Feeding, Care-giving and Behaviour Characteristics of Undernourished Children Aged between 6 and 24 Months in Low Income Areas in Nairobi, Kenya

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Abstract

Childhood undernutrition remains a public health problem in slums in Nairobi, yet little is known about current childcare practices, particularly child eating and maternal feeding behaviour and their impact on child growth. Treatment options for malnutrition in this setting involve the use of sweet, high energy ready to use foods (RUF), which have the potential to displace home foods, but few studies have assessed this. This thesis therefore aimed to quantify high-risk caring practices in children aged 6-24 months and how these vary with nutrition status. The effects of RUF on meal frequency and eating and feeding behaviour were also assessed. The programme of research was underpinned by the following research questions:

- What are the commonest modifiable risk factors for undernutrition found in children and how does this pattern vary with nutrition status?
- Do ready to use foods displace complementary foods in moderately undernourished children?
- Do ready to use foods affect eating and feeding behaviour?

Preliminary studies were carried out to test the feasibility of using observations to assess childcare practices. Caregivers of children aged between 6 and 24 months were recruited in Wagha town, a semi urban area in Lahore, Pakistan and in selected slums in Nairobi, Kenya. A structured observation guide was used to collect information on caregiver child interactions during mid-morning meals in Pakistan and lunch time meals in Kenya. A description of childcare practices in the household, specifically dietary practices, feeding behaviour and hygiene practices were assessed by asking the following questions: Who feeds the child? How is the child fed? What is the child fed and how often? What are the hygiene practices of caregivers?

Thirty meal observations, 11 in Pakistan and 19 in Kenya, were carried out in homes, while 11 meals were observed in day-care centres in Nairobi. Eating and feeding behaviours varied between cultures. Compared to caregivers in Kenya, caregivers in Pakistan offered more encouragement during meals. In Kenya, encouragement was mainly in response to food refusal and undernourished children were more likely to show aversive eating behaviour. Caregivers would respond to this behaviour by either restraining the child or simply leaving them alone. In day-care centres, laissez faire feeding was common as

children were left to feed themselves with little or no assistance. Poor hygiene practices were also common, especially in Kenya where caregivers did not wash their hands before feeding their children. Meal observations were not representative as only one meal could be observed and they were also not practical because of insecurity in the slums.

Based on these findings, a cross sectional study carried out in seven health facilities was designed. Caregivers of children aged 6-24 months were recruited from health facilities in two stages. In the first stage, undernourished children (weight for age or weight for length <- 2 Z scores or length for age <-3 Z scores) were quota sampled either from outpatient therapeutic or supplementary feeding programs based on severity and supplementation status between February and August 2015. Undernourished children were recruited from well-baby clinics during growth monitoring. Between July and August 2016 healthy children (weight for age >-2 Z scores) were also recruited from well-baby clinics at the same health facilities. For both groups, child anthropometric measurements were taken and information on sociodemographic, hygiene breastfeeding frequency, meal frequency, dietary diversity, child eating and caregiver feeding behaviour collected using a structured interview guide. Among children receiving ready to use foods, information on child interest in food, food refusal and caregiver force-feeding was also collected for both family meals and ready to use food meals.

We recruited 415 children (54.5% female), over half (58.6%) of whom were undernourished. Caregivers and their children came from disadvantaged backgrounds characterized by low parental education. They also lacked access to basic hygiene and sanitation facilities. There was no association between nutrition status and hygiene as nearly all children came from households that lacked piped water (83.6%) and shared toilets (82.9%). Compared to healthy children, undernourished children were more likely not to be breastfeeding (undernourished 11.5%; healthy 5.2% P=0.002) and to receive plated meals at a low frequency (undernourished 12.2%; healthy 26.2% P=0.002). Diets offered were mainly carbohydrate based and there was no association between dietary diversity and nutrition status.

Close to one third of children showed low interest in food 25.8% (107) and high food refusal 22.5% (93). Force-feeding was also relatively common 38.5% (155). Compared to healthy children, undernourished children were more likely to show low interest in food (undernourished 34.2%; healthy 14.0% P<0.001) and high food refusal (undernourished

30.9%; healthy 10.5% P<0.001); and their mothers were more likely to be anxious about feeding them (undernourished 20.6%; healthy 6.4% P<0.001). Within the undernourished group, 49.4% had either low interest in food or high food refusal or both. Force-feeding was common in both groups, with a non-significant trend towards more force-feeding in the undernourished infants (undernourished 41.4%; healthy 34.5% P=0.087). Children were more likely to be force-fed if they had low interest in food (odds ratio [95% CI] 3.72 [1.93 to 7.15] P<0.001) or high food refusal (4.83[2.38 to 9.78] P <0.001), after controlling for maternal anxiety and child nutrition status.

Children appeared to prefer RUF to home foods which is good for treatment compliance, but it may have a negative impact on intake of home foods. Although a single sachet of RUF appeared not to displace family meals in moderately undernourished children, actual energy intake was not measured in this study and these findings are therefore inconclusive.

Children in slum areas in Nairobi are exposed to many risk factors which puts them at risk of infection and undernutrition and provision of ready to use foods as a treatment option does not address the underlying problem. There is therefore a need for poverty alleviation strategies which will lead to improved access to hygiene facilities and better environmental conditions. Measures to improve access and utilization of safe nutritious foods as well as mother-child interactions during meals are also required. A better understanding of child care practices and underlying factors that influence them is also required for the design of effective and sustainable interventions in this setting.

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Author's Declaration

I, Antonina Namaemba Mutoro, hereby declare that this thesis, has been written principally by myself in collaboration with others as acknowledged, and that it has not been submitted in any previous application for a higher degree.

Abbreviations

CHW: Community Health Worker

CWC: Child welfare clinics

EED: Environmental Enteric Dysfunction

FAO: Food and Agriculture Organization

IDSUE: Indicator Development for Surveillance of Urban Emergencies

LAZ: Length for age Z scores

LHV: Lady Health Visitor

LNS: Lipid based Nutrient Supplement

MAM: Moderate acute Malnutrition

MCH: Maternal Child Health booklet

MUAC: Mid Upper Arm Circumference

NCHS/CDC: National Centre for Health Statistics/ Centre for Disease Control and Prevention

OTP: Outpatient Therapeutic Program

PS: Psychosocial stimulation

RUF: Ready to use foods

RUTF: Ready to use therapeutic foods

SAM: Severe acute malnutrition

SFP: Supplementary Feeding Program

UNESCO: United Nations Educational, Scientific and Cultural Organization

UNICEF: United Nations Children's Fund

USAID: United States Agency for International Development

PAHO: Pan American Health Organization

WAZ: Weight for age Z scores

WHO: World Health Organization

WLZ: Weight for length Z scores

1 Introduction and literature review

1.1 Introduction

The first 1000 days of life are characterized by rapid growth and development and are therefore critical for child survival, growth and development. Nutrition deficiencies during this period have been shown to have long term negative consequences (Victora et al., 2010, Black et al., 2013, Victora et al., 2008). Despite this knowledge, undernutrition during childhood remains a major public health problem in developing countries worldwide. Its onset is usually between ages of 6 and 18 months and it is attributed to increased energy and nutrient requirements which are not met due to either poor feeding practices, reduced intake (poor appetite) or increased nutrient losses which occur as a result of frequent illness (Shrimpton et al., 2001, Black et al., 2008b). Given the magnitude of the problem, there is a need for not only effective but also sustainable interventions.

The most recent Lancet series on maternal and child nutrition proposed a model based on the UNICEF conceptual framework, showing areas of intervention that need to be considered in order to improve infants and young child growth and development (Black et al., 2013). These areas of intervention include breastfeeding and complementary feeding, dietary supplementation for children, dietary diversification, feeding behaviour and stimulation, treatment of severe acute malnutrition and disease prevention and management. Although this framework acts as a helpful guide in identifying key intervention areas, there is a need for better understanding of the types and prevalence of risk factors as well as factors that influence their occurrence in different settings, given the wide variations across populations and context specific barriers.

This thesis explores the prevalence of risk factors present in slums in Nairobi, Kenya that can be modified at health facility level. Although the focus is on child care practices in Nairobi, preliminary studies were also carried out in Wagah town, a semi-rural area in Pakistan.

The thesis is divided into seven chapters. This chapter covers the background of the study, literature review and statement of the problem. The second chapter provides a description of preliminary studies that were carried out in Pakistan and Kenya. These studies informed the design of the main study which is described in Chapter three. The results are divided across three chapters. The first results chapter, chapter four, provides a description of socio economic characteristics of the sample and complementary feeding practices, dietary diversity and meal frequency. It explores the number and overlap of these risk factors found in individual children and how these vary between undernourished and healthy children. Chapter five provides a description of child eating and feeding behaviour in healthy and undernourished children. Chapter six focusses on undernourished children only and it provides a description of the characteristics of malnourished children and the number of risk factors found in these children. It also explores the effects of ready to use foods on meal frequency and eating and feeding behaviour. The final chapter, chapter 7, provides a summary of the findings, an integrated discussion and conclusion.

1.2 Literature review

1.2.1 Literature search strategy

Electronic searches for relevant literature were carried out in PubMed using the following search terms to identify literature on child care practices: malnutrition, undernutrition, care practices, child care, nutrition status, feeding practices, complementary feeding, responsive feeding, responsive care, psychosocial stimulation, energy regulation, energy compensation, appetite regulation, energy intake. The terms ready to use therapeutic foods, ready to use supplementary foods, supplementary feeding, malnutrition, moderate malnutrition, severe malnutrition were used to identify literature on management of malnutrition. The following limits were used: humans, English language and birth to 23 months. Other relevant studies were identified from cited references.

1.2.2 Definition and prevalence of undernutrition

Undernutrition is defined as a state of negative nutrient balance in the body, caused by lack of macro and micronutrients required for normal body function. The type of response exhibited in undernutrition is dependent on the type of nutrients that are deficient as well as the duration of the deficiency. During childhood, undernutrition affects either the timing or the intensity of growth in order to conserve energy required for vital body functions (Martorell et al., 1979). It can either be chronic if it develops over a long period of time or acute if it occurs over a short period of time but what qualifies as a long or short period is not defined (Khara and Dolan, 2014). Undernutrition usually presents as growth failure and is defined by either weight for age (WAZ), length for age (LAZ) or weight for length Z scores (WLZ) <-2 SD of the World Health Organization standards (WHO Multicentre Growth Reference Study Group, 2006). Although these anthropometric deficits are usually described as separate conditions, it is worth noting that they are not mutually exclusive. Children can present with more than one deficit simultaneously, for example a child can have both wasting and stunting (McDonald et al., 2013).

Low length for age (stunting) is an active cumulative reduction in growth that indicates failure to reach ones genetic potential for height and is the most prevalent form of undernutrition (Golden, 2009). It is estimated that 20% of stunting has in utero origin, 20% occurs in the first 6 months, 50% between 6 and 24 months and only 10% after two years (Victora et al., 2010). Joint malnutrition estimates from UNICEF, WHO and the World Bank show that although the worldwide prevalence of stunting has reduced from 39.6% in 1990 to 22.9% in 2016, approximately 155 million children remain stunted with significant regional differences in prevalence (UNICEF/WHO/World Bank, 2017) . In Asia, for example, in the past 16 years there has been a 35% reduction in stunting rates, while Africa has experienced a 17% increase in stunting. Although these figures provide a relatively good estimate of the problem, they do not represent variations that occur between and within countries.

Wasting, a reduction or loss of body weight in relation to height, is defined as weight for height <-2SD of the WHO growth standards and or Mid Upper Arm Circumference (MUAC) < 12.5 cm (WHO Multicentre Growth Reference Study Group, 2006, WHO/UNICEF/WFP, 2014). Wasting implies recent and severe weight loss because of either starvation or illness, but it may also reflect chronic unfavourable conditions and is also referred to as acute undernutrition. Worldwide, approximately 52 million children are wasted many of whom live in Asia (69%) and Africa (27%) (UNICEF/WHO/World Bank, 2017). Although informative, these figures underestimate the extent of the problem because of the seasonal occurrence of wasting (Khara and Dolan, 2014). Researchers therefore recommend the use of incidence rather than prevalence when measuring wasting. Low weight for age (underweight) is a composite measure of wasting and stunting and therefore does not distinguish between the two conditions. A child who is underweight can have either wasting only, stunting only or both. Although low weight for age is not a good measure of nutrition status at population level, in health facilities, it acts as a relatively good screening tool for identifying children with weight faltering.

Undernutrition can also be classified by severity. Moderate undernutrition is defined as a LAZ, WLZ Z scores between -3 and -2SD or a Mid Upper Arm Circumference (MUAC) of between 11.5cm and 12.5cm. It affects approximately 60 million children worldwide. Severe undernutrition on the other hand, defined as WAZ, WLZ, LAZ <-3SD of the WHO growth standards and or MUAC < 11.5cm affects approximately 19 million children worldwide (de Onis and Blossner, 1997). Although the above anthropometric indices are useful when diagnosing undernutrition, it is important to note that they are a measure of statistical deviation from a standard and should therefore be considered as statistical concepts with no clear linkage to physiological changes (Briend et al., 2015).

In Kenya, undernutrition remains a public health problem, despite a significant reduction in prevalence over the past few years. In the 2014 Kenya Demographic and Health Survey (KDHS), the most recent survey, 26% of children were stunted which was a 14% reduction in stunting rates compared to the 2008 survey. There was also a decline in wasting from 7.4% to 4% and underweight from 15% to 11% rates (Kenya National Bureau of Statistics, 2010, Masibo and Makoka, 2012, Kenya National Bureau of Statistics, 2015). Significant regional differences in undernutrition rates in Kenya were also reported. For example, stunting rates were higher in rural (29%) than urban areas (20%). Nairobi, the country's capital, had one of the lowest stunting rates in the country at 19% (Kenya National Bureau

of Statistics, 2015). However, data from the Kenya Demographic Health Survey under-sample slum areas and therefore underestimates the prevalence of undernutrition in these areas. Various surveys in low income areas in Nairobi have reported stunting prevalence of up to 50% in children under 5 years (Olack et al., 2011, Kimani-Murage et al., 2015, Fotso et al., 2012). This shows a need for regular assessment of health indicators in low income areas.

1.2.3 Effects of undernutrition

Describing the effects of malnutrition in terms of physical growth underestimates the negative impact it has on affected populations. The effects of undernutrition can be classified broadly as either short term or long term. Short term consequences include mortality, morbidity and disability while long term consequences include short adult size, reduced intellectual ability and economic productivity, low reproductive performance and increased risk of metabolic and cardiovascular diseases (Black et al., 2008b).

Undernutrition is the underlying cause of death in nearly half of all child deaths (Black et al., 2013, Pelletier et al., 1995, Black et al., 2008b, Schroeder and Brown, 1994, Bejon et al., 2008). In the 2008 maternal and child undernutrition series, Black et al. (2008b) showed that risk of death from major childhood illnesses increased with decreasing weight for age, weight for length and length for age Z scores, an indication that undernourished children are at higher risk of death (Black et al., 2008b). They further showed that stunting, severe wasting and intrauterine growth retardation, were responsible for 2.1 million (21%) child deaths. In Africa alone, 1.1 million child deaths were attributed to undernutrition. In the follow up 2013 series, stunting and underweight were both still accountable for 14% of child deaths while wasting was accountable for 12.6% deaths (Black et al., 2013). A relatively recent analysis of 10 cohort studies in Africa, Asia and Latin America that aimed to quantify the association between nutrition indices and mortality in children under five years, showed that children with two or more anthropometric deficits were at higher risk of dying than children with no deficits. Children classified as being underweight, stunted and wasted had a 12-fold Hazard Ratio [95% CI] 12.3 [7.67 to 19.6] risk of dying than children who had no anthropometric deficiencies (McDonald et al., 2013). However, the authors could not determine cause-specific mortality because of small sample sizes. They were also not able to differentiate the effects of moderate and severe forms of anthropometric deficits on mortality (McDonald et al., 2013). Both these factors provide a better

understanding of the effects of undernutrition on child survival and are vital for the design of interventions.

High mortality rates in undernourished children can partly be explained by the cyclical relationship between undernutrition and infection, where undernutrition increases risk of infection by reducing immunity and infection increases risk of undernutrition through reduced intake caused by poor appetite and increased nutrient losses (Figure 1.1). Although this concept partly explains the relationship between undernutrition and infection, there is still a debate about whether undernutrition leads to infection or if it increases severity of diseases (Rytter et al., 2014).

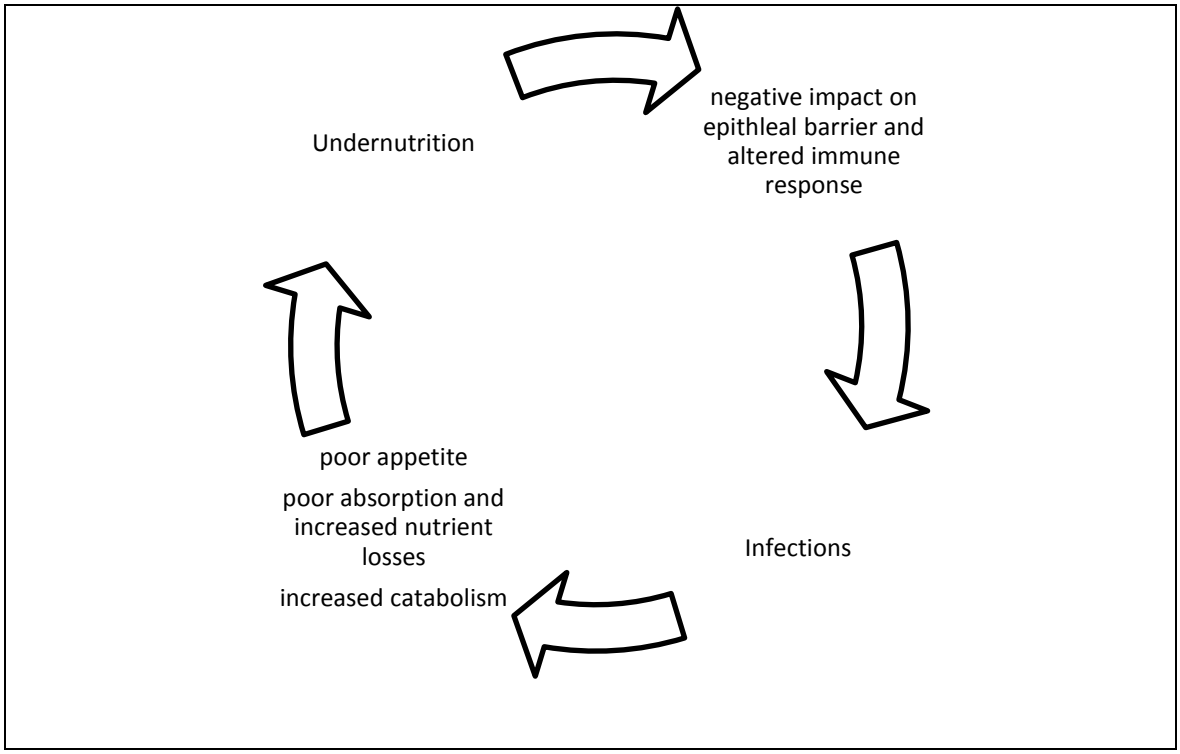


Figure 1.1: Relationship between undernutrition and infection

Undernutrition in childhood is also associated with increased risk of non-communicable diseases in adulthood (Black et al., 2008a, Barker, 1997). Low birth weight in infancy is associated with high blood pressure, renal dysfunction and altered glucose metabolism but the associations reported by different studies appear to be weak and causation cannot be inferred because of the observational nature of these studies (Victora et al., 2008, Huxley et al., 2002). A cohort study in Malawi assessed the effects of severe acute malnutrition on growth, body composition, functional outcomes and risk factors for non-communicable diseases in children aged 24 months, 7 years post discharge (ChroSAM). This study showed that compared to siblings (n=217) and other children in the same community

(n=184), children previously treated for Severe Acute Malnutrition (n=352) were more likely to show “thrifty growth”.

