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DETERMINANTS OF STUNTING AMONG CHILDREN 2 YEARS OF AGE AND BELOW IN RUTSIRO DISTRICT, RWANDA

By

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DECLARATION

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DEDICATION

This thesis is dedicated to: the almighty God, my kids, my husband luc Niragire

My loved late sister Umwali Diane, my late parents, my adoptive father Gasigwa

Madam Claudia, Mr Byiringiro Emmanuel, Madam Dr Madeleine, Madam Evelyne, my brothers in

law Joseph and Pascal And all my friends who made the whole study process easy.

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ABSTRACT

DETERMINANTS OF STUNTING AMONG CHILDREN 2 YEARS OF AGE AND BELOW IN RUTSIRO DISTRICT, RWANDA

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Introduction: Chronic malnutrition or stunting contributes substantially to the overall global burden of disease in children under five years of age. Stunting is associated with decreased neurodevelopment, irreversible cognitive deficits, limited educational achievement and low economic productivity as an adult. Low and middle-income countries bear the greatest burden of stunted children worldwide representing 90% of the total.

In Rwanda, 38% of children under 5 years of age were stunted in 2015. Identifying the determinants of childhood stunting is essential to the development of effective preventative strategies.

Purpose: The purpose of this study is to identify the determinants of stunting among children two-years of age and younger in Rutsiro District, Rwanda.

Methods: A secondary analysis of data collected in a study entitled "Examining the Effects of Environmental Enteropathy on Stunting in Children under-5- years of age in Rutsiro, Rwanda (2016) was used. The sample was a subset of 2-year-old children and under enrolled in the original study. Chi-square test and multiple logistic regressions were used to determine association between study variables and stunting.

Results: Findings indicated that children were at increased risk of stunting if they lived in households with severe hunger (OR: .45, $p \leq .001$); lower wealth category (OR: 3.4, $p \leq .001$); used water from an unprotected source (OR: 3.7, $p \leq .001$); used untreated drinking water (OR: 2.5, $p \leq .001$); had unimproved toilette (OR: 19.2, $p \leq .001$); practiced unsafe stool disposal (OR: 1.5, $p \leq .001$); child did not receiving minimum dietary diversity (OR: 1.50, $p \leq .023$); and child not receiving micronutrients powder (OR: 1.9, $p \leq .001$).

Conclusion: Stunting among children 2-years of age and under is a complex public health problem in Rutsiro District, Rwanda. Improvement in sanitation, hygiene, complimentary feeding and nutritional supplements are needed to decrease stunting and therefore morbidity and mortality in children.

Key words: childhood stunting, determinants, Rwanda

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LIST OF SYMBOLS AND ABBREVIATIONS/ACRONYMS

CP   Complementary   Feeding

CPD   Continuous Professional Development

EE   Environment Enteropathy

EED   Environment Enteric Disease

RDHS   Rwanda   Demographic   and Health Survey

HIV   Human   Immunodeficiency   Virus

IYCF   Infant   and Young   Child   Feeding

MNPS   Micronutrients   Supplement

MOH   Ministry of   Health

NGO   Non-Governmental   Organization

UNICEF   United   Nations   Children's Fund

WHO   World   Health   Organization

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CHAPTER 1: GENERAL INTRODUCTION

1.0. INTRODUCTION

The weight of various underlying causes of stunting depends on contextual factors. breastfeeding and complementary feeding during the first years of life directly that impact on child's physical development. even if most of the delays in physical growth happens by the time of complementary feeding, exclusive breastfeeding represent the essential ground for adequate linear and psychmotor growth in later infancy(de Onis & Branca 2016, p12-14)

Evidence proved that stunting becomes difficult to reverse after 2 years of age(Dewey & Begum 2011, p1-18). The introduction of adequate quantity and quality complementary foods at 6 months through to 23 months reduces the chances of stunting(Allen 2012, p28-31). The intake of food poor in micronutrients through complementary foods in many developing populations has been associated with linear growth delays. (Allen 2012, p 29-37). In Ethiopia it was found that the complementary food introduced too soon or too late exposes the child stunting (Tessema et al. 2013, p75). the probability of getting stunted was reported lower in infants aged between 6-8 months of age who were fed with a variety of iron-rich solid foods in report from a stude done in Bangladesh, whereas poor dietary diversity was associated with increased incidence of stunting(Marriott et al. 2012, p354-70). Other factors mentioned are environmental such as having clean drinking water and having adequates sanitation facilities(Cumming and Cairncross, 2016, P91-95)

1.1. DEFINITIONS OF KEY TERMS PERTINENT TO THE STUDY

Complementary feeding: Is a process of introducing solid and semi-solid food to infant diet in support to breastfeeding, when the last is no longer meeting the infant's nutritional needs for growth and development (UNICEF, 2012).

Malnutrition: Malnutrition was defective nutrition status due to unbalanced diet intake. Based on the age, and anthropometric measures (body weight and height), the WHO categorized malnutrition in the following three categories: Underweight, Wasting and stunting(NLIS 2010,p1).

Wasting: Wasting is defined as a mismatch between weight and height of the child (low weight-for-height). The last is an indicator of acute malnutrition (under nutrition) (NLIS 2010; Singh et al. 2013, p770).

Underweight: Underweight is defined as a mismatch between weight and age (low weight-for-age) it is an indicator of past (chronic) and current (acute) malnutrition (under nutrition)(Singh et al. 2013,p770).

Stunting: Stunting was defined as a delayed linear growth compared to the age of the child. The indicator reflects, a chronic malnutrition(Singh et al. 2013, p770). For the purpose of this study, the stunting which refers to the low height for age is considered(Singh et al. 2013, p768-770).

Minimum Dietary Diversity: Proportion of children 6-23 months of age who received four from seven types of food as recommended by WHO(Rocky *et al.*, 2016, P1-14)

1.2. BACKGROUND TO THE STUDY

Adequate food intake is an essential component for child growth and development(Lutter, 2012, p214). Inappropriate diet can affect childhood development at all age. However, a nutritional deficiency that affects a child within the first two years known as a window of opportunity period is more critical(WHO, 2008, p2). childhood malnutrition is the most frequent health problem in developing countries and it is responsible for delayed linear growth in addition to morbidity and among under five years children in the world (Amare *et al.*, 2016,p2).

Malnutrition among under 5 years children is frequent in developing countries. Reports estimated that 15 % of under 5 years children countries were underweight in 2015(WHO, 2015), while around 42 % of them were stunted(WHO, 2015,p1). Underweight and stunting are reported to be high in Africa and Asia and Both malnutrition combined are responsible for about 2.1 million deaths worldwide in children aged below 5 years. Malnutrition has far-reaching consequences at all child age. However, the period of 6-24 months of age is the most critical given that at this stage kids have more metabolic demands(UNICEF, 2013, p3). Inadequate nutrition intake has been a major public health concern in low and middle-income countries and Rwanda(NISR, 2015). Reports from Rwanda documented that, malnutrition which was illustrated by stunting revealed a prevalence rate of 44% among under five years old children in 2010(NISR, 2010, 2015)and is currently reported at 38% in `2015(NISR, 2015).

The separated DHS results showed (by age, sex and/or area of residence) clearly a difference; for instance, the most affected children are those around 23 months old (rising up at 55.1% for age group 18 to 23 months old), and male children compared to the female count more stunted cases (47.4%). Rwanda DHS (2010) showed stunting difference across the residence area. The rural zone was the most affected (46.5%) compared to urban residence zone (27.3%). The same report showed a difference across provinces as well, where Northern had a prevalence rate of 50.7% and Western 49.9%(NISR, 2010).

To date, there is a little empirical evidence on the causes underlying malnutrition in Rwanda. However, reports say that mothers and caregivers have a low knowledge on appropriate children feeding (Ministry of Health, 2014, p4). Additionally, study done elsewhere documented that inappropriate early nurturing for children especially the inadequate introduction of complementary feeding was associated with malnutrition among children(Kumar *et al.*, 2006,p417). Maternal health and nutrition play an important role as well in predicting an optimal care to infant and young children. According to RDHS 2010, 7.3% women in childbearing age are malnourished (Body Mass Index or BMI<18.5) and those from the lowest and 2nd wealth quintiles bearing the highest burden at 10.0% and 8.6% respectively(NISR, 2010).

Given that the majority of Rwandan population stays in the rural area, where the access to water and sanitation is limited and many relies on agriculture as their source of foods and income(Nivers, 2014,p31). Their staple foods are tubers, cereals, roots, legumes and green vegetables(Kathiresan, 2012,p22). Certain segments of the population face food insecurity. Twenty-eight percent (28%) of households were at the limit of the food consumption score in 2012(screening, 2012, p5.). These households had a dietary pattern dominated by roots or tubers and sometimes pulses. Food insecurity, poverty, and a monotonous diet may prone these households to imbalanced diet and hence to malnutrition in rural areas. In the above-mentioned context, results from RDHS, 2010 might be suggesting that Children living in an environment characterized by poverty, poor nutrition and high prevalence of infectious diseases are likely to become stunted. Additionally, feeding practices might be playing a critical role as well. it was recognized that In Rwanda, Only 3% of the under two years old children eat eggs or fortified infant foods, whereas dairy products were consumed by 20% of the under two children(RDHS, 2014-15). Despite high exclusive breastfeeding rates in Rwanda, 16% of the infants are stunted at 6 months of age. Inappropriate complementary feeding practices (e.g. too early or too late introduction of complementary foods or inadequate composition of weaning foods) may aggravate the magnitude of stunting(Tessema, *et al*, 2013, p1). Stunting as a chronic undernutrition indicator is due to multifactorial causes from contextual factors to underlying and immediate causes. According

to WHO conceptual framework on Childhood, household and family factors, inadequate feeding practices during breastfeeding and complementary feeding and infections, along with community and social factors such as politics, economy, health and healthcare, education and sanitation systems to named but few, are causes of stunted child growth(Stewart CP,et al, 2013,p,2). As shown in the WHO conceptual framework of malnutrition, the causes of under nutrition are at different levels (i.e. basic, underlying and immediate causes). Basic causes include limited access to resources, inadequate capital and social-cultural, economic and political context. Underlying causes are categorized into food insecurity, care and feeding practices and unhealthy living environments. Immediate causes are inadequate dietary intakes and diseases(Tessema, et al, 2013, p1). Some of the child feeding indicators were positively or negatively associated with child nutrition status indicators(Jones *et al.*, 2014; Reinbott *et al.*, 2015). The likelihood of stunting was lower in infants 6-8 months of age who were fed varied and iron-rich solid foods in studies conducted in Bangladesh and other developing countries, whereas low food diversity was associated with increased incidence of stunting(Rah *et al.*, 2010).

