta, Cabral, Chan, & Keenan, 2012). Infant mortality includes both neonatal mortality which is death of an infant below 28 days of age and post-neonatal mortality which is death of an infant between 28 days and 364 days of age (Dallolio, Lenzi, & Fantini, 2013). The issue of infant survival is given prominence in Sustainable Development Goal 3 to end preventable deaths of newborns and children under 5 years of age, with a bold target to reduce neonatal mortality to at least as low as 12 per 1,000 live births and under-5 mortality to at least as low as 25 per 1,000 live births by 2030 (UN, 2016). The international community has over the years embarked on addressing the infant mortality issue by developing various health programs, but disparities remain among districts and within countries (UNICEF, 2015).

Globally, infant mortality rate (IMR) is estimated at 32 per 1000 live births while in Sub-Saharan Africa the IMR is 58 per 1000 live births (UNICEF, 2015). The current lowest infant mortality rate is in Iceland which is recorded at 1/1000 live births, whereas Finland has a low IMR estimated at 2 per 1000 live births (WHO, 2017). In the developing world for instance in Djibouti, the infant mortality rate is 54 deaths per 1000 live births (UNICEF, 2015). The IMR in Somaliland is estimated at 72 per 1000 live births which is one of the highest in the world, as compared to global rates (MOH, 2016). In addition, the IMR in Hargeisa District, Maroodi Jeex region stands

at 75/1000 live births which is the highest in comparison to other districts in Somaliland (MOH, 2016).

Maternal factors such as maternal age at first pregnancy, birth interval, and healthcare seeking behavior by attending Ante-Natal Care (ANC) visits are paramount in prevention of infant mortality (De Jonge *et al.,* 2014). Studies show that infants born to young women who are aged below 19 years at first birth and infants born to old women aged above 29 years during their first birth are more likely to die, than infants born to women aged between 19 and 28 years at first birth (Yu, Mason, Crum, Cappa, & Hotchkiss, 2016).This is because young maternal age at first birth can cause maternal-fetal nutrients competition, and lead to low birth weight and reduced chances of infant survival, whereas old maternal age at first birth can cause maternal complications and consequently pre-term birth, a factor that can contribute to infant mortality (Marshall, Raynor, & Myles, 2016). A study conducted in Bangladesh on the determinants and consequences of short birth intervals found out that short birth intervals of 18 months and below are associated with increased chances of infant mortality (De Jonge *et al.,* 2014). This is as a result of preterm births arising from maternal complications. According to a study conducted in Ethiopia, mothers who visit healthcare facilities for antenatal care are more advantaged over those who fail to attend, in that, antenatal care enables detection and timely management of risk factors and danger signs increasing chances of infant survival (Dulla, Daka, & Wakgari, 2017).

It is however notable that according to the Somaliland MOH report (2016), maternal and child health project evaluations conducted found out that morbidity among children was common among mothers with young maternal age, short birth intervals and those not utilizing Maternal and Child Health (MCH) Centres during pregnancy. However, the maternal factors that affect infant survival in Hargeisa District, Maroodi Jeex Region are not known. A commentary on promoting

research to improve maternal and infant health in West Africa, asserts that different countries and geographical areas have unique characteristics and contextual factors (Sombie *et al.,* 2017), thus maternal factors affecting infant survival in different groups and setting might vary, as is the case with Hargeisa District, Maroodi Jeex Region, Somaliland. The interventions to improve infant survival should be evidence based for them to address the problem of infant mortality (Weldearegawi *et al.,* 2015), including Hargeisa District. As such, there is need to determine the maternal factors that affect infant survival in Hargeisa District, Maroodi Jeex Region.

Birth weight, preterm birth and exclusive breastfeeding are infant factors that can affect the survival of the infant (Gebregzabiherher, Haftu, Weldemariam, & Gebrehiwet, 2017). A study conducted in Ethiopia found that low birth weight below 2500gms is a predictor of infant mortality, in that, it predisposes infants to morbidity, while infants born with a birth weight of 2500gms and above are less likely to die (Gebregzabiherher *et al.,* 2017). According to Kc *et al.* (2015), preterm births involving infants born before 37 weeks of gestation are most common in the developing countries than in the developed countries, and preterm infants are at a greater risk for mortality as compared to infants born at 37 weeks and beyond. This is because preterm infants are born premature with weaker immunity, and their organs are not fully mature for extra uterine life (Marshall *et al.*, 2016).

Exclusive breastfeeding is considered one of the fundamental interventions of reducing infant mortality, in that, weaning before six months of exclusive breastfeeding is associated with under-nutrition of the infant and reduced immunity. These complications predispose infants to recurrent bacterial infections, decreasing the likelihood of infant survival (Demelash, Motbainor, Nigatu, Gashaw, & Melese, 2015). Previous evidence has shown mothers with complications during pregnancy give birth to premature infants with low birth weight and exclusive breastfeeding

is not commonly practiced (MOH, 2016). However, no study has been conducted in Hargeisa District, Maroodi Jeex region to establish how infant factors are affecting infant survival. According to Sombie *et al.* (2017), it's vital to identify specific factors affecting infant survival, in a given area in order to use the evidence to inform program planning and reinforce the practice of reducing infant mortality.

Environmental factors like water supply and sanitation practices are factors that can influence infant survival (WHO, 2014). The source of water is considered a factor that can affect infant survival. Piped water is considered safe for domestic consumption and is less associated with the risk of infant mortality, in that, piped water is treated and free from pathogens, whereas water from unprotected sources such as wells and rivers can be contaminated and is associated with increased risk of infant mortality (Jaadla & Puur, 2016). According to a study in Nigeria, sanitation practices particularly use of flush toilet facilities are associated with lower rates of infant mortality as compared to open defecation and pit latrines, because flush toilets have improved public sewage system that reduces contamination and transmission of disease causing micro-organisms to infants (Oluwatomipe, Abimbola, & Elijah, 2014). However, these environmental factors have not been investigated to determine how they affect infant survival in Hargeisa District, Maroodi Jeex Region. According to Alemu (2017), environmental factors are key determinants of infant survival, and identification of specific factors of influence can inform the design of programs focusing on infant survival. Therefore, this is an area that merits research.

The relationship between maternal factors, infant factors and environmental factors can affect infant survival (Li, Mattes, Stanley, McMurray, & Hertzman, 2014). This is because maternal factors such as the level of education and income of the mother can operate through infant factors such as infant's place of birth and birth weight, and consequently affect infant survival.

According to studies conducted in Ethiopia, mothers with low levels of education and low income, have limited knowledge on nutritional requirements during pregnancy, they also have inadequate knowledge about the advantages of hospital delivery. In effect, they often give birth to low birth weight infants and the place of birth is at home, factors that can reduce chances of infant survival (Dube, Taha, & Asefa, 2013). A study conducted in South Sudan found mothers with low levels of education can lack knowledge about exclusive breastfeeding. The study further established that infants not breastfed exclusively are likely to have weakened immunity and once exposed to pathogens from untreated water can develop diarrhea disease which is a common infant complication associated with infant mortality (Mugo, Agho, Zwi, Damundu, & Dibley, 2018). Understanding the relationship between the factors affecting infant survival provides valuable insights on the causal pathway leading to infant mortality, and enables program planners to design integrated programs that will be effective in addressing the factors affecting infant survival (Sombie *et al.*, 2017; UNICEF, 2018). A previous study conducted in Somaliland investigated the determinants of mortality while targeting the entire population, and not infants in particular. This study investigated demographic factors, water sources for the population and sanitation practices (MOH, 2016), but did not analyze the relationship between these factors and infant survival. The relationship between maternal factors, infant factors, environmental factors and infant survival has not been established in Hargeisa District, Maroodi Jeex Region. Therefore, this is an area that merits research.

1.2 Statement of the Problem

Hargeisa District, Maroodi Jeex Region has one of the highest infant mortality rates of 75 per 1000 live births compared to the national infant mortality rate of 72 per 1,000 live births according to the Somaliland Ministry of Health records of 2015. Despite this high rate of infant

mortality in Hargeisa District, Maroodi Jeex Region, there is no study examining the maternal factors, infant factors and environmental factors affecting infant survival, and how these factors are related to each other to affect infant survival in Hargeisa District. The high infant mortality rate in Hargeisa District requires innovative strategies that will address the factors affecting infant survival. This will provide evidence for redesigning maternal and child health interventions (MOH, 2015), such as birth spacing services, antenatal care services, nutritional interventions aiming to prevent low birth weight, programs promoting exclusive breastfeeding, and programs focusing on use of safe water and hygienic practices. According to UN (2016), many infant deaths are preventable with existing interventions, but to make the best use of available resources, it's vital for health managers, planners and policy makers to establish determinants of infant survival in a given geographical setting. Therefore, there is need to establish the factors affecting infant survival in Hargeisa District, Maroodi Jeex Region.

1.3 Objectives

1.3.1 Main objective

To investigate the factors that influence infant survival in Hargeisa District, Maroodi Jeex Region, Somaliland.

1.3.2 Specific Objectives

1. To determine maternal factors that influence infant survival in Hargeisa District, Maroodi Jeex Region.

2. To determine infant factors that influence infant survival in Hargeisa District, Maroodi Jeex region.

3. To establish environmental factors that influence infant survival in Hargeisa District, Maroodi Jeex Region.

4. To establish the relationship between maternal factors, infant factors, environmental factors and infant survival in Hargeisa District, Maroodi Jeex Region.

1.4 Research Questions

1. What maternal factors influence infant survival in Hargeisa District, Maroodi Jeex Region?

2. What infant factors influence infant survival in Hargeisa District, Maroodi Jeex Region?

3. What environmental factors influence infant survival in Hargeisa District, Maroodi Jeex Region?

4. What is the relationship between maternal, infant, environmental factors and infant survival in Hargeisa District, Maroodi Jeex Region?

1.5 Justification of the Study

Infant survival remains a huge burden in many developing countries, (Weldearegawi *et al.,* 2015). The success of reducing infant mortality depends on determination of the factors affecting infant survival in a given geographical area (Ntenda, Chuang, Tiruneh, & Chuang, 2014; Sombie *et al.,* 2017), as is the case in Hargeisa District. Therefore, all efforts should be geared towards establishing the maternal factors, infant factors and environmental factors affecting infant survival in Hargeisa District. The district has an estimated population of 50,000 children under the age of one year at risk of infant mortality (MOH, 2016). The population of infants in Hargeisa District is considered the highest in comparison to other districts in the country. The IMR of 75 per 1000 live births is the high (MOH, 2015). According to UNICEF (2016), this rate is higher than the Sub-

Saharan and global rates estimated at 58/1000 live births and 32/1000 live births respectively. A major component in developing pragmatic interventions to improve infant survival is a deeper understanding of the factors affecting infant survival. The strategies put in place by the Ministry of Health and private organizations to reduce deaths among infants includes maternal and child health interventions, nutritional programs to prevent low birth weight and Water, Sanitation and Hygiene (WASH) programs. Despite the fact that these strategies have been implemented, infant mortality rate remains high.

It's also notable that there is limited data in relation to factors affecting infant survival in Hargeisa District, Somaliland. The previous literature (MOH, 2015) did not address the factors associated with the high infant mortality in Hargeisa district. The study was conducted in other Regions and concentrated on assessing the frequency of infants born prematurely with low birth weights, sources of water used in households, hygienic practices, and the practice of exclusive breastfeeding. The study conducted in Somaliland most mothers were of low socio-economic status. This current study was conducted in Hargeisa District, Maroodi Jeex region Somaliland, and used data from two groups both mothers whose infants died under the age of one year (cases) and mothers whose infants survived above the age of one year (controls), comparison was made between the two groups to establish the maternal factors, infant factors and environmental factors affecting infant survival. The relationship between the factors affecting infant survival was also investigated. Data produced from this study will be useful to researchers, policy makers and program managers in designing and implementing policies and programs to address the challenge of high infant mortality in Hargeisa District.

1.6 Scope of the Study

The study focused on factors affecting infant survival in Hargeisa District, Maroodi Jeex Region, Somaliland. The study examined maternal factors, infant factors and environmental factors affecting infant survival in Hargeisa District, Maroodi Jeex Region, Somaliland.

1.7 Conceptual Framework

This study utilized a simplified conceptual framework of Mosley and Chen to give direction on identifying factors that can affect infant survival *(*Mosley & Chen, 2003; Ntenda *et al.,* 2014), in Hargeisa District. According to this conceptual framework and literature reviewed (Shifa, Ahmed, & Yalew, 2018; Adewuyi, Zhao & Lamichhane, 2017), the proximate factors that can affect infant survival are socioeconomic factors, maternal factors, infant factors and environmental factors. The conceptual framework is shown in Figure 1.1. According to this conceptual framework, it is assumed that the factors that can affect infant survival under socioeconomic factors include the level of education and level of family income; the maternal factors that can affect infant survival include variables such as maternal age, parity, birth interval and health care seeking behavior; infant factors that can affect infant survival include variables such as birth weight and prematurity; while environmental related factors that can influence infant survival include variables such as drinking water and sanitation.