Thrifty growth is associated with future cardiovascular and metabolic disease and is characterized by selective growth of vital organs such as the brain at the expense of growth of less vital organs such as the liver (Lelijveld et al., 2016). In this study, undernourished children had a higher diastolic blood pressure, smaller MUAC (adjusted difference vs community controls 5·6 mm, 1·9 to 9·4, P=0·001; adjusted difference vs sibling controls 5·7 mm, 2·3 to 9·1, P=0·02), less lean mass (adjusted difference vs community controls -24·5, -43 to -5·5, P=0·01; adjusted difference vs sibling controls -11·5, -29 to -6, P=0·19) lower hip circumference (adjusted difference vs community controls 1·56 cm, 0·5 to 2·7, P=0·01; adjusted difference vs sibling controls 1·83 cm, 0·8 to 2·8, P<0·0001) than their siblings and children in the same community. All these measures are associated future cardiovascular and metabolic disease (Lelijveld et al., 2016). Although findings from this study are plausible, these findings are not generalizable because children recruited in this study were treated as inpatients based on the National Center for Health Statistics (NCHS) criteria while the current treatment protocol focuses on community management of uncomplicated SAM. It is therefore possible that children on the CMAM programme suffer from more adverse effects because they are more likely to survive (Lelijveld et al., 2016). More research is therefore needed to assess long term effects of undernutrition in children on CMAM.

In women, maternal undernutrition also increases the risk of perinatal and neonatal mortality (Ozaltin et al., 2010). A pooled analysis of 109 demographic health surveys in 54 middle income countries between 1991 and 2008 showed that children born to stunted mothers have a 60% increased risk of neonatal mortality compared with children born to non-stunted mothers absolute probabilities [95% confidence interval] 0.41 [0.040 to 0.042] P=0.018 (Ozaltin et al., 2010). Undernutrition also adversely affects adult size, intellectual ability, economic productivity and reproductive performance (Lelijveld et al., 2016, Stein et al., 2010, Coly et al., 2006). Growth failure in the first two years is also associated with reduced stature in adulthood (Stein et al., 2010, Coly et al., 2006). A cohort study in Senegal assessing the amount of catch up growth after preschool stunting and the effect of rural to urban migration during adolescence, showed that the adjusted height deficit between stunted and non-stunted children was 6.0cm and 9.0cm in women and men respectively (Coly et al., 2006). Similar findings were observed in the ChroSAM study in

Malawi (detailed description provided above). Children previously treated for SAM had lower HAZ than their siblings (adjusted difference vs community controls 0·4, 95% CI 0·6 to 0·2, P=0·001; adjusted difference vs sibling controls 0·2, 0·0 to 0·4, P=0·04) (Lelijveld et al., 2016). In an analysis of data from five cohort studies in Brazil, South Africa, Guatemala, India and the Philippines, Stein et al. (2010) also found that although there were variations in growth patterns in the different countries, in all cohorts, there was a modest recovery in growth retardation from birth to mid childhood, an indication of the chronic effect of undernutrition on growth (Stein et al., 2010).

Final adult height is a marker of cognitive ability, schooling outcomes and general health (Martorell et al., 2010, Grantham-McGregor et al., 1987). In an analysis of 5 cohort studies, Martorell et al. (2010) found that adults who were stunted at two years of age completed nearly one year less of schooling compared with non-stunted individuals (Martorell et al., 2010). Considering that every year spent in school is associated with a 10% increase in income then stunted children are more likely to earn less as adults compared with non-stunted individuals (Psacharopoulos, 1994, Grantham-McGregor et al., 2007). Although plausible some of these associations are confounded by poverty and the quality of education offered (Grantham-McGregor et al., 2007).

1.2.4 Poverty as a cause of undernutrition

The causes of undernutrition are numerous, contextual and interrelated. Figure 1.2 shows the diagrammatic representation of a framework developed by UNICEF, for better design and implementation of nutrition programmes. This framework classifies the causes of undernutrition into three categories, basic causes, underlying causes and immediate causes (UNICEF, 1991). Basic causes reflect structural and political processes. They include, social, economic, environmental and political issues that lead to uneven distribution of resources (UNICEF, 1991). Underlying causes includes factors that are in the immediate environment, namely food security, children care practices, hygiene and sanitation practices as well as access to health care. For this literature review, the focus will be on poverty as a basic cause of undernutrition and its effects on underlying determinants namely the child's physical environment and food security. The impact of environmental factors and food security on child health and dietary intake will also be explored.

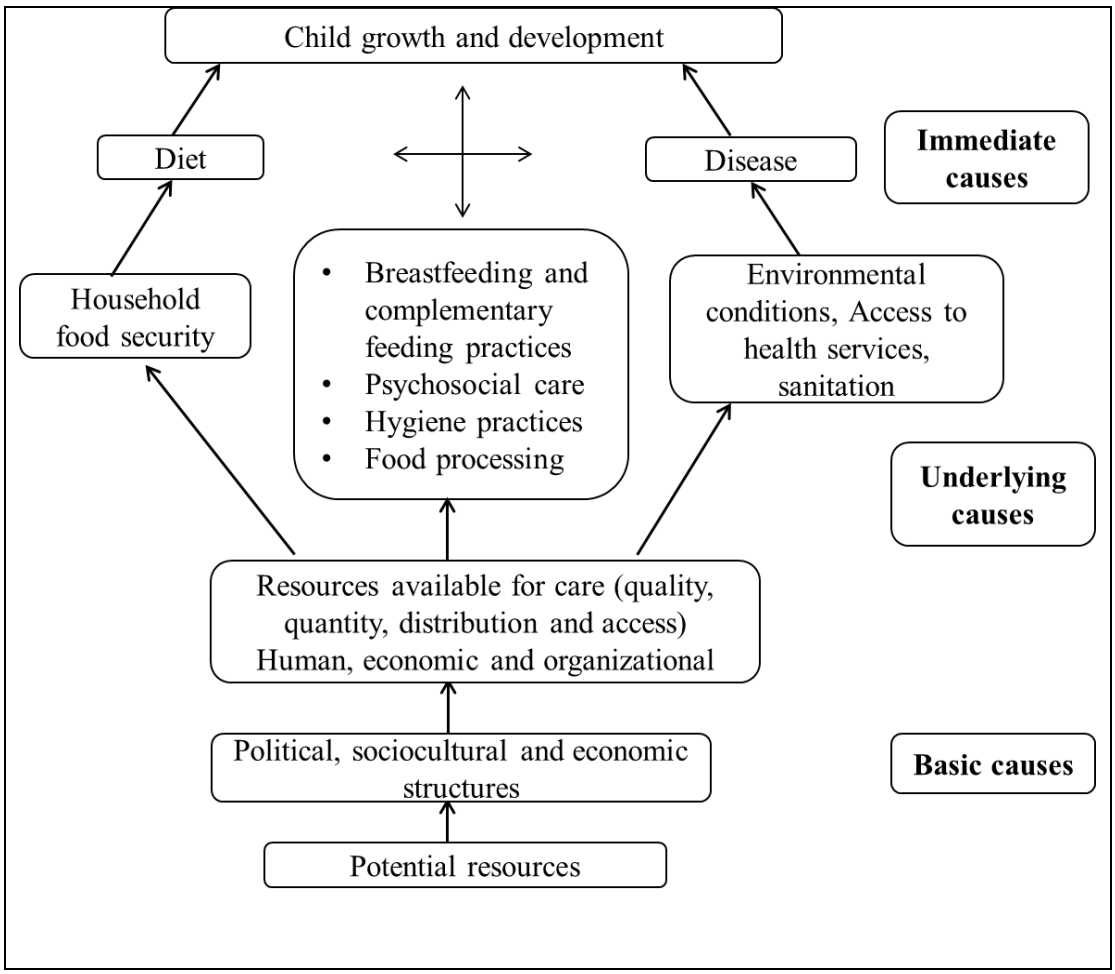


Figure 1.2: UNICEF conceptual framework for malnutrition

Poverty is defined in absolute and relative terms (UNESCO, 2017). Absolute poverty quantifies poverty in relation to the amount of money required to meet basic needs. For example, the World Bank defines poverty as living on less than 1.90 dollars a day (Ferreira et al., 2015). Relative poverty on the other hand measures poverty in relation to the economic status of other members of the same society. People are therefore classified as poor if they fall below prevailing standards of living in a given societal context (UNESCO, 2017). Poverty is an important cause of undernutrition because it affects the level of exposure to health risks such as poor hygiene and sanitation and food insecurity, therefore increasing vulnerability and the consequences of ill health (Figure 1.3).

The effects of poverty on child health are demonstrated by the high prevalence of preventable child deaths and undernutrition in developing countries (Black et al., 2013, UNICEF/WHO/World Bank, 2017). In most countries, childhood stunting rates are about 2.5% higher in the lowest wealth quintiles compared to the highest (Black et al., 2013). This can partly be explained by access to health care as children from poor backgrounds are less likely to receive preventive and curative interventions (Victora et al., 2003, African Population and Health Research Center, 2014).

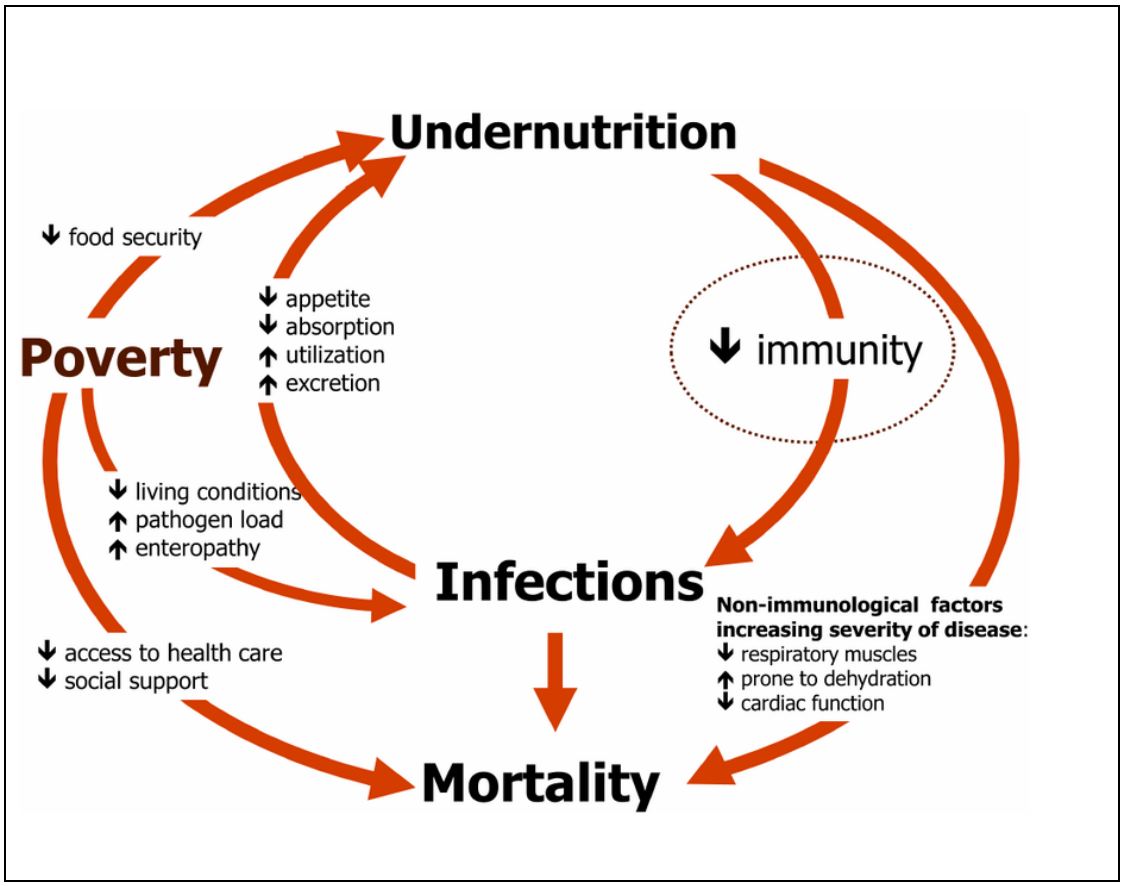


Figure 1.3: Relationship between poverty, mortality, infections and undernutrition. Source (Rytter et al., 2014)

Urban areas are thought to experience less poverty and better health than rural areas because of more employment opportunities, greater food availability and good access to health, water and sanitation facilities (Smith et al., 2005). However, there is evidence showing that urban residents are in the same predicament as their rural counterparts (Kennedy et al., 2006). For example, a secondary analysis of the Multiple Indicator Cluster Surveys in Angola, Senegal and Central African Republic showed no significant differences in the prevalence of stunting across urban and rural populations when the data was stratified by wealth quintile.

In the poorest wealth quintile, there was no difference in stunting rates in urban and rural areas in Angola (49.5% vs 52.8%), Central African Republic (44.2% vs 42.9%) and Senegal (27.0% vs 34.7%) (Kennedy et al., 2006). This finding can partly be explained by increased poverty levels in urban areas because of high rural to urban migration. This coupled with poor urban planning and unemployment leads to formation of slums.

The UN-HABITAT defines a slum household as a group of individuals living under the same roof in an urban area who lack one or more of the following: durable housing of a permanent nature that protects against extreme climate conditions; sufficient living space which means not more than three people sharing the same room; easy access to safe water in sufficient amounts at an affordable price; access to adequate sanitation in the form of a private or public toilet shared by a reasonable number of people; security of tenure that prevents forced evictions (UN-HABITAT, 2003).

In many developing countries, a large proportion of the population reside in slums (UN-HABITAT, 2015). For example, in Nairobi, over half the population (60%) reside in approximately 100 informal settlements (UN-HABITAT, 2003). Lack of proper hygiene and sanitation facilities is a common characteristic of slums in Nairobi. For example, in Kibera, the largest slum in Africa, there are only 1000 toilets servicing a population of about 200,000 people, with approximately 85 households sharing one toilet (Corburn and Hildebrand, 2015). Due to the high demand of toilet facilities, residents resort to using polythene bags as toilets which are then thrown on roof tops and the surrounding environment and are known as ‘flying toilets’. Access to safe water is also an issue as 75% of slum dwellers buy water from kiosks and only 3% of the population has access to public taps (Corburn and Hildebrand, 2015). Furthermore, the water that is available is contaminated and requires treatment before use, but many households are not able to afford fuel to boil water (Kimani-Murage and Ngindu, 2007, Muoki et al., 2008). Proximity to garbage dumpsites, industrial waste outlets, toxic waste dumps and contaminated water sources also increases exposure to vector borne diseases and toxins.

Poor hygiene and sanitation is associated with poor childhood health (Checkley et al., 2004, WHO, 2004b). Worldwide, poor hygiene and sanitation accounts for 88% of all diarrhoea cases through transmission of pathogens via unsafe drinking water, contaminated food or from unclean hands (WHO, 2004b). Diarrhoea accounts for approximately 1.5 million deaths annually (UNICEF/WHO, 2009). In developing countries, children under two years of age experience on average 3-8 episodes of diarrhoea per year which is associated with a higher risk of stunting (Checkley et al., 2008, Kosek et al., 2003). In a pooled analysis of longitudinal studies on diarrhoea in 5 countries, Checkley et al. (2008) found that a higher burden of diarrhoea prior to 24 months was associated with stunting at 24 months (Checkley et al., 2008). The adjusted odds of stunting at 24 months increased by 1.13 when the diarrhoeal incidence prior to 24 months increased by five episodes. Similarly, the odds of stunting at 24 months increased by 1.16 when the longitudinal prevalence of diarrhoea increased by 5% [95% CI 1.07 to 1.25] (Checkley et al., 2008). There is however evidence to show that the effects of acute diarrhoea on weight gain are transient. Findings from a longitudinal study in rural Bangladesh, showed that episodes of diarrhoea occurring at the beginning of a three month interval had no effect on weight gain (Briend et al., 1989). The authors concluded that weight gain during periods without diarrhoea were more important than weight gain during diarrhoea episodes. The association between undernutrition and diarrhoea was therefore attributed to a higher prevalence or severity of diarrhoea in undernourished children. Although both these views are plausible, studies assessing associations between infections such as diarrhoea and undernutrition are observational in nature and therefore, causation cannot be inferred.