1.3. PROBLEM STATEMENT

There is a comparable growth rate among fully breastfed infants in developing countries with that of the infants in developed countries during the period of the first 4-6months of life(Jones et al. 2014.p1). However, thereafter infants in developing countries start deviating from that satisfactory pattern of growing after this period due to lack of some nutrient such as dense complementary foods(Jones et al., 2014,)(Heidkamp et al. 2015,p815). The situation on complementary feeding practices in Rwanda is not documented. The available report provides limited information on knowledge of care providers (MoH 2014, p6), or to among HIV-exposed children (Condo et al. 2015,p17-23). Both reports do not elaborate on complementary feeding practices among ordinary children or on feeding practices indicators and on quality/ quantity of what caretakers provide to their kids. Additionally, the report investigated did not investigate if a relationship between feeding practices and childhood malnutrition, especially delayed linear growth exist. This is a knowledge gap that this study is intended to address.

1.4. RESEARCH OBJECTIVES

1.4.1. OVERALL AIM

The aim of the study is to identify if associations exists between complementary feeding practices and stunting among 2-year old children and under in Rwanda.

1.4.2. OBJECTIVES

- To determine the proportion of stunted children aged 2 years and below in Rutsiro district

- To describe complementary feeding practices adopted by mothers / caregivers of children aged 2 years and below in Rutsiro District

- To identify if there is an association between complementary feeding and stunting among children aged 2 years and below in Rutsiro district

- To identify other factors associated to stunting

1.5. RESEARCH QUESTIONS

- What proportion of children aged 2 years and below in Rutsito district is stunted?
- What are the current feeding practices adopted by mothers / caregivers of children aged 2 years and below in Rutsito district?
- Are complementary feeding practices associated with stunting among children aged 2 years and under in Rutsito District?
- What other factos are associated with stunting among children aged 2 years and below in Rutsito District?

1.6. SIGNIFICANCE OF THE STUDY

Stunting is a longitudinal nutritional problem associated with lifelong consequences (UNICEF 2013,p12-22). Under 5 years malnutrition requires a rapid and continuing intervention counting early detection and effective management. To put a stop to nutrients deprivation that results to stunting, efforts should focus on dual maternal- Child nutrition starting from conception period to 2 years of child age. the mentioned period is commonly known as "thousand days window of opportunity"(UNICEF 2012,p3-59). Furthermore the continuous screening to prevent stunting, nutrition plans must assure that maternal nutrition, infant, and young child feeding practices are optimal as much as possible(Bhandari et al. 2008, p5-23). In addition, this assumes that food security is guaranteed. However, even if nutrition is a crosscutting issue, DHS documented surprising results on malnutrition showing the north province among those where children are undernourished when it appears among reach region of the country(NISR, 2010, p149). Such results dictate that besides food security there are additional factors associated with malnutrition and among them cultural and behavioral factors (Caulfield et al. 2002, p552).

As examples, the most recent research by United Nations Children Funds (UNICEF) supported the Ministry of Health (MoH) on Knowledge Attitude and Practice (KAP) on Early Nurturing of Children, documented that as few as 22% of the study participants had

knowledge about the appropriate feeding practices during pregnancy with only 21% acknowledging that they practiced. Furthermore, the study informs that only 26% and 24% had knowledge of and practiced iron supplementation respectively. The knowledge and practice of exclusive breast in this study were reported to be 37% and 57% respectively while knowledge and practice of early initiation (within 1 hour of delivery) of breastfeeding are 42% and 62% respectively(MoH, 2014, p84)

However, very little is known about the role played by feeding patterns in this situation.

Therefore, this study will contribute to the existing body of nursing knowledge on how complementary feeding is done. The study will inform nurse educators on areas of emphasis in the curricula of nursing based on the identified gaps. Decision makers will also be informed in evidence-based policy making regarding complementary feeding. The study can trigger an extensive community- based intervention on complementary feeding

1.7. CONCLUSION TO THE CHAPTER ONE

This chapter presented the introduction, keys terms definitions, background, problem statement, objectives, research questions and significance of the study.

CHAPTER II: LITERATURE REVIEW

2.0. INTRODUCTION

This chapter presents a review of literature relevant to the study. it is offering an overview of what is already known on our research topic and identified research gaps that need to be addressed. the gap was translated into research objectives and questions that our study tried to answer in the study results.

2.1. THEORETICAL LITERATURE

Childhood stunting, the most prevalent form of under nutrition worldwide, contributes substantially to the overall disease burden and mortality in children (Black 2008). In 2015, an estimated 156 million children under five-years of age, globally were stunted (WHO 2015). Stunting is defined as height-for-age below 2 standard deviations from the median height-for-age determined by the World Health Organization child growth standards (WHO 2006). Previous studies have found stunting to be associated with increased morbidity and mortality, decreased neurodevelopment, irreversible cognitive deficits, low school enrolment and loss of economic productivity as an adult (Onis & Branca, 2016). Low and middle-income countries (LMIC) bear the greatest burden of stunted children worldwide representing 90% of the total (Onis *et al.*, 2013)

The causes of childhood stunting are complex, multidimensional and interrelated and include household, environmental, socioeconomic and cultural factors (Stewart 2013). Nutritional deficiencies during the first two years of life leads to irreversible damage including impaired cognitive development, decreased educational achievement, and low economic productivity (Black et al. 2008).

Recent studies suggest that stunting may begin during fetal life and be strongly linked to the prenatal period (Christian et al, 2013) An estimate of 20% of stunting is caused by intrauterine restriction and maternal under nutrition (Black et al, 2015). The period of 6-24 months of age has been identified as one of the most critical time periods of growth of the infant (Black et al, 2015).

As the most common cause of stunting is inadequate nutrition, action to be taken in its management must rely on emphasizing the 1000-day window from conception until the second birthday of the child. Research findings reveal that optimal complementary feeding is one of the best effective practices to significantly reducing stunting in the first two years of life (Issaka *et al.*, 2014). The introduction and quality of complementary feeding, which is the addition of semi-solid food to support the breast milk at 6 months, is essential for adequate linear growth. Complementary feeding should be given to the child 3 times a day and include dietary diversity (carbohydrate, legumes, fruits, vitamins even water) with a good mixture of food from both animal and plants (Rocky *et al.*, 2016).

This figure is helped in explaining the trajectoire of stunting from conception to 2 years(during 1000 days)
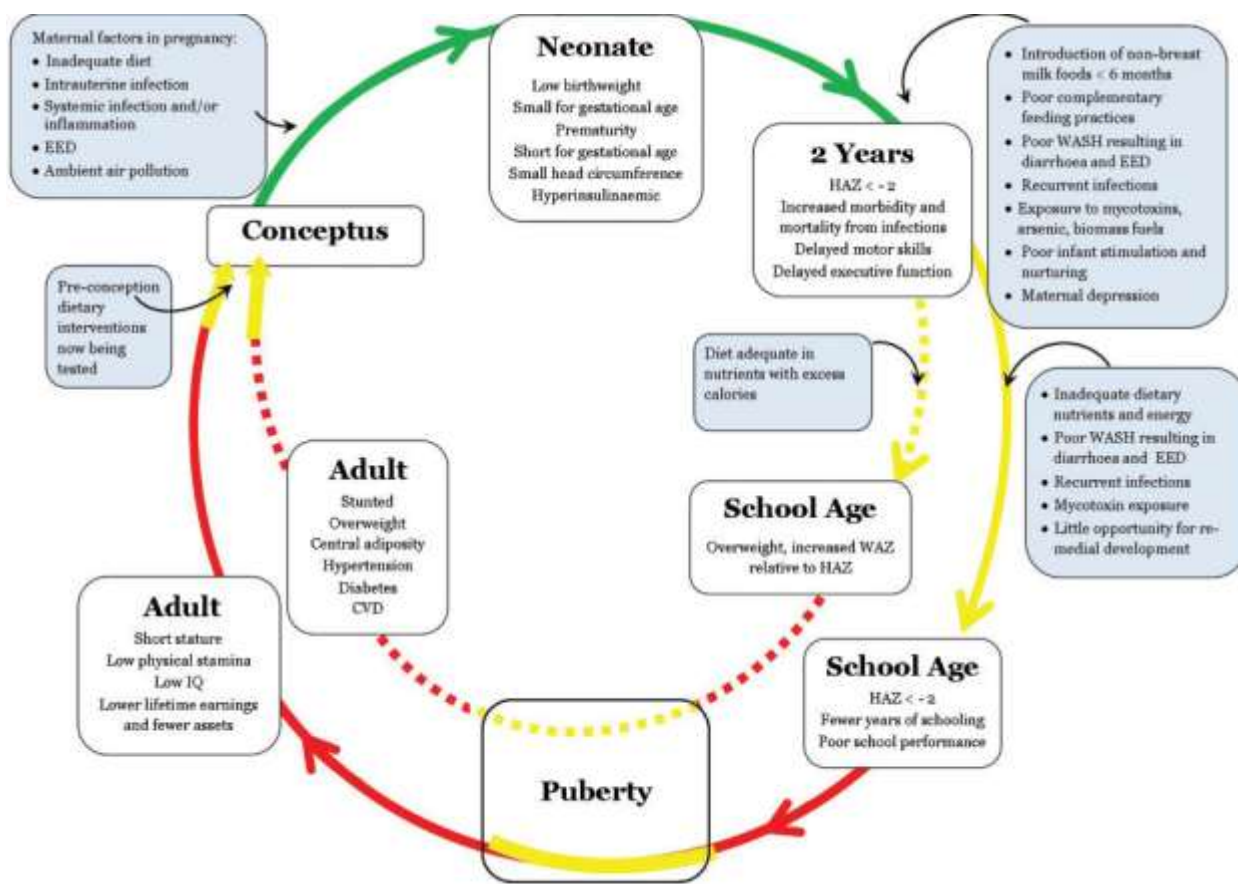
Figure 1. The stunting syndrome.