According to Ntenda *et al.* (2014), socioeconomic factors such as low maternal education level and low income level, and maternal factors like young maternal age, high parity, and short birth intervals are factors that can reduce the chances of infant survival. Ntenda *et al.* (2014) further point out that health care seeking behavior by attending antenatal care visits is associated with reduced chances of infant mortality. It is assumed that infant factors such as low birth weight and

prematurity and environmental factors such as poor sanitation and untreated water are also factors associated with reduced chances of infant survival.

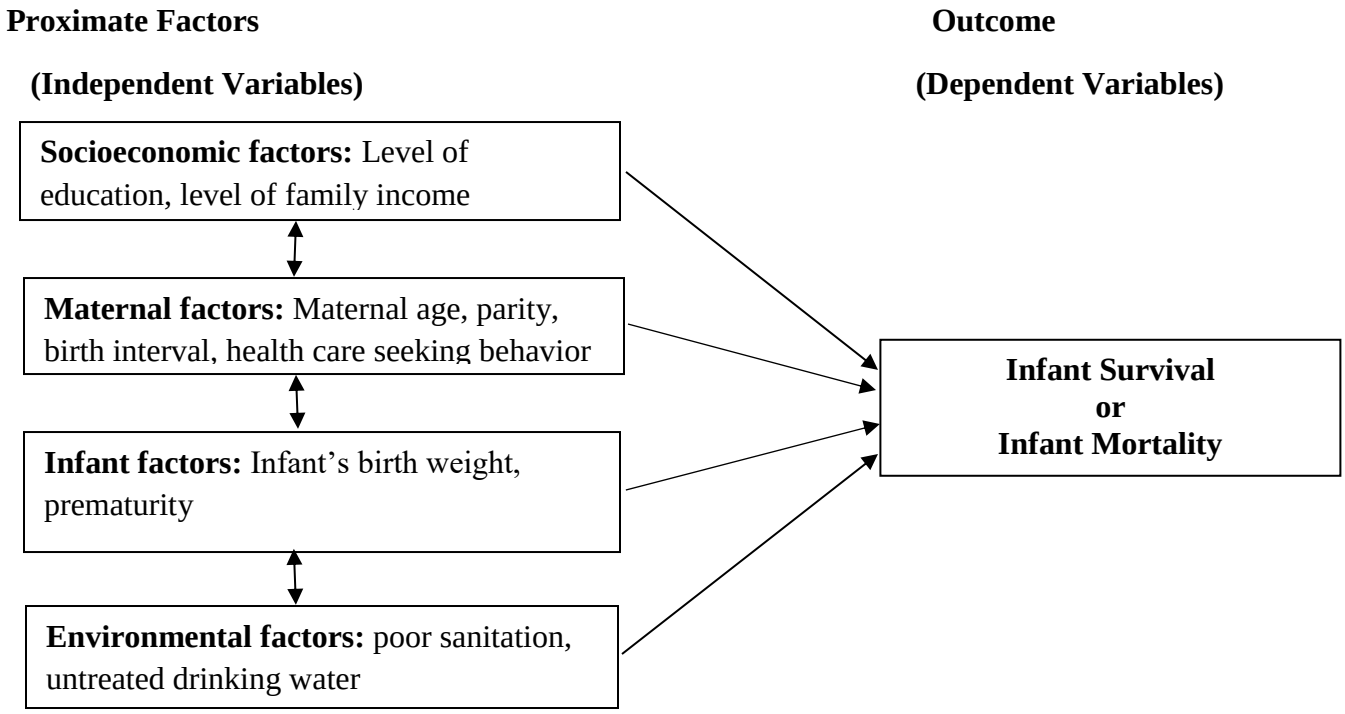

Figure 1.1 Conceptual Framework of Determinants of Infant Survival by Ntenda *et al* (2014) Adapted from Mosley and Chen (2003)

1.8 Operational Framework

Based on literature review, the factors that can affect infant survival have been identified and operationalized (Fall *et al.,* 2015; MOH, 2016; Shifa *et al.,* 2018). Literature reviewed showed that socioeconomic factors specifically level of education and level of family income can fall under the category of maternal factors (Shifa *et al.,* 2018). For this reason, socioeconomic factors were merged with maternal factors. The independent variables selected to be included in the operational framework for this study, are based on the important factors identified as gaps in knowledge from literature reviewed. As such, the study only focused on maternal factors, infant factors, environmental factors and the relationship between these factors that affect infant survival. In this study, it is hypothesized that maternal factors namely: maternal age, maternal level of education, level of income, birth interval, parity, and healthcare seeking behavior affects infant survival in Hargeisa District. It is also hypothesized that infant factors (infant's age, place of birth, birth weight, prematurity, and exclusive breastfeeding) and environmental factors (safe drinking water and sanitation) affect infant survival in Hargeisa District. It is assumed that there is a relationship between maternal factors, infant factors, environmental factors and infant survival in Hargeisa District. This operational framework forms the basis of investigating the factors affecting infant survival in Hargeisa District. The intervening variables assumed to have influence on infant survival were lack of access to health care facilities and poor infant care practices. The operational framework is shown in Figure 1.2.

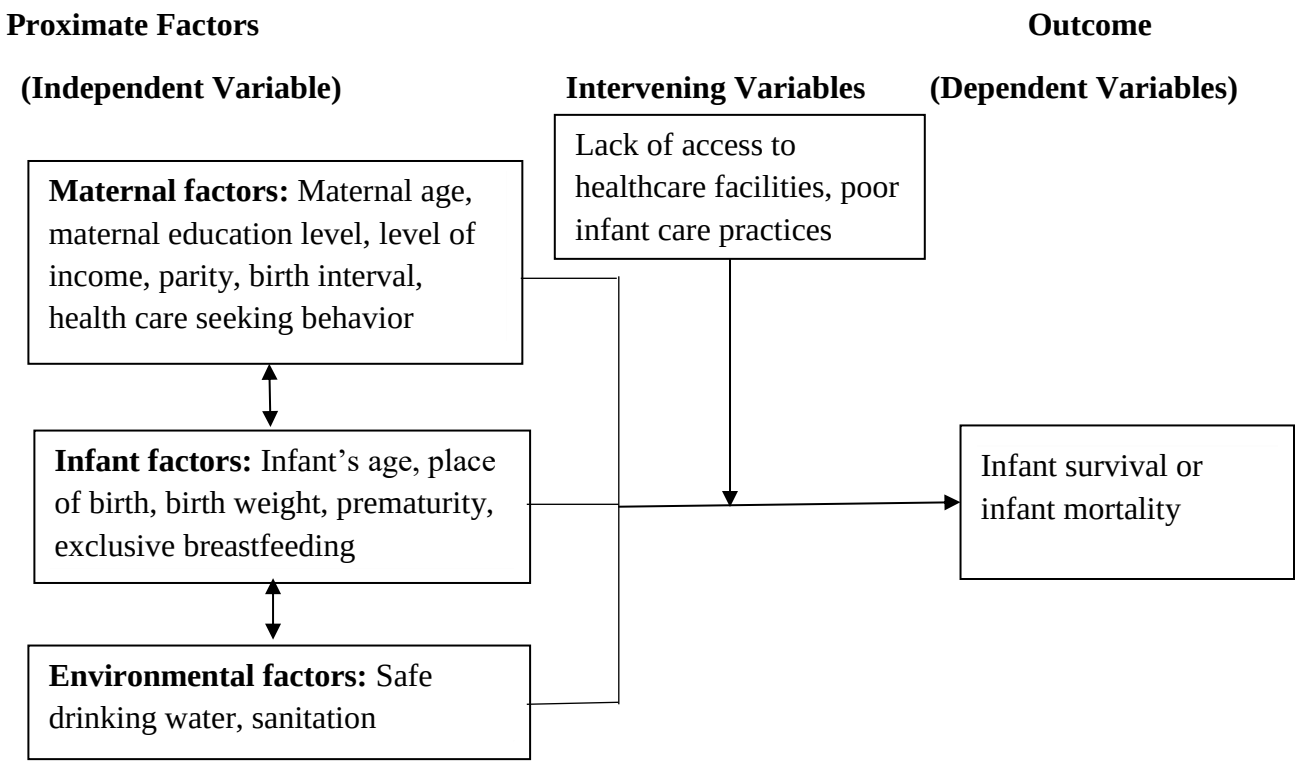

Figure 1.2 Operational Framework showing Determinants of Infant Survival by Ntenda *et al* (2014) adapted from Mosley and Chen (2003)

CHAPTER TWO: LITERATURE REVIEW

2.1 Introduction

Despite the fact that substantial progress has been made globally to improve infant survival, infant survival remains a major public health challenge especially in low income countries (Deribew *et al.,* 2016). Worldwide, more than 5 million infants die annually under the age of one year, with 90% of these deaths (4.5 million) occurring in developing countries (UNICEF, 2016), Somaliland being one of them. In regard to the progress made, infant mortality rates have decreased globally from an estimated rate of 63 deaths per 1,000 live births in 1990 to 32 per 1000 live births in 2015(WHO, 2015). A substantial decline has also been observed in Sub-Saharan Africa with a decline from approximately 108/1000 live births in 1990 to 58/1000 live births (UNICEF, 2015). The substantial difference in mortality rate between the developed and developing countries is linked to factors such as maternal level of education, income status level, parity, birth interval, birth weight, exclusive breastfeeding and environmental conditions (Saaka & Iddrisu, 2014; Shifa *et al.,* 2018; Weldearegawi *et al.,* 2015).

In Somaliland, the national infant mortality rate is estimated at 72 per 1000 live births (MOH, 2015). This rate is high in comparison to other countries in the region, such as Kenya with IMR of 37 deaths per 1000 live births, Ethiopia with IMR of 41 deaths per 1000 live births and Djibouti with IMR of 54 deaths per 1000 live births (UNICEF, 2015). In Hargeisa District, Maroodi Jeex Region, the IMR stands at 75 per 1000 live births (MOH, 2015). According to (Dube *et al.,* 2013), maternal factors, infant factors and environmental factors can play a significant role in determining infant survival. Maternal factors, for instance maternal age, level of education, level of income, parity, birth interval and healthcare seeking behavior can have a direct impact on the outcome of the pregnancy and infant survival (Yu *et al.,* 2016). Dube *et al.* (2013), assert that

infant factors such infant's age, place of birth, birth weight, prematurity, and exclusive breastfeeding can determine infant survival. Environmental factors such as the quality of water and sanitation can also affect the health status of infants (Elder, Goddeeris, Haider, & Paneth, 2014).

A previous study conducted in Somaliland (MOH, 2016), found that mothers whose infants died had a history of young age, short preceding birth intervals and were not visiting the maternal and child health centers for antenatal care. Infants born had low birth weight and most of them were premature. A previous study conducted in Somaliland showed that untreated water and poor sanitation practices were common causes of morbidity. Despite this knowledge, it is unclear whether these factors affect infant survival in Hargeisa District. According to (Sombie *et al.,* 2017), different geographical areas including districts might differ in terms of the determinants of infant survival. As such, this study investigated factors affecting infant survival in Hargeisa District, Maroodi Jeex Region.

2.2 Maternal Factors

Infant survival is affected by various factors in both developed and developing regions. Some studies have tried to establish the maternal factors associated with reduced chances of infant survival (Adebowale, 2017; Ntenda *et al.,* 2014). According to Yu *et al.* (2016), maternal factors include maternal age, maternal education level, level of income, parity, birth interval, and healthcare seeking behavior. Studies have shown that maternal age can be a predictor of infant mortality, in that, mothers aged below 20 years and mothers aged above 34 years at first pregnancy are at a greater risk of infant mortality than mothers aged between 20 years and 34 years. The higher risk of mortality among infants born to younger mothers can be due to physical immaturity, maternal-fetal competition for nutrients, lack of knowledge and skills on child care and poor access

to health care services, while for older mothers could be as a consequence of a decline in reproductive system efficiency with age and maternal morbidities such as hypertension and gestational diabetes (Fall *et al.*, 2015; Marshall *et al.*, 2016; Ntenda *et al.*, 2014; Yu *et al.*, 2016). However, according to another study done by Caselli *et al.* (2014), it was found that maternal age of Sardinian women living in Italy does not affect infant mortality, possibly because protecting their own health during childbearing and providing good infant care protected the health of their infants, hence reducing the risk of infant mortality. However, no study has been done in Hargeisa to determine whether maternal age affects infant survival. (Sombie *et al.*, 2017), asserts that factors affecting infant survival can differ among groups in a given region, as is the case in Hargeisa District.