Environmental enteric dysfunction, (EED), a condition that has no obvious signs and symptoms, is also linked to poor hygiene and sanitation and is thought to be caused by chronic ingestion of pathogenic microorganisms. EED is characterized by a disturbance of the small intestine structure and function. The small intestine is a long convoluted tube lined with a layer of small finger like protrusions called villi, which increase the surface area for absorption and enhance the physical and immunological function of the mucosal barrier. In EED the villi tend to be short, which means there is reduced absorption, increased gut permeability, intestinal and systemic inflammation all of which are associated with stunting (Lunn et al., 1991, Kosek et al., 2013, Campbell et al., 2003). In Gambia for example, increased intestinal permeability in a cohort of children aged 2-15 months explained up to 43% of growth faltering (Lunn et al., 1991). There are several pathways through which EED can lead to undernutrition. First reduced appetite because of

inflammation (Braun and Marks, 2010). Second the presence of inflammatory factors which limit the production and action of growth hormones (Bartz et al., 2014) and finally malabsorption. Although the condition is common, it is difficult to detect, because of its asymptomatic nature (Kelly et al., 2004). EED was initially diagnosed using biopsies of the small intestine and tests of intestinal absorptive capacity. Although biopsies are a useful diagnostic procedure, their invasive nature makes them unethical especially for infants who do not have any clinical signs of disease. Non-invasive tests such as sugar permeability tests are increasingly being used to test intestinal permeability, but the association between dual sugar permeability tests and infant growth failure remains unclear because of changes in assay methodologies (Campbell et al., 2003, Lunn et al., 1991). In order to improve diagnosis of EED in infants and young children, standardized non-invasive diagnostic tests are required.

The use of wood, charcoal, coal, dung or crop wastes on open fires or traditional stoves is common in low income areas (WHO, 2016). When used in poorly ventilated households, emissions from these fuels can reach up to 100 times the recommended safety levels resulting in household air pollution (HAP) (WHO, 2016). Household air pollution increases the risk for respiratory infections in children and is considered the single largest environmental risk factor for health worldwide accountable for approximately 4.3 million premature deaths (Smith et al., 2000, WHO, 2016). More than half of deaths attributed to pneumonia in children under five years of age are caused by HAP (WHO, 2016).

Considering the environmental conditions in slums areas, it is not surprising that slum dwellers have more health disparities than rural and non-slum dwellers (Mberu et al., 2016, Fotso et al., 2012). In Nairobi, children living in slums are more likely to die from diarrhoea and pneumonia than children in non-slum and rural areas (Kyobutungi et al., 2008, Mberu et al., 2016, African Population and Health Research Center, 2014, UN-HABITAT, 2003). Environmental contamination is an important risk factor for infants and toddlers because of their developmental stage which increases exposure to environmental contaminants. Learning how to crawl and walk also increases exposure to dirty floors inside the house and the surrounding external environment. There is therefore a need to consider the impact of environmental conditions on child growth.

1.2.5 Food security

Food insecurity affects approximately 780 million people in developing countries worldwide (FAO et al., 2015). In Kenya, approximately 1.1 million Kenyans are food insecure because of frequent droughts which affect food production and high reliance on maize imports which are affected by fluctuating food prices (USAID, 2015). High fuel prices also affect food and non-food prices which when coupled with stagnant wage rates makes food unaffordable. In slums in Nairobi, approximately 50% of households are food insecure, with significant differences within and between slums (IDSUE, 2014).

Food insecurity is characterized by feelings of uncertainty and anxiety over food, perceptions that food is of insufficient quantity and quality, reported reductions of food intake, consequences of food intake and shame of socially reporting unacceptable means of obtaining food (Coates et al., 2007). This results in the use of coping mechanisms which include cutting out foods such as animal sources of proteins, fruits and vegetables, modifying recipes, reducing the number of meals eaten in a day, buying rotten fruits and vegetables, scavenging foods from dumpsites, giving priority to children and sometimes the head of the household (Pelto and Armar-Klemesu, 2015, Kimani-Murage et al., 2014).

Associations between food insecurity and undernutrition have been reported by different authors, but most of this studies are observational in nature and are therefore subject to response bias and selection bias (Saha et al., 2008, Baig-Ansari et al., 2006, Mutisya et al., 2015, Psaki et al., 2012). Measures of food insecurity such as the Household Food Insecurity Access Scale HFIAS, which assess food access and the psychosocial manifestations of anxiety and uncertainty, have also been shown to vary with culture making cross cultural comparison difficult (Coates et al., 2007, Deitchler et al., 2010). The scale is also meant to assess food insecurity at population level and it might therefore not provide a clear picture of household food insecurity which is important for nutrition programs and interventions. Dietary quality and food utilization should also be considered when assessing food security. Food utilization is defined as a household's ability to prepare the food available in a safe, age appropriate and nutritious way. Factors that affect food utilization include availability of cooking facilities such as stoves, utensils and fuel; cultural beliefs about food and caregiver behaviour and knowledge all of which are aspects of childcare (Renzaho and Mellor, 2010).

1.2.6 Child care practices

Care is defined as the behaviours and practices of caregivers (mothers, siblings, fathers and child care providers) to provide time, attention, stimulation, emotional support and discipline necessary for a child's healthy growth, self-regulation, cognitive development, language acquisition and socio-emotional adjustment (Engle and Lhotska, 1999, WHO, 2004a). In the nutrition context, care refers to practices that affect nutrient intake, health, cognitive and psychosocial development of the child. These practices include young child feeding, psychosocial care, food preparation and related practices, personal hygiene and household hygiene practices. Care practices are not only limited to infants and young children but they also extend to women of child bearing age, lactating mothers and pregnant women, but this is beyond the scope of this study. This review will therefore focus on care practices in infants and young children.

Ideally, care should be provided in a responsive manner (World Health Organization, 2004). This means that the caregiver should directly respond to a child's needs in a sensitive, consistent and accurate way taking into account the child's developmental level as well as ability (Engle et al., 1999, Engle, 1995). Emphasis is placed on a feedback mechanism which starts with the caregiver observing the child's cues through motor actions, facial expressions or vocalizations and movements, followed by accurate interpretation of these signals and finally swift, consistent and effective action to meet the child's needs (Eshel et al., 2006).

1.2.6.1 Factors affecting childcare practices

Feeding is a complex but important determinant of a child's health and nutrition status that is influenced by socio economic factors such as maternal age and education, family size and cultural and religious beliefs and practices. Most of the factors that negatively affect childcare are interrelated and stem from poverty and therefore socioeconomic status should be adjusted for in observation studies assessing factors affecting childcare.

Low maternal education for example is associated with inadequate dietary intake, poor sanitation, low cognitive stimulation and stunting (Lippe, 1999, Wachs et al., 2005, Abuya et al., 2012, Armar-Klemesu et al., 2000). This is because educated mothers are thought to have better health seeking and decision-making abilities (Shavers, 2007). Maternal age is

also associated with the quality of care offered to infants. Young mothers are more likely to breastfeed for a shorter time and might be behaviourally immature to attend to their infant's needs (LeGrand and Cheikh, 1993). They are also more likely to have low socio-economic status, less schooling and less stable partnerships than older women all of which affect childcare practices (Fall et al., 2015, Markovitz et al., 2005, LeGrand and Cheikh, 1993). The number of children born to a mother and number of children under 5 years in the household is also likely to affect the quality of care offered, especially in cases where there are limited resources (Alam et al., 1989).

Maternal mental health is also likely to affect childcare practices and is associated with undernutrition in some settings (Rahman et al., 2004). Depressive symptoms such as sadness, loss of interest in daily activities and bouts of withdrawal can interfere with consistent and responsive caregiving practices (Wachs et al., 2009).There is however limited evidence on the effect of maternal depression on child growth and development especially in low and middle income countries. Child characteristics such as size, age, gender and temperament also affect the quality of care they receive (Engle et al., 1999). For example, in slums in Kenya, male children are more likely to be introduced to complementary foods early than female children (Kimani-Murage et al., 2011). Caregivers are also more likely to pay attention to a child who is easy to feed than a child who is lethargic (Engle, 1995).

1.2.6.2 Breastfeeding practices

Infant and young child feeding is highly dependent on timing. Feeding practices that are started too early or too late have a negative impact on child growth. When assessing infant feeding it is therefore important to consider not only what the child is fed but also when, how and by who (Pelto et al., 2003). The World Health Organization recommends that infants should be exclusively breastfed for the first 6 months of life, meaning they should not receive any other drinks or foods apart breastmilk, medicine or supplements prescribed by a doctor (PAHO, 2003).

This recommendation was informed by a Cochrane systematic review by Kramer and Kakuma (2002) which showed that exclusive breastfeeding for first 6 months reduced the incidence of gastrointestinal infections and increased lactation amenorrhea in mothers (Kramer and Kakuma, 2012, Kramer and Kakuma, 2002). Exclusive breastfeeding has also

been shown to be protective against diarrhoea and pneumonia incidence, prevalence and mortality (Lamberti et al., 2011, Lamberti et al., 2013, Arifeen et al., 2001). The association between exclusive breastfeeding and reduced incidence of diarrhoeal diseases can be explained by the fact that in many low and middle income countries (LMIC), children are introduced to contaminated foods and drinks because of poor access to hygiene and sanitation facilities as well as poor hygiene practices. This might also reflect loss of immune protection from breastmilk.

Despite the reported benefits of exclusive breastfeeding, introduction of foods and drinks before six months remains prevalent in LMIC (Cai et al., 2012, Black et al., 2008b). In the 2008 maternal and child undernutrition series, Black et al. (2008b) showed that only 47-57% of infants below the age of 2 months in Africa, Asia, Latin America and the Caribbean were exclusively breastfed. According to the series, in sub Saharan Africa alone 36% of infants are not exclusively breastfed (Black et al., 2008b).

In Kenya, exclusive breastfeeding rates have improved significantly over the past years (Matanda et al., 2014b, Kenya National Bureau of Statistics, 2010, Kenya National Bureau of Statistics, 2015). According to the recent Kenya Demographic Health survey, 61% of infants under six months were exclusively breastfed compared to only 32% in 2008 (Kenya National Bureau of Statistics, 2015, Kenya National Bureau of Statistics, 2010). According to the survey, 84% of infants aged 0-1 month were exclusively breastfed. This proportion however, decreased by half (42%) in children aged 4-5 months an indication that mothers were more likely to give water, other milks and other foods as children grew older (Kenya National Bureau of Statistics, 2015). Although breastfeeding rates appear to be high nationally, in slum areas, exclusive breastfeeding rates are as low as 2% (Kimani-Murage et al., 2011).

After 6 months caregivers are encouraged to continue frequent, on-demand breastfeeding until 2 years of age or beyond (PAHO, 2003). Continued breastfeeding is encouraged after 6 months because in many LMIC, breastfeeding provides 35-40% of energy in child's diet (PAHO, 2003). Lack of continued breastfeeding is also associated with increased risk of diarrhoea, pneumonia and mortality (Black et al., 2008b, Lamberti et al., 2011, Lamberti et al., 2013, Briend and Bari, 1989).

Continued breastfeeding rates are relatively high especially in Africa where 77% of children aged between 6 and 23 months are breastfed (Black et al., 2013). In Kenya, 50% of children were breastfed until two years (Kenya National Bureau of Statistics, 2015). Considering the fact that suboptimal breastfeeding practices account for approximately 804,000 child deaths there is still a need a need to promote good infant feeding practices especially in areas of high risk such as slums in Nairobi (Black et al., 2013).

1.2.6.3 Complementary feeding

Breastmilk alone is not sufficient to meet a child's nutrient requirements past the age of 6 months. This age is also marked by various developmental milestones inclusive of good head support and balance and improved hand mouth coordination which indicate that a child is ready for complementary feeding. Caregivers are therefore required to respond to the child's needs by introducing safe and age appropriate complementary foods (PAHO, 2003). In Ethiopia for example, (Beka et al., 2009) observed that although mothers practiced continuous breastfeeding up to 24 months, they did not introduce complementary foods till the age of 12 months and this was associated with stunting (Beka et al., 2009). Similarly, Tessema et al. (2013) also found that children who experienced late introduction of complementary foods (>6 months) were two times more likely to be stunted. In the United Kingdom, introduction of "lumpy foods" past the age of 10 months foods was associated with feeding difficulty at 15 months of age suggesting there might be a critical period for introducing solid foods (Northstone et al., 2001). Although plausible, these studies are observational in nature and therefore causal inferences cannot be made. Furthermore, these associations can also be reversed where feeding difficulties result in delayed introduction of lumpy foods. Mothers might opt to offer the child less lumpy foods which are easy for the child to eat.

In Kenya, a relatively large proportion (80%) of children aged 6-8 months receive complementary, but the type and quality of food offered is not always adequate to meet the child's energy and nutrient requirements.(Kenya National Bureau of Statistics, 2015). For example, cereal based porridge is mostly given as the first food in many LMIC (Oni et al., 1991, Onyango et al., 1994, Simondon and Simondon, 1995, Kimani-Murage et al., 2011, Ruel et al., 1999). The energy provided by porridge ranges between 0.6 and 0.8 kcal/g but in cases where the preparation is made entirely of cereal products and water the energy density can be as low as 0.25kcal/g (Michaelsen et al., 2009, Treche and Mbome, 1999).

The unprocessed nature of the cereals further hinders absorption of micronutrients such as iron, zinc and calcium, because of high in anti-nutritive factors such as phytic acid (Michaelsen et al., 2009, Davidsson et al., 1994). When enriched and provided as part of a varied diet, porridge/gruel can be a good source of energy. However, the diet in many of these settings tends to be monotonous, as diets are mainly characterized by high intake of starchy staples with low intake animal proteins, fruit and vegetables, which are rich sources of vital micronutrients such as iron and zinc (Onyango et al., 1994, Michaelsen et al., 2009, Bwibo and Neumann, 2003, Kulwa et al., 2015a).

1.2.6.4 Dietary Diversity and meal frequency

Dietary diversity is defined as the variety and number of different foods consumed over a given period and is commonly used to assess dietary adequacy and quality (Ruel, 2003). Dietary diversity is usually presented as a summary of the total number of single foods or food groups eaten at individual, household or population level with reference to a period usually 24 hours (Arimond and Ruel, 2004, Hatløy et al., 2000, Hatloy et al., 1998, Onyango et al., 1998). When food groups are used, the final score is known as a dietary diversity score (DDS) and when individual foods are used the final score is referred to as a food variety score (FVS). Although both DDS and FVS are good measures of dietary diversity, the DDS is considered to be better (Hatloy et al., 1998). Individual foods on the other hand are best for educational purposes, as it is easier to give advice to caregivers by mentioning individual foods rather than food groups (Ruel, 2003).

Poor dietary diversity is associated with child nutrition status (Garg and Chadha, 2009, Gibson et al., 2009, Nti and Lartey, 2008, Tessema et al., 2013, Zongrone et al., 2012, Onyango et al., 1994). Secondary analysis of Demographic Health Survey data from 11 LMIC in Africa, Southeast Asia and Latin America, assessing relationship between dietary diversity and nutrition status showed a positive association between dietary diversity and height for age in a younger age group (Arimond and Ruel, 2004). Similarly, in rural Kenya, weight for age, height for age and weight for length increased with an increased food diversity (Onyango et al., 1998).

Key issues that come up when measuring dietary diversity is the lack of a standardized measure. The number of food groups used varies depending on the aim of the study. For example in a cross sectional study assessing the association between DD and nutrition

status used seven food groups to create their DDS (Arimond and Ruel, 2004); 10 food groups were used to validate dietary diversity as an indicator of micronutrient adequacy (Kennedy et al., 2007). In a study assessing the number of food groups that accurately measured dietary diversity, (Steyn et al., 2014) compared four different food groups each with a different number of components. The smallest food group had six components while the largest group was made up of 21 components.

The recall period and the classification of different foods also tends to vary, making comparison difficult (Ruel, 2003). For example, animal sources of protein are either classified into three separate groups, flesh foods (meat, fish, and poultry), eggs and dairy or are combined to form two food groups (Kennedy et al., 2007, Moursi et al., 2008, Steyn et al., 2006, Hatløy et al., 2000, Hatloy et al., 1998).

Apart from meal composition, the number of times a child is fed is likely to influence their nutrition status, depending on the energy density of the meals offered (Dewey and Brown, 2003). The World Health Organization recommends that healthy breastfed infants aged 6-8 months should receive complementary foods 2-3 times a day while those between 9 and 24 months should be fed3-4 times per day (PAHO, 2003). Snacks can also be offered one to two times per day. These recommendations were based on theoretical calculations in children with low energy intake from breastmilk. Children were also assumed to have gastric capacity of 30g/kg body weight per day and a minimum energy density of 0.8 kcal/g from complementary foods (Dewey and Brown, 2003). It is however, important to note that if the energy density of the meals provided is adequate, 1.0 kcal/g, children across all ages can meet their energy requirements if they receive at least three meals day. Meal frequency recommendations should be used as a guide rather than a prescription and caregivers should be encouraged to respond to a child's needs. Low meal frequency is common in many LMIC worldwide (Kulwa et al., 2015a, Bentley et al., 2015, Lohia and Udipi, 2014). For example, in rural Tanzania, children were offered an average of two meals a day 1.74±0.73 (mean ± SD) (Kulwa et al., 2015a). Similar meal frequencies were also reported in urban slums in India (Lohia and Udipi, 2014).

1.2.7 Eating and feeding behaviour: Who feeds the child and how, and is the child willing to eat?

Feeding behaviour in this context refers to the interaction between the caregiver and the child during a feeding episode. Key constructs used to assess these interaction at caregiver level include adaptation to the child's characteristics, active and responsive feeding and the feeding situation (Engle et al., 1999). At child level, appetite and hunger, food preferences and child characteristics such as age, gender and birth order are all important variables to consider.

The person who feeds the child plays an important role determining food intake. Although it is assumed that the mother is the primary caregiver, other people such as older siblings, family and non-family members also play an active role. Ideally, caregivers should have a positive relationship with the child and should feed the child according to their development level. This is an important factor, as the capacity of the caregiver as well as their relationship with the child is a determinant of the quality of care the child receives (Engle et al., 1999). In cases where infants are left with older siblings, sensitivity to the infant's needs and skill in meeting them may not always be present, which might lead to inadequate intake (Pelto et al., 2003, Baig-Ansari et al., 2006, Engle, 1991). Alternate caregivers have also been shown to be less responsive during meals (Wondafrash et al., 2012).