Source: (Onis *et al.*, 2013)

2.3. EMPIRICAL LITERATURE

2.3.1. UNDERNUTRTION IN DEVELOPING COUNTRIES

Thirty percent of children in developing countries are stunted with physical growth delayed at height more than 2 standards deviation below global standard. Annual Report of UNICEF

found 30-40% prevalence of stunting in sub- Saharan Africa which may vary according to country or Region, According to the 2016 Global Nutrition Report", the prevalence of stunting in Mozambique in children under 5 years is still high at 43.3%, underweight 19% and wasting 5.9% (Cruz *et al.*, 2017 p2)

2.3.2. BREASTFEEDING

According to the WHO, the lives of 800,000 children, under 5 years of age, could be saved every year if all children 0–23 months were optimally breastfed (WHO, 2015p2). The benefits of optimal breastfeeding impacts child health during the newborn, infancy and early childhood period resulting in improved cognitive ability, school attendance, and higher income in adult life (WHO 2009). Previous research has found that children who are breastfed in the first six months of life have a six times greater chance of survival as opposed to non-breastfed children (UNICEF 2009).

The importance of breastfeeding during the first 23 months of life was demonstrated by Sankar et al. (2015) in a systematic literature review to evaluate the effects of optimal breastfeeding on all-cause and infection-related mortality in infants and children aged 0-23 months. Results indicated that children aged 6–23 months who were not breastfed had higher risk of all-cause and infection-related mortality than children who were continued on breastfeeding.

In a similar study, Lamberti et al. 2013 found that suboptimal breastfeeding increased the risk of pneumonia morbidity and mortality outcomes across age groups. Pneumonia mortality was higher among not breastfed compared to exclusively breastfed infants 0-5 months of age (RR: 14.97; 95% CI: 0.67-332.74) and among not breastfed compared to breastfed infants and young children 6-23 months of age (RR: 1.92; 95% CI: 0.79-4.68).

2 .3.3 . INADEQUATE BREASTFEEDING

Despite the well documented benefits of breastfeeding, globally rates of breastfeeding are low (WHO, 2015). The WHO estimates that only 43% of the world's newborns are put to the breast within 1 hour of birth and 40% of infants 6 months of age or less are exclusively

breastfed (WHO 2015). Inadequate breastfeeding practices include delayed initiation of breastfeeding (greater than one hour after birth) and non-exclusive breastfeeding for the first 6 months of the child's life, early cessation of breastfeeding.

Research has found a strong association between early cessation of breastfeeding and stunting due to the child not receiving the nutrients and natural human antibodies provided by human milk (Stewart *et al.*, 2013 p15)

2.3 .4. OVERVIEW OF COMPLEMENTARY FEEDING PRACTICES

The World Health Organization (WHO) recommends exclusive breastfeeding for the first 6 months of life followed by the introduction of nutritionally adequate and safe complementary foods and continued breastfeeding up to 2 years or beyond (WHO 2003). At 6 months of age, breast milk is insufficient to meet the nutritional needs and growth and development of the infant (WHO, 2010). According to the WHO, indicators of proper complimentary feeding is the starting of solid, semi-solid or soft foods in addition to breast milk at 6 months of age, minimum meal frequency, minimum dietary diversity, minimum acceptable diet, and consumption of iron-rich or iron-fortified foods (WHO, 2008). WHO defines *minimum dietary diversity* of food when child is receiving four or more of the seven food groups: 1. Grain, roots and tubes, 2. Legumes and nuts, 3. Dairy product, 4. flesh foods, 5.eggs, 6.vitamin A- rich fruits and vegetables, and 7 other fruits and vegetables (Issaka *et al.*, 2015). *Minimum meal frequency* is defined as a breastfed infant, aged 6–8 months, is fed two times a day; breastfed child aged 9–23 months is fed three times a day; and non-breastfed child, aged 6–23 months, is fed four times a day. Factors associated with ineffective complementary feeding include introduction of foods less than 4 months or greater than 6 months of age, early cessation of breastfeeding (< 6 months), frequency of complimentary food less than 3 times a day and no respect of minimum diversity meal (Egyir *et al.*, 2016p1889).

2.3.5. INADEQUATE   COMPLEMENTARY   FEEDING

Research conducted in low-income countries has identified inappropriate CF as one of the major causes of under nutrition (Victor 2014 p545). The timely initiation of CF at the 6th month of age and dietary diversity has been found to be associated with decreased malnutrition and stunting. Saaka, Wemakor, Abizari and Aryee (2015 p702), study among 1984 children aged 6–23 months in Ghana, found that children who started complementary feeding at six months of age were 25 % protected from chronic malnutrition. In this study, compliance to complementary feeding was low with 34.8 % of children receiving minimum dietary diversity (≥4 food groups), 27.8 % receiving minimum acceptable diet and only 15.7 % received appropriate complementary feeding. In a similar study in Myanmar, the introduction of complementary foods earlier than 4 months of age was a risk factor for underweight and stunting in children (Zhao et al., 2016 p702). In a study in Tanzania among 2402 children aged 6–23 months, the prevalence of minimum dietary diversity, meal frequency and acceptable diet were 38.2%, 38.6% and 15.9%, respectively (Victor et al. 2014p545).

2.3.6. DETERMINANTS OF INAPPROPRIATE COMPLEMENTARY FEEDING

 There are many barriers or obstacles to effective complementary feedings. Issaka et al. (2015p26-28) evaluated complementary feeding practices in children aged 6–23 months in the four Anglophone West African countries of Ghana, Liberia, Nigeria and Sierra Leone using Demographic and Health Surveys. Factors related to inappropriate complementary feeding included younger age of child (6 -1 1 months), lower household income, mothers had no schooling, children whose mothers perceived them to be small in size at birth and those who were delivered at home, children who had acute respiratory infection in the previous 2 weeks and whose fathers worked in a non-agricultural industry. The main factors associated with minimum dietary diversity in the four countries were: child's age, household wealth, child illness, access to the media and father's education. For minimum meal frequency and minimum acceptable diet, the main risk factors were regional differences and child's age.

In Tanzania, complementary feeding indicators and associated factors were evaluated in 2402 children aged 6–23 months using data from the 2010 Tanzania Demographic and Health Survey. (Victor et al. 2014 p545-546). Factors associated with higher risk of inappropriate CF indicators included children whose mothers did not have any postnatal check-ups, younger children (6–11 months), limited exposure to mass media such as radio and television, lower paternal education, lower household and wealth/ poor economic status.

2.3.7. EFFECT OF INAPPROPRIATE COMPLEMENTARY FEEDING

Study   conducted in Bangladesh show that inappropriate complementary feeding is most cause to increase the level of malnutrition in children under five year, this was emphasized by (Zhao *et al.*, 2016p702) in study conducted in Myanmar which revealed the importance of adequate complementary feeding during this crucial and their consequences in case of early introduction of CF where infants develop more respiratory illnesses and eczema ,also infants might be exposed on pathogenic microbes due to unhygienic manipulation(food, water..)even delay have consequences like insufficient nutrient intake as well as delays in eating behaviors and some developmental skills(motor skills)without forget continued breastfeeding which will help in vitamin A deficiency prevention. Within these and other cause like infections are responsible for one third of malnutrition cases. It was been identified that poor complementary feeding is associated directly with stunting(Stewart *et al.*, 2013 p28)

2.3.8. FACTORS RELATED TO STUNTING

2.3.8.1. HOUSEHOLD, FAMILY AND MOTHERS FACTORS

Stunting in children under 5 years of age is affected by several household environmental factors including, inadequate childhood stimulation, food insecurity, disease burden, low caregiver education, and poverty. Shinsugi et al. (2015 p5) evaluated the factors associated with stunting among children 0- 59 months according to the level of food insecurity in Kenya. Results indicated that children between 2 and 3 years old were about 3.5 times more likely to be stunted compared with those aged 0 to 5 months, animal rearing, low

socialeconomic status. Fikadu et al. (2014 p1) study in Ethiopia among children aged 24 to 59 months found the following household factors to be associated with stunting; children living in households with more than five family members; households with three under-five children; mothers worked as merchants; children who breast fed for <2 years; were exclusively breast fed for < 6 months or were bottle fed.

Maternal factors also affect childhood stunting, including maternal malnutrition, size of family and maternal mental health, age of mother. Maternal undernutrition contributes to adverse pregnancy outcomes, childhood mortality and stunting. issaka (Black 2008 p17). Neufeld et al (2004 p649) examined the relationship between changes in maternal weight from the first to second trimester of pregnancy to fetal growth and infant length at birth among 200 pregnant women in 4 rural villages in Guatemala. Results indicated that mothers of infants who were born stunted had a significantly lower mean weight and height pre pregnancy and lower rates of weight gain from the first to the second trimester than did their non-stunted counterparts. The rate of maternal weight gain from the first to the second trimester of pregnancy was a significant predictor of infant length at birth

Ozaltin(2010 p1515) conducted a similar study, analyzing Demographic and Health Surveys in 54 countries to examine the association between maternal stature and offspring mortality, underweight, stunting, and wasting in infancy and early childhood in 54 low- to middle-income countries. Results indicated an inverse association between maternal height and child mortality, underweight, and stunting.

Family size has been found to be associated with malnutrition and stunting (Cruz, 2017 p1). Children from larger families of more than 5 members are at higher risk for stunting, which is associated with financial issues as more resources are required. Families with more than one child under one year of age this expose children to stunting due to inadequate feeding practice both breast feeding and complementary feeding (Cruz *et al.*, 2017 p10).

Finlay (2011 p3) study analyzed data from the Demographic and Health Surveys of 55 low- and middle-income countries to examine the association between maternal age, infant mortality, child anthropometric failure, diarrhea and anemia for first births. Results indicated that the

First-born child of a woman less than 27–29 years of age in low- to middle-income countries,

Was at a higher risk of infant mortality, stunting, underweight, diarrhea and moderate to severe anemia

Depression and poor maternal mental health has been found to be associated with suboptimal breast-feeding and complementary feeding practices. Surkan (2011 p610) meta-analysis of seventeen studies in eleven developing countries examining the association between maternal depression and early childhood underweight found that children of depressed mothers were at an increased risk of both underweight and stunting: In northern Ghana, children from depressed mother were more likely to be stunted compared to children from mothers who were not depressed(AOR=2.48) (Wemakor *et al.*, 2016 p4)

Small for gestational age is a risk factor for stunting (Xie *et al.*, 2016 p2) . Xie et al. (2016p2) found that an infant born small for gestational age was at higher risk factor for stunting. In this study, SGA newborns with maternal inadequate gestational weight gain (BMI <18.5) had a higher risk of stunting at 5 years of age. A similar study done in low to middle countries found that maternal stature is very associated to stunting (Özaltin, Hill and Subramanian, 2010 p1515)

2.3.8.2. INFECTION

The interaction between nutrition and infection has been described as *synergistic* with infection aggravating malnutrition and malnutrition lowering resistance to infection (Scrimshaw, Taylor , & Gordon, 1968 p1582). Malnutrition causes immunosuppression which increases a child's susceptibility to infection.