A study conducted in Bangladesh by Huda, Tahsina, El Arifeen, and Dibley (2016), found that maternal education can affect infant survival. The study, found that mothers with higher levels of education at tertiary level had lower risks of infant mortality, while mothers with lower levels of education at primary level and those with no education at all had increased risks of infant mortality. The study found that the low infant mortality among literate mothers is because mothers with higher levels of education are more conscious about their general health state and that of their infants, through recommended feeding and care practices and better healthcare seeking behavior. According to Damghanian, Shariati, Mirzaiinajmabadi, Yunesian, and Emamian (2014), tertiary and secondary levels of maternal education are associated with use of family planning methods for birth spacing and utilization of prenatal care than primary level of maternal education. These are factors associated with lower risks of infant mortality. However, in another study conducted by (Omedi & Gichuhi, 2014), maternal education was found not to be a predictor of infant survival, possibly due to successful government policies focusing on provision of primary education and

safe water and sanitation, making the effect of maternal education insignificant. A study conducted in Borama District, Somaliland, found that the illiteracy levels for women is high, and this might contribute towards reduced health care seeking behavior and high child mortality rates (MOH, 2015), however, no study has been conducted in Hargeisa District to determine whether maternal education affects infant survival.

According to a study conducted in Malawi by Ntenda *et al.* (2014), the family level of income can influence infant survival. The study found that high income families had lower rates of infant mortality in comparison to middle and low income families, because, richer families and middle income families can afford to pay for healthcare services for their infants, as well as provide sufficient food to prevent infant malnutrition, risk of infections and infant mortality (Marshall *et al.,* 2016). However, according to another study conducted in Nigeria by (Edeme, Ifelunini, & Obinna, 2015), on the relationship between household income and child mortality, the study found that household income has no significant effect on infant mortality despite the variation in income levels among the Nigeria population. This is possibly because both low income families, middle income families and high income families could access healthcare services for their infants. A situational analysis study conducted in Somaliland found that most families come from low income families (MOH, 2015), however, no study has been conducted to determine whether family income levels affects infant survival in Hargeisa District, Somaliland. According to (UNICEF, 2016), determining the influence of socioeconomic factors such as income levels on infant survival, aids in designing interventions that are affordable, programs that will increase utilization of healthcare services and improve infant survival.

According to a study conducted in Norway among women of reproductive age, it was found that short and very long inter birth interval can affect infant survival (Barclay, Keenan, Grundy,

Kolk, & Myrskylä, 2016). Studies have proposed that women with short birth intervals may not have adequate time to recuperate physiologically from the previous birth, or if a mother has children closely spaced together, she might have limited resources in terms of food, money, time and ability to provide for each child, in effect, affecting infant survival (De Jonge *et al.,* 2014; Habimana-Kabano, Broekhuis, & Hooimeijer, 2016). Birth intervals longer than 59 months, are associated with a decline in woman's reproductive ability and can increase the risk of infant mortality (Kozuki & Walker, 2013). A study conducted in Ethiopia on the effect of short birth interval on infant mortality found that promoting the length of birth interval to at least 24 months lowered the risk of infant mortality by 50%, while a birth interval of less than 18 months was associated with increased risk of infant mortality (Dadi, 2015). However, no study has been conducted in Hargeisa District, to determine whether birth interval affects infant survival.

Parity is a maternal factor that can increase the risk of infant mortality. According to (Kozuki & Walker, 2013), nulliparity is associated with risks such as obstructed labor during childbirth which can reduce the chances of infant survival, whereas high parity is linked to increased risk of premature births, intrauterine growth restriction and infant mortality from hypertension, placenta previa and uterine rupture. According to a study conducted in Malawi, infants born to mothers who have four or more children have a higher risk of dying before 12 months than infants born to mothers who have two or three children, possibly because of maternal age, multiple births and family socioeconomic status (Ntenda *et al.,* 2014). The birth size also reflects on the quality of health care given to the mother, maternal nutritional status and health status during pregnancy (Singh & Maheshwari, 2014). A study conducted in Mogadishu, Somali, showed that majority of the Somali women give birth to approximately 7 children (Gure, Dahir,

Yusuf, & Foster, 2016), however, no study has been conducted in Hargeisa District to determine whether parity affects infant survival.

Healthcare seeking behavior in particular utilizing antenatal care services is a worldwide recommended strategy to improve infant survival (Dulla *et al.*, 2017). It is recommended that pregnant women should visit the healthcare facilities at least four times during their pregnancy to enable health care workers to assess them, identify risks and treat conditions that can affect infant survival (Arunda, Emmelin, & Asamoah, 2017). According to a study conducted in Zimbabwe by Makate and Makate (2017), the study established that antenatal care is associated with reduced infant mortality, possibly due to improved maternal nutritional status, that reduced the odds of mothers from giving birth to low birth weight babies, a factor that can contribute to reduced odds of infant survival. Another study found that healthcare seeking behavior involving utilization of antenatal care services promotes infant care practices and infant vaccination, consequently leading to improved chances of infant survival (Doku & Neupane, 2017). However, no study has been conducted in Hargeisa District to determine whether healthcare seeking behavior affects infant survival.

2.3 Infant Factors

Several studies have tried to establish the infant factors that can affect infant survival. Among the infant factors that can affect infant survival are infant's age, place of birth, birth weight, preterm birth and exclusive breastfeeding (De Jonge *et al.*, 2014; Ntenda *et al.*, 2014). According to Andreev and Kingkade (2015), infants age is associated with infant mortality, in that, the lower the level of infant mortality in a given region, the more heavily will infant deaths be concentrated at the earliest stages of infancy, possibly due to the influence of antenatal and perinatal environment relative to the postnatal environment. An infant is a child considered to be under the

age of one year, a neonate is a child under 28 days of age, while post neonatal is a child above the age of 28 days to 365 days (Shin *et al.,* 2016). According to UNICEF (2018), the neonatal period can be the most vulnerable time for a child, and the highest risk of dying can be during their first month of life as a result of premature births, complications during labor and delivery and infections such as sepsis, meningitis and pneumonia, while the reasons behind post neonatal mortality include malnutrition, and diarrheal diseases as a result of poor sanitation and hygiene. According to Ezeh, Agho, Dibley, Hall, and Page (2014), determining the period when majority of the infants are dying can inform program managers when to design child health interventions that will address the main causes of infant mortality. In Hargeisa District, few studies have been conducted to determine the relative contribution of infant's age to infant survival. As such, it's an area that merits research.

According to a study conducted in Bangladesh, the place of birth can affect infant survival, in that, infants born at home can have reduced odds of infant survival in comparison to infants born at healthcare facilities (Fatima-Tuz-Zahura, Mohammad, & Bari, 2016). This is because infants born at home are not attended by skilled birth attendants, who have the knowledge and skills of safely managing the delivery and newborn complications. According to Elder *et al.* (2014), infants born at healthcare facilities are managed by skilled birth attendants, who are equipment with appropriate equipment, supplies and drugs which can be used to manage newborn complications and increase infant survival rate. A study conducted in Somaliland, found that many deliveries are conducted at home by traditional birth attendants, who are not skilled in managing possible newborn complications (MOH, 2016). In Hargeisa District, Somaliland, no study has been conducted to determine whether the place of birth affects infant survival. As such, there is a need

to determine whether home or healthcare facilities births are associated with the high infant mortality in the district.

According to Gaiva, Fujimori, and Sato (2016), birth weight is considered an indicator that can influence infant health and survival, possibly because the risk of death among infants of low birth weight with less than 1500gms is 30 times higher when compared with infants of normal birth weight at 2500gms or more. Low birth weight is categorized into three groups namely: low birth weight which is classified as a birth weight of less than 2,500gms, very low birth weight which is classified as a birth weight of less 1,500gms and extremely low birth weight which is classified as a birth weight of less than 1,000gms (Lowe, Kotecha, Watkins, & Kotecha, 2018). Infants born with low birth weight are more predisposed to infections due to low immunity than infants with normal birth weight (Marshall *et al.,* 2016). Another study conducted by Ding *et al.* (2013), found that low birth weight contributes to approximately 70% of the IMR in the less developed countries, and the contributing factors to low birth weight include maternal complications during pregnancy, early birth, pregnancy at an early age, high parity, short birth spacing, nutritional deficiencies, and inadequate prenatal care. However, no study has been conducted in Hargeisa District to determine whether birth weight can affect infant survival.

According to Cupen, Barran, Singh, & Dialsingh (2017), preterm birth is a significant factor in mortality among infants, in that, infants born before 37 weeks of gestation are at a greater risk for mortality as compared to infants born at 37 weeks and beyond. Cupen *et al.* (2017), further states that preterm birth can be classified based on gestational age as extremely preterm (less than 28 weeks), very preterm (between 28 and 32 weeks), moderate preterm (between 32 and 34 weeks, and late preterm (34 to less than 37 weeks). According to a study conducted in Nepal on the level of mortality risk for babies born preterm in a tertiary hospital, the study found that there was an

increased risk of infant mortality among infants born below 37 weeks of gestation compared to infants born at 37 weeks gestation and above (Kc *et al.,* 2015). The risk of death among the late preterm and early term is attributed to prematurity of vital organ systems such as the respiratory system which is vital for extra uterine life (Marshall *et al.,* 2016). In Hargeisa District, no study has been conducted to determine whether preterm birth affects infant survival. As such, this is an area that merits research.

According to Sankar *et al*. (2015), it is recommended that breastfeeding should be initiated early, infants should be breastfed exclusively during their first 6 months of life which is feeding the infant with only breast milk, and continued breastfeeding should be encouraged until 2 years of age. Exclusive breastfeeding reduces the risk of diarrheal diseases, pneumonia and other infectious diseases and helps for a quicker recovery (Debes, Kohli, Walker, Edmond, & Mullany, 2013). This is because breast milk contains immunoglobulins that help fight off bacteria and viruses. As such, weaning before six months predisposes the infant to diseases and increases the risk of infant deaths (Chandhiok, Singh, Sahu, Singh, & Pandey, 2015). A study conducted in Ethiopia on trends and determinants of childhood mortality, found that infants not exclusively breastfed had higher mortality than infants who were exclusively breastfed, in that, exclusive breastfeeding provides immunity against infections and enables sick infants to recover quickly (Mehretie, Feleke, Mengesha, & Workie, 2017). According to a study conducted by UNICEF in Somaliland on infant and young child feeding, the study found that approximately 56% of mothers' breastfeed exclusively (UNICEF, FSNAU, & MOH, 2017). However, this study did not investigate whether exclusive breastfeeding is linked to infant mortality. In Hargeisa District, no study has been conducted to establish whether exclusive breastfeeding affects infant survival. Therefore, there is need to determine if exclusive breastfeeding affects infant survival in Hargeisa District.

2.4 Environmental Factors

According to Ezeh *et al.* (2014), unsafe water supply and unsafe sanitation are environmental factors that can affect infant survival. According to UNICEF (2015), water collected from unprotected sources such as wells and rivers are contaminated and if not treated are linked to infant mortality. A study conducted in Ethiopia by Deribew *et al.* (2016), found that infant deaths due to diarrheal diseases were attributed to unsafe water supply from unprotected sources. Another study conducted in Nigeria by Oluwatomipe *et al.* (2014), found that piped water supplied by water tankers had lower incidences of diarrhea, other water borne diseases and infant mortality than water collected from unclean wells and boreholes. According to WHO (2015), among the leading causes of infant mortality are diarrheal diseases from contaminated water, as such, interventions aiming to improve infant survival should not neglect basic environmental conditions such as ensuring households have access to clean water (UNICEF, 2018). In Hargeisa District, no study has been conducted to determine whether water supply affects infant survival. This is an area that merits research.

According to Alemu (2017) , more than 2.6 billion people worldwide lack basic sanitation facilities, and this results in four billion cases of diarrhea each year causing 28% of infant deaths. A study conducted in Nigeria on combating infant mortality, found that sanitation plays a role in influencing infant mortality, in that, use of flush toilet facilities is linked to improved infant survival than use of pit latrines and open defection (Oluwatomipe *et al.*, 2014). This is because flush toilets sewage systems are designed to reduce contamination and transmission of disease causing micro-organisms (Fagbeminiyi & Faniyi, 2015), in that, hand washing facilities provided and their use by infants parents reduces the risk of transmitting pathogens to their infants during feeding (Dube *et al.*, 2013; UNICEF, 2015). Although many households lack basic sanitation

facilities especially in the rural areas (MOH, 2016), no study has been conducted in Hargeisa District to determine whether sanitation affects infant survival. According to Jaadla and Puur (2016), determining the impact of sanitation on infant mortality is vital in designing community based interventions needed to prevent infant deaths.