Feeding styles describe the balance of control between the caregiver and child during meals and are associated with food acceptance (Dearden et al., 2009, Ha et al., 2002, Abebe et al., 2017).Three main feeding styles are commonly used to describe interactions during meals: responsive/active, force and laissez faire feeding (Birch and Fisher, 1995, Dettwyler, 1986). In force feeding, the caregiver attempts to take complete control over when and how much the child eats. It is characterized by excessive coercion, punishments, threats (physical punishments, punishments by supernatural figures, withholding desserts, facing same food at next meal) and physical restraint during the meal as well as guilt invoking phrases. In extreme cases, crude methods such as forcing liquids into the child's mouth by simultaneously occluding the child's nose have been reported in Nigeria (Oni et al., 1991). This feeding method is associated with increased food rejection especially in older children and can have adverse effects on a child's feeding habits (Birch and Fisher, 1998, Wright et al., 2006, Ha et al., 2002). This however appears to be dependent on the

age of the child (Ha et al., 2002). A meal observation study assessing the relationship between responsive feeding, dietary intake and nutrition status in 91 child caregiver pairs in rural Vietnam, showed 18 month old children were more likely to reject food when their caregivers used force (Ha et al., 2002). In contrast, in 12 month old children, force feeding appeared to promote food acceptance.

In laissez-faire feeding children have complete control over when and what to eat based on the belief that "if a child is hungry he will eat" (Dettwyler, 1989). This feeding method was observed in an ethnographic study in an urban area in Mali in the late 80's and can have a negative impact on energy intake and subsequently child growth, especially in cases where a child has low appetite. Laissez faire feeding is relatively common in LMIC and is characterized by low levels of encouragement during meals (Engle and Zeitlin, 1996, Ha et al., 2002, Bentley et al., 1991b). In Nicaragua, for example, Engle and Zeitlin (1996) observed active feeding in only 39% of the feeding events observed in 80 children aged between 12 and 19 months. However, this varied by the type of eating event as caregivers were more likely to encourage children during meals (59%) than snacks (29%) and bottle feeds (21%). Different scales were used to assess feeding behaviour during different eating occasions. For example, active feeding during lunch consisted of encourage, threaten, serves additional food, demonstrates child how to eat, talks to the child during meals and orders the child to eat, while the bottle-feeding scale was made up of only one variable, encourages child (Engle and Zeitlin, 1996). The scales used had a low internal reliability (α=0.30 for lunch and 0.36 for snacks), a possible indication that the behaviours included in the scale were not measuring the same behaviour (Engle and Zeitlin, 1996).

Similarly, Ha et al. (2002) reported encouragement in only 30% of intended bites. Intended bites in this study were defined as unit of analysis when food is brought up to the child's mouth with the intention of consumption, whether it was consumed or not (Ha et al., 2002). In both studies, caregivers were more likely to offer encouragement when the child refused to eat, an indication that encouragement was used as strategy to compensate for poor eating habits, rather than enhance good eating habits (Engle and Zeitlin, 1996).

Responsive feeding, a recommended feeding method, not only considers a child's hunger and satiety signals but also their psychomotor abilities (PAHO, 2003). It involves recognizing low appetite, encouraging the child to eat, feeding the child in a warm affectionate way and allowing children who are old enough to feed themselves. In

responsive feeding there is a balance of control between the child and caregiver (Engle, 2002).

The term active feeding is also used to describe feeding behaviour. In some studies, active feeding and responsive feeding are used interchangeably, while in others the terms represent a different set of behaviours (Moore et al., 2006, Abebe et al., 2017). For example, in a meal observation study in rural Bangladesh, active feeding was defined as a behaviour that encourages the child to eat or encourages the mother to feed either directly through force feeding or indirectly through words (Moore et al., 2006). The aim of that study was to elaborate the responsive framework, by applying them to meal observations in children aged between 8 and 24 months. Three key behaviours were assessed, responsive feeding, active feeding and social behaviour. Findings from this study showed that mothers who were active feeders were not necessarily responsive or social. When combined, the three behaviours had a low internal reliability $\alpha = 0.37$ an indication that the behaviours were all distinct components of caregiver behaviour that should be coded separately (Moore et al., 2006). This shows the need for standardized measures of eating and feeding behaviour.

Positive feeding behaviours are associated with greater food acceptance in infants and young children (Moore et al., 2006, Dearden et al., 2009, Aboud et al., 2009). In rural Vietnam for example, compared to no verbalization, the odds ratio [95% confidence interval] of accepting a bite were 2.4 times [1.8 to 3.1] $P \leq 0.001$ higher when the caregiver used positive verbalization (Dearden et al., 2009). Similarly, in Bangladesh, positive responsive behaviour was associated with a higher number of mouthfuls eaten (Moore et al., 2006). Despite this, caregivers only offer encouragement when children do not want to eat, or when they are unwell (Bentley et al., 1991b, Moore et al., 2006, Engle and Zeitlin, 1996). As a result, caregivers may miss an opportunity to promote good eating practices as well as psychosocial stimulation during meals (Aboud and Akhter, 2011).

Child self-feeding is also associated with greater food acceptance, but in many settings children are not given opportunities to feed themselves (Moore et al., 2006, Dearden et al., 2009, Bentley et al., 1991a). Feeding a child in some settings is considered a way of bonding, while in other settings caregivers feel that feeding saves time. This is probably because the child is usually seated on the caregiver's lap, a position that restricts

movement and the opportunity to reject food (Moore et al., 2006, Bentley et al., 1991a, Dearden et al., 2009) .

Responsive feeding interventions have shown that an increase in self-feeding and maternal responsiveness can be achieved, but this does not necessarily translate to increased weight gain (Aboud et al., 2009, Aboud and Akhter, 2011, Vazir et al., 2013). In rural Bangladesh, for example, a cluster randomized study assessing the impact of a responsive feeding intervention on weight, number of mouthfuls eaten, self-fed mouthfuls and mother's verbal acts showed an increase in the self-feeding (Cohen d=0.38) and maternal responsiveness (Cohen d=0.36) in the intervention group but no difference in weight gain and mouthfuls consumed. In this study, mothers of children aged 8-20 months (mean age 14 months) received education five key responsive feeding messages: wash your child's hands before he/she picks food; be responsive watch listen and respond in words to your child's signals; when your child refuses, pause and question why, do not force feed or threaten and offer a variety of foods including fish, eggs, fruit and vegetables while the control group received standard health messages (Aboud et al., 2009).

In contrast, in a similar study using the same messages but in slightly older children (mean age 17 months), Aboud et al. (2008) reported an increase in weight and self-feeding in the intervention group despite a decline in mother's responsive behaviour. The decline in responsive feeding in the intervention group was explained by caregivers not seeing a need to feed responsively when the child was self-feeding. There was also no difference in the number of mouthfuls eaten by children in the control and intervention groups (Aboud et al., 2008). The number of mouthfuls does not represent energy intake. It is therefore possible that the energy content of foods offered to the intervention group was higher, which might explain higher weight gain in this group (Parkinson et al., 2004). This difference could only have been detected if the energy content of the meals and the amount of food eaten at the end of meal were taken into account. The differences in weight gain in the two studies are a possible indication that self-feeding might be more beneficial in older children and although younger children should be encouraged to self-feed, they still require assistance.

In India, Vazir et al. (2013) observed an increase in mental index scores in a group that received a responsive feeding intervention in addition to complementary feeding and development stimulation. In this cluster randomized study, village clusters received either

standard care (control group), complementary feeding messages or complementary feeding messages, responsive feeding and development stimulation messages. Mothers were recruited into the study when the child was three months and were followed up for 12 months. Weight gain in this study was only significantly higher in the complementary feeding intervention group. This suggests that responsive feeding alone is not sufficient to promote physical growth (Vazir et al., 2013). The increase in mental index scores in the responsive feeding and stimulation group show the importance of psychosocial stimulation in mental development.

Psychosocial stimulation (PS) refers to age appropriate activities by caregivers that promote psychological stimulation, mental growth as well the development of positive interactive behaviour in children. It is characterized by responsiveness, provision of a warm and loving environment, child acceptance and involvement and encouragement of exploration, learning and independence (Engle, 1995). Balance of control must also be established between the caregiver and the child.

In Jamaica, an education intervention study on PS targeting moderately malnourished children showed an improvement in child's hearing, speech, hand eye coordination and movement in the PS group. In these studies PS was described as structured play using homemade toys and books (Powell et al., 2004, Walker et al., 1991). Improved mental and motor development was reported in severely malnourished children whose mothers received lessons on PS for 6 months (Nahar et al., 2009). Mothers were taught how to incorporate play into daily activities such as feeding and bathing the child. In addition, mothers were also encouraged to talk the child. A unique aspect of this study was that they aimed to improve maternal self-esteem through provision of positive feedback and education. At follow up, however, the majority (64%) of the children still remained severely malnourished, an indication that PS alone is not sufficient to improve the nutrition status of malnourished children (Nahar et al., 2009).

"A child who does not eat is a logistic and emotional challenge to any caregiver." (Engle and Pelto, 2011), yet few studies assess the role of appetite in childcare. There is usually an assumption that as long there is food a child will eat, which is not always the case. Poor appetite is usually characterized by the absence of hunger, food refusal or reduced intake (Dettwyler, 1989), definitions which are based on caregiver's perceptions of child intake. One study in Peru that attempted to validate maternal reports of poor appetite showed that

children had between 25-35% reductions in energy intake from non-breastmilk sources during periods when their caregivers felt they had poor appetite, an indication that caregivers' perceptions in some cases are valid (Brown et al., 1995a). However, considering that appetite in some cases is measured based on population and cultural norms, there is a likelihood of underreporting the prevalence of poor appetite in populations where it is prevalent. Poor appetite can be caused by illness, intestinal parasitic infections, monotonous diets, micronutrient deficiencies all of which are common in low income settings (Dettwyler, 1989, Brown et al., 1990). There is therefore a need to assess child appetite when looking at childcare practices.

Although studies on child caregiver interactions are informative, they are difficult to compare mainly because of variations in age range, hypothesis and indicators used to measure eating and feeding behaviour (Bentley et al., 2011). Furthermore, most of the scales used to measure behaviour have a low reliability which shows the need to identify key behaviours that describe mother child interaction during meals. Causation cannot be inferred from these studies due to their observational nature and the associations observed are complex. A child's behaviour can influence the mother's response and vice versa (Engle et al., 1999). For example, mothers are likely to invest more time and resources in children who are healthy. Furthermore, intervention studies on responsive feeding are mainly carried out in Asian countries. More research that involves prospective follow up and observation of subjects is needed to provide information on feeding practices in African countries, specifically slums areas in Nairobi.

1.3 Treatment of undernutrition

The causes of undernutrition are complex and multifactorial as described in previous sections, but treatment primarily focuses on provision of high energy ready to use foods, especially in African countries. The following sections will focus on treatment options for severe acute and moderate acute malnutrition and their effectiveness, and possible secondary effects on eating and feeding behaviours. Moderate acute malnutrition (MAM) or moderate wasting is defined as weight for length between -2 and -3Z scores and or mid upper circumference ≥11.5 cm and <12.5 cm, while severe acute malnutrition (SAM) or severe wasting is defined as a weight for length and or mid upper arm circumference of <-3SD of the World Health Organization growth standards and or a mid-upper arm

circumference less than 11.5 cm and or bilateral pitting oedema (WHO Multicentre Growth Reference Study Group, 2006, WHO/UNICEF/WFP, 2014).

The aim of treating undernutrition is to promote catch up growth by correcting any energy and nutrient deficiencies in infants and young children. Treatment options offered therefore aim to replace depleted nutrient stores as well as provide extra nutrients which cannot be stored, but need to be eaten daily (Golden, 2009). Treatment therefore involves specially formulated foods such as milks, ready to use foods (RUF) and blended flours. The type of treatment offered is dependent on the presence of medical complications such as oedema, persistent vomiting, fever, anaemia, dehydration, convulsions and fast breathing. Poor appetite is also considered to be a complication and is assessed using an appetite test. During appetite testing, the caregiver feeds the child ready to use food under close supervision. A child is considered to have a good appetite if they complete the minimum amount of therapeutic food for their weight (Kenya Ministry of Medical Services and Ministry of Public Health and Sanitation, 2010). Children who present with complications or have poor appetite are referred for inpatient care.

In patient treatment is based on WHO guidelines and it occurs in two phases: a stabilization and rehabilitation (WHO, 2013, WHO, 2009). During the stabilization phase, life threatening complications are addressed and children are given a low energy, low protein, therapeutic milk (F75) at regular intervals until complications resolve. This formula contains 75kcal per 100ml and is given on admission under close supervision because of the high risk of refeeding syndrome. When the child's condition becomes stable, they are started on a high energy, high protein formula, F100, meant to promote weight gain and catch up growth. As the name suggests the formula contains 100kcal per 100 ml. F100 is exclusively used for inpatient management because it requires preparation by experienced staff. Its liquid consistency also makes it prone to bacterial contamination and the fact that it resembles infant formula means that there is a risk it can undermine breastfeeding if used at community level (Briend et al., 1999).

1.3.1 Community Management of Acute Malnutrition (CMAM)

Previously, all severely undernourished children were treated as in-patients. However, this put an immense burden on health facilities/treatment centres, because of low bed capacity and inadequate staff required to successfully provide treatment. Furthermore, children were prone to centre acquired infections and, because their caregivers stayed in treatment centres for a long time, other children in the household were left without proper care (Collins, 2001). There was therefore a need for a treatment option that could be administered safely at household level. This resulted in the formulation of a high energy ready to use food (RUF) which was meant to be used at community level in place of F100 (Briend et al., 1999). The RUF had the same nutrient profile as F100 except for dried skimmed milk, which was replaced with lactoserum and groundnut paste (Briend et al., 1999). The supplement also had low moisture content, which meant it was safe from bacterial contamination.

Ready to use foods were first tested in a health facility in Chad where twenty severely undernourished children were given both RUF and F100 ad libitum on different occasions (Briend et al., 1999). The amount of each therapeutic food eaten was then calculated. Although children ate more RUF than F100, the difference in energy intake was not sufficient to cause refeeding syndrome which meant that the food was safe (Briend et al., 1999). This was followed by a larger study in a drought stricken area in Ethiopia where ready to use therapeutic food (RUTF) was used to treat 167 uncomplicated SAM cases (Collins and Sadler, 2002). When compared to the SPHERE standards, Collins and Sadler (2002) reported higher recovery rates (85% vs >75% P=0.031) and lower mortality (4.1% vs <10%) and defaulter rates (4.7% vs <15% P=0.003) an indication that ready to use foods were equally as effective as therapeutic milks in treating severe acute malnutrition. Subsequent studies also showed that RUF led to higher weight gain and significantly shortened the rehabilitation time compared to standard inpatient therapy (Ciliberto et al., 2005, Diop el et al., 2003).

Based on the above evidence, the World Health Organization endorsed RUF for community management of acute malnutrition in 2007 with the aim of increasing coverage, timely diagnosis and treatment of affected communities (WHO et al., 2007). These guidelines were recently updated to include recommendations on vitamin A supplementation (WHO, 2013). Although RUF were designed for community management

of severe acute malnutrition, in some settings RUF are also used for management of moderate acute malnutrition.

1.3.2 Management of Moderate Acute Malnutrition

Moderate acute malnutrition (MAM), is managed in health centres at community level using blended food supplements, which are a mixture of cereals such as corn, wheat and soy (CSB) together with sugar, oil and legumes, complementary foods and more recently ready to use foods (Lazzerini et al., 2013). These supplementary foods are provided in addition to the child's home diet to provide extra nutrients and energy that might be lacking in the diet. However, nutrition characteristics of foods used to treat children in LMIC appears to fall short of the WHO recommendations (Lazzerini et al., 2013).

Ready to use foods are now widely used for treatment of moderate malnutrition (Lazzerini et al., 2013, Lenters et al., 2013, Thakwalakwa et al., 2010, Thakwalakwa et al., 2012). Conflicting results have been reported about their effectiveness compared to blended flours (Table 1.2 Table 1.3). For example, a cluster randomized effectiveness trial in Mali reported higher sustained recovery rates in children who received RUF than those on CSB++ (Ackatia-Armah et al., 2015). In contrast, in rural Malawi, LaGrone et al. (2012) found that despite a longer recovery time in the CSB++ group, there was no difference in recovery rate when children on CSB++ were compared to children on different formulations of RUF (LaGrone et al., 2012). Similar findings are reported when CSB is compared with RUF, a possible indication that RUF are more effective than blended flours (Nackers et al., 2010, Matilsky et al., 2009, Karakochuk et al., 2012). Furthermore, children appear to require treatment for a shorter duration when they are on RUF, which makes them an attractive treatment option.

In general, it is difficult to compare findings from these studies, because different formulation and quantities of supplements are given for different periods of time ranging from 8 to 16 weeks. Definitions for malnutrition and recovery also vary for example some studies define recovery based sustained measurements on two consecutive visits while others define recovery as the child's anthropometric measurements at the end of the treatment period (Lazzerini et al., 2013). These limitations were raised in a Cochrane systematic review evaluating the effectiveness of different types of foods for children with moderate malnutrition. Lazzerini et al. (2013) concluded that although ready to use foods

had better clinical outcomes compared to blended flours, they did not reduce mortality or the risk of progression to SAM an indication that provision of RUF alone is not sufficient to promote normal child growth and development.

Modest effects of RUF foods on weight gain can be explained partly by poor compliance to treatment, as children are offered approximately only 30% of their prescribed RUF dose (Maleta et al., 2004). The rest of the RUF is either shared or discarded especially in cases where RUF are mixed with other foods (Flax et al., 2009). There is therefore a need to assess how RUF are used within the household.

To assess the benefits of RUF interventions, children treated for MAM should be followed up after treatment but very few studies do this (Chang et al., 2013). A study in rural Malawi that compared clinical outcomes 1 year after recovery from MAM in children successfully treated for MAM with either CSB++ or RUF, showed that close to one third of fully recovered children relapsed after treatment, an indication that weight gain does not represent a return to normal biological function (Chang et al., 2013). This study also showed the need for other interventions, as the common causes of death among recovered children included fever, diarrhoea and malaria. Food insecurity also appeared to be contributing factor as repeated episodes of MAM and SAM were observed during food insecure months in the region (Chang et al., 2013). The fact that all studies are carried out in rural areas in Africa does not present a clear picture of what happens in treatment programs in urban areas and in other LMIC that have a high prevalence of undernutrition.