Infection makes children susceptible to malnutrition by loss of appetite, reduce intestinal absorption and loss of nutrients (Katona and Katona-apte, 2008 p1583). The vicious cycle of malnutrition and infection impacts the health children worldwide, especially in low-resource countries where infectious disease are a leading cause of death for children under five years of age.

Diarrheal illness, malaria and sub-clinical environmental entropathy have been found to be associated with stunting (Checkley, 2008; Kang et al. 2013; Owino, 2016 p255). multi-country analysis of longitudinal data found that a higher burden of diarrhea prior to 24 months of life was associated with a greater frequency of stunting at 24 months of age. The reversibility of stunting was relatively uncommon within the 2 years of life with only 6% of children who were stunted at 6 months of age recovering from stunting at 24 months of age. The more days of diarrhea increased the chance of becoming stunted than a 24-month-old child with fewer days of diarrhea.

Kang et al. (2013) study in Ghana, examined the association between malaria episodes and stunted growth in 1070 infants who were recruited at 3 months of age and followed until age 2 years of age. Results indicated that the risk of stunting increased by 0.32 (p-value: 0.004) for every malaria episode.

Environmental enteric dysfunction (EED) also known as "tropical enteropathy" has been identified as playing a centra:l role in the prevalence of stunting in children living under unsanitary conditions (Crane et al. 2015 P8). EED is an asymptomatic syndrome that is widespread among children in low-and middle-income countries and associated with microbial and parasitic contamination of food related to unsafe water, poor sanitation and hygiene, exposure to feces and contact with animals. Multiple pathological changes occur in EED that contributes to growth failure includes chronic intestinal inflammation, reduced nutrient absorption atrophy of intestinal villa, inflammation in the mucosa, bacterial translocation, systemic inflammation. Studies suggest that low efficacy of oral vaccine in developing countries may be in part due to chronic gut and systemic inflammation.

This figure is helped in explaining relation or viscious cycle between infection and malnutrition
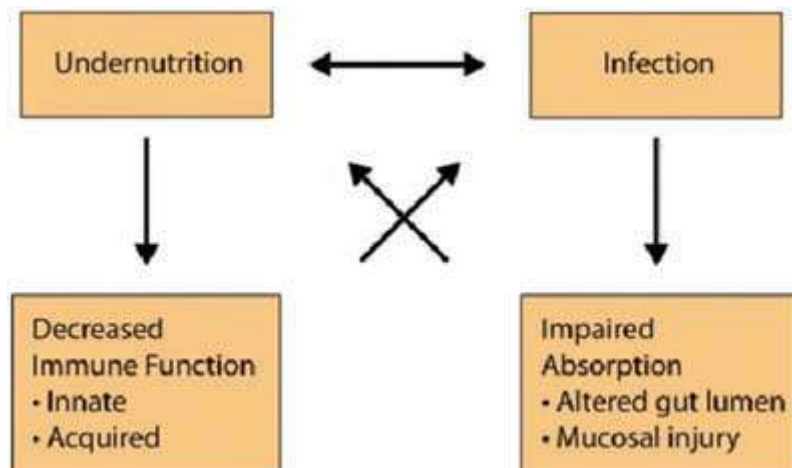
.Figure 2. Interaction between malnutrition and infection

2.3.8.3. COMMUNITY AND SOCIETAL FACTORS

2.3.8.3. A POLITICAL ECONOMY

Political stability and instability have a big impact in health outcome of population. Studies by (Stewart *et al.*, 2013 P7) found several factors related to political economy such macro or micro economic, food price and financial crises can affect household nutrition habit where poor households are more affected by lacking some nutrients(zinc, vitamin A and B12, within political program they can male social program to reduce poverty, make nutritional program ..

2.3.8.3. B HEALTH CARE SYSTEM

The current study done in 345 health centers located in a rural area in Rwanda revealed that having the community insurance known as "Mutuelle de Sante" is associated with lower risk for stunting regardless of family income (Lu et al., 2016 p49). However, the poverty was stated to be a factor associated with stunting and severe stunting in a study conducted in 2380 Nepalese children.

Study conducted in Ethiopia found that health care is in association with stunting where in the far region they observed stunted children live in 2km from the nearest health clinic than non-stunted children, the same relation was found in south Africa in term of distance (Wirth *et al.*, 2017 p8)

Although many parents believe in health care provider and would benefit from counseling related to malnutrition prevention and treatment, the shortage of health care providers makes that counseling difficult.

2.3.8.4. MATERNAL EDUCATION

Previous research has found maternal education to be strongly associated with stunting in children under 5 years of age (Abuya et al. 2011; Mokoka & Masibo, 2015; Musbah & Worku 2016 p73). Mokoka and Masibo (2015 p254) analyzed Demographic and Health Survey data from Malawi (2010), Tanzania (2009–10) and Zimbabwe (2005–06) to evaluate the association between stunting and maternal education. Stunting was significantly associated with mother's educational level in all three countries with higher levels of maternal education reducing the odds of child stunting. In Ethiopia, a similar study among children less than five years of age, found mothers who completed secondary school and above were 52% less likely to have a stunted child than mothers who had never attended any formal schooling (Musbah and Worku, 2016 p73). Abuya et al., (2011 p2) study in Kenya found that children born to mothers with primary education were at 94% lower odds of having stunted growth compared to mothers with no primary education (p <0.01).

2.3.8.5. ENVIRONMENTAL   FACTORS

Globally and in some countries like, sub Saharan,   South Asia, East Asia , pacific region where environment risk is   the second cause   leading of stunting related to poor water sanitation, poor sanitation conditions, and use of solid fuel) (Danaei *et al.*, 2016 p2). The study by (Saxton *et al.*, 2016 p869) revealed a method to reduce stunting is promoting hand washing and accessibility of sanitation and water. This finding was emphasized in a study conducted in Indonesia   in which high prevalence of stunting was found   in family with household with improved latrine even drink untreated water.(Torlesse *et al.*, 2016)

Danaei et al. (2016 p7) assessed risk factors for childhood stunting in 137 developing countries. Findings indicated that the three leading risk factors for stunting worldwide were 1) infant was small for gestational age; 2) poor sanitation; 3) and diarrhea. In South Asia, sub-Saharan Africa, East Asia and the Pacific, environmental risk factors (i.e. poor water quality, poor sanitation, and use of solid fuels) had the second largest impact on stunting.

2.3.9. CONSEQUENCES   OF   STUNTING

There is a strong evidence that stunting has both short and long term consequences on growth and development of child

2.3.9. 1. A SHORT   CONSEQUENCES

Increased morbidity and mortality from infections, particularly pneumonia and diarrhea is a short-term consequence of stunting (Penddergast 2014).

Stunting have many negative impact on the health of children, anthropometric measures are low comparing to others where there is no correlation between the age and height of child, poor growth development

Poor nutrition and frequency infections which may worsen the nutritional status and increase also infection susceptibility it become like a vicious cycle, in case of infection nutritional status is   impaired   by reducing appetite, impaired intestinal absorption,

catabolism increased and direction of nutrient away from growth and immune system and malnutrition also increase the risk of infection by its negative impact on the epithelial barrier function and immune function(Stewart *et al.*, 2013 p31) also developmental problems like poor psychomotor and mental development(Stewart *et al.*, 2013 p31)

In addition , it has been detected in early life the high prevalence of stunting and hypertension in children and adolescent, stunting may be also a risk factor of childhood changes in metabolic syndrome, Biologically it has been found that individual with stunting showed a significantly higher prevalence of altered HDL- Cholesterol, lower means of waist circumference at age 23 years.(Grillo *et al.*, 2016 P551)

2.3.9. 2. A LONG –TERM CONSEQUENCES

Children with stunting suffer a lot in their life, mostly when it occur in the first 2 years in later time , they are at risk for poor job productivity, reduced intellectual performance, (Huicho *et al.*, 2017 P2) In addition to this other report done by (Heymsfield and Stevens, 2017 P2) found that stunting extend far beyond short stature and include impairments in brain development, cognitive function, school performance, and work force in capabilities.

Those consequences was emphasized by (Danaei *et al.*, 2016 P2) where they said that stunting have poor outcome in health like cognitive development, and educational and economic attainment later in life.

Many obstetrician complications may happen due to short mothers or stunted who are at risk for obstructed labour , asphyxia at birth for example in Nepal stunted mothers had a 50% increased risk of having a baby with symptoms of birth asphyxia(Stewart CP, Lannotti L, Dewey KG, 2013)(Stewart *et al.*, 2013)

2.4. CRITICAL REVIEW AND RESEARCH GAP IDENTIFICATION

Stunting is worldwide burden, second cause of death of under 5 children, high prevalence in developing countries especially those with political instability, it is associated with poor

nutrition diet intake. Enhancing effective nutrition both breastfeeding and complementary feeding and reducing associated infections are the only way for preventing stunting.

complementary feeding practices have been discovered in many studies especially inadequate complementary feeding , relationship between complementary feeding and stunting however most of them were cross sectional study, better have longitudinal studies during 1000days of children's life for assessing adequate nutrient adaptation individually, family and community

There is limited scientific data on complementary feeding practices and its relation to the nutritional status of children aged 6-23 months old in East Africa countries. Most of the studies have focused on breastfeeding practices (Zambrano, 2017)and (Muchina, 2010) while few studies (Issaka *et al.*, 2015)focused on complementary feeding.