2.5 Relationship between Maternal Factors, Infant Factors, Environmental Factors and Infant Survival

According to Li *et al.* (2014) , the relationship between maternal factors, infant factors and environmental factors can affect infant survival, however, the pathway of influence through which these factors operate is a complex one. Several factors ranging from maternal factors, infant factors to environmental factors have brought huge differentials in the mortality risks among infants (Shifa *et al.,* 2018). According to Adebowale (2017) and Ntenda *et al.* (2014), there can be a correlation between maternal factors, infant factors and infant survival, in that, old maternal age at first pregnancy is a risk factor for preterm births due to increased risks of hypertension and placenta previa. Preterm births can result to reduced odds of infant survival (Cupen *et al.,* 2017). Infants born from mothers with low levels of education are at a higher risk of death than infants whose mothers have higher levels of education (Huda *et al.,* 2016). This is because low maternal level of education tends to be an impediment towards optimal health seeking behavior, and sanitary practices which influence infant survival. For instance, mothers with low levels of education, may lack the knowledge to observe hygienic sanitation practices such as use of toilet facilities and hand washing, this might affect infant survival (Oluwatomipe *et al.,* 2014). However, Mekonnen, Tensou, Telake, Degefie, and Bekele (2013), found out there is no relationship between infant survival and maternal factors, infant factors, and environmental factors. According to (Damghanian *et al.,* 2014), a maternal factor such as healthcare seeking behavior can influence the

birth weight of infants, and consequently affect infant survival, in that, antenatal care visits promotes health care seeking behavior by adopting nutritional advise and counselling given during the antenatal care visits, hence preventing low birth weight; an infant complication that can increase the odds of infant mortality.

Saaka and Iddrisu (2014), asserts that infant survival can be affected through the relationship between a maternal factor such as mothers' level of knowledge, infant factor such as exclusive breast feeding, and environmental factor such as use of unsafe water. This is because mothers with low levels of education can lack the knowledge to exclusively breastfeed their infants, which affects the infant's immunity and can easily be predisposed to diarrheal diseases from use of untreated water, which is common among mothers with low levels of education and low income. As such, these factors interact to contribute towards increased risks of infant mortality (Dube *et al.*, 2013).

A study conducted in Somaliland that described health and illness among the general population (MOH, 2016), and not specifically infants found that demographic factors, water sources for the population and sanitation practices influenced mortality rates. However, this study did not analyze the relationship between these factors that can influence infant mortality. The relationship between maternal factors, infant factors, environmental factors and infant survival in Hargeisa District is unknown. There is need to determine the relationship between the factors that affect infant survival in Hargeisa District. A deeper understanding of the relationship between the factors affecting infant survival will enable program planners to contextualize interventions (Defor, Kwamie, & Agyepong, 2017), that will be implemented to reduce infant mortality in Hargeisa District.

2.6 Summary of Knowledge Gaps

According to Sombie *et al.* (2017), different geographical areas have unique contextual characteristics such as socio-economic conditions (Ntenda *et al.*, 2014), that can cause factors that affect infant survival to vary from one region to another. A previous study found that young maternal age, short birth intervals, low utilization of maternal and child health centres for antenatal care were common characteristics among mothers whose infants died, and most of the Somali women come from low income families with low levels of education (MOH, 2016). A study conducted in Mogadishu found that Somali women have high parity, and that the high parity might be a contributing factor to infant mortality (Gure *et al.,* 2016). However, no study has been conducted in Hargeisa District, Maroodi Jeex Region, Somaliland to determine the maternal factors that affect infant survival. It is not known whether maternal age at first pregnancy, maternal level of education, level of income, parity, birth interval or healthcare seeking behavior affects infant survival in Hargeisa District. This is an area that merits research.

A study conducted in Somaliland found that 56% of women breastfeed exclusively (UNICEF *et al.*, 2017) other studies conducted found that majority of the infants are born at home with unskilled birth attendant and this might contribute to increased risk of infant mortality, in addition, the study found out that most of the infants who die are of low birth weight and premature (MOH, 2016). However, no study has been conducted in Hargeisa District to determine the infant factors affecting infant survival. There is no study showing whether infant's age, place of birth, birth weight, prematurity and not exclusively breastfeeding affects infant survival in Hargeisa District. There is need to investigate these factors.

According to the Ministry of Health, Somaliland (MOH, 2015), environmental factors have been suggested to contribute to high infant and child mortality rates. However, the specific factors

associated with poor infant survival in Hargeisa District have not been investigated. As such, there is need to establish whether unsafe water supply and sanitation affect infant survival in Hargeisa District. According to (Jaadla & Puur, 2016), environmental factors are considered vital determinants of infant mortality during the post-neonatal period. Determining the environmental factors affecting infant survival in Hargeisa District, will enable program managers to involve different stakeholders involved with water and sanitation such as the Ministry of Water and the Ministry of Environment, in order to come up with effective interventions that will address the problem of infant mortality.

A study conducted in Somaliland targeting people from the entire population and not specifically infants, identified demographic factors and environmental factors such as water sources and sanitation as factors that can influence morbidity and mortality. However, this study did not investigate the relationship between these factors that influence infant survival. Understanding the relationship between the factors that affect infant survival is critical towards developing integrated interventions that will address maternal factors, infant factors and environmental factors with a multi-sectoral approach (Li *et al.,* 2014) . However, in Hargeisa District the relationship between maternal factors, infant factors, and environmental factors and infant survival is not known. This is an area that merits research.

2.7 Matching of Cases and Controls

Matching of cases and controls is done as recommended by Woodward (2014), in order to adjust for confounding during the analysis stage. As such, one case is matched with a single control, so that the control can have identical values of the confounding variables. This is done to ensure cases and controls are identically balanced, so that any significant statistical difference between them cannot be due to the confounders. Woodward (2014) further points out that common

matching variables are age and place of residence. According to previous studies conducted on factors affecting infant survival (Chaman, Zolfaghari, Sohrabi, Gholami, & Khosravi, 2014; Dube et al., 2013; Sharifzadeh, Kokab, & Hassan, 2008), the studies involved matching of cases and controls in respect to age and residence. This current study sought to investigate the factors affecting infant survival in Hargeisa District.

CHAPTER THREE: RESEARCH METHODOLOGY

3.1 Study Site

This study was carried out in Hargeisa, which is the largest administrative District in Maroodi Jeex Region, and it is the capital city of the Republic of Somaliland. Hargeisa is a commercial hub for retail services, construction, trading among other activities. It is located on a latitude of 9.55 and longitude of 44.0667, near the town of Gabiley which is considered an agricultural centre in Somaliland (MNPD, 2016). Hargeisa District is divided into five sub-districts namely: Koodbuur, Mohamed Habey, Ahmed Dhagax, 26th June and Gaali Baax. Hargeisa has an estimated population of 1.5 million people, with approximately 50,000 as infants (MOH, 2016). Hargeisa has both public and private institutions offering health services to the residents. Appendix IV shows a map of the study site (Hargeisa District) and Appendix V shows a map of the location of Hargeisa District in Somaliland.

3.2 Study Population

The study population was mothers whose infants died under the age of one year or survived up to one year of age in Hargeisa District. The study population consisted 875 mothers in Hargeisa District during the period of September 2014 to December 2015.

3.2.1 Inclusion Criteria

(i) Mothers who resided in Hargeisa District, Somaliland

(ii) Mothers who delivered their babies at home or in a health facility

(iii) Cases comprised mothers whose baby died under one year of age from September 2014 to December 2015.

(iv) Controls comprised mothers whose baby survived up to one year of age and had the closest date of delivery (within two days) and same residence (sub-district) to a case.

3.2.2 Exclusion Criteria

The study excluded mothers who had multiple pregnancies and could not be matched in either the case group or control group in respect to infant's date of birth and residence.

3.3 Study Design

The study design was a comparative cross-sectional study to investigate factors affecting infant survival in Hargeisa District, Maroodi Jeex Region.

3.4 Sample Size Determination and Sampling Procedures

3.4.1 Sample Size Determination

The sample size was calculated using the sample size formula for two comparison groups, as recommended by Fleiss (1981).

$$ni = \{p1(1-p1)+p2\ (1-p2)\}(Z/E)2$$

Where;

ni= sample size required in each group (cases and controls)

p1= proportion of mothers whose infants died under the age of one year (cases). p1 is 7.5%.

p2= proportion of mothers in the control group. In this case, p2 is undocumented, hence, p2 is used as 50% to achieve the maximum sample size

Z= The number relating to the degree of confidence desired in the results which is 95% confidence interval falling in 1.96 normal distribution curve.

E = desired margin of error in this case 5%

Therefore, ni = {0.075(1-0.075) + 0.5(1-0.5)} (1.96/0.05)2

= {0.319}(1536.64)

ni= 490

However, since the population of cases was below 10,000 as recommended by Fisher et al (1983) in Mugenda and Mugenda (2003) the adjusted sample size (nf) will be;

nf=Nn/N+n where;

nf= desired sample size when the population is less than 10,000

N= desired sample size when population is more than 10,000, in this case the sample size is 490

n=estimate of the population size, cases recorded were 125.

$$= \frac{490 \times 125}{490+125}$$

nf = 99.5 (100)

Therefore, the sample size required for each group was 105 with 5% (Dube *et al.,* 2013) of 100 added to cater for a possible non-response rate. As such, the required total sample for both groups at a ratio of 1:1 was 210.

3.4.2 Sampling Procedures

From a target population of 875 mothers, 210 study participants were recruited. A sampling frame for the cases group consisting of 125 mothers was developed by coding each case, and the recommended sample size of 105 for the cases group was generated by randomly drawing the

sample using SPSS version 22. A sampling frame for the control group consisting of 256 mothers with infants who were alive and above one year was developed by coding each control. The recommended sample of 105 mothers for the controls' group was then selected by matching each case with a control with the closest date of birth (within two days), and from the same Sub-district (Ahmed Dhagax, Gacanlibaax, Koodbuur, Mohamed Haibey or 26th June), using SPSS version 22. The sampling procedures for cases and controls is shown in Figure 3.1. Matching was done to ensure that the controls arose from the same population as cases with an equal chance of experiencing similar exposure factors such as biological and environmental factors.

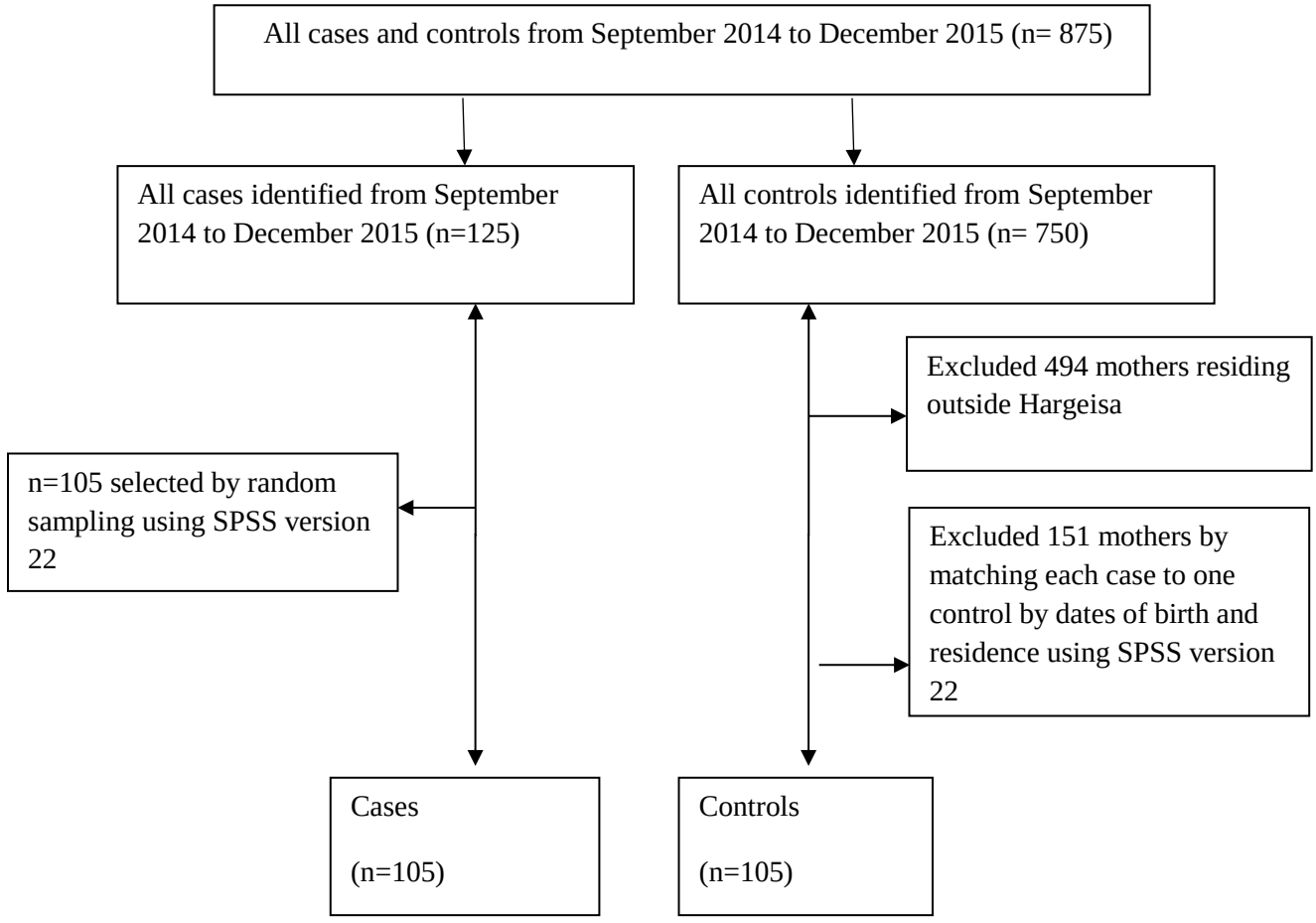

Figure 3.1 Flowchart Showing the Sampling Procedures

3.5 Research Instrument

Structured questionnaire was used to collect the data. The questionnaire had both open and closed ended type of questions. The questionnaire was divided into five sections; Section I: Socio-demographic factors, Section II: Maternal factors, Section III: Infant factors, and Section IV: Environmental related factors.