Table 1.1: Intervention studies comparing the effective of ready to use foods vs no treatment/standard care

Author	Setting and study design	Objective/hypothesis	Inclusion criteria	Intervention and duration	N	Primary and secondary outcomes	Key findings
Thakwalakwa et al 2010	Malawi (rural) single center randomised control trial investigator blinded	To assess the effect of LNS and CSB compared to no treatment in underweight infants during lean season	6-15 months children in community (WAZ<-2 NCHS/CDC growth reference)	CSB (284 kcal/day) LNS (220kcal/day) Duration: 12 weeks	N=192 control=59 mean age 11.3±2.5; LNS=66 mean age 11.3±2.5; CSB-67 mean age 11.2±2.7	weight change **Secondary outcomes:** mean changes in length, Haemoglobin and (WAZ, WLZ and LAZ), head circumference, incidence of adverse events	Highest gain in WAZ in LNS group compared to CSB and control +0.02vs -0.31 vs -0.32 P=0.03 Compared to control group children in the LNS group had higher gains in weight 0.15kg [0.00 to 0.30] P=0.05 and WAZ 0.33 [-0.02 to 0.65] P=0.04. No difference between control and CSB group
Thakwalakwa et al 2012 November 2007 to April 2008	Malawi (Rural)	To assess the effectiveness of LNS and CSB administered through the national health system in MAM children during lean season	6-18 months children in community (WAZ<-2 NCHS/CDC growth reference)	CSB (284 kcal/day) porridge containing 5 spoonful of CSB LNS (220kcal/day) three spoonfuls Duration: 12 weeks 4 week follow up	N=299 control: 86 CSB: 109 LNS: 104	weight change **Secondary outcomes:** mean changes in length, Haemoglobin and (WAZ, WLZ and LAZ), head circumference, incidence of adverse events	Modest effect of supplements on growth. Compared to control children on LNS gained 90g more weight (P=0.185) and their WLZ increased by 0.22 (P=0.049)

CSB: Corn Soy Blend; LNS: Lipid based Nutrient Supplement; NCHS/CDC: National centre for health statistics/Centre for Disease Control and prevention; WAZ: weight for age Z scores; LAZ: Length for age Z scores; WLZ: Weight for Length Z scores

Table 1.2: Effectiveness of Ready to use supplements compared to Corn soy blends in treatment of moderate acute malnutrition

Author	**Setting and study design**	**Objective/hypothesis**	**Inclusion criteria**	**Intervention and duration**	**N**	Primary and **secondary outcomes**	**Key findings**
Ackatia-Armah, 2015 Year: May 2010-May 2011	Rural Mali Cluster randomized effectiveness trial with partial cross over	Assess impact of supplement on continued participation physical growth	Age: 6-35 months mean age 14.9±6.2 months WHO standard WLZ<-2 and ≥-3SD 2 or MUAC <12.5 cm and ≥11.5cm WLZ<80% and ≥70%	500 kcal RUSF Corn soy blend (pack per day 92g) Misola MI1 bag per week Cereal legume milled flour (LMF)1 bag **Duration:** 12 weeks	1264 RUSF: 335 CSB++:342 Misola: 301 LMF: 281	Weight, length, MUAC **Recovery:** defined as WLZ>-2SD or MUAC >12.5cm on two visits, haemoglobin **Secondary outcomes:** Food security, socio demographic characteristics	High sustained recovery in RUSF group RUSF 73.1% vs 61.2 CSB++ vs 61.1% MI vs 57.9 LMF P<0.001 Shorter recovery time in RUSF group than other treatments Median 5.9[4.9 to 7.0] RUSF vs 6.5[5.6 to 8.9] CSB vs 8.7 [7.0 to 10.4] MI vs 9.7[8.1 to 11.8] weeks LMF. Difference significant only for MI and LMF group
LaGrone 2012 Year: 2009-2010	Malawi (rural) Randomized controlled non inferiority investigator blinded trial	Children on CSB++ will not be more than 5% worse than those on RUSF	Age:6-59 months Newly admitted MAM children (WHZ<-2 and ≥-3 without bipedal oedema) in feeding clinics	75 kcal soy RUSF, soy whey RUSF CSB++:higher protein content **Duration:**12 weeks (bi-weekly follow up)	N=2,712 CSB++=888; Soy RUSF=906; soy Whey RUSF=918	Recovery: WHZ≥-2SD **Secondary outcomes:** time to recovery, rate of adverse events, rates of increase in weight, length and MUAC	No difference in recover rate CSB++ 85.9% [95%CI 83.5 to 88.1] vs Soy RUSF 87.7%[85.5%vs 89.8%] vs soy/whey RUSF 87.9 [85.7 to 89.9] P>0.3. Longer recovery time in CSB (24.9 ± 17.5) days than Soy RUSF (22.5±14.2 P<0.003) days and soy whey RUSF (22.6±15.0 P<0.006) days

Misola MI1 bag per week (60% millet or maize flour, 20% soy flour, 10% peanut flour, amylase powder) Cereal legume milled flour 1 bag (LMF) (millet beans, sugar, oil) soy RUSF (soy flour, peanut paste, sugar, soy oil, vitamins and minerals) and soy whey RUSF (peanut paste, sugar, vegetable fat, whey, soy protein, cocoa vitamins and minerals)

Table 1.3: Effectiveness of Ready to use supplements compared to Corn soy blends in treatment of moderate acute malnutrition

Author	Setting and study design	Objective/hypothesis	Inclusion criteria	Intervention and duration	N	Primary and secondary outcomes	Key findings
Nackers, 2010 Year: Intervention August to October 2007 Follow up ended July 2008	Rural Niger Field randomized trial	To compare clinical effectiveness of RUTF and CSB for MAM treatment	Age:6-59 months Newly admitted MAM children (WHM from 70-<80% NCHS reference) or with MUAC >110cm and <13.5cm	Plumpy'nut 2 sachets (1000kcal/day) or CSB premix (1231kcal/day) **Duration:** 16 weeks weekly follow up followed by 6 months follow up	CSB=236; RUTF=215	weight gain g/kg/day and recovery rate (WHM%>85% for 2 consecutive weeks) **secondary outcomes:** mortality, MUAC gain, Hb, relapse and height gain 6 months after discharge	Higher recovery rate in RUTF group 79% vs 64% in CSB P<0.001; average weight gain up to discharge was 1.08g/kg/day higher in RUTF group as compared to CSB; 1/5 of the children relapsed shorter treatment duration in RUTF group 4 weeks vs 6 weeks p<0.001
Matilsky et al 2009 July 2007-February 2008	Malawi (rural) randomized clinical effectiveness trial	Moderately wasted children receiving 75kcal soy/peanut and peanut milk are more likely to recover during an 8-week intervention than children receiving iso-energetic CSB	Age: 6-60 months MAM children (WHZ<-2 but ≥-3) with good appetite	749kcal/day CSB, soy peanut fortified spread, milk/peanut fortified spread **Duration:**8 weeks biweekly follow up	milk peanut=465 mean age: 20.1 ± 12.4 soy peanut=450 mean age: 19.6± CSB=447 Mean age: 19.6 ±13.6	recovery (WHZ>-2) weight gain, stature, MUAC and development of adverse outcomes	Children in the CSB group remained in the programme longer 4.0 weeks vs 3.3 weeks and were less likely to recover milk/peanut 79% soy/ peanut 80% and CSB 72% (p<0.01)
Karakochuk, 2012	Ethiopia (Rural) Cluster randomized effectiveness trial.	To compare recovery of children receiving CSB or RUSF using cox proportional hazard ratio analyses and survival analyses	Age 6-60 months WFH ≥70% to < 80% NCHS growth references	300g CSB and vegetable oil (1413kcal 92g RUSF (500 kcal, 13g protein) **Duration:** 16 weeks	N=1125 CSB: 750 but only 698 completed RUSF:371 but only 351 completed	Recovery WFH≥85% on 2 consecutive visits	Borderline difference in recovery in RUSF group compared with CSB group 73% vs 67% p=0.056 CSB group had a 15% lower recovery rate than RUSF group 0.85 [95%CI 0.73 to 0.99 P=0.039]

Soy peanut fortified spread (peanut paste, soy flour, vegetable oil and sugar), milk/peanut fortified spread (peanut paste and dry skimmed milk, vegetable oil sugar)

1.3.3 Possible effects of Ready to use foods on eating and feeding behaviour

Complementary foods in many LMIC tend to be bland boiled carbohydrates. Considering that ready to use foods are sweet and high energy, there is a likelihood that they reduce intake of complementary foods during and after treatment especially in moderately undernourished children who are offered RUF in addition to home foods. This can partly be attributed to preference for high energy foods (Johnson et al., 1991b, Birch et al., 1990).

Table 1.4: Energy content and ingredients in ready to use therapeutic foods

Nutrient	Spread per 100g (min)
Energy (kcal)	520-550
Protein (g)	10-12% Total Energy
Total Lipid (fat) (g)	45-60% Total Energy
Ingredients	**%Weight**
Full fat milk	30
Sugar	28
Vegetable oil	15
Peanut butter	25
Vitamin and mineral complex	

Energy compensation refers to a mechanism where an individual is able to adjust energy intake based on the energy density of a previous meal, snack or beverage commonly referred to as a preload with the aim maintaining energy balance (Almiron-Roig et al., 2013). This results in the maintenance of a relatively constant level of caloric intake which is regulated by internal rather than external cues (Birch and Deysher, 1986).

Experimental studies assessing energy compensation are characterised by the provision of a standard quantity of a preload with varying energy densities and macronutrient (fat or carbohydrate) content. This enables detection of the effect of energy density as well as nutrient composition of a preload on intake of subsequent meals. After the preload is provided subjects are required to stay for a stipulated period without consuming anything (inter meal interval) after which a standard test meal of known energy density is provided for ad libitum consumption. The difference in the amount of energy consumed after intake of a high calorie and a low-calorie preload gives an indication as to whether energy compensation has occurred. Low energy intake from a given test meal after consumption of a high calorie preload is an indication of energy compensation and in cases where the

process of energy compensation is accurate, the reduction in energy intake from the test meal is approximately equal to the preload energy density.

The compensation index (COMPX), calculated by dividing the difference in the energy intake after two preloads by the difference in energy content of the preloads, reflects the precision of energy compensation where a (COMPX) value of 100% indicates complete energy compensation. Overall, pre-school children have been reported to have COMPX scores of between 50% and 100% (Birch and Deysher, 1985, Birch and Deysher, 1986, Faith et al., 2012, Hetherington et al., 2000).

$$\text{COMPX (\%)} = \frac{\text{Test meal}_{\text{Low energy preload}} - \text{Test meal}_{\text{High energy preload}}}{\text{Preload}_{\text{High}} - \text{Preload}_{\text{Low}}} \times 100$$

Evidence of energy compensation in pre-school children has been reported by various experimental studies (Birch and Deysher, 1985, Birch and Deysher, 1986, Johnson et al., 1991a). Birch and Deysher (1985) reported a lower snack intake in pre-school children 20 minutes after they received high energy dense pre-loads (156kcal/100ml) in the form of yoghurt (Birch and Deysher, 1985). Similarly, in a subsequent study that involved both adults and children Birch and Deysher (1986) reported lower intakes of energy from a test meal after consumption of a high calorie pudding (132kcal) in 2-5 year old children.

There is limited information on energy compensation in diseased and malnourished children. Only 3 studies carried out in the United Kingdom assessed energy compensation in failure to thrive (FTT) (Kasese-Hara et al., 2002), moderately undernourished cystic fibrosis children (Poustie et al., 2006) and in children on enteral nutrition (Kane et al., 2011). Kasese-Hara et al. (2002) reported a lack of energy compensation in FTT children, an indication of possible altered energy regulation in FTT children, which enables them to feed more to replace missing energy however, more research is needed to confirm this (Kasese-Hara et al., 2002). In contrast, in a one year trial assessing the effect of protein energy supplements on growth and nutrition status in moderately malnourished cystic fibrosis children, Poustie et al. (2006) reported no benefit of supplementation compared to standard care which included dietary advice. The lack of benefit in this case was attributed reduced intake of the home diet as well as poor compliance to the intervention (Poustie et al., 2006).

Studies on energy compensation provide valuable information on energy homeostasis but most of them are experimental and do not necessarily reflect what happens in the home setting. Other factors such as the use of small sample sizes which do not allow detection of primary outcomes, varying energy densities of the preloads as well as the lack of a standard inter meal interval and the lack of justification for the time intervals selected makes comparison of studies difficult. Short time intervals have been shown to reflect the effect of the volume and weight of the preload rather than its energy density (Almiron-Roig et al., 2013, Zandatra and de Graaf, 2000). There is therefore a need to come up with a standardized time interval that takes into account the duration of digestion of key macronutrients in the preloads provided.

There is evidence of energy compensation in infants and young children in LMIC. For example in Guatemala, Martorell et al. (1978) estimated a 10kcal displacement of energy from home foods in children receiving 99 kcal per 100 ml of supplement (Martorell et al., 1978). They concluded that the energy displaced was not enough to affect child growth. In Jamaica, however, stunted children aged 9-23months reduced their intake of home foods after receiving 750 kcal of a milk based supplement. Baseline intakes of home diets was similar in stunted and non-stunted children however at 6 months energy intake from the home diet was significantly lower in the supplemented group an indication that supplemented children reduced their energy intake (Walker et al., 1991). Similarly in India, (Bhandari et al., 2001) reported an 18%-36% decrease in energy intake from home foods in children who received a milk cereal mixture (224kcal) for 52 weeks compared to a non-intervention group, a possible indication of energy compensation. In contrast two studies that measured energy intake from home diets in supplemented children reported an increase in intake of energy from home diets (Adu-Afarwuah et al., 2007, Maleta et al., 2004). The conflicting results in these studies shows a need for more research on the effects of RUF on intake of complementary foods.

Responsive feeding should be practiced in all feeding episodes regardless of the meal or type of food given. There is however, evidence to show that caregivers are more likely to physically pressure their children to eat and are less likely to allow self-feeding during ready to use meals (Flax et al., 2013). There is therefore a need to assess the effect of RUF on eating and feeding behaviour.

1.4 Situation in Kenya and problem statement

The Kenyan government has taken an active role in the fight against undernutrition by developing a Food and Nutrition Security Policy which provides a framework to promote good nutrition through increased availability of quality food (Republic of Kenya, 2011). Furthermore, through the National Nutrition Action Plan 2012-2017, a framework for coordinated implementation of nutrition interventions outlined in the policy, the government and key stakeholders aim to reduce infant morbidity and mortality through High Impact Nutrition Interventions (HINI) such as exclusive breastfeeding, timely complementary feeding, iron folate, vitamin A and zinc supplementation, hand washing, de-worming, food fortification and management of moderate and severe acute malnutrition (Republic of Kenya, 2012).

Community Management of Acute Malnutrition also known as Integrated Management of Acute Malnutrition (IMAM) is widely used as a treatment strategy. In Nairobi alone, there are 80 outpatient therapeutic feeding programs that are supported by the Ministry of Health, Concern International, UNICEF and other partners. The number of OTP treatment centres in Nairobi was increased with the aim of increasing coverage of treatment of acute malnutrition in slums. However, the program faces several challenges which result in erratic utilization (Appleford et al., 2015, Kirichu and Kumar, 2013). Inadequate health services infrastructure and understaffing result in poor quality of service provided and long waiting hours in the facilities leads to infrequent use. Poor health seeking behaviour and constant movement (urban to rural areas) also affect clinic attendance (Kirichu and Kumar, 2013). There is also inconsistent supply of therapeutic foods as result of high costs of RUF and lack of funds to support nutrition programs in Nairobi which is classified as a non-emergency area (UNICEF, 2009). At community and household level, stigmatization of caregivers with children on treatment and food insecurity also have a negative impact on use of RUF making it an unsustainable treatment option for MAM children (Kirichu and Kumar, 2013). Despite the widespread use of RUF in Nairobi, there is lack of information on how they are used within households and their impact on childcare practices.

Despite all these interventions, undernutrition remains a problem in slum areas. This can be attributed to extreme poverty levels and unsanitary environmental conditions as described in section 1.2.4. Studies have shown that a change of environment can have a significant positive impact on child growth (Golden, 1994), but this is not an option for

many families that are faced with extreme poverty. Given the unsustainability of RUF as a treatment option and the fact that the environment cannot be changed, the question that remains is what can be done to improve child growth and development in low income areas? This question can be answered if there is adequate information about the type, prevalence as well as the overlap of risk factors of undernutrition that can be modified at community level using the health facility as a focal point.

Childcare practices specifically feeding and hygiene practices in undernourished children in urban areas are not well documented. Studies in urban areas tend to focus on individual childcare practices and factors that influence them such as breastfeeding and complementary feeding practices, food insecurity, hygiene and sanitation (Kimani-Murage et al., 2011, Kimani-Murage et al., 2014, Muoki et al., 2008, Mutisya et al., 2015, Taffa and Chepngeno, 2005). Maternal knowledge on child practices has also been assessed (Waihenya et al., 1996). To the best of our knowledge no studies have assessed eating and feeding behaviour and its impact on nutrition status in infants and young children as well as the overlap of risk factors in undernourished children.

1.1 Aim and research questions

The aim of this study was to identify potential intervention areas that can improve management of moderate undernutrition in children aged between 6 and 24 months in low income areas in Nairobi. This was done through assessment of childcare practices in healthy and undernourished children (both moderate and severe) with the aim of identifying and quantifying the number and range of modifiable risk factors for undernutrition. The effect of RUF on childcare practices was also assessed. The following research questions were used as a guide

1. What are the commonest modifiable risk factors for undernutrition and how does this pattern vary with nutrition status and severity? Modifiable risk factors were defined as risk factors that had the potential to be changed through nutrition education and counselling.
2. How are ready to use foods fed to children and do they have an influence on frequency of intake of family meals and child eating and caregiver feeding behaviour?

Current childcare practices were also described using the following questions

1. Who feeds the child and how?
2. Which types of foods are given to children and how often?
3. What is the child's behaviour during meals and does it vary with the type of meal offered?
4. Is the child willing to eat?
5. How do caregivers respond to their child's behaviour?
6. How do caregivers feed ready to use supplementary and therapeutic foods?
7. What are the hygiene practices of caregivers?