2.5. CONCEPTUAL FRAMEWORK(RELATE IT TO THE STUDY)
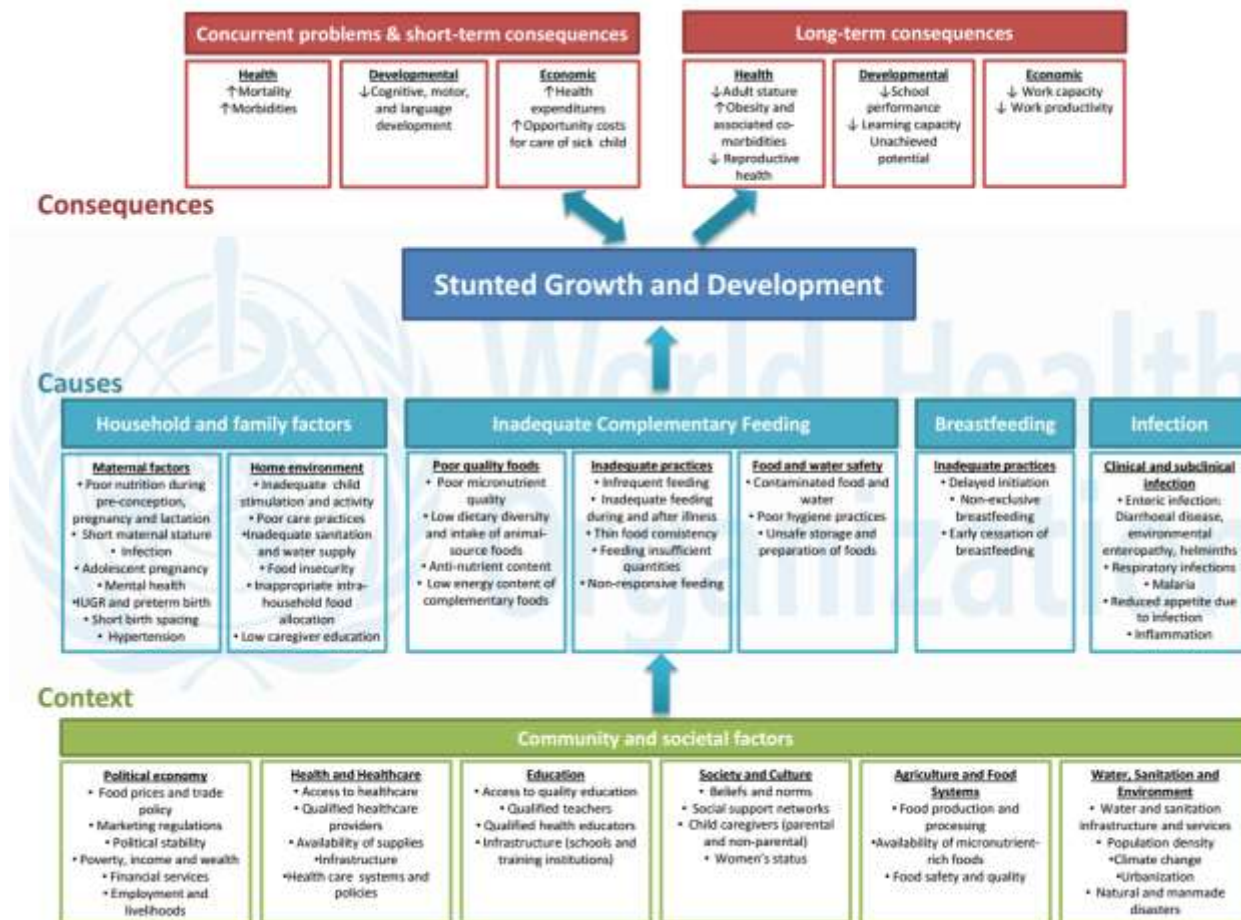
Figure 2Contextualized complementary feeding in a broader framework for stunting prevention(Stewart et al. 2013,p29)

2.6. CONCLUSION TO CHAPTER 2

This chapter presented the literature review of study, it concluded   the theoretical and Empirical literature, conceptual framework and gap in literature review.

CHAPTER III: METHODOLOGY

3.1. INTRODUCTION

the chapter three is describing the research process from the design,

3.2. STUDY DESIGN AND AREA

This study was basing on secondary data analysis of "effects of environmental enteropathy on stunting among under 5 years children in Rwanda Case of Rutsito". The original study was a health center based cross sectional study conducted in 3 health centers located in Rutsito district namely, Crete Congo Nil, Kivumu and Kayove.

3.3. POPULATION

This study was interested in the 2 years old children and below who are under growth monitoring at afrementioned health centers.

3.4. SAMPLE AND SAMPLING STRATEGIES

This study involved 362 participants. The sample was selected from a list submitted by the Community Health workers to health centres mentioned above. From the list, researchers applied a systematic sampling by selecting a child out 4. The sampling process continued up to the completion of the sampling size

3.5. DATA COLLECTION TOOL (AVAIL SAMPLE OF TOOL IF POSSIBLE)

Data in this study were collected using a standarsied questionnaire, covering household characteristics, nutrtion , water and sanitation. From the child side, anthropometric measurements were done and other biological samples. (for this study we used anthropometric measurements and data from the questionnaire only)

3.6. DATA MANAGEMENT AND DISSEMINATION

Data collected for the purpose of the ovarall study are kept within the UR standards. and results will be dissemiated through international conferences, publication and seminors.

3.7. LIMITATION AND CHALLENGES

This is a secondary data analysis researchers were not aible to ask more questions (we used what database offered only). This is a cross sectional study therefore we can not claim for causal relationship. our study was conducted in one distcict, therefore exteranl validity to the whole country is limited**.**

3.8. DATASET AND MEASUREMENTS

EE database had different variables measured using the Food Frequency Questionnaire and the Household Food Security Questionnaire. These instruments are valid, reliable and widely used tools that are recommended by WHO. For the purposes of this study, extracted data focused on variables related to Young Feeding indicators (IYCF).

3.9. FEEDING PATTERN INDICATORS

The WHO distinguish optimal infant feeding by availing core and optional feeding practice indicators for assessing the adequacy of Infant and Young Child Feeding (IYCF) practices(WHO 2008,p6). These indicators included early initiation of breastfeeding, Exclusive breastfeeding (EBF) under-6 months, and continued breastfeeding at 1 year, the introduction of solid, semi-solid, or soft foods, minimum dietary diversity, minimum meal frequency, minimum acceptable diet, and bottle feeding(WHO 2008,p6). The sub-optimal feeding practice was defined as compliance deviation to any of these recommended practices.

3.10. DATA ANALYSIS

Additionally, Descriptive statistics was summarized in frequency tables for categorical variables. To test for the main research question a bivariate analysis with Chi-square test was computed. To answer our main research question a multiple logistic regression was computed.

3.11. ETHICAL CONSIDERATIONS

The whole project was approved at Ministry of Health and IRB at University of Rwanda, permissions were secured from administrative authorities in Rutsito District and all participants signed consent forms prior to participation.

As this was a secondary data analysis we applied for secondary data analysis and the permission was granted.

3.12. CONCLUSION TO CHAPTER 3

This chapter presented the methodology of research including research design, research approach, research setting, sample size, procedure, data analysis, ethical considerations.

CHAPTER FOUR: RESULTS

4.1. INTRODUCTION

This chapter is presenting the results and it is starting with descriptive analysis continued with univariate analysis on factors associated with stunting.

4.2**. Background Characteristics**: Results on socio-demographic characteristics of the participants are summarized in table 1. According to the table above half of the participants were married woman (60.1%) who attended or not primary education (64.9%) in age range between 25to 34 years (55.2%) and attended less than 4 times antenatal care (52.1%). with regard to maternal employment , the majority of the participants (93.5%) are not employed.

Table 1. Socio-demographic characteristics

	N	Percentage
Maternal employment status		
Not employed	330	93.5
Employed	23	6.5
Maternal education		
Primary and less	229	64.9
Secondary and above	124	35.1
Secondary and above		
Mother's age		
15-24 years	66	18.7
25-34 years	195	55.2
35-49 years	92	26.1
Marital status		
Currently married	212	60.1
Cohabitant	116	32.9
Single	25	7.1
Attended ANC		
Less than 4 times	184	52.1
At least 4 times	169	47.9

4.3. Water and sanitation: Results on household characteristics are depicted in the table 2. According to the results household from which participants came from experienced moderate hunger (49.9%) and severe hunger (5.7%). household without hunger represented 44.5%.

Results on wealth category show that half of the participants are in the second wealth category (50.1%) followed by those in the third category (21.8%). participants in the first category represented 28%. with regard to water and sanitation, results show that half of the household use water from protected source while 47.1% are still using water from unprotected source. with regard to toilettes 63.3% of the household use improved latrine while 36.5% are still using unimproved toilettes. 75.9% are not using shared toilettes. 62.3% of the participant treat drinking water (mostly boiling). results on child hand washing shows that 57.2% of the participants wash hands of their kids after defecation. results on stool disposal showed that 53.3% of the participants are disposing children stool unsafely.

Table 2. Water, Sanitation and Household Characteristics

	N	Percentage
Household Hunger		
Little hunger (no hunger)	157	44.5
Moderate hunger	176	49.9
Severe hunger	20	5.7
Wealth category		
Category 1	99	28
Category 2	177	50.1
Category 3	77	21.8
Source of drinking water		
Unprotected	167	47.3
Protected	186	52.7
Type of toilette		
Improved	224	63.3
Not improved	129	36.5
Shared Toilette		
Shared	85	24.1
Not shared	268	75.9
Drinking water treatment		
Treated	220	62.3
Untreated	133	37.7
Washing station		
Yes	28	7.9
No	325	92.1
Child hand washing		
After the child has defecated	202	57.2
Before feeding	151	42.8
Stool disposal		
Safe disposal	165	46.7
Unsafe disposal	188	53.3

4.4 **Childhood morbidity:** Results on child characteristics and childhood morbidity are summarized in table 3. Results showed that above half of the children in the study were female (55.5%) and majority were aged between 9 to 24 months (87.8%.). results on the morbidity inform that 36.6% of the children had diarrhea within 2 weeks preceding the data collection, 47% had fever, 24.4 were vomiting and 64 coughed .

Table 3. child characteristics and morbidity		
	N	Percentage
Sex of child		
Male	157	44.5
Female	196	55.5
Stunting stutas		
Stunted	114	32.3
Not stunted	239	67.7
Age of the child		
0-5 month	11	3.1
6-8	32	9.1
9-24months	310	87.8
Diarrhea		
Yes	130	36.6
No	223	63.2
Fever		
Yes	166	47
No	187	53
Vomiting		
Yes	86	24.4
No	267	75.6
Cough		
Yes	226	64
No	127	36

Results on complementary feeding are depicted in table 3. According to the table 60.1% of the participants in the study fed their children with cereals/tubers food groups. Pulse and nuts were provided in 70.4% of the case while only dairy product was provided in 22.8% of case.