3.6 Data Collection Procedures

Data was collected by four bilingual research assistants over a period of one month (December, 2015) during community outreach programs. The principal researcher trained the research assistants on use of the research instrument, seeking informed consent from study participants, administration of structured questionnaires and collection of complete and reliable data. The principal researcher ensured research assistants were well versed with all instructions and questions in questionnaires to reduce errors during data collection. The researcher explained to the mothers about the study topic, objectives and significance of the study and that filling the questionnaire will take approximately 20 minutes. Mothers who are 18 years and above signed the informed consent form agreeing to participate in the study. This was after explaining all the details about the study topic, purpose, benefits of the study, their right to withdraw at any point, and confidentiality of their identity. Thereafter, the questionnaires were administered to get information about the study variables in the questionnaires.

Questions consisted of multiple choice, closed ended questions and open ended questions. The data was collected on the basis of information from the mothers whose babies died under the age of one year and mothers whose babies survived up to the age of one year. The principal researcher and research assistants were available to assist the mothers in filling the questionnaires

as necessary. Once the questionnaires were filled the principal researcher checked the questionnaires for correctness and completeness.

3.7 Pre-testing Instrument

Pre-testing of the instrument was conducted to ensure reliability and validity of the questionnaire and check for clarity, applicability and the length of time it would take to administer the questionnaire. The structured questionnaire was pre-tested by administering to 5 % of the study population (Dube *et al.,* 2013). As such, the exercise included 5 cases and 10 controls from the study population. The exercise identified the need to recruit four bilingual research assistants as interpreters who explained some of the questions in Somali since some study participants could not fully understand English. Pretesting also helped to eliminate ambiguous questions. The approximate time determined for administering the questionnaire was 20 minutes.

The researcher ensured data validity and reliability by pre-testing the questionnaire. Validity of a research instrument is a determination of the extent to which the instrument actually reflects the abstract constructs being examined. This is the truthfulness or correctness of the measurement as planned or intended (Scholtes, Terwee, & Poolman, 2011). Measuring of content validity was done using Lawshe's formula known as Content Validity Ratio (CVR). The content validity technique entails confirmation by subject matter expert raters (SMEs), indicating that the research instruments and the entire tool have content validity. CVR yields values ranging from +1 to -1; positive values indicate that at least half of the SMEs rated the item as essential (Lawshe, 1975). The formula is computed as follows:

CVR= (ne-N/2)/N/2

Where: CVR=Content Validity Ratio

ne =number of SME panelists indicating essential

N= total number of SME panelists

Substituted as in:

CVR= (9-10/2)/10/2

= 0.80

Therefore, the questionnaire passed the overall test content validity.

According to Scholtes *et al.* (2011), reliability is concerned with how consistent an instrument measures the concept of interest. A reliable instrument enhances the power of the study to show the differences and relationship in the population under study. The characteristics of reliability include dependability, consistency, accuracy and comparability. Reliability is expressed as a coefficient: 0.0 not reliable, 1.00 perfect reliability, 0.80 and above acceptable and indicating high reliability. The research instrument was tested for reliability using internal consistency (Cronbach's alpha) technique which requires only a single administration of test (Gliem & Gliem, 2003). The technique is computed as follows:

Alpha = Nr / (1 – r (N - 1))

Where:

r = mean inter-item correlation

N = number of items in the scale

Cronbach's alpha test was calculated using the reliability command in SPSS version 22 to generate inter-item correlation matrix, then summed up and estimated the average. The test showed the coefficient was 0.89 implying there was a high degree of reliability.

3.8 Data Analysis

Data was entered into databases designed in Statistical Package for Social Sciences Software (SPSS). The data was cleaned and checked for completeness. Coding was done at the data entry stage with all the variables that were categorical and ensured that labels were attached to each code. All variables in socio-demographic factors were analyzed using descriptive statistics to show the frequency distribution of the study participants. Bivariate analysis using Pearson's chi square was undertaken to determine the relationship between independent variables and dependent variables. Pearson chi square was used to determine the relationship between infant survival and categorical variables for maternal factors, infant factors, and environmental related factors. A cut off value of p=0.05 was used to determine statistical significance in all the analysis conducted. Results generated were presented in form of tables and graphs.

Following lax criterion as recommended by Altman (1991) and Dube *et al.* (2013), the variables with p-value less than 0.20 were considered as candidates to be entered in the multivariate model. The cut off value of p=<0.20 was used to exclude the variables that cannot be significantly associated with infant survival, and only include potential variables that might be significantly associated with infant survival (Altman, 1991) . Multivariate analysis using conditional logistic regression was conducted to explore the independent associations between the outcomes of being a case or control and a set of predictor variables. Conditional logistic regression was also used to adjust for confounding factors, with a stepwise procedure known as hierarchical regression (Birkeland, Weimand, Ruud, Høie, & Vederhus, 2017; Pourhoseingholi, Baghestani, & Vahedi,

2012), to examine the relationship between maternal factors, infant factors, environmental related factors and infant survival. In the first step, maternal factors with p value below 0.20 were included in the multivariate model, in the second step, infant factors with p value below 0.20 were included in the multivariate model, and finally in the last step, environmental related factors with p value below 0.20 were included in the multivariate model. The results generated were presented in form of tables.

3.9 Minimization of Bias

Selection bias was minimized by selecting controls from the same residential area as cases through matching to ensure that the controls and cases had an equal chance of experiencing similar exposure factors such as biological and environmental factors. This ensured comparability of exposures between cases and controls and generalizability of study results.

To overcome language barrier as some study participants could not understand some English words in particular medical terminology on the questionnaire, the researcher employed the services of bilingual research assistants who interpreted the English words to Somali language. The use of bilingual research assistants was done to ensure there is clarity with the questions asked to increase accuracy of answers given and minimize bias.

Study participants were asked questions based on their experiences, hence, mothers whose infants died under the age of one year were in a position to recall even very trivial factors during and after pregnancy, unlike the mothers whose infants' survived up-to the age of one year. As such, there is a possibility the study was affected by recall bias. The researcher gave the study participants enough time before answering the questions to reflect and think through the circumstances relating to infant survival, to minimize recall bias. The researcher also restated the

questions if the respondents were not sure of the answer. This approach has been used in other similar studies making findings in this study comparable.

3.10 Ethical Considerations

Permission to conduct research was given by Maseno University School of Graduate Studies and ethical approval was given by Maseno University Ethics Review Committee. Community permission was also obtained through relevant community members. The principal researcher briefed the study participants about the nature of the research, its purpose and implications. Written informed consent was obtained individually from each of the study participants before filling the questionnaires, to ensure that participation was purely on a voluntary basis. Study participants were informed that all information obtained will be treated confidentially by ensuring their identity will not be revealed to anyone and that data obtained will only be used for the purpose of the study only. Questionnaires collected were locked in a cabinet to which access was restricted to the researcher and research assistants only. An information sheet was also provided to study participants concerning the purpose of the study how information will be processed, stored and used.

CHAPTER FOUR: RESULTS

4.1 Introduction

This chapter presents the results of the data obtained from the study on factors affecting infant survival in Hargeisa District, Maroodi Jeex Region, Somaliland. The response rate was 100 %.

4.2 Socio-Demographic Characteristics of Study Participants

A total of 210 mothers (105 cases and 105 controls) were enrolled in this study. Table 4.1 gives the socio-demographic characteristics of the study participants. The study participants' ages range from 15 years to 44 years. Cases have a mean age of 30 years and a standard deviation of ± 6.53 while controls have a mean age of 32 years and a standard deviation of ± 6.54. Majority 80 (38%) of the mothers have never gone to school, 50 (24%) have completed secondary school education, 46 (22 %) have completed primary school education, while 34 (16%) have completed college diploma or university degree. Most 191 (91%) of the study participants are married, 12 (5.7%) are divorced, while 7 (3.3 %) are single. In terms of levels of family income, 132 (63%) of the study participants come from low income families earning less than 450,000 SlSh per month, 44 (21%) come from lower middle class families earning 450,001-750,000 SlSh per month, 20 (10%) come from upper middle class families earning 750,001-2,400,000 SlSh per month and 14 (6.7 %) come from high income families earning more than 2,400,000 SlSh per month. Majority of the study participants 147 (48%) come from Gali baax Sub-district, 69 (22 %) from Koodbuur Sub-district, 48 (16%) from Muhamud Habey Sub-district, 30 (10%) from Ahmed Dhagax Sub-district and 15 (5%) from 26th June Sub-district.

Table 4.1 Socio-Demographic Factors for Study Participants

n=210*

Variable	Totals n (%)
Study Participants' Age	
15-24 years	42 (20.0 %)
25-34 years	70 (33.3%)
34-44 years	98 (46.7%)
Level of Education	
Never gone to school	80 (38.1%)
Primary School	46 (21.9%)
Secondary School	50 (23.8%)
University diploma or degree	34 (16.2%)
Marital Status	
Single	7 (3.3%)
Married	191 (91.0%)
Divorced	12 (5.7%)
Residence	
26th June	15 (4.9%)
Ahmed Dhagax	30 (9.7%)
Muhamed Habey	48 (15.5%)
Koodbuur	69 (22.3%)
Gali baax	147 (47.6%)
Level of income per month	
Low level of income (≤450,000 SlSh)	132 (62.8%)
Lower middle class (450,001-750,000 SlSh)	44 (21.0%)
Upper middle class (750,001-2,400,000 SlSh)	20 (9.5%)
High level of income (>2,400,000 SlSh)	14 (6.7%)

*The total study participants comprised cases (n=105) and controls (n=105)

4.3 Relationship between Maternal Factors and Infant Survival

Results in Table 4.2 shows the relationship between maternal factors with infant survival. Regarding the maternal age of study participants at first pregnancy, more cases 12 (57%) than controls 9 (43), are less than 20 years at first pregnancy. Correspondingly, more cases 11 (51%) than controls 7 (49%) are above 30 years at first pregnancy. Pearson chi square test shows the association between maternal age at first pregnancy with infant survival. It was found there is no association between maternal age below 20 years at first pregnancy (p=0.490), and maternal age above 30 years at first pregnancy (p=0.324), with infant survival.

Concerning the level of education, a higher percentage of cases (56%) have never gone to school as compared to 44% of controls. More controls 22 (65%) than cases 12 (35%) have completed College diploma or University degree. Using Pearson chi square test, to test the association between the level of education with infant survival, it is observed there is a significant association between the level of education and infant survival (p=0.017). Regarding the relationship between the level of family income and infant survival, more cases 78 (59%) than controls 54 (41%), come from low income families. Pearson chi square test shows there is an association between the level of family income and infant survival (p=0.001).

On the length of birth interval, more cases 44 (64%) than controls 25 (36%) have a birth interval of less than 18 months, while more controls 18 (58%) as compared to cases 13 (42%) have a birth interval between 25 and 30 months. Pearson chi square test shows there is a significant association between birth interval (p=0.030) and infant survival. Regarding parity, the findings show that more cases 50 (58%) than controls 36 (42%) have a parity of 4-7. Similarly, more cases 26 (61%) than controls 17 (40%) have a parity of 8 and above. Pearson chi square test shows there is a significant association between parity (p=0.005) and infant survival.

On healthcare seeking behavior by attending antenatal care visits, it is observed that a higher percentage (69%) of cases as compared to controls (31%) do not receive antenatal care, while a higher percentage of controls (57%) than cases (43%) receive antenatal care 3 to 4 times during their pregnancy. Using Pearson chi square test, it is observed there is a significant association between healthcare seeking behavior by attending antenatal care visits (p=<0.001) and infant survival.