2 Preliminary studies

2.1 Background

Undernutrition remains a public health problem in Kenya and Pakistan. Despite major geographical, cultural and religious differences in these two countries, similar causes of undernutrition have been reported. Poor infant and young child feeding practices remain prevalent in both countries (National Institute of Population Studies and International, 2013, Kenya National Bureau of Statistics, 2015). Currently, there is inadequate information on care practices specifically child eating and caregiver feeding behaviour in infants and young children aged 6-24 months in urban slum areas in Kenya and in semi-urban areas in Pakistan. This chapter provides a description of meal observation studies that were carried out with the aim of testing the feasibility of using observations for data collection and describing childcare practices in Kenya and Pakistan.

The opportunity to carry out preliminary studies in Pakistan arose from connections my supervisor, Professor Charlotte Wright, had with Professor Shakila Zaman, a Pakistani public health researcher, based at the Institute of Public Health at the Lahore Medical and Dental College. She was in the process of setting up a trial comparing the effectiveness of ready to use therapeutic foods versus normal diet in the treatment of moderate malnutrition in Wagah town. When Prof Wright informed her of my intentions to assess childcare practices, Prof Zaman was keen to collaborate with us and assist in setting up and carrying out the pilot phase of the study. I was then able to join Professor. Wright on a visit to Lahore.

Three preliminary studies were carried out as shown in Figure 2.1. The first pilot study was carried out during a two-week visit to Lahore, Pakistan in February 2014. The aim of this visit was to develop and test research tools by observing childcare practices in homes. I also worked with two Master of Science students in Human Nutrition at the University of Glasgow, Iqra Shah (IS) Pakistani national and Ivan Mwase (IM) a Ugandan. IS used my questionnaire to collect data on childcare practices in Wagah town in June 2014. IM and I also worked closely to collect data on childcare practices in day-care centres in slum areas in Nairobi. This was then followed by meal observations in homes in low income areas in

Nairobi in August 2014. In Nairobi, we worked closely with a local researcher Dr Victor Owino who assisted in setting up the study.

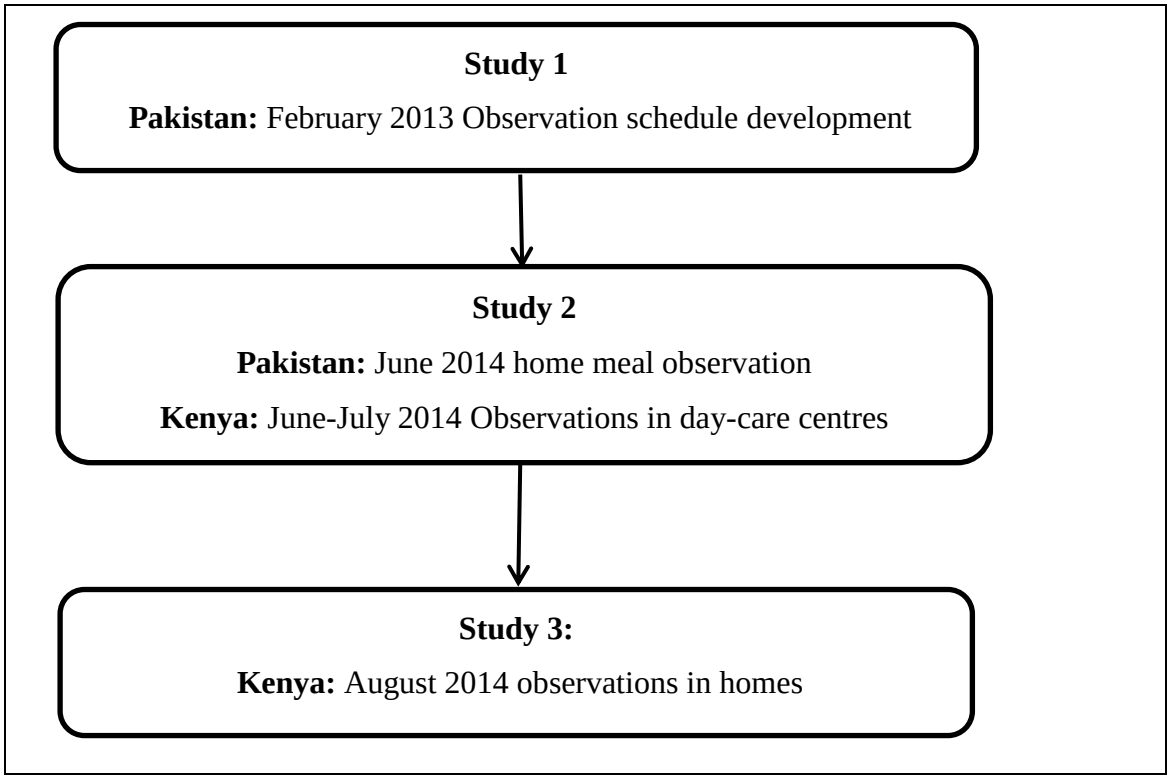


Figure 2.1: Sequence of preliminary studies in Pakistan and Kenya

2.2 Introduction

Observations are invaluable when assessing behaviour because they allow the researcher to view processes directly within a social interaction as they take place (Gardner, 2000). They also help summarize and quantify relevant aspects of complex interactions. When assessing health behaviour, observations are considered to be more accurate than reported behaviour as people tend to over report positive behaviours as demonstrated by studies assessing hygiene practices (Curtis et al., 1993, Bentley et al., 1994). Information from observations can either be structured, where the researcher formulates rules for observation and recording, or unstructured where the observer aims to collect as much information as possible about the subject.

Meal observations are important because they provide information on the quality of interaction between the caregiver and the child during meals. This information is usually recorded in a structured observation schedule (Bentley et al., 1994, Engle and Zeitlin, 1996, Bentley et al., 1991b). Although informative, the quality of information collected from structured observations is highly dependent on how well an observer is able to capture the information (Bentley et al., 1994). Furthermore, observation schedules are subject to observer bias where knowledge of the aim of the study and study participants can influence the observer's perceptions. In such cases, video recordings are considered ideal because they provide a permanent record of observations made which means recordings can be preserved for later coding and reliability checks can be carried out after the event (Dearden et al., 2009, Ha et al., 2002, Abebe et al., 2017, Flax et al., 2013).

Regardless of the method used to collect data, observation studies are generally intrusive and are therefore subject to participant reactivity bias. Studies try to control for this by making surprise visits, using the same observers in the same households, making contact with households on several occasions before actual observations are done, or spending long hours in households, making the whole process labour intensive (Moore et al., 2006, Gittelsohn et al., 1998, Bentley et al., 1991b). However, very few measure participant reactivity. In rural Nepal for example, Gittelsohn et al. (1998) examined changes in behaviours during observations with the aim of assessing participant reactivity. They also requested observers to code specific behaviours such as interactions between the observer and members of the household. Findings from this study showed that reactivity occurred on the first day only and there after behaviours were constant (Gittelsohn et al., 1998). This

is a possible indication that observations made initially might not always be reliable and there is therefore a need for multiple observations.

In developing countries meal observation studies have shown that eating and feeding behaviours are associated with the child's age, health, type of meal offered and that caregivers tend to offer little encouragement during meals (Bentley et al., 1991b, Engle and Zeitlin, 1996, Moore et al., 2006). Cultural beliefs about infant feeding also appear to play a role (Dettwyler, 1986). An ethnographic observation study in Mali, showed that caregivers believe that children are independent and will ask for food when hungry. Such non-responsive feeding styles have also been associated with reduced food intake and undernutrition as described in chapter 1 (Gittelsohn et al., 1998, Oni et al., 1991, Nti and Lartey, 2008, Ha et al., 2002, Dearden et al., 2009).

Most meal observation studies are carried out in rural or semi-rural areas (Abebe et al., 2017, Flax et al., 2013, Dearden et al., 2009, Moore et al., 2006, Bentley et al., 1991b, Nti and Lartey, 2008, Kamau-Thuita et al., 2002). Very few observation studies have been carried out in low income urban areas (Engle and Zeitlin, 1996). A two day 10 hour meal observation study carried out in a semi-rural area in Kenya assessing time allocation for childcare practices showed that carrying out observations at household level was feasible, but a few challenges were encountered. First the researchers mentioned that they needed to reschedule observations (Kamau-Thuita et al., 2002). Their initial plan was to carry out observations from 7.00a.m in the morning, but they found this to be intrusive, as most of the households visited had only one room. Second, following children around was described as tedious and finally, because surprise visits were made, the research team had to reschedule observations when the household was not available (Kamau-Thuita et al., 2002). Although informative, this study did not assess mother-child interaction during meals.

The aim of these preliminary studies was to test the feasibility of using meal observations to assess child eating and maternal feeding behaviour in children aged 6-24 months in low income areas in Nairobi, Kenya and Wagha border, Pakistan. The following research questions were used as a guide (Pelto et al., 2003).

1. What types of foods are children fed?
2. Who feeds the child and do they do so well?
3. How are children fed?
4. Is the child willing to eat and what do caregivers do when the child does not want to eat?
5. What are the hygiene practices of caregivers?
   Do caregivers wash their hands before meals?
6. Is there a difference in childcare practices in healthy and undernourished children?

2.3 Study One: Designing and testing research tools in Pakistan

2.3.1 Methods

This was a cross sectional observation study that involved in depth observation of a small number of participants in Pakistan. Lahore is a semi-arid area generally characterised by hot summers and cool winters. There are four seasons, varying in onset and duration according to location: a cool, dry winter from December to February; a hot, dry spring from March to May; the summer rainy season from June to September; and the retreating monsoon in October and November. In Pakistan, 45% of children are stunted, 11% are wasted and 30% are underweight with significant regional differences (National Institute of Population Studies and International, 2013). For example, stunting rates in Islamabad are 22% while stunting rates are up to 76% at the Afghan border (Cesare et al., 2015). The study was carried out in a semi-rural village, Wagah, situated in Lahore District, Punjab on the Indian Pakistani border. In Punjab, approximately 40% of children are stunted (National Institute of Population Studies and International, 2013). The main economic activity in this area is agriculture.

2.3.1.1 Sampling and recruitment procedures

Caregivers of healthy children aged between 6 and 24 months receiving complementary foods were recruited between 22nd February and March 8, 2014 during a 2 week visit to Pakistan. Children who were unwell or had special needs were excluded. Purposive sampling was used to identify study participants. This involved deliberate selection of households that had children aged 6-24 months by a lady health visitor (LHV) working in one area of the town.

Lady health visitors provide primary health services inclusive of health promotion, disease prevention, curative and rehabilitation services and family planning to communities residing in rural and urban slums in Pakistan. Each health visitor is attached to a government health facility where they receive training on primary health care. They are responsible for about 1,000 people (200 households). Apart from provision of primary health care, health visitors are required to register the population in their service area. The register includes information on pregnancies, births, deaths and family planning methods used by eligible couples. The LHV approached the families, explained the reason for our visit and requested for consent for meal observations. Caregivers who agreed to participate suggested a suitable day and time for meal observations.

2.3.1.2 Meal observations

Morning and mid-morning meals were observed. I positioned myself in a non-intrusive position and watched mothers feed their children. A semi-structured observation guide was used to collect information about the meal (see Appendix 1). In addition, informal interviews were carried out with assistance from two Pakistani research assistants. The two assistants translated questions and responses from English to Urdu and vice versa.

Variables included in the meal observation schedule were adapted from various meal observation studies carried out in Ghana, Malawi and Bangladesh and were adapted to suit the current study's needs (Flax et al., 2013, Moore et al., 2006, Nti and Lartey, 2008). Information on the time the meal started, type of foods offered, who fed the child, location of the caregiver and child during meals and utensils used during the meal were recorded during meal observations (Moore et al., 2006, Ha et al., 2002). Food consistency was coded as liquid, thin spoonable, thick spoonable, moist lumpy and dry solid. These

definitions were adapted from the National Dysphagia Diet and are described below (NHS, 2014).

- Liquid: runs off the spoon without leaving any residue for example soup, water, juice
- Thin spoon able: food runs off the spoon freely but leaves a thin coating for example thin porridge. No chewing is required
- Thick spoon able: Foods that sit on the spoon and do not flow off it. No chewing is required
- Moist lumpy: moist soft textured foods such as mashed potatoes. Minimal chewing is required
- Dry solid: foods that are bite size pieces such as rice, served without stew, beans. Chewing is required.

Information about whether or not the child was having their meal alone or with the rest of the family was recorded. If the rest of the family was involved, I recorded if the child was offered the same meal as the rest of the family and if they had their own plate or a shared plate. This was done because in some settings, children are given specially prepared foods which tend to be mainly low in energy and carbohydrate based (Bentley et al., 1991a). When the caregiver and the child share a plate, it is difficult to quantify the amount of food eaten by the child and there is a risk that the child eats small quantities of food which are not adequate to meet their energy and nutrient needs.

Child and caregiver actions were recorded using Likert scales. *Child's actions* included: *interest in food* which was assessed by looking at how readily a child accepted food. Observations were coded as very interested, moderately interested, interested, less interested and not at all interested. *Physical actions* included playing alone, playing with someone, playing with object and no action (Flax et al., 2013). The child's *mood* was recorded as excited, very happy, calm, sad and crying. This differed from coding used in other studies that describe child verbalizations as flat, positive, negative or lack of verbalizations (Flax et al., 2013).

Caregiver's actions included *verbal encouragement*, which was present if the caregiver used enticing words such as the food is sweet. *Physical force* was assessed by looking at whether the caregiver restrained the child or forced the child to open their mouth.

Caregiver's distraction during the meal was described as attention diverted to another person or activity while *mechanical verbalizations* included orders such as "eat your food". *Self-feeding* during meals was assessed by looking at whether the caregiver gave the child opportunity to self-feed by either giving them finger foods or by demonstrating how to eat. I also observed if the caregiver distracted the child during feeding by either offering the child a toy, playing a game with the child. All caregiver actions were coded as all the time, most of the time, sometimes, rarely and never. Additional actions included action taken when the child refused to eat. Possible actions included *offers food again, restrains* the child and *leaves the child alone*. At the end of the meal, I recorded if the child completed food that was served and if they were offered more food. Both were coded as yes or no.

2.3.2 Results

Four morning and mid-morning meals in healthy infants were observed. Foods offered to children at these times included biscuits and milk, eggs and halwa, a sweet dessert pudding made from carrots, sugar, water and milk. All children were fed by their mothers and were not given opportunities to feed themselves. Below is a detailed description of the meals.

2.3.2.1 Observation One

A one-year-old child was fed rusk, a dry piece of bread and milk. The food consistency was moist and slightly lumpy. The child was offered food in their own plate. The rest of the family was not having their meal at the same time. Both mother and child were seated on the same chair facing each other. When the meal started, the child appeared interested in food as they eagerly accepted every spoonful offered. Although the child looked happy and was playful, she was quiet throughout the meal.

During the meal, the child reached out for the plate and spilled the food. The mother simply looked at the child, cleaned up the mess and prepared more food. After sometime, the child lost interest and started refusing bites offered. The mother tried to distract the child by giving them a colourful wrapper to play with. Towards the end of the meal the child started spitting out food.

The mother offered food to the child quietly and paid close attention to the child. When the child spit out food the mother interpreted this as a sign that the child was full and terminated the meal. The child did not finish food served. The meal lasted 20 minutes.

2.3.2.2 Observation Two

An 8-month-old child was hand fed halwa from a shared family plate. The food consistency in this case was moist and slightly lumpy. The child's father and two other siblings were also having their breakfast. In addition to halwa, the rest of the family ate puri, an unleavened deep-fried bread, which the mother considered to be oily for the child. The child was seated on their mother's lap and was facing away from the mother. When the meal started, the child was interested in food offered and eagerly accepted food. The child also looked very happy and was playful. There were no verbalizations from the child.

The mother did not talk to the child throughout the meal and was distracted by the LHV. During the meal, the child started coughing. The mother stopped feeding the child and instead offered water. The child was not offered more food after this. It was difficult to quantity the amount of food eaten by the child because the meal offered on a shared plate. The meal in this case took 10 minutes.

2.3.2.3 Observation Three

A 9 month old child was fed a mashed boiled egg (moist lumpy) in his own plate. The mother and child were seated on a bed facing each other at the beginning of the meal. The child was not interested in food offered and kept turning away when the mother placed the spoon close to his mouth. The child looked irritated and unhappy and at some point, he started crying. The mother tried to encourage the child to eat by using soothing words. Verbal responses appeared to increase with food refusal. Furthermore, the mother physically restrained the child by holding his hands together with one hand and feeding with their free hand. The child struggled to break free from the mother's restraint during the meal and started crying. In response, the mother made soothing sounds but did not let go of the child's hands. She then took the child, held him on her laps and offered more food but the child would not eat. The child did not complete their food and the meal lasted 15 minutes.

2.3.2.4 Observation Four

A 16-month-old child was offered a mashed boiled egg. The egg in this case was moist lumpy. Both the mother and child were seated on a bed facing each other. The child was partially lying down (half way seated) because the mother said this made it easy to feed him, as there was less spillage. The mother reported that she made the child sit up when she fed him solid foods like rice. The child was interested in food offered and looked happy throughout the meal. At the beginning of the meal, he was given a toy car, which he played with throughout. The mother reported that she usually gave him toys to distract him during feeding so that he could accept food more easily. The mother was quiet throughout the meal. Although distracted by conversations going on around her, the mother smiled at the child as she was feeding him. The child completed all the food that was served and was not offered any more food. The meal took 10 minutes.

2.3.3 Summary findings from Study One

The aim of this pilot study was to assess the feasibility of using meal observation as a data collection method and aimed to describe eating and feeding behaviours during meals. Although it was feasible to carry out meal observations in Pakistan, the meals observed were not representative as the consisted of either snacks (2) or breakfast (2). All children were fed by their mothers and they were not given a chance to feed themselves. In nearly all observations, children were seated on a chair or bed facing their mother. Two children were given eggs for snacks which is a good protein source and might reflect high dietary diversity. However, considering that in nearly all observations the child ate alone, there is a likelihood that children are not offered some foods that are eaten by the rest of the family because of beliefs about foods. This was observed in a family that was having a common meal on a shared plate. To confirm this, a meal observation that involves the rest of family was required.

Aversive child behaviour during meals included pushing food away, turning away from food, spitting out food and crying. Caregivers responded to this behaviour by either restraining the child, stopping the meal, talking to the child or distracting the child by giving them toys to play with. There was generally lack of encouragement from the caregiver during meals, as most caregivers were quiet. However, some caregivers used nonverbal gestures to communicate with the child such as smiling.