While fresh food (and meat) was given to children in 17.7% of the case eggs were given in 1.7% of the case. The group of food rich in vitamin A category together with Fruits and vegetables were fed in 2.3% of the case. In this study participant who managed to feed their children with the Minimum Dietary Diversity represented 4.8%. Micronutrients supplements known as (MNPs) was, fresh food fed to children by 68.3% of the participants

Table 3. Complementary feeding   practices

	N	Percentage
Cereal and tubers group		
No	140	39.9
Yes	211	60.1
Pulse and nuts		
no	104	29.6
Yes	247	70.4
Dairy products		
No	271	77.2
Yes	80	22.8
Fresh food(meats)		
No	289	83.3
Yes	62	17.7
Eggs		
No	345	98.3
Yes	6	1.7
Vitamin A group		
No	343	97.7
Yes	8	2.3
Fruits and vegetables		
No	343	97.7
Yes	8	2.3
Minimum dietary diversity		
No	334	95.2
Yes	17	4.8
Micro nutrients powder (ongera)		
Yes	241	68.3
No	112	31.7

The results on the factors associated to stunting are depicted in table 4a and inform that attending factors like antenatal care (Chi-square 3.82, p≤.033), household hunger (Chi-square 10.812, p≤.004) and wealth index (Chi-square 10.812, p≤.004)

Table 1Table 4a: Bivariate analysis on factors associated stunting among 2 years children and under

	Stunted (%)	Not stunted (%)	Chi-square	P-value
Woman employed			.070	.792
Not employed	106(32.1)	224(67.9)		
Employed	8(34.8)	15(65.2)		
Maternal education			.820	.455
Primary school and less	73(31.9)	156(68.1)		
Secondary school and above	41(33.1)	83(66.9)		
Age of the mother			4.914	.086
15-24 years	21(31.8)	45(68.2)		
23-35 years	55(28.2)	140(71.8)		
36-49 years	38(41.3)	54(58.7)		
Marital status			1.988	.370
Married	69(32.5)	143(67.5)		
Staying with partner	40(34.5)	76(65.5)		
Single mother	5(20)	20(80)		
Attended ANC			3.82	.033
Less than 4 times	68(37)	116(63)		
At least 4 times	46(27.2)	123(72)		
Household Hunger			10.812	.004
Little hunger (no hunger)	32(22.4)	111(77.6)		
Moderate hunger	73(39)	114(61)		
Severe hunger	9(39.1)	14(60.9)		
Wealth category			10.812	.004
Wealth category 1	59(48.8)	62(51.2)		
Wealth category 2	34(21.4)	125(78.6)		
Wealth category 3	21(28.8)	52(71.2)		

Other factors associated to stunting are presented in table 4b. And according to the results factors like source of drinking water (Chi-square 16.036, p≤.001) type of toilette (Chi-square 130.556, p≤.001) stool disposal (Chi-square 13.804, p≤.001), Minimum Dietary diversity (Chi-square 8.371, p≤.004) and use of micro nutrients supplements (MNPs) (Chi-square 8.371, p≤.004)

Table 4b: Bivariate analysis on factors associated stunting among 2 years children and under

	Stunted (%)	Not stunted (%)	Chi-square	P-value
Source of drinking water				
Protected	84(45.2)	102(54.8)		
			P.VALUE	
Unprotected	30	137(82)		
Water treatment			16.036	.000***
Treated (boiling)	54(24.5)	166(75.5)		
Not treated	60(45.1)	73(54.9)		
Having washing station			.740	.262
Yes	7(25)	21(75)		
No	107(32.9)	218(67.1)		
Child hand washing			.264	.344
Before feeding	51(33.8)	100(66.2)		
After defecation	63(31.2)	139(67.7)		
Type of toilette			130.556	.000***
Improved	24(10.7)	200(83.3)		
Not improved	90(69.8)	39(30.1)		
Stool disposal			13.804	.000***
Safe disposal	37(22.4)	128(77.6)		
Unsafe disposal	77(41)	111(59)		
Minimum Dietary Diversity			8.519	.004**
No	114(33.9)	222(66.1)		
Yes	0	17(100)		
Use of micronutrients Powder			8.371	.004**
Yes	66(27.4)	175(72.6)		
No	48(42.9)	64(57.1)		
N= 353, outcome : stunting , *p<0.05, ***p<0.001				

To identify independent predictors, a multiple logistic regression was computed and results are presented in the table 5. Household with severe hunger are more likely to have stunted children compared to those with moderate hunger (OR: .450, CI: .276; .736, p≤.001). with regard to wealth category participants in Wealth category 1 (which represent the poorer) are 3 times higher at risks of having stunted children compared to those in wealth category 3 (which represent rich household) (OR: 3.49, CI: 2.079, 5.887, p≤.001). for the water source ,

household were people are still using water from unprotected source are nearly 4 times higher at risk of having a stunted child compared to those who use water from protected source (OR: 3.761, CI: 2.761, 6.135, p≤.001). the same applies with water treatment participants who don't treated drinking water (boiling) are 2.5 times at risk of having a stunted child compared to those who boiled water (OR: 2.527, CI: 1.596; 3.999, p≤001). Results related to the type of toilettes inform that participants who don't use improved toilette are several times higher at risk of having stunted children compared to those who use improved toilettes (OR: 19.2, CI: 10.23; 33.87, p≤.001). The other factor is the stool disposal whereby unsafe disposal was associated to 2 times higher at risk of having a stunted child compared to those who safely hand child 'stools.

Results on complementary feeding inform that participants who did not manage to feed their children with Minimum Dietary diversity are nearly 2 times at risk of having stunted children compared to those who managed to provide Minimum Dietary Diversity (OR: 1.50, CI: 1.003, 1.560, p≤.023). the same appliers for MNPs , woman who failed to feed their children with Micronutrients Powder are 2 times at risk of having stunted children compared to woman who did (OR: 1.989, CI: 2.761, 6.135, p≤.001).

Table 5: Multiple logistic regression model for factors associated to stunting

	OR	95% CI	p-Value
Household Hunger			
Severe hunger	1		
Moderate hunger	.450	[.276,.736]	.001**
Little or no hunger	.448	[.178, 1.131]	.0.085
Wealth category			
Wealth category (3)	1		
Wealth category (1)	3.49	[2.079, 5.887]	.000***
Wealth category (2)	2.35	[1.268, 4.378]	..007**
Water source			
Protected	1		
Unprotected	3.761	[2.761, 6.135]	.000***
Water treatment			
Treated	1		
Not treated	2.527	[1.596, 3.999]	.000***
Toilette type			
Improved	1		
Not improved	19.231	[10.231, 33.872]	.000***
Stool disposal			
Safe disposal	1		
Unsafe disposal	2.400	[1.504, 3.829]	.000***
Minimum Dietary Diversity			
Yes	1		
No	1.50	[1.003, 1.560]	.023*
Feeding with micronutrients powder			
Yes	1		
No	1.989	[1.244, 3.179]	.004**

4.2. CONCLUSION   TO CHAPTER FOUR

Chapter presented findings, into differents tables and their interpretations.

CHAPTER FIVE: DISCUSSION, summary , conclusions and Recomandationnns

5.1. INTRODUCTION

This chapter discusses the study findings as related to available country context literature. A summary of the findings and conclusions are also presented. Finally, the chapter presents the recommendations formulated to researchers, policy makers, nursing community and other partners in health.

5.2. CURRENT FEEDING PRACTICES

The study informed that mothers (caregivers) who managed to provide animal sourced diet were less than 50% for all animal-sourced food. In another area, above half of the participants gave their kids cereals/tubers food groups. Our results might be suggesting that households has limited resources to purchase animal sourced food which seems to be unaffordable for many as this was suggested in the literature(Issaka *et al.*, 2014). Additionally, the results showed that only 4.8% of the woman (caregivers) afforded to feed their kids with the minimum dietary diversity which mean that the variety of the diet is limited in many households which is in line with the findings from other studies from developing countries (Rocky *et al.*, 2016).

In the context of fighting against malnutrition and stunting in particular , The government initiated a program providing Micronutrients Nutrients Powder(MNPs) for the mothers who have under five years children, however, only 68.3% meaning that some woman does not give the supplements to their kids as a consequence of rumors surrounding the distribution MNPS (Issaka *et al.*, 2014).

5.3. FACTORS ASSOCIATED WITH STUNTING

In this study 32.2 % of the children were stunted and this was a bit less to national figure on stunting prevalence reference). In this study, a number of factors were identified as independent determinants associated with stunting. starting with complementary feeding, results showed that the Minimum Dietary Diversity was associated with stunting and results

suggest that the more the Minimum Dietary Diversity if offered, the less the prevalence of stunting and it is the same case for MNPs which is in line with literature that started that : Inappropriate feeding practice increases risk of under nutrition(Beyene, Worku and Wassie, 2015, p1). additional factors identified is Household hunger where families whoexperience food insecurity are the ones to have undrnourshed kids and was found in others studies.severe hunger are more likely to have stunted children compared to those with moderate hunger and this suggest that stunting as a chronic malnutrition resulted from repetitive poor food intake due to household inability to provide adequate food as it was found in other studies(Psaki *et al.*, 2012, p2-11). it is in the line with findings on wealth category, whereby participants from the lowest wealth category are have more stunted cases which actually might be reflecting their difficulties in accessing food.

This study found as well that availability of drinking water, type of toilette and stools disposal were negatively associated with stunting among children which mean that the more the drinking is cleaned, the more the toilettes are improved and the more stools are safely disposed the less the stunting prevalence. Such results suggests that children who are in the mentioned situation are exposed t repetitive infections and   the literature suggest that repetitive infections interact with nutrition through the complex cascade of diarrhea, malabsorption, loss of appetite, diversion of nutrients for the immune response, and urinary nitrogen loss, all of which lead to **nutrient** losses and further damage to defense mechanisms and reduced dietary intake as it is explained in the literature (Katona and Katona-apte, 2008, p1).