Table 4.2 Relationship between Maternal Factors and Infant Survival

Variable	Cases (n=105) n (%)	Controls n=105 n (%)	Totals n=210 n (%)	$\chi 2$	Df	P-value
Maternal age at first pregnancy below 20 years				0.476	1	0.490
Yes	12 (57.1%)	9 (42.9%)	21 (100.0%)			
No	93 (49.2%)	96 (50.8%)	189 (100.0%)			
Maternal age at first pregnancy above 30 years						
Yes	11 (51.0%)	7 (49.0%)	18 (100.0%)	0.972	1	0.324
No	94 (49.0%)	98 (51.0%)	192 (100.0%)			
Level of education				10.202	3	0.017*
Never gone to school	45 (56.2%)	35 (43.8%)	80 (100%)			
Primary School	29 (59.2%)	17 (37.0%)	49 (100%)			
Secondary School	19 (40.4%)	31 (62.0%)	47 (100%)			
College/University	12 (35.3%)	22 (64.7%)	34 (100%)			
Level of family income				15.649	3	0.001*
Low level of income (≤450,000 SlSh)	78 (59.1%)	54 (40.9%)	132 (100.0%)			
Lower middle class (450,001-750,000 SlSh)	11 (25.0%)	33 (75.0%)	44 (100.0%)			
Upper middle class (750,001-2,400,000 SlSh)	10 (50.0%)	10 (50.0%)	46 (100.0%)			
High level of income (>2,400,000 SlSh)	6 (42.9%)	8 (57.1%)	12 (100.0%)			
Birth interval				10.705	4	0.030*
Less than 18 months	44 (63.8%)	25 (36.2%)	69 (100.0%)			
19-24 months	27 (50.0%)	27 (50.0%)	54 (100.0%)			
25-30 months	13 (41.9%)	18 (58.1%)	31 (100.0%)			
31-36 months	14 (43.8%)	18 (56.3%)	32 (100.0%)			
37 and above months	7 (29.2%)	17 (70.8%)	24 (100.0%)			
Parity				10.694	2	0.005*
1-3	29 (35.8%)	52 (64.2%)	81 (100.0%)			
4-7	50 (58.1%)	36 (41.9%)	86 (100.0%)			
8 and above	26 (60.5%)	17 (39.5%)	43 (100.0%)			
Healthcare seeking behavior by receiving antenatal care (ANC)				17.523	2	<0.001*
0 ANC visits	53 (68.8%)	24 (31.2%)	77 (100.0%)			
1-2 ANC visits	39 (37.9%)	64 (62.1%)	103 (100.0%)			
3-4 ANC visits	13 (43.3%)	17 (56.7%)	30 (100.0%)			

Note: *implies significance at 5% level

4.4 Relationship between Infant Factors and Infant Survival

More cases' infants 19 (70%) than controls' infants 8 (30%) have a birth weight below 1500gms. A higher proportion (62%) of controls' infants have a birth weight of 2500gms and above as compared to 38% of cases' infants. Using Pearson chi-square test, it is observed there is an association between birth weight (p=<0.001) and infant survival. In regard to gestational age of infant at birth, more cases' infants 22 (61%) are born below 34 weeks of age as compared to 14 (39%) of controls' infants. However, using Pearson chi-square test, it is observed there is no association between gestational age (p=0.266) and infant survival.

Concerning exclusive breastfeeding, the study shows that more controls' infants than cases' infants are breastfed exclusively. Pearson chi-square test is used to test if there is an association between exclusive breastfeeding and infant survival. The test shows that there is no significant association (p=0.343). Regarding the place of birth for infants, the study shows that more cases' infants 61 (56%) than controls' infants 48 (44%) are born at home. Using Pearson chi-square test, the test shows there is no association between the place of birth for infants (p=0.073) and infant survival. The results of the relationship between infant factors and infant survival are shown in Table 4.3.

Table 4.3 Relationship between Infant Factors and Infant Survival

Variable	Cases (n=105) n (%)	Controls n=105 n (%)	Totals n=210 n (%)	$\chi 2$	Df	P-value
Birth weight of infant in gms				20.500	2	<0.001*
Below 1500	19 (70.4%)	8 (29.6%)	27 (100.0%)			
1500-2499	38 (69.1%)	17 (30.9%)	55 (100.0%)			
2500 and above	48 (37.6%)	80 (62.4%)	128 (100.0%)			
Gestational age of infant at birth				2.646	2	0.266
Below 34 weeks	22 (61.1%)	14 (38.9%)	36 (100.0%)			
34-36 weeks	24 (52.2%)	22 (47.8%)	46 (100.0%)			
37 weeks and above	59 (46.1%)	69 (53.9%)	128 (100.0%)			
Infants breastfed exclusively				0.897	1	0.343
Yes	75 (48.1%)	81 (51.1%)	156 (100.0%)			
No	30 (55.6%)	24 (44.4%)	54 (100.0%)			
Place of birth for infants under study				3.224	1	0.073
Home	61 (56.0%)	48 (44.0%)	109 (100.0%)			
Health facility	44 (43.6%)	57 (56.4%)	101 (100.0%)			

Note: *implies significance at 5% level

Regarding infants age at death for cases, the study shows that majority of the deaths 59 (56%) occurr between 0-28 days (neonatal period), while 46 (44%) occur between 4-52 weeks (post-neonatal period). Figure 4.1 shows the percentage of infant deaths according to the ages at death.

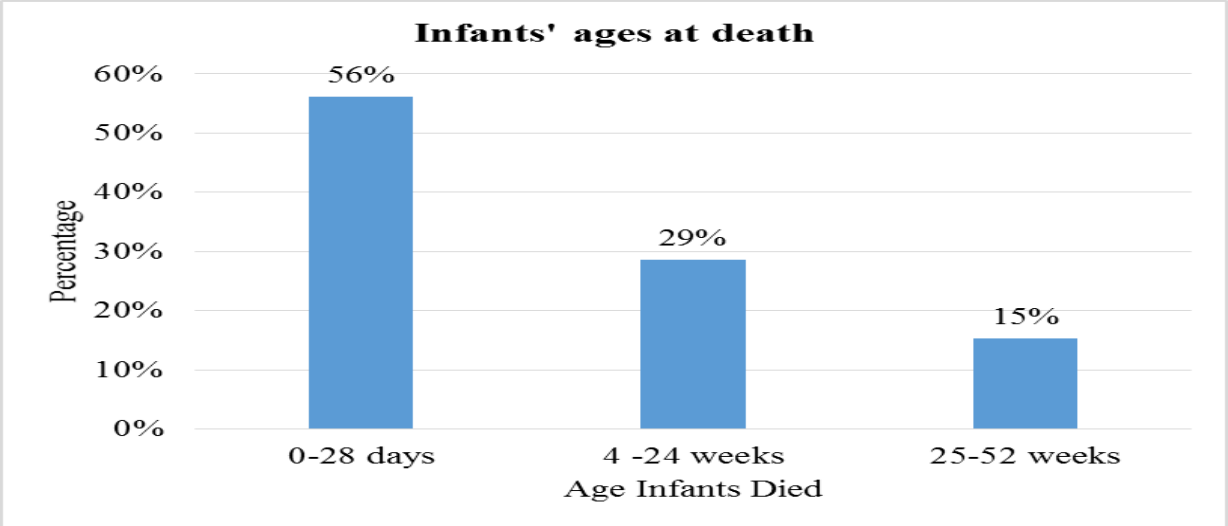

Figure 4.1 Infants' Ages at Death

On infant complications, majority 30 (29%) of the infants who die have asphyxia, 23 (22%), have diarrhea diseases, while 18 (17%) have pneumonia. Figure 4.2 shows the complications that caused infant deaths.

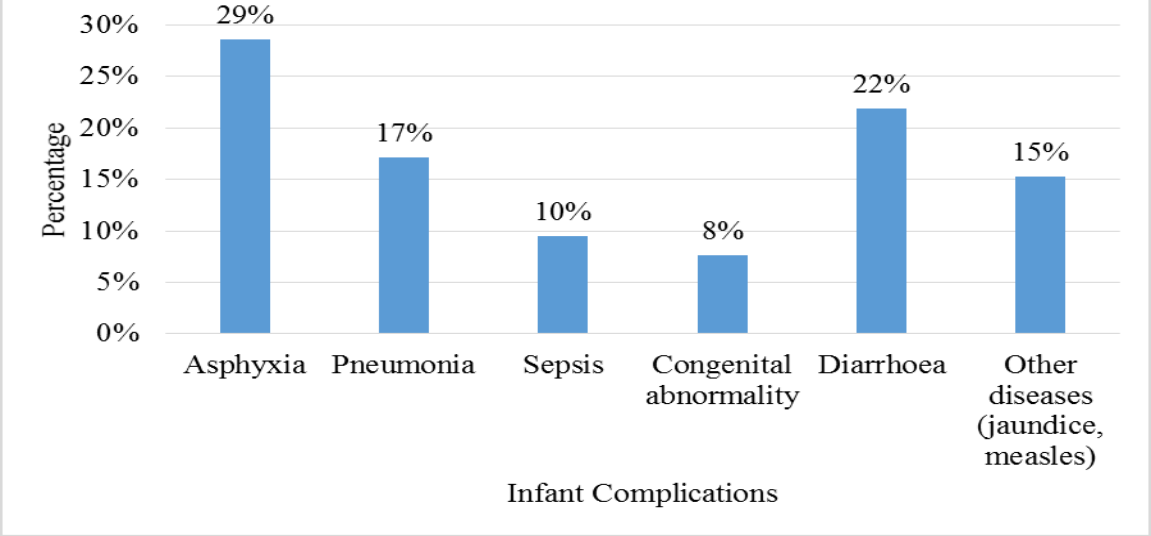

Figure 4.2 Infant Complications

4.5 Relationship between Environmental Factors and Infant Survival

On the sources of drinking water, more cases 75 (56%) than controls 60 (44%) use water from wells (untreated water) while, more controls 40 (55%) than cases 33 (45%) use piped water (treated water). Using Pearson chi square test, it is observed there is an association between use of water from wells (p=0.031) and infant survival. However, there is no association between use of piped water (p=0.310) and infant survival. Regarding sanitation, slightly more controls 25 (51%) than cases 24 (49%) have households with flush toilets, while more cases 81 (54%) than controls 69 (46%) have household with latrines. Pearson chi square test, shows there is no association between households with flush toilets (p=0.870) or households with latrines (p=0.067) with infant survival. Concerning method of garbage disposal, more cases 19 (53%) than controls 17 (47%) are disposing garbage by open dumping and burying. More controls 43 (55%) than cases 35 (45%) involve garbage disposal companies to collect and dispose their garbage. Using Pearson chi-square test, it is observed that there is no association between the method of garbage disposal and infant survival (p= 0.340). The results on the relationship between environmental factors and infant survival are shown in Table 4.4.

Table 4.4 Relationship between Environmental Factors and Infant Survival

Variable	Cases (n=105) n (%)	Controls (n=105) n (%)	Totals n=210 n (%)	$\chi 2$	Df	P-value
Source of drinking water						
Piped water (treated)				1.029	1	0.310
Yes	33 (45.2%)	40 (54.8%)	73 (100.0%)			
No	72 (52.6%)	65 (47.4%)	137 (100.0%)			
Wells (not treated)				4.667	1	0.031*
Yes	75 (55.6%)	60 (44.4%)	135 (100.0%)			
No	30 (40.0%)	45 (60.0%)	75 (100.0%)			
Household with flush toilet				0.027	1	0.870
Yes	24 (49.0%)	25 (51.0%)	49 (100.0%)			
No	81 (50.3%)	80 (49.7%)	161 (100.0%)			
Household with a latrine				3.360	1	0.067
Yes	81 (54.0%)	69 (46.0%)	150 (100.0%)			
No	24 (40.0%)	36 (60.0%)	60 (100.0%)			
Garbage disposal method						
Composting	9 (40.9%)	13 (59.1%)	22 (100.0%)	4.526	4	0.340
Open dumping	33 (61.1%)	21 (38.9%)	54 (100.0%)			
Open dumping and burning	19 (52.8%)	17 (47.2%)	36 (100.0%)			
Dumping and burying	9 (45.0%)	11 (55.0%)	20 (100.0%)			
Garbage collected by waste disposal company	35 (44.9%)	43 (55.1%)	78 (100.0%)			

Note: * implies significance at 5% level

4.6 Relationship between Maternal Factors, Infant Factors, Environmental Factors and Infant Survival

Multivariate analysis using conditional logistic regression model was undertaken because it examines the influence that a set of independent variables have on dependent variables. From the preliminary bivariate analysis done, the current study established that the following variables namely: maternal age below 20 years at first pregnancy, maternal age above 30 years at first pregnancy, gestational age at birth, exclusive breastfeeding, source of drinking water (piped water), households with flush toilets, and garbage disposal methods are variables with p-values of

0.20 and above. These variables are excluded from the conditional logistic regression model following lax criterion. Only variables with p-values below 0.20 are included in the regression model because they are considered as potential co-variates which can be significantly associated with infant survival.

A stepwise procedure of conditional logistic regression by hierarchical regression is used to examine the influence of maternal factors, infant factors and environmental factors on infant survival. The results on multivariate hierarchical logistic regression of maternal, infant and environmental related factors influencing infant survival is presented in Table 4.5. Overall, the model is not a significant predictor of the relationship between maternal factors, infant factors, environmental factors and infant survival [X2(7) =9.129 P=0.332, Nagelkerke R2=0.404]. Of all the variables fitted in the model, secondary level of education, parity of 1-3, poor healthcare seeking behavior by not attending antenatal care visits, and a birth weight below 1500gms turn out to be significantly associated with infant survival.