Some of the limitations of this study included reactivity, where caregivers might have changed their feeding behaviour due to our presence. Pakistan is not my native country and due to my distinct features (height and skin colour) I attracted the attention of locals who were curious to find out what we were doing. Although I tried to minimize this by wearing local clothing (Salwa Kameez), in some of the homes we visited there would be an audience consisting of children and a few mothers. This might have influenced feeding behaviour as some mothers were uncomfortable. In one of the homes, the child being observed would look at me and start crying. This made feeding impossible. In addition, there was language barrier as mothers did not speak English and this made communication difficult. I was also not able to understand what the mothers were saying though the presence of the translator and made things simpler. The presence of the health visitor might have also influenced feeding behaviour, as mothers might have tried to present positive feeding practices.

Meal observations were a valuable and practical data collection method. In order to enhance their application, there was a need to identify standard behaviours that would improve the description of childcare practices and enable comparison in different settings. There was also a need to collect socio demographic information. Overall, meal observations were not representative of feeding behaviours in an African setting. Further piloting was therefore needed in low-income areas in Kenya where the definitive study was to be carried out.

2.4 Research tool development process for study two and three

An interview guide made up of both closed and open-ended questions was developed (see Appendix 2). Questions on socio demographic were derived from a questionnaire that was previously that was previously designed by Professor Shakila Zaman. Socio demographic questions included the number of people living in the household, their age, education level and occupation. Family monthly income was also collected. Housing characteristics included the number of years they had resided in their house, house ownership, construction, number of rooms in the house, type of water supply, type of bathroom, garbage disposal and type of sewer system.

Information on child's gender, date of birth and birth order was also collected. The following information on childcare practices was collected: who decides what the child eats, who feeds the child, age of introduction of solid foods, first food offered, child's appetite during meals, action taken when child stops eating and whether caregiver feels they have not eaten enough.

Meal frequency was measured by asking the number of meals and snacks offered in a day. Dietary diversity was assessed using food frequency first, because of the rapidly changing nature of infant and young child feeding practices, the food frequency questionnaire provided a measure of usual intakes of different food groups, therefore minimizing day to day variability without relying on multiple day assessments of actual foods consumed (Gibson, 2005). Second, the method puts a low burden on the respondent and it takes a relatively short time to administer (Gibson, 2005). Given the cross sectional nature of this study, this method was therefore suitable. Food groups as opposed to types of foods were used to collect dietary information. These food groups included meat/fish/poultry, eggs, milk, legumes and pulses, fruits, leafy vegetables and starchy vegetables. Responses were coded as once a day, more than once a day, once a week, more than once a week, once a month and rarely/never.

Most meal observation variables used during the initial observation were maintained, but slight modifications were made to improve descriptions (see Appendix 2). Instead of recording only the type of food, the ingredients used to make the meal were also recorded. This would provide information of the meal content. For supplement meals, the supplement packet was classified as a "utensil" if the supplement was fed by squeezing from the packet directly into the child's mouth (Flax et al., 2013). The amount of food eaten was noted as: does not eat, less than half, half, more than half and all. This was done because other observation studies report that children rarely finish the foods offered (Moore et al., 2006, Bentley et al., 1991b). This was also observed during the initial meal observations in Pakistan. For supplement meals information on the type of supplement offered, the prescribed dose and how the supplement was served (plain or mixed with other foods) was also collected.

All behaviours were recorded at the beginning of the meal, 5 minutes into the meal and at the end of the meal. Five minutes was selected because in the piloting phase as well as in other studies the average meal duration is usually 10 minutes (Flax et al., 2013).Variables that were retained from phase 1 included interest in food, mood, distraction, self- feeding.

Interest in food was defined as how readily a child accepted food and was coded using 5 categories: very interested, moderately interested, neutral, less interested and not at all interested. *Distraction* during meals was described as diverted attention from the feeding episode either because they were playing with an object, playing with someone else or looking at someone or something else. *Self-feeding* was defined as any bite a child fed themselves without assistance from the caregivers. Distraction and self-feeding were coded using a five point likert scale: not at all, rarely, sometimes, most of the time and all the time.

Caregiver's actions included encouragement, use of negative actions and distraction during meals. *Encouragement* was defined as smiling at the child, praising the child, demonstrating to the child how to eat and lightly touching the child. *Negative actions* included flat verbalizations such as "eat your food", threats or silence during the meal. Caregivers were *distracted* if their attention was diverted from the child during the meal. Caregiver actions were recorded using a five-point Likert scale: not at all, rarely, sometimes, most of the time and all the time. Additional behaviours that occurred during meals were also recorded.

Information on hygiene practices were collected using spot check observations and were grouped into three categories: personal hygiene, food hygiene and household hygiene (Webb et al., 2006, Nti and Lartey, 2008). Personal hygiene was assessed using the following variables: presence of soap and water within reach and hand washing practices before meals, while food hygiene was measured by looking at the use of clean feeding utensils, food storage and cleanliness of feeding area. Observations of household hygiene included presence of trash outside the house, stagnant water, animals inside the house and animal waste inside and outside the house (Nti and Lartey, 2008). All measures of hygiene were coded as yes or no.

2.5 Study Two: Piloting in Pakistan

Data collection in Pakistan was carried out by Iqra Shah (IS). I designed the interview guide and meal observation schedule used for data collection (see section 2.4) and gave her instructions on how to carry out interviews and meal observations. I also sought ethical approval from the ethics committee. IS did her own analysis and write up for her MSc dissertation. I reanalysed the data she had collected and interpreted the findings. A summary of the data collection methods and key findings are presented below.

2.5.1 Study design, target population, recruitment strategy and data collection and analysis procedures

This was an exploratory, observation cross sectional study which involved intensive exploration of a small number of healthy children in their natural home environment using a structured interview and meal observation schedule. The study was carried out in three basic health units of Wagah town, Lahore Pakistan. The target population for this study was mothers of healthy infants and young children aged between 6-24 months attending well baby clinics. The aim was to recruit a sample size of at least 30 mother child pairs for the questionnaire and at least 15 caregivers for the mealtime observation. Non-probability sampling, specifically purposive sampling was used. This involved deliberate selection of well-nourished children from well-baby clinics. Children who were undernourished were excluded. Anthropometric measurements were not taken in Pakistan and the child's nutrition status was therefore based on health workers reports..

The study protocol was reviewed by the Lahore Medical and Dental College (reference number: LM&DC 4537) and the University of Glasgow (reference number: 200130125) ethics review committees. Recruitment took place in well baby clinics. An oral account of the study was provided to mothers in Urdu (official language in Pakistan). Mothers who agreed to participate were then requested to sign consent forms. Baseline information was collected at the health facility and participants were asked for their home address for the observation part of the study.

Socio economic and demographic information was collected using a structured interview guide. Caregivers were asked questions regarding employment status, family characteristics and feeding practices. Meal observations were carried out in homes. This

involved observing and recording child eating and caregiver feeding behaviour using a structured observation schedule. Caregivers were requested to feed the child as they normally would. General observations of the home environment and hygiene practices of the caregiver were also made.

Both qualitative and quantitative methods were used for analysis. Frequencies, percentages, and medians were used to analyse and present descriptive statistics. Data collected from interviews and meal observations was transformed for further analysis (Table 2.1). Due to a small number of responses in some groups, responses were summarized into two categories. Briefly, interest in food was coded as interested and low interest, mood as calm and sad; distraction as rarely distracted and distracted. Information on food frequency was coded into three at least once a day, at least once a week and rarely.

Child and caregiver actions were summarized by counting the frequency of each action. If an action occurred at least two times during the meal then it was scored as present (Moore et al., 2006). For example, a child was interested in food if they eagerly accepted food on more than one occasion (beginning, after five minutes, end of the meal) during the meal. Statistical tests were not carried out because of the small sample size.

Table 2.1: Transformed eating and feeding behaviour variables

Variable	Original coding	Recoded
Child's actions		
Interest	Very interested	
	Moderately interested	Interested
	Neutral	
	Less interested	Low interest
	Not at all interested	
	Excited	
Mood	Very happy	Calm
	Calm	
	Sad	
	Crying	Sad
	All the time	
Distracted	Most of the time	Distracted
	Sometimes	
	Not at all	Rarely distracted
	Rarely	
Caregiver's actions		
Positive encouragement, negative actions, distracted	All the time	
	Most of the time	Sometimes
	Sometimes	
	Rarely	Rarely
	Not at all	

2.5.2 Results

Descriptive statistics are first presented for interviews followed by findings from meal observations. Twenty child caregiver pairs were interviewed but only seven meal observations were done. The median [range] age of the children was 13[6 to 22] months and half the children were male 55% (11). The median age of the caregivers was 26 [24 to 28] years. Most caregivers, resided in permanent houses 75% (15), had piped water in their homes and had a closed sewer system 95% (19).

Complementary foods were introduced at 6 months by most caregivers 85% (17). The first complementary food offered in most cases (12/20) was Cerelac, a brand of instant cereal. A few children were given biscuits (3/20), rusk, a hard-dry bread (2/20) and khichri a Pakistani dish made of rice and lentils (2/20). The child's mother decided what the child ate 95% (19). Children were mostly fed by their mothers but when the mother was away this responsibility was left to grandmothers (55%), aunties (15%) or the child's father.

Most of the children 70% (14) met the WHO recommendation for meal frequency. Over half the children 55% (11) were offered between one and two snacks. Only one third of the mothers felt their child had good appetite (Table 2.2). Intake of animal source proteins was low, as over half the children were rarely offered meat or eggs (Table 2.3). Children were more likely to be offered sweet and savoury snacks daily than fruits and leafy vegetables (Table 2.3). Intake of pulses was relatively good, as more than half the children were offered pulses at least once a week. Milk intake was high, as all mothers reported giving their children milk at least once a day.

Table 2.2: Description of meal frequency and appetite rating

Characteristics	Number of children % (n)
Meals/day	
Low meal frequency	10% (2)
Borderline	20% (4)
Snacks/day	
No snacks	35% (7)
1-2 snacks	55% (11)
Appetite rating	
Good	30% (6)
Moderate	65% (13)

Table 2.3: Frequency of consumption of different foods

Frequency	Once daily % (n)	At least once a week %(n)	Rarely %(n)
Meat/fish/ poultry	5 (1)	35 (7)	60 (12)
Eggs	10 (2)	35(7)	55 (11)
Pulses	5 (1)	55 (11)	25 (8)
Fruits	30(6)	35 (7)	35 (7)
Leafy vegetables	0	25 (4)	75 (16)
Starchy vegetables	10 (2)	55 (11)	35 (7)
Sweet snacks	50 (10)	10 (2)	25 (8)
Savoury snacks	50 (10)	25 (5)	25(5)

(n=20)

2.5.2.1 A description of meals observed

Child and caregiver behaviour are presented in Table 2.4. At the beginning of the meal, one child initially had low interest in food; however, five minutes into the meal all children showed interest in the food they were offered. Towards the end of the meal, two children had showed lack of interest. All children were calm at the beginning and middle of the meal. However, towards the end, two children were crying. Most children were attentive at the beginning and five minutes into the meal, however, at the end of the meal three children were distracted (Table 2.4). Caregivers encouraged children to eat at the beginning and middle of the meal; however, towards the end of the meal one caregiver did not offer encouragement (Table 2.4). Overall, all children showed some interest in food and were calm during meals. Only one child was distracted. Positive encouragement from caregivers was present as all caregivers encouraged children to eat at some point during the meal. Negative actions were also relatively common as 57% (4) caregivers showed negative actions more than once during the meal. Distraction was relatively high as all caregivers apart from one were distracted at some point during the meal.

Over half the caregivers, 57% (4) washed their hands before feeding the child and only 29% washed the child's hands. Nearly all caregivers, 6/7 fed the child in a clean environment and used clean feeding utensils. Three homes had stagnant water around the house and animals inside.

Table 2.4: Child and caregiver behaviour during meal observations

	Beginning % (n)	Middle % (n)	End % (n)
Child behaviour			
Interested	86 (6)	100 (7)	71 (5)
Calm	100 (7)	100 (7)	71 (5)
Attentive	86 (6)	86 (6)	57 (4)
Caregiver behaviour			
Encourages	100	100	86 (6)
Positive actions	43 (3)	43(3)	43(3)
Attentive	43 (3)	14 (1)	14 (1)

n=7

2.5.2.2 Summary: Meal observations in Pakistan

Interviews and meal observations were well accepted in this setting. Families recruited were wealthy and had access to basic hygiene facilities. Caregivers reported timely introduction of complementary foods, low intake of animal source proteins and high intake of sweet and savoury snacks. During meal observations, children were calm and showed interest in food. Although caregivers offered positive encouragement during meals, this was occasionally accompanied by orders such as eat your food or silence. Hand washing before meals was relatively common as half the caregivers washed their hands before feeding the child.

In this study, more interviews than meal observations were done due to several factors. First, the researcher had limited time for data collection (1.5 months) as she was required to travel back to Glasgow to complete her dissertation. Second, data collection took place during high summer when temperatures are as high as 48˚C. This meant that data could only be collected early in the morning when it was cooler. Consequently, most meals observed were mid-morning snacks, which were not representative of eating and feeding behaviour during other meals. There is evidence to show that children eat snack foods better than meals (Engle and Zeitlin, 1996). Wagah town had a mix of both middle and low-income homes, however, families recruited were wealthy and this did not provide a clear impression of childcare practices in low-income areas. Furthermore, only healthy children were included in the study and there was therefore a lack of information on eating and feeding behaviour in undernourished children.

2.6 Piloting in day-care centres in Kenya

There is an increase in women's participation in the labour market in many developing countries (Verick, 2014). In Kenya, approximately 62% of women participate in the labour force (Suda, 2002, National Malaria Control Programme et al., 2016). This involvement in employment conflicts with traditional childcare responsibilities and as a consequence mothers seek alternative childcare services from day care centres (Were et al., 2013). In low income areas, children spend a substantial amount of time in day-care facilities mainly because mothers from low income households are more likely to seek alternative care earlier than those from well off households (Phillips and Adams, 2001). The quality of care provided in these facilities is therefore likely to play a significant role in child growth and development.

Day care centres have been shown to have both positive and negative impacts on child growth and development. In some studies, day-care centres were reported to have a positive impact on maternal child relationships and child growth, while others have reported a high risk of contracting infectious diseases such as diarrhoea and respiratory infections due to increased person to person contact and poor hygiene and sanitation practices (Haskins and Kotch, 1986, de Hoog et al., 2014, Braga et al., 2014, Phillips and Adams, 2001, Taddei et al., 2000). In many developed countries day-care centres are regulated and standard requirements such as suitably trained staff that have first aid knowledge, an appropriate child to staff ratio in order to ensure each child gets adequate attention. They are also required to have good ventilation and lighting, proper toilets, hand washing facilities and play areas (Office for Standards in Education, 2001). Such regulations are difficult to enforce in countries where there are no laws regulating day-care centres.

In slums in Nairobi, many women are employed in the informal sector and as a result there is an increase in the use of privately owned day-care centres which are cheap and easy to access. The quality of care provided by carers in these centres is unknown. The aim of this study was to assess the nutrition status of children aged 6-24 months in day-care centres and describe feeding and hygiene practices in these centres.

2.6.1 Methods

This study was carried out in Mukuru kwa Njenga and Mukuru kwa Ruben slums, located in the eastern part of Nairobi. The slums were selected because they were relatively easy to access. Mukuru slum occupies 450 acres of land and is home to over 700,000 people. The slum is divided into two major slums, Mukuru kwa Ruben and Mukuru kwa Njenga, which are separated by a railway line. Mukuru kwa Njenga lies on the East of the railway and Mukuru kwa Ruben is on the Western part. Mukuru kwa Njenga and Mukuru kwa Ruben are made up of one roomed semi-permanent structures made from iron sheets walls and roofs and cemented floors (Figure 2.2 and Figure 2.3). The sewer system in this area is open and there is poor access to clean water and proper toilet facilities (Figure 2.4).

Ethics approval for the study was provided by the University of Glasgow, college of Medical, Veterinary and Life Sciences ethics review committee (200130125). Locally the study was approved by the National Council of Science, Technology and Innovation, the Kenyatta National Hospital/ University of Nairobi ethics review committee (P236/04/2014) and the Ministry of Health (PMO/NRB/OPR/VOL1-3/35). Written consent was also obtained from the day-care centre owners and from parents of selected children.

A detailed description of the research procedures are presented in the published paper (see Appendix 3). Briefly information on day-care characteristics, number of caregivers in the facility, centre construction, number of rooms, water supply, type of toilet, garbage disposal and hygiene practices were collected using a structured interview and observation guide (see Appendix 4). For selected children, anthropometric measurements were taken using standardized procedures. This was followed by meal observations.

Figure 2.2

Figure 2.3

Figure 2.4

Figure 2.2: Semi permanent housing structures in Mathare slum

Figure 2.3 : A One-roomed day-care centre in Mukuru kwa Njenga slum

Figure 2.4: Open sewer system in Mukuru kwa Njenga slum

2.6.2 Summary: Day-care centre observations

Twenty three day-care centres were identified through a survey carried of care centres in slum four slums in Nairobi, Mukuru kwa Ruben (n=5), Mukuru kwa Njenga (n=5), Mathare (n=8) and Korogocho (n=5). In most of the day-care centres, 14/23, mothers provided food from their homes while in some food was prepared at the centre (5/23). Some centres provided both options to mothers. The ages of the 288 children in these centres ranged from three months to 5 years.

From the 23 day-care centres, 10 were selected for in depth surveys. These centres were selected based on the number of children in attendance (>10). All day-care centres, apart from one which was run by a non-governmental organization (NGO), were privately owned and were run from the owners private home. The centre owned by the NGO was spacious, clean and well ventilated. Education charts were hang on the walls and children were provided with toys. The rest of the centres, tended to have limited space and dirty floors. There was no designated sitting area/sleeping area for the children and in some cases they sat either outside the house or on the floor inside the house. The caregivers did not play or talk to the children. In nearly all centres, one caregiver attended to 10 or more children.

A total of 33 children (mean age 15.9±4.9 months) were recruited from five privately owned day-care centres. One third of the children were undernourished. Meals observations were carried out in 11 children. Foods offered during observations were mainly dry carbohydrates. Most children were served cold food because food was not reheated before serving. This was common especially in cases where food was provided from home.