5.5. SUMMARY OF FINDINGS KEYS FINDINGS

In this study, participants (mothers) were unemployed married woman with lower level of education and where from household which belongs to the lower wealth category and have limited access to the food as it was shown by the household hunger levels.

The study revealed as well that many participants are still drinking untreated water from unprotected source. Some of the participants are still using unimproved shared toilettes and do not apply is a safe stools disposal.

With regard to complementary feeding, results show that few participants were able to provide animal sourced food to their kids and this affect their ability to provide the minimum dietary diversity.

Results on factors associated with stunting, the study informed that being in low wealth category affect the access to quality food and hence expose children to stunting. Furthermore, the study informed that the quality of toile, quality of drinking water , the way mothers dispose the stool of their children negatively affect the child linear growth and the association might be mediated by the repetitive infections. lastly the study found that complementary feeding especially meeting the minimum dietary diversity and providing the MNPs affect the child linear growth.

5.6. Conclusions

From the results, it is concluded that stunting among children is a complex phenomenon resulting from direct or indirect causes varying from poor access to food which lead to inadequate complementary feeding especially the inability of the families to providing dietary diversity. Other root causes are infection mediated whereby repetitive infection from the poor quality of drinking water, adequate sanitation and poor hygiene lead to gastrointestinal infection which interfere with nutrients absorptions or decrease immunity and expose to new infections and hence to low appetite and end up in malnutrition.

5.7. Recommendations

From the results of this study the following recommendation are formulated to:

Decision makers (Ministry of Health and partners)

Stunting is still a matter of concerns, and a crosscutting issues. Therefore, it is recommended that the MoH should work with other partners (Ministry of Local Governments and district of Rutsiro) to improve socioeconomic status of the population as this would ease the access to food.

Additionally, the ministry of health in partnership with ministry of infrastructure, and district of Rutsiro , should work hand in hand to improve water and sanitation infrastructure in Rutsiro district.

The Ministry of health through the community health workers and nursing staff working close to community should benefit refresher course on stunting and help them in promoting water sanitation and hygiene in the population.

1. MOH continue to delivery different message regarding malnutrition, complementary feeding through social media.

2. Community health workers should emphasize on home visit, family with children under 5years by assessing anthropometric measures, pregnancy women with continuous health education.

3. Local authorities and community health workers to emphasize on Akarima k igikoni, ibimina, umugoroba w'ababyeyi by introducing topics related to nutrition, hygiene, sanitation and complementary feeding practices,

4. Local authorities to emphasize and distribute Girinka munyarwanda to poor family and share milk from those without to help children to gain some animal products

5. The ministry of agriculture and veterinary should sensitize households in Rwanda on innovative and cost-effective agricultural and livelihood strategies, for example, Akarima kigikoni to facilitate easy access of vegetables and fruits which will in turn improve micronutrient intake and dietary diversity of the children.

6. Local Authorities should sensitize the population to listen some emission like Urunana where there is educative message

6.2.2 . Recommendations for research

The following suggestions are made for the further research:

1. A longitudinal study on feeding practices should be conducted throughout 1000 days to rule out effective feeding practices , individual adaptation and growth patterns

2. A Big study should be in done in country to determine the quantity and quality of dietary intake in children with same age ,similar conditions and different regions to establish the adequacy of nutrients intake of the diet. This will allow for comparison between actual dietary intake and common factors associated to stunting.

REFERENCES

Allen, L. H. (2012) 'Global dietary patterns and diets in childhood: Implications for health outcomes', *Annals of Nutrition and Metabolism*, 61, pp. 29–37. doi: 10.1159/000346185.

Amare, D., Negesse, A., Tsegaye, B., Assefa, B. and Ayenie, B. (2016) 'Prevalence of Undernutrition and Its Associated Factors among Children below Five Years of Age in Bure Town , West Gojjam Zone , Amhara National Regional State , Northwest Ethiopia', *Hindawi Publishing Corporation Advances in Public Health*, 2016.

Beyene, M., Worku, A. G. and Wassie, M. M. (2015) 'Dietary diversity, meal frequency and associated factors among infant and young children in Northwest Ethiopia: a cross- sectional study', *BMC Public Health*. BMC Public Health, 15(1), p. 1007. doi: 10.1186/s12889-015-2333-x.

Bhandari, N., Kabir, A. K. M. I. and Salam, M. A. (2008) 'Review Article Mainstreaming nutrition into maternal and child health programmes : scaling up of exclusive breastfeeding', pp. 5–23.

Caulfield, L. E., Richard, S. A., Rivera, J. A., Musgrove, P. and Black, R. E. (2002) 'Chapter 28 Stunting , Wasting , and Micronutrient Deficiency Disorders'.

Condo, J. U., Gage, A., Mock, N., Rice, J. and Greiner, T. (2015) 'Sex differences in nutritional status of HIV-exposed children in Rwanda: A longitudinal study', *Tropical Medicine and International Health*, 20(1), pp. 17–23. doi: 10.1111/tmi.12406.

Cruz, L. M. G., Azpeitia, G. G., Súarez, D. R., Rodríguez, A. S., Ferrer, J. F. L. and Serra-Majem, L. (2017) 'Factors Associated with Stunting among Children', pp. 1–16. doi: 10.3390/nu9050491.

Cumming, O. and Cairncross, S. (2016) 'Can water, sanitation and hygiene help eliminate stunting? Current evidence and policy implications', *Maternal and Child Nutrition*, 12, pp. 91–105. doi: 10.1111/mcn.12258.

Danaei, G., Andrews, K. G., Sudfeld, C. R., Mccoy, C., Peet, E., Sania, A., Fawzi, M. C. S., Ezzati, M. and Fawzi, W. W. (2016) 'Risk Factors for Childhood Stunting in 137 Developing

Countries : A Comparative Risk Assessment Analysis at Global , Regional , and Country Levels', pp. 1–18. doi: 10.1371/journal.pmed.1002164.

Dewey, K. G. and Begum, K. (2011) 'Long-term consequences of stunting in early life', *Maternal and Child Nutrition*, 7(SUPPL. 3), pp. 5–18. doi: 10.1111/j.1740-8709.2011.00349.x.

Egyir, B. K., Ramsay, S. A., Bilderback, B., Safaii, S. and Ramsay, S. A. (2016) 'Complementary Feeding Practices of Mothers and Their Perceived Impacts on Young Children : Findings from KEEA District of Ghana', *Maternal and Child Health Journal*. Springer US, 20(9), pp. 1886–1894. doi: 10.1007/s10995-016-1994-0.

Food and Agriculture Organization of the United Nations (1999) *The state of food insecurity in the world*. Available at: http://www.fao.org/documents/advanced_s_result.asp?FORM_C=AND&SERIES=232.

Grillo, L. P., Gigante, D. P., Horta, B. L. and Barros, F. C. F. De (2016) 'Childhood stunting and the metabolic syndrome components in young adults from a Brazilian birth cohort study'. Nature Publishing Group, 70(5), pp. 548–553. doi: 10.1038/ejcn.2015.220.

Heidkamp, R. A., Ayoya, M. A., Teta, I. N., Stoltzfus, R. J. and Marhone, J. P. (2015) 'Complementary feeding practices and child growth outcomes in Haiti: An analysis of data from Demographic and Health Surveys', *Maternal and Child Nutrition*, 11(4), pp. 815–828. doi: 10.1111/mcn.12090.

Heymsfield, S. B. and Stevens, J. (2017) 'Anthropometry : continued refinements and new developments of an ancient method', pp. 1–2. doi: 10.1109/ISM.2015.117.

Huicho, L., Huayanay-espinoza, C. A., Herrera-perez, E., Segura, E. R., Guzman, J. N. De, Rivera-ch, M. and Barros, A. J. D. (2017) 'Factors behind the success story of under-five stunting in Peru : a district ecological multilevel analysis', *BMC Pediatrics*. BMC Pediatrics, pp. 1–9. doi: 10.1186/s12887-017-0790-3.

Issaka, A. I., Agho, K. E., Page, A. N., Burns, P. L., Stevens, G. J. and Dibley, M. J. (2014) 'Determinants of inadequate complementary feeding practices among children aged 6–23 months in Ghana', *Public Health Nutrition*, 18(4), pp. 669–678. doi: 10.1017/S1368980014000834.

Issaka, A. I., Agho, K. E., Page, A. N., Burns, P. L., Stevens, G. J. and Dibley, M. J. (2015) 'Determinants of suboptimal complementary feeding practices among children aged 6-23 months in four anglophone West African countries', *Maternal and Child Nutrition*, 11(4), pp. 14–30. doi: 10.1111/mcn.12194.

Jd, P., Chandna, J., Allen, E., Linkman, K., Cumming, O., Aj, P. and Mj, G. (2017) 'Water , sanitation and hygiene (WASH) interventions : effects on child development in low- and middle-income countries (Protocol)', (3). doi: 10.1002/14651858.CD012613.www.cochranelibrary.com.

Jones, A. D., Ickes, S. B., Smith, L. E., Mbuya, M. N. N., Chasekwa, B., Heidkamp, R. A., Menon, P., Zongrone, A. A. and Stoltzfus, R. J. (2014) 'World Health Organization infant and young child feeding indicators and their associations with child anthropometry: A synthesis of recent findings', *Maternal and Child Nutrition*, 10(1), pp. 1–17. doi: 10.1111/mcn.12070.

Kathiresan, A. (2012) 'Farm Land Use Consolidation in Rwanda: Assessment from the Perspectives of Agriculture Sector', p. 45. Available at: http://www.minagri.gov.rw/fileadmin/user_upload/documents/agridocs/Farm_Land_Use_Consolidation_in_Rwanda.pdf.

Katona, P. and Katona-apte, J. (2008) 'The Interaction between Nutrition and Infection', 90024. doi: 10.1086/587658.

Kumar, D., Goel, N. K., Mittal, P. C. and Misra, P. (2006) 'Influence of infant-feeding practices on nutritional status of under-five children', *Indian Journal of Pediatrics*, 73(5), pp. 417–421. doi: 10.1007/BF02758565.

Lu, C., Mejia-Guevara, I., Hill, K., Farmer, P., Subramanian, S. . and Binagwaho, A. (2016) 'Community-Based Health Financing and Child Stunting in Rural Rwanda', *AmericanJournal of Public Health*, 106(1), pp. 49–55. doi: 10.2105/AJPH.2015.302913.Community-Based.