Table 4.5 Multivariate Hierarchical Regression on the Association between Maternal Factors, Infant Factors, Environmental Factors and Infant Survival in Hargeisa District, Maroodi Jeex Region

Variable	Model 1		Model II		Model III	
	AOR	95% C.I for AOR	AOR	95% C.I for AOR	AOR	95% C.I for AOR
Level of Education						
Never gone to school	2.000	0.797-5.019	2.161	0.802-5.822	2.223	0.827-5.976
Primary School	0.826	0.261-2.613	0.651	0.187-2.261	0.707	0.208-2.403
Secondary School	0.460*	0.189-1.116	0.379*	0.148-0.972	0.390*	0.153-0.996
College/University	1.000				1.000	
Level of family income						
Low level of income	1.283	0.395-4.165	1.043	0.286-3.804	1.066	0.296-3.841
Lower middle class	0.343	0.088-1.334	0.296	0.066-1.326	0.289	0.065-1.278
Upper middle class	0.764	0.149-3.933	0.642	0.109-3.771	0.606	0.105-3.512
High level of income	1.000				1.000	
Birth interval						
Less than 18 months	2.809	1.042-7.576	2.644	0.906-7.721	2.725	0.942-7.888
19-24 months	0.663	0.191-2.302	0.765	0.214-2.736	0.794	0.225-2.805
25-30 months	1.000		1.000		1.000	
31-36 months	0.890	0.281-2.823	0.812	0.215-3.064	0.849	0.228-3.163
37 and above months	1.472	0.520-4.167	1.357	0.441-4.176	1.312	0.431-3.995
Parity						
1-3	0.349*	0.144-0.844	0.372*	0.145-0.952	0.371*	0.145-0.950
4-7	1.000		1.000		1.000	
8 and above	0.956	0.397-2.302	1.082	0.421-2.784	1.034	0.405-2.640
Healthcare seeking behavior						
0 ANC visits	3.194*	1.048-9.730	3.475*	1.016-	3.779*	1.133-12.609
1-2 ANC visits	0.981	0.333-2.890	1.201	11.890	1.321	0.414-4.214
3-4 ANC visits	1.000			0.364-3.964	1.000	
Birth weight of infant						
Below 1500gms			1.143*	0.326-4.008	1.175*	0.338-4.084
1500-2499gms			1.000		1.000	
2500gms and above			0.248	0.109-0.566	0.237	0.237-0.105
Place of birth						
Home			0.767	0.371-1.584	0.818	0.389-1.720
Health facility			1.000		1.000	
Source of drinking water is wells (not treated)						
Yes					1.333	0.547-3.247
No					1.000	
Household with a latrine						
Yes					1.526	0.576-4.041
No					1.000	

Note: * implies significance at 5% level

The results of conditional logistic regression model for maternal factors, infant factors and environmental factors affecting infant survival in Hargeisa District, Maroodi Jeex Region are presented in Table 4.6. After adjusting for the maternal factors, infant factors and environmental factors in the regression model, the study shows that mothers who complete secondary school education are 61% less likely to experience infant death compared to mothers who never attend school, and mothers who complete primary school [AOR = 0.390, 95% CI: (0.153-0.996), P=0.049]. In regard to parity, mothers with a parity of 1-3 are 63% less likely to experience infant death compared to mothers with a parity of 4-7 and mothers with a parity of 8 and above [AOR = 0.371, 95% CI: (0.145-0.950), P=0.039].

Concerning health care seeking behavior by attending antenatal care visits, mothers who do not attend ANC visits are three times more likely to experience infant death than mothers who attend 1-2 times and mothers who attend 3-4 times [AOR = 3.779, 95% CI: (1.133-12.609), P=0.031]. Regarding birth weight, infants born with a birth weight of below 1500 grams are 1.2 times more likely to die as compared to infants born with a birth weight below 1500 grams and 2500 grams and above [AOR = 1.175, 95% CI: (0.237-0.105), P=0.001].

Table 4.6 Summary of the Association between Maternal Factors, Infant Factors, and Infant Survival in Hargeisa District, Maroodi Jeex Region

Variable	B	S.E	Wald	Df	Exp (B)	95% C.I for Exp (B)	P-value
Level of Education				3			
Never gone to school	0.799	0.505	2.506		2.223	0.827-5.976	0.113
Primary School	0.346	0.624	0.308		0.707	0.208-2.403	0.579
Secondary School	0.941	0.478	3.878		0.390	0.153-0.996	0.049*
College/University	0.000				1.000		
Level of family income				3			
Low level of income	0.064	0.654	0.10		1.066	0.296-3.841	0.922
Lower middle class	-1.241	0.758	2.678		0.289	0.065-1.278	0.102
Upper middle class	-0.500	0.896	0.312		0.606	0.105-3.512	0.577
High level of income	0.000				1.000		
Birth interval				4			
Less than 18 months	1.003	0.542	3.418		2.725	0.942-7.888	0.064
19-24 months	-0.231	0.644	0.128		0.794	0.225-2.805	0.720
25-30 months	0.000				1.000		
31-36 months	-0.163	0.671	0.059		0.849	0.228-3.163	0.808
37 and above months	0.271	0.568	0.228		1.312	0.431-3.995	0.633
Parity				2			
1-3	0.991	0.480	4.268		0.371	0.145-0.950	0.039*
4-7	0.000				1.000		
8 and above	0.034	0.478	0.005		1.034	0.405-2.640	0.944
Healthcare seeking behavior				2			
0 ANC visits	-1.330	0.615	4.678		3.779	1.133-12.609	0.031*
1-2 ANC visits	0.279	0.592	0.222		1.321	0.414-4.214	0.638
3-4 ANC visits	0.000				1.000		
Birth weight of infant				2			
Below 1500gms	-0.161	0.636	0.064		1.175	0.237-0.105	0.001*
1500gms-2499gms	0.000				1.000		
2500gms and above	1.439	0.416	11.959		0.237	0.338-4.084	0.800
Place of birth				1			
Home	-0.201	0.379	0.281		0.818	0.389-1.720	0.596
Health facility	0.000				1.000		
Source of drinking water is wells (not treated)				1			
Yes							
No	0.287	0.454	0.400		1.333	0.547-3.247	0.527
Household with a latrine	0.000				1.000		
Yes				1			
No	0.577	0.470	1.540		1.526	0.576-4.041	0.390
	0.000				1.000		

Note: * implies significance at 5% level

CHAPTER FIVE: DISCUSSION

5.1 Introduction

This chapter discusses the findings of this study and compares with the findings of other researchers. The following factors are discussed: maternal factors, infant factors, and environmental factors that influence infant survival. The association between these factors that influence infant survival is also discussed.

5.2 Relationship between Maternal Factors and Infant Survival

Infant survival is affected by various factors in both developed and developing countries. This study sought to determine the maternal factors affecting infant survival in Hargeisa District. The current study found out there is a significant association between the mother's level of education with infant survival in Hargeisa District. The study found that, the proportion of mothers who never attend school is higher in the case group than the control group, while more controls have secondary school level of education than cases. This finding concurs with findings of previous studies conducted that found out that the higher the level of maternal education, the lower the risk of infant mortality (Huda *et al.,* 2016; Damghanian *et al.,* 2014), in that, mothers with higher levels of education seem to access and adopt new ideas and messages faster than their counterparts with low levels of education (De Jonge *et al.,* 2014). There is a possibility that in Hargeisa District many mothers have low levels of education, in effect, are less conscious about their health during pregnancy and birth and are less conscious about applying recommended infant care practices. In addition, it's possible that mothers with low levels of education have limited employment opportunities and income, thus, they do not take sick infants to the hospital as they cannot afford to pay for the costs of treatment. This finding of the current study and others point

out the need for increasing enrollment of women in secondary schools and institutions of higher learning.

Findings from this study also shows that the level of family income affects infant survival in Hargeisa District. Infant mortality is higher among study participants who come from low income families than those who come from middle and high income families. This finding echoes the findings of studies conducted by Ntenda *et al.* (2014) and Kozuki and Walker (2013), who previously established that low family income affects infant survival, because these families often face an increased risk of financial burden, limiting their ability to provide nutritious and sufficient food to prevent malnutrition and reduce the risk of infections. The finding in this study could probably be attributed to the fact that low income families in Hargeisa District, are not able to afford to cater for the costs of healthcare expenses. As such, it's possible that sick infants often don't receive recommended treatment for illnesses and conditions they have, and this affects infant survival.

The current study shows that birth interval affects infant survival in Hargeisa District. Findings from this study indicate that a higher proportion of infants in the case group than control group are born at birth intervals less than 18 months. The study further shows that a higher proportion of infants in the control group than the case group are born at birth interval 25-30 months. These findings imply that infant mortality is higher among mothers with birth intervals of less than 18 months than mothers with a birth interval of 25-30 months. These findings concurs with a study conducted in Norway by Barclay *et al.* (2016), and also concurs with another study conducted by De Jonge *et al.* (2014), that found that infant mortality is highest among pregnancy intervals of 18 months and the recommendation for a healthy pregnancy, is a birth to birth interval of at least 24 months under the assumption of nine months gestation (Dadi, 2015). This finding of

short birth intervals could possibly be attributed to low use of family planning methods, thus are not able to space the births to the recommended intervals of at least 24 months. As such, these women possibly do not recuperate from one pregnancy before supporting the next one, leading to maternal complications that can cause low birth weight and increased risk of infant mortality.

Findings from this study also shows that parity affects infant survival in Hargeisa District. A higher proportion of cases than controls have a parity of four to seven, and a higher proportion of controls than cases have a parity of one to three. These findings indicate that infant mortality is higher among mothers with higher parities of four to seven. These findings echo the finding of a study conducted in Malawi by Ntenda *et al.* (2014), which established that infants born to mothers who have four or more children are at a higher risk of death before 12 months. Another study by Singh and Maheshwari (2014), found that higher parities are associated with poor maternal nutritional status, a contributing factor to low birth weight and increased risk of infant mortality. It's possible that the high parity practiced in Hargeisa District is due to cultural norms and traditions, encouraging women to have many children. High parity in effect, contributes to maternal malnutrition, a factor that can lead to low birth weight that can affect infant survival. Low birth weight is identified in this study, as a factor that can affect infant survival in Hargeisa District. As such, there is a possibility there might be an association between high parity and low birthweight in Hargeisa District. The finding of this current study suggests the need for family planning methods to prevent high parities which are associated with high infant mortality.

The study shows that healthcare seeking behavior by attending antenatal care visits affects infant survival in Hargeisa District. The study observes that a higher proportion of cases than controls do not attend antenatal care visits, and a higher proportion of controls than cases attend antenatal care visits three to four times during their pregnancy. This finding implies that infant

mortality is higher among mothers not attending antenatal care visits. The current finding concurs with findings of previous studies conducted by Dulla *et al.* (2017), and Makate and Makate (2017), who found out that antenatal care is associated with reduced infant mortality, possibly because high risk pregnant mothers are identified and their complications are managed appropriately to reduce the risks of infant mortality. The finding of this current study points out the need to increase antenatal care visits in Hargeisa District, in order to improve infant survival. Mothers attending antenatal care visits can also be educated about infant danger signs in order to detect them at early stages and seek healthcare attention. They can also be educated about infant care practices to promote infant health and improve chances of infant survival.

The study found there is no association between maternal age and infant survival. This finding contradicts with findings of previous studies which established that mothers aged below 20 years and mothers aged above 30 years at first pregnancy are at a greater risk of infant mortality (Fall *et al.,* 2015; Marshall *et al.,* 2016; Ntenda *et al.,* 2014; Yu *et al.,* 2016). However, this finding of no association between maternal age and infant survival concurs with findings from a previous study conducted by Caselli *et al.* (2014), among Sardinian women. The study established that maternal age does not affect infant survival because antenatal care enables women to maintain their own health during childbearing, and also provide good infant care. However, though the findings of the study conducted among Sardinian women concurs with the finding of the current study, the reasons given for no association may not apply in Hargeisa District. This is because pregnant women in Hargeisa District might not be able to maintain their own health during childbearing, due to the fact that many of them do not attend antenatal care visits. Findings from a study conducted by Ntenda *et al.* (2014), found out that antenatal care visits are vital in identification and management of maternal complications to improve chances of infant survival

5.3 Relationship between Infant Factors and Infant Survival

The current study shows that birth weight affects infant survival in Hargeisa District. A higher proportion of cases' infants than controls' infants are born weighing below 1500gms, and infant mortality is higher among infants born weighing below 1500gms as compared to infants born with a birth weight of 2500gms and above. This finding concurs with findings of a previous study that found out that infant mortality increases with decreasing weight and infants born with less than 1500gms have lower chances of survival (Watkins, Kotecha, & Kotecha, 2016). This is due to the fact that infants born with low birth weights are prone to infections (Marshall *et al.,* 2016). This might be the case in Hargeisa District because another finding of this current study in regard to infant complications, showed that sepsis contributed to infant deaths in Hargeisa District. It's likely that that the low birth weight affecting infant survival in Hargeisa District is as a result of high parity and lack of antenatal care. This possibility is consistent with findings from a previous study conducted by (Ding *et al.,* 2013), which established that the contributing factors to low birth weight are high parity and inadequate prenatal care, and these factors can contribute to infant mortality.