During meals, children were seated on dirty floors and in most cases (54%) they were left to feed themselves. Although caregivers provided them spoons, young children lacked proper hand mouth coordination and would therefore spill food, which they would then pick from the floor and eat. Although children readily accepted food, only four ate more than half the portion they were offered. There was generally low encouragement during meals and caregivers mainly ordered and threatened children. Hygiene was also poor as children were fed in dirty environments and caregivers did not wash their hands or the children's hands before meals.

Findings from day-care centres showed that undernutrition was relatively common in these settings. This could be attributed partly to the quality of care offered in these centres. However, considering that most mothers provided mainly carbohydrate meals raises the question of how are children cared for within households. It is important to consider the child's background and quality of care they receive at home as this also increases susceptibility to negative outcomes.

2.7 Study 3: Observations in homes Kenya

These observation studies took place in two stages. The aim of the first stage was to assess the feasibility of meal observations in homes in a low-income area and to compare eating and feeding behaviour in healthy and undernourished children during a lunchtime meal. This was done in August 2014. The second stage was carried out in July 2015. The aim of these observations was to assess eating and feeding behaviour during ready to use meals.

2.7.1 Methods

This observation study was carried out in Mukuru and Pipeline slums located in the eastern part of Nairobi. The slums were selected because they were relatively easy to access and also because of their proximity to health facilities. A description of Mukuru slum is provided in section above. Pipeline slum on the other hand is made up stone built apartment buildings, which are made up of one-roomed houses (Figure 2.5). Though houses have a closed sewer system, the buildings are densely populated and like Mukuru kwa Ruben and Mukuru kwa Njenga, residents share bathroom and toilet facilities and lack proper access to water. In these slums, residents purchase water for home use from vendors at Ksh 20 (14 British pence) per 20-litre jerrican.

Subjects were recruited from well-baby clinics and outpatient nutrition clinics in one government (Mukuru health centre) and two faith based health facilities (Ruben centre and Pipeline PCEA). The first round was carried out in Mukuru health centre and Pipeline PCEA clinic and the second in Ruben centre. Ethical approval was obtained from the same committees described in section 2.6.1. The study was also approved by Nairobi County health office at sub county level, the Sub County Medical Officer of Health (SCMOH), the Sub county Nutrition Officer (SCNO) and facility heads. Before data collection, approval to conduct the study at each of the facilities was sought from the relevant authorities.

Figure 2.5: Pipeline slum in Nairobi

2.7.1.1 Study design, sample size, sampling procedure, inclusion and exclusion criteria

This exploratory cross sectional study involved observation of a small number of healthy and undernourished children using a semi structured interview and meal observation schedule. The target population was caregivers of infants and young children aged between 6 and 24 months attending health facilities either within or on the periphery of low-income areas in Nairobi. At least 30 children (15 healthy and 15 undernourished) aged 6-24 months were to be recruited for home observations. Purposive sampling was used during recruitment. This involved deliberate selection of both healthy and undernourished children attending well baby clinics and outpatient therapeutic treatment centres.

Caregivers were included in the study if they agreed to participate in the study and had a healthy or undernourished child aged between 6 and 24 months. Children were classified as healthy if they had a Weight for Length and Weight for Age >-2 Z scores of the median World Health Organization growth standards and undernourished if they had weight for length and or weight for age <-2 Z scores of the median World Health Organization growth standards. Children were excluded if they had oedema, congenital disorders affecting growth such as Down's syndrome, cerebral palsy or if they had illnesses which required specialized care.

2.7.1.2 Recruitment process and research procedures

Caregivers were recruited from Mukuru health centre and Pipeline PCEA clinic in August 2014. Health workers introduced me to mothers before the clinic started. Health workers then took anthropometric measurements. Caregivers were then approached for consent.

I went through the information sheet with mothers giving details of the study. Caregivers who agreed to participate were given information sheets and were requested to sign consent forms. After consent was received, I took the caregiver's contacts and we agreed on a suitable day and time to visit their homes. Community health workers were present during recruitment and assisted in taking directions.

In Ruben centre, only undernourished children were recruited from the outpatient therapeutic program in July 2015. Caregivers were approached after anthropometric measurements were taken and recorded by health workers. Recorded weight, height and mid upper arm circumference measurements were entered in World Health Organization Anthro Software version 3.2.2 to check if the child met the inclusion criteria. Caregivers were then asked if the child was receiving ready to use therapeutic foods. Only children on RUF were included for meal observations. The same process was used to obtain consent.

During the first phase, all meal observations were carried out in homes. However, during the second phase some observations were done in the health centre, due to security concerns in Mukuru kwa Ruben. Although I was always in the company of community health volunteers who were well-known in the area, we were almost robbed in broad daylight as we made our way to one of the homes. Luckily, a shopkeeper had seen what was about to happen and discretely offered us shelter in her shop.

Only lunchtime meals were observed in order to get a clear picture of eating and feeding behaviour during main meals. Caregivers were contacted the day before the meal observation was scheduled, to confirm availability. At the start of data collection, it was difficult to trace caregivers back to their homes, because some provided incorrect numbers or, when contacted, some mothers said they were not available. For easy follow up, we decided to follow caregivers from the health centre to their homes. Most children were given lunch at midday. We therefore arrived at homes 30 minutes before the meal and spent between one and two hours in homes. When we got to homes, I tried to sit in a non-intrusive place, but this was not always possible, due to the layout and small size of the houses. Caregivers were however encouraged to follow their usual feeding practices.

Weight, recumbent length and the mid upper arm circumference (MUAC) were measured according to standardized procedures (Lohman et al., 1992, World Health Organization, 2008b). Children were measured either naked or with light clothing of known weight. Weight was measured using a digital weighing scale (SECA 385 digital weighing scale III) to the nearest 0.1 kg. Length was measured to the nearest 0.1cm using a portable length mat rollameter 100 (Raven Equipment Ltd Dunmow, U.K). The caregiver was requested to assist. Caregivers were instructed to place the baby on the length board and hold the baby's head in position (Frankfort plane position). The researcher held down the child's legs with one hand and moved the footboard with the other applying gentle pressure to the knees to straighten the legs. Length measurements were then read and recorded in centimetres.

Mid upper arm circumference was measured using WHO MUAC tape (S0145620 MUAC, Child 11.5 Red/PAC-50). The tip of the child's left shoulder and elbow was located with the child's arm bent. The MUAC tape was then used to determine the midpoint. The tape was placed on the left arm at the midpoint between elbow and shoulder. The researcher then read the measurement from the tape window and recorded it to nearest 0.1 cm.

The dependent variables in this study were caring practices. Aspects of caring practices that were assessed included: feeding practices (who feeds the child, what is the child fed and how often); feeding behaviour (feeding style and caregiver child interaction during a feeding episode). Hygiene practices included hand washing behaviour, availability and accessibility of portable water, availability of soap in the household and cleanliness of the environment. Independent variables included; socio economic status, maternal and child characteristics.

Analyses were conducted using Statistical Package for the Social Science (SPSS) version 19. Frequencies and percentages used to present descriptive statistics. Due to the small sample size continuous data is presented as median [range]. Anthropometric information (weight, length and mid upper arm circumference) was converted to standard deviation scores using the World Health Organization 2006 growth standards. Children were then classified as undernourished if they had weight, height, Body Mass Index for age Z scores of <2-SD. Methods used for analysing meal observations in Pakistan were also used in Kenya.

2.7.2 Results: meal observations in Kenya

Out of the 33 caregivers approached for meal observations, only 19 caregivers were recruited (Figure 2.6). The rest, either declined to participate or were lost to follow up. Nearly all meal observations 17/19 were carried out in homes. The rest, two, were carried out in health facilities. Out of the 19 children recruited, 68% (13) ate home foods, seven of who were undernourished. Nearly all respondents, 17/19 were the child's mother. The median age for caregivers was 27 [19 to 37] years and nearly all of them 15/17 were married and living with their spouses. One caregiver was divorced and the other (the child's aunt) had never been married. All but one caregiver reported living in rented accommodation. More than half the caregivers 58% (11) resided in semi-permanent structures and nearly all of them 79% (15) resided in one-roomed houses, which served as a bedroom, sitting room and kitchen. Toilets were shared with neighbours in nearly all homes apart from one. Most toilets 14/18 were latrines and although they had a flush system in most cases this was not working. Only four homes had their own flush toilet. Household waste in most cases 88% (13) was collected by a "private firm". Only four caregivers reported disposing garbage in a dumping site.

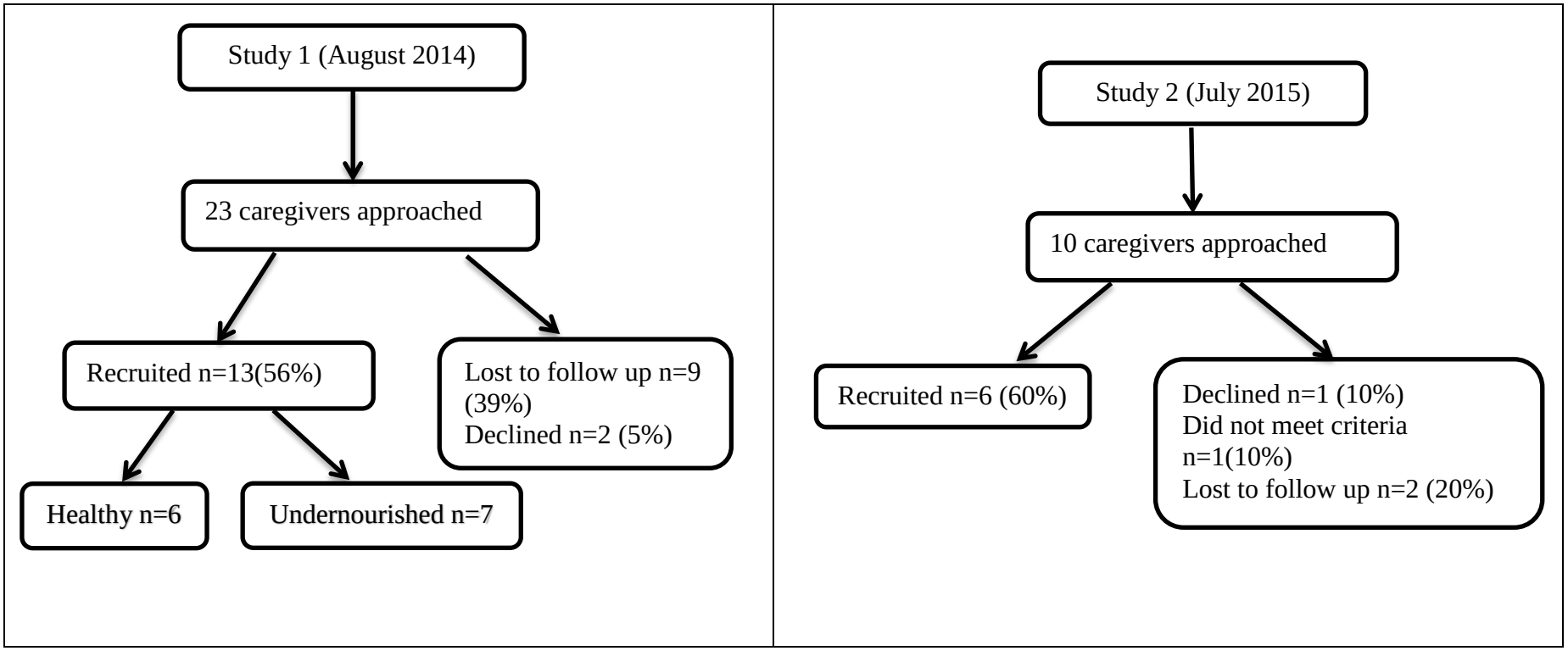


Figure 2.6: Recruitment process for meal observations

2.7.2.1 A description of child characteristics and childcare and feeding

A total of 19 children (9 male 10 female) aged median [range] 13 [7 to 26] months were recruited. More than half the children 68% (13) were undernourished. Healthy children were on average older than undernourished children (Table 2.5). All children on supplements and 4/7 undernourished children on home foods were severely undernourished. All caregivers except one introduced foods at 6 months. The first food given by most caregivers 65% (11) was porridge. Four caregivers reported giving boiled bananas, pumpkin and fruits and one reported giving cow's milk to her child. Most children 14/17 were usually fed by their mothers. Other caregivers included child's father, siblings aged between 8 years and 14 years and relatives. Appetite rating did not discriminate between healthy and undernourished children (Table 2.6). Compared to healthy children, undernourished children were more likely to have good appetite 33% vs 57% and equal proportion of healthy and undernourished children had poor appetite.

Table 2.5: Comparison of child characteristics based on food offered during meal observations.

Characteristics	Healthy home food n=6	Undernourished home food n=7	Undernourished RUF* n=6
Age (months)	15.3 [6.6 to 21.2]	12.6 [8.1 to 20.1]	12.3 [9.9 to 26.2]
Weight for age z scores	-0.59 [-1.3 to 0.11]	-2.59 [-5.75 to -1.80]	-3.80 [-5.49 to -2.74]
Length for age Z scores	-0.63 [-0.94 to 0.87]	-1.90 [-6.41 to 0.69]	-3.02 [-5.60 to -1.61]
Weight for length z scores	-0.53 [-1.41 to 0.09]	-2.31[-3.81 to -1.68]	-3.16 [-4.52 to -1.51]
BMI z scores	-0.56 [-1.36 to 0.05]	-2.30 [-3.37 to -1.35]	-3.09 [-4.54 to -1.03]
MUAC z score	-0.24 [-0.62 to 1.39]	-2.11 [-4.37 to -1.02]	-3.13 [-4.12 to -1.21]

*RUF: Ready to use foods; Data presented as Median [Range].

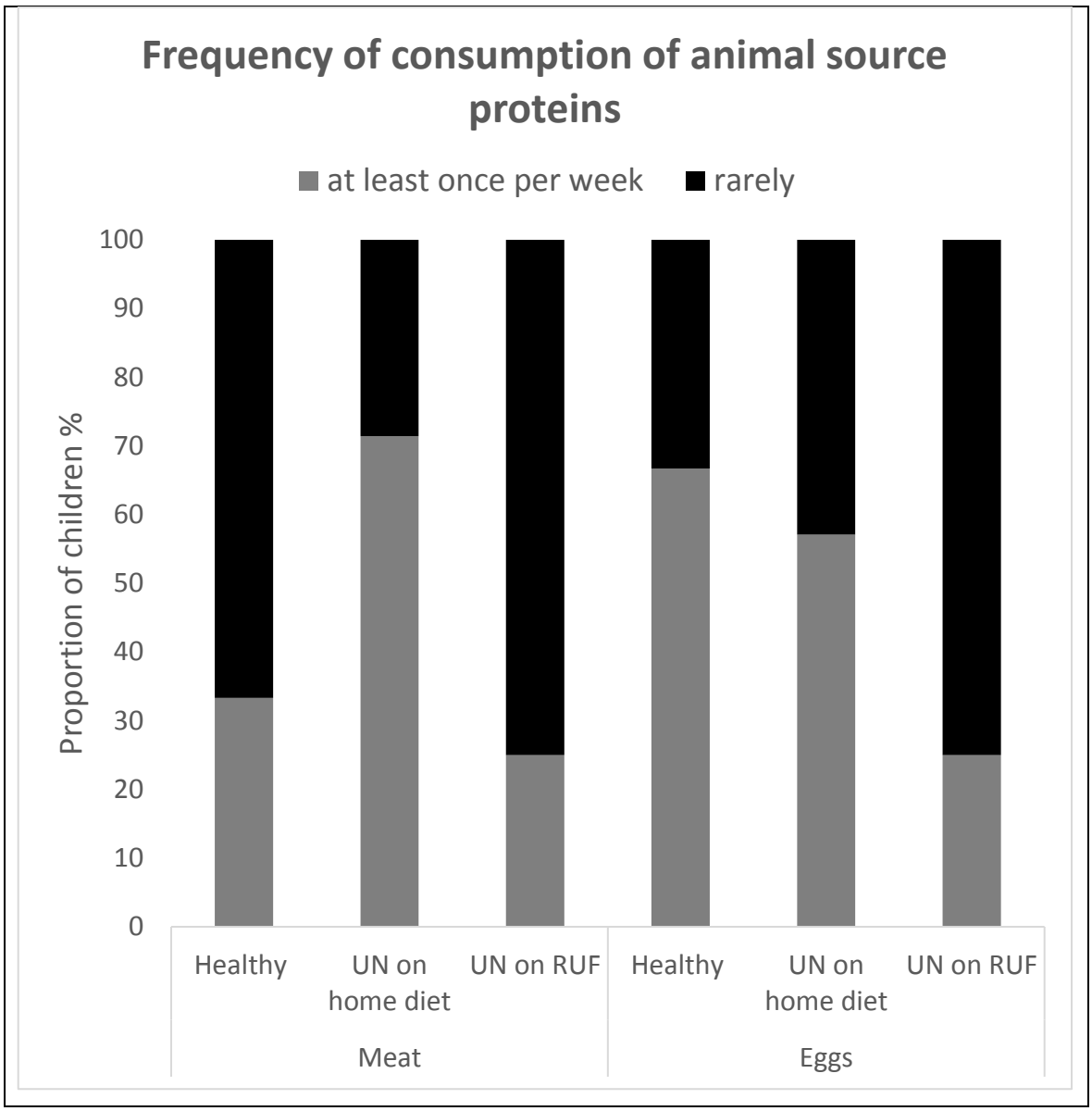
Table 2.6: Child appetite rating in children eating home foods

Appetite rating	Healthy children (n=6)	Undernourished children (n=7)
	%(n	%(n
Good	33 (2)	57 (4)
Moderate	33 (2)	14 (1)
Poor	33 (2)	29 (2)

Intake of animal source proteins was low in all children. No child received animal proteins on a daily basis. A higher proportion of undernourished children on home diet 72% (5) were offered either meat/fish/poultry at least once a week compared to healthy children 33% (2) and undernourished on RUF 25% (1) (Graph 2.1). None of the mothers offered their children eggs daily. Compared to undernourished children on RUF, more healthy children 67% (4) and undernourished children on home diet 57% (4) were offered eggs at least once a week. Milk