Lutter, C. K. (2012) 'Growth and complementary feeding in the Americas', *Nutrition, Metabolism and Cardiovascular Diseases*. Elsevier B.V, 22(10), pp. 806–812. doi: 10.1016/j.numecd.2012.07.004.

'Lyambabaje Aaa' (no date).

Marriott, B. P., White, A., Hadden, L., Davies, J. C. and Wallingford, J. C. (2012) 'World Health Organization (WHO) infant and young child feeding indicators: Associations with growth measures in 14 low-income countries', *Maternal and Child Nutrition*, 8(3), pp. 354–370. doi: 10.1111/j.1740-8709.2011.00380.x.

Ministry of Health, R. and U. R. (2014) *Knowledge , Attitudes & Practices assessment on early Nurturing of Children Report*. Kigali.

Muchina, E. (2010) 'NUTRITIONAL STATUS OF CHILDREN AGED 0-24 MONTHS IN', 10(4), pp. 2358–2378.

NISR (2010) 'Rwanda Demographyic and Health Survey', *National Institute of Statistics*.

NISR (2015) 'Rwanda Demographic and Health Survey 2014-15', *National Institute of Statistics Rwanda*. Rockville, Maryland: National Institute of statistics.

Nivers, A. N. (2014) 'Rwanda Poverty Pro le Report Results of Integrated Household Living Conditions Survey [EICV] National Institute of Statistics of Rwanda National Institute of Statistics of Rwanda, Rwanda Poverty Profile Report Integrated Household Living Conditions Sur'.

NLIS (2010) 'COUNTRY PROFILE INDICATORS Interpretation Guide', *Journal of Nutrition*, p. 1. doi: 10.1159/000362780.Interpretation.

[/./de Onis, M. and Branca, F. (2016) 'Childhood stunting: A global perspective', *Maternal and Child Nutrition*, 12, pp. 12–26. doi: 10.1111/mcn.12231.

Onis, M. De, Dewey, K. G., Borghi, E., Onyango, A. W., Blössner, M., Daelmans, B., Piwoz, E. and Branca, F. (2013) 'Orginal Article The World Health Organization ' s global target for reducing childhood stunting by 2025 : rationale and proposed actions', 9, pp. 6–26. doi: 10.1111/mcn.12075.

Özaltin, E., Hill, K. and Subramanian, S. V (2010) 'Association of Maternal Stature With Offspring Mortality, Underweight, and Stunting in Low- to Middle-Income Countries', *Journal of the American Medical Association*, 303(15), pp. 1507–1516. doi: 10.1001/jama.2010.450.

Psaki, S., Bhutta, Z. A., Ahmed, T., Ahmed, S., Bessong, P., Islam, M., John, S., Kosek, M., Lima, A., Nesamvuni, C., Shrestha, P., Svensen, E., McGrath, M., Richard, S., Seidman, J., Caulfield, L., Miller, M. and Checkley, W. (2012) 'Household food access and child malnutrition: results from the eight-country MAL-ED study', *Population Health Metrics*. Population Health Metrics, 10(1), p. 24. doi: 10.1186/1478-7954-10-24.

Rah, J. H., Akhter, N., Semba, R. D., de Pee, S., Bloem, M. W., Campbell, a a, Moench-Pfanner, R., Sun, K., Badham, J. and Kraemer, K. (2010) 'Low dietary diversity is a predictor of child stunting in rural Bangladesh.', *European journal of clinical nutrition*. Nature Publishing Group, 64(12), pp. 1393–1398. doi: 10.1038/ejcn.2010.171.

Reinbott, A., Kuchenbecker, J., Herrmann, J., Jordan, I., Muehlhoff, E., Kevanna, O. and Krawinkel, M. (2015) 'A child feeding index is superior to WHO IYCF indicators in explaining length-for-age Z-scores of young children in rural Cambodia.', *Paediatrics and international child health*, 35(2), pp. 124–34. doi: 10.1179/2046905514Y.0000000155.

Rocky, M., Chowdhury, K., Rahman, S. and Khan, M. H. (2016) 'Levels and determinants of complementary feeding based on meal frequency among children of 6 to 23 months in Bangladesh', *BMC Public Health*. BMC Public Health, pp. 1–11. doi: 10.1186/s12889-016-3607-7.

Saxton, J., Rath, S., Nair, N., Gope, R. and Mahapatra, R. (2016) 'Original Article Handwashing , sanitation and family planning practices are the strongest underlying determinants of child stunting in rural indigenous communities of Jharkhand and Odisha , M "Eastern India : a cross-sectional study', pp. 869–884. doi: 10.1111/mcn.12323.

Singh, J. P., Gupta, S. B., Shrotriya, V. P. and Singh, P. N. (2013) 'Study of Nutritional Status Among Under Five Children Attending Out Patient Department at A Primary Care Rural Hospital , Bareilly (UP)', *Scholars Journal of Applied Medical Sciences*, 1(6), pp. 769–773. Available at: www.saspublisher.co ,AAStewart, C. P., Iannotti, L., Dewey, K. G., Michaelsen, K. F. and Onyango, A. W. (2013) 'Contextualising complementary feeding in a broader framework for stunting prevention', *Maternal and Child Nutrition*, 9(S2), pp. 27–45. doi: 10.1111/mcn.12088.

Stewart CP, Lannotti L, Dewey KG, M. K. & O. A. (2013) 'Childhood Stunting : Context , Causes and Consequences WHO Conceptual framework', *Maternal and Chind Nutrition*, 9(September), pp. 27–45.

Tessema, M., Belachew, T. and Ersino, G. (2013) 'Feeding patterns and stunting during early childhood in rural communities of Sidama, South Ethiopia.', *The Pan African medical journal*, 14, p. 75. doi: 10.11604/pamj.2013.14.75.1630.

Torlesse, H., Cronin, A. A., Sebayang, S. K. and Nandy, R. (2016) 'Determinants of stunting in Indonesian children : evidence from a cross-sectional survey indicate a prominent role for the water , sanitation and hygiene sector in stunting reduction', *BMC Public Health*. BMC Public Health, pp. 1–11. doi: 10.1186/s12889-016-3339-8.

UNICEF (2012) *Nutrition in the First 1 , 000 Days*, *The State of the World's Children*.

UNICEF (2013) *Improving Child Nutrition The achievable imperative for global progress*. New York, NY 10017 USA.

Wemakor, A., Mensah, K. A., Victora, C., Adair, L., Fall, C., Hallal, P., Martorell, R., Richter, L., Sachdev, H., Barker, D., Bhutta, Z., Ahmed, T., Black, R., Cousens, S., Dewey, K., Giugliani, E., Haider, B., Kirkwood, B., Morris, S., Sachdev, H., O'hara, M., Swain, A., Sawyer, A., Ayers, S., Smith, H., Okronipa, H., Marquis, G., Lartey, A., Brakohiapa, L., Perez-Escamilla, R., Mazur, R., Gold, K., Spangenberg, K., Wobil, P., Schwenk, T., Weobong, B., Asbroek, A., Soremekun, S., Danso, S., Owusu-Agyei, S., Prince, M., Kirkwood, B., Gavin, N., Gaynes, B., Lohr, K., Meltzer-Brody, S., Gartlehner, G., Swinson, CX XZaq`T., Cummings, E., Davies, P., Cooper, P., Murray, L., Rondó, P., Rezende, G., Lemos, J., Pereira, J., Cooper, P., Tomlinson, M., Swartz, L., Woolgar, M., Murray, L., Molteno, C., Widdowson, E., Rahman, A., Harrington, R., Bunn, J., Casey, P., Goolsby, S., Berkowitz, C., Frank, D., Cook, J., Cutts, D., Black, M., Zaldivar, N., Levenson, S., Heeren, T., Meyers, A., Hurley, K., Surkan, P., Black, M., Stewart, R., Surkan, P., Kennedy, C., Hurley, K., Black, M., Radloff, L., Zhang, M., Adewuya, A., Ola, B., Aloba, O., Dada, A., Fasoto, O., Fisher, J., Mello, M., Patel, V., Rahman, A., Tran, T., Holton, S., Holmes, W., Weobong, B., Akpalu, B., Doku, V., Owusu-Agyei, S., Hurt, L., Kirkwood, B., Prince, M., Bindt, C., Appiah-Poku, J., Bonle, M., Schoppen, S., Feldt, T., Barkmann, C., Koffi, M., Baum, J., Nguah, S., Tagbor, H., Guo, N., Patel, V., DeSouza, N., Rodrigues, M., Rahman, A., Iqbal, Z., Bunn, J., Lovel, H., Harrington, H., Anoop, S., Saravanan, B., Joseph, A., Cherian, A., Jacob, K., Husain, N., Cruickshank, J., Tomenson, B., Khan, S., Rahman, A., Adewuya, A., Ola, B., Aloba, O., Mapayi, B. and Okeniyi, J. (2016) 'Association between maternal depression and child stunting in Northern Ghana: a cross-sectional study', *BMC Public Health*. BMC Public Health, 16(1), p. 869. doi: 10.1186/s12889-016-3558-z.

WHO (2008) 'Indicators for assessing infant and young child feeding practices Definitions - Part 1 Definitions', *WHO Library Cataloguing-in-Publication Data*, (november), p. 19.

WHO (2015) 'Underweight in children'. WHO, 2015.

Wirth, J. P., Rohner, F., Petry, N., Onyango, A. W., Matji, J., Bailes, A., Onis, M. De and Woodruff, B. A. (2017) 'Original Article Assessment of the WHO Stunting Framework using Ethiopia as a case study', pp. 1–16. doi: 10.1111/mcn.12310.

Xie, C., Epstein, L. H., Eiden, R. D., Shenassa, E. D., Li, X., Liao, Y. and Wen, X. (2016) 'Stunting at 5 Years Among SGA Newborns', *Pediatrics*, 137(2), pp. 1–10. doi: 10.1542/peds.2015-2636.

Zambrano, P. (2017) 'The Health , Social and Economic Impacts of Breastfeeding'.

Zhao, A., Gao, H., Bo, L., Win, N. N., Peiyu, W., Li, J. and Zhang, Y. (2016) 'Inappropriate Feeding Behavior: One of the Important Causes of Malnutrition in 6- to 36-Month-Old Children in Myanmar', *American Journal of Tropical Medicine and Hygiene*, 95(3), pp. 702–708.