The current study established that there is no association between gestational age and infant survival in Hargeisa District. This is because the proportion of cases and controls in respect to gestational age is not significantly different. However, it is observed that more cases than controls are born below 34 weeks of gestation, and more controls than cases are born with a gestational age of 37 weeks and above. This finding of no association between gestational age and infant survival contradicts the findings of a previous study by Cupen *et al.* (2017), that found out that gestational age is a key factor that can contributes to infant mortality especially in regions with high infant mortality rate, as is the case in Hargeisa District. The current finding from this study also

contradicts with findings of Marshall *et al.* (2016), who established that infants born before 37 weeks of gestational age are at a greater risk of infant mortality, in that, the increased risk of death is attributed to prematurity of vital organs such as the respiratory system which is vital for extra uterine life. There is a possibility that gestational age is not associated with infant survival in Hargeisa District, because some mothers who give birth at gestational age below 37 weeks receive specialized health care services for preterm babies, in effect reducing the risk of infant mortality, while other mothers who give birth at gestational age below 37 weeks do not attend antenatal care visits and they do not receive appropriate care for preterm babies. For these reasons, it's likely that there are similar proportions of cases and controls in respect to the categories of gestational ages in Hargeisa District, hence, no association between gestational age and infant survival.

Findings from this study show there is no association between exclusive breastfeeding and infant survival in Hargeisa District. Although the study shows that more controls' infants than cases' infants are breastfed exclusively, these proportions are not significantly different. There is a possibility that some women in Hargeisa District lack the knowledge and understanding of the benefits of exclusive breastfeeding, thus they don't practice exclusive breastfeeding, whereas there is also a possibility there are women in Hargeisa District practicing exclusive breastfeeding because they understand the benefits of exclusive breastfeeding to the infant. This finding of no association between exclusive breastfeeding and infant survival implies that exclusive breastfeeding does not increase or reduce the chances of infant survival in Hargeisa District. This finding contradicts the findings of studies conducted by Sankar *et al.* (2015) and Debes *et al.* (2013) that found out that exclusive breastfeeding is a key factor associated with infant survival especially in regions with high infant mortality rate, in that, infants who are not exclusively breastfed have increased risks of susceptibility to infections and mortality due to low immunity.

The finding from this current study indicates the need to scale up interventions that will encourage and increase the number of mothers' breastfeeding exclusively, as previous studies have shown that infants not exclusively breastfed have increased risks of infant mortality.

The study established that the place of birth is not associated with infant survival in Hargeisa District. The study shows that the proportion of cases' infants born at home and the proportion of controls' infants born in healthcare facilities is not significantly different. This finding implies that the place of birth does not increase or reduce the chances of infant survival in Hargeisa District. This finding contradicts the findings of previous studies conducted by Fatima-Tuz-Zahura *et al.* (2016) and Elder *et al.* (2014), that found out that the place of birth particularly in areas with high infant mortality like Hargeisa District affects infant survival. These studies further showed that survival rate is higher among infants born in healthcare facilities than infants born at home as infants born at healthcare facilities are managed by skilled birth attendants with the equipment and drugs that can treat newborn complications. There is a possibility that in Hargeisa District, mothers have different beliefs about the choices of place of birth. Probably, some mothers do not have trust and confidence with healthcare facilities, thus, they prefer home deliveries, whereas other mothers belief in the care provided by skilled birth attendants, hence, they prefer healthcare facilities births. The finding of no association between the place of birth and infant survival indicates that the proportion of cases and controls in respect to place of birth is not significantly different. This points out the need to encourage hospital births as pointed out in another study by Dulla *et al.* (2017), to increase the number of skilled birth attendants deliveries, hence improve infant survival.

Findings from this study shows that most of the infant deaths in Hargeisa District occur during the neonatal period, and asphyxia is the leading cause of infant death, followed by diarrhea

and pneumonia. These findings concur with findings from previous studies conducted by UNICEF (2018) and Shin *et al.* (2016) that showed that the neonatal period is the most vulnerable time of infants, and during this period infants are at the highest risk of mortality from respiratory conditions such as asphyxia and infections such as sepsis, and pneumonia. There is a possibility that deaths during the neonatal period from asphyxia and pneumonia in Hargeisa District are as a result of poor quality of care given by healthcare providers, when managing these complications or it's likely that mothers are not taking their infants to healthcare facilities to receive treatment. During the post-neonatal period, there is a possibility that deaths from diarrhea are as a result of unhygienic infant feeding. The finding of this current study implies there is need to provide more interventions and capacity building programs on neonatal care, in order to ensure healthcare professionals are skilled in managing newborn complications such as asphyxia and pneumonia. In addition, healthcare professionals can be given more trainings on diarrhea management.

5.4 Relationship between Environmental Factors and Infant Survival

Findings from this study show that in Hargeisa District, there is an association between wells as sources of drinking water with infant survival. The study shows that more cases than controls give their infants drinking water from wells (untreated water). Therefore, there is a possibility that infants developed diarrhea diseases by drinking untreated water from wells, and the diarrheal diseases contributes to infant mortality. The finding of this current study concurs with previous studies conducted by Deribew *et al.* (2016) and Oluwatomipe *et al.* (2014).who established that use of unsafe drinking water from unprotected wells, causes diarrheal diseases and if the diarrheal disease is not managed can consequently lead to infant mortality. It's likely that most of the residential areas in Hargeisa District lack piped water supply, as a result of the aftermaths of the civil war that saw the destruction of most of the infrastructure including water

supply systems. It's also likely that women who use water from wells don't treat the water before use, thus, they often give infants contaminated drinking water. It was observed that the study did not establish any association between use of piped water and infant survival. Although more controls than cases used piped water which is treated water, the proportions between cases and controls in respect to use of piped water is not significantly different. As such, there is a possibility that some women are using piped water which is known to improve infant survival, while others are not using piped water, a known risk factor for infant mortality. However, the proportions between these two groups of women is not different. Regarding use of untreated water from wells for drinking purpose, there is need to educate mothers on how to treat water sourced from wells, to prevent diarrheal related illnesses that can cause infant mortality.

The current study found out that there is no association between households with flush toilets and infant survival. The study also established there is no association between household with latrines and infant survival. It is observed that the proportion of mothers living in households with flush toilets or latrines in respect to cases or controls is not significantly different. As such, households with latrines or flush toilets does not increase or reduce the chances of infant mortality. This finding contradicts the findings of studies conducted by Alemu (2017) and Oluwatomipe *et al.* (2014), who established that in areas with high infant mortality, as is the case in Hargeisa District, lack of flush toilets and unhygienic latrines are factors that contribute to infant mortality, in that, mothers are unable to maintain high levels of hygiene. For instance, after visiting the toilet or latrine, mothers lack handwashing facilities that are vital in prevention of transmission of pathogens to their infants during feeding. It's likely that in Hargeisa District, there are mothers living in households with or without flush toilets or latrines who are observing high levels of sanitation, and there is a possibility that there are other mothers who are not observing high levels

of sanitation. However, the proportion of these groups is not significantly different. Nonetheless, as pointed out in another study (Fagbeminiyi & Faniyi, 2015), it's vital to encourage families to own households with flush toilets, in that, they are associated with increased chances of infant survival.

Findings from this study show there is no association between the method of garbage disposal and infant survival in Hargeisa District. Although it is observed that more cases than controls are disposing their garbage by open dumping and burning, while more controls than cases are disposing their garbage through garbage disposal companies, these proportions between cases and controls in respect to garbage disposal are not significantly different. This finding contradicts the findings of a study conducted by Dube *et al.* (2013), that found out that burning and open dumping of garbage contribute to infant mortality especially in regions with high infant mortality rate, but the finding in Hargeisa District shows there is no association, despite the high infant mortality rate. The finding in Hargeisa District also contradicts the finding of another study that found out that open dumping contaminants the environment, predisposing infants to infectious diseases such as diarrheal diseases, while burning of garbage generates smoke that contributes to respiratory diseases and infant mortality (UNICEF & SHARE, 2016). Despite the fact that there is no association between the method of garbage disposal and infant survival. Previous findings from other studies point out the need to educate mothers on recommended methods of garbage disposal that will decrease the risk of exposing infants to environmental contaminants, hence, improve chances of infant survival.

5.5 Relationship between Maternal Factors, Infant Factors, Environmental Factors and Infant Survival

Association between maternal factors, infant factors, environmental factors and infant survival is a critical objective that was included in the study. This is because understanding the pathway of influence through which these factors operate is key towards determining the factors of greatest influence that contribute to infant mortality. Findings from this study established that there was a relationship between maternal factors, infant factors, environmental factors and infant survival. Of all the factors investigated, the study showed that secondary level of education and parity of 1-3 reduces the risk of infant mortality, while poor healthcare seeking behavior by not attending antenatal care visits and low birth weight below 1500 grams increases the risk of infant mortality in Hargeisa District.

This current finding in Hargeisa District that secondary school level of education reduces the risk of infant mortality than primary school level of education and never attending school echoes the findings of Huda *et al.* (2016), who established that higher levels of education are associated with optimal healthcare seeking behavior and reduction of risks associated with infant mortality. It's possible that in Hargeisa District mothers with secondary school level of education are more conscious about their health. For this reason, it's likely that their secondary school level of education is influencing their decision on the number of children they should have, since they can understand and apply family planning messages much better than their counterparts with low levels of education. As such, secondary school level of education can be a contributing factor to mothers having a parity of 1-3. A parity of 1-3 as pointed out by other studies by Ntenda *et al.* (2014) & Singh and Maheshwari (2014), reduces the risk of infant mortality by decreasing the

risks of maternal complications. These findings point out the need to promote enrollment of more girls in secondary school and encourage mothers to have a parity of 1-3 to improve infant survival.

Findings from this study also show that mothers not attending antenatal care are more likely to experience infant mortality than mothers attending antenatal care visits. In addition, the study established that infants born with a birth weight of less than 1500gms are more likely to die than infants born with a birth weight of 2500gms and above. These findings are consistent with previous studies conducted by Damghanian *et al.* (2014) and Cupen *et al.* (2017), that found out that a maternal factor such as healthcare seeking behavior by attending antenatal care visits, provides an opportunity for mothers to be advised and counselled on nutrition to prevent giving birth to low birth weight babies. It's possible that in Hargeisa District, not attending antenatal care visits limits mothers from receiving adequate knowledge on nutrition and how to be conscious about their health. As such, it's possible that high risk mothers with maternal complications do not receive specialized health care during the antenatal period to effectively manage complications such as hypertension in pregnancy, which can contribute to premature births and low birth weight. These findings point out the need to encourage pregnant women to attend antenatal care visits, to ensure any abnormalities that can contribute to infant mortality are managed.

CHAPTER SIX: SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

6.1 Summary of Findings

In summary, findings showed that infant survival was affected by maternal factors, infant factors, and environmental factors. The maternal factors that affected infant survival were level of mothers' education, level of family income, birth interval, parity and healthcare seeking behavior. Findings from this study also showed that on infant factors, birth weight affects infant survival. Findings from this study also showed that the infants' age and infant complications affected infant survival. This study also found that the source of drinking water from wells (untreated water) affects infant survival. Findings from this study established there is an association between the level of education, parity, healthcare seeking behavior, birth weight and infant survival.

6.2 Conclusions

The maternal factors that affect infant survival in Hargeisa District include low levels of education, low level of family income, short birth intervals of less than 18 months, high parity of 4-7 and 8 and above, and poor healthcare seeking behavior by not attending antenatal care visits. The infant factors that affect infant survival are low birth weight less than 1500gms. Infant mortality is higher during the neonatal period than post-neonatal period and the main infant complications contributing to infant deaths are asphyxia, pneumonia and diarrhea. The environmental factor that affects infant survival in Hargeisa District is source of drinking water from wells (untreated water). The relationship between maternal factors, infant factors and environmental factors influence infant survival in Hargeisa District, with secondary school level of education and parity of 1-3 increasing the chances of infant survival, while healthcare seeking behavior by not attending antenatal care visits and low birth weight of less than 1500gms increased the risk of infant mortality.

6.3 Recommendations from Current Study

1. Health education programmes targeting mothers should be enhanced with detailed teachings on the importance of family planning methods to reduce high parity and short birth intervals.
2. Health programmes targeting mothers should include health education programs with information about the importance of attending antenatal care visits in order to identify and manage risk factors of low birth weight, hence reduce the chances of infant mortality.
3. More effort should be put to enhance care given to infants with complications, hence prevent infant deaths from asphyxia, pneumonia and diarrhea.
4. Health education programmes should include teachings on treating drinking water sourced from wells to ensure infants are drinking clean and safe water.

6.4 Suggestion for Further Research

1. The effectiveness of antenatal care services programs on improving infant survival should be assessed.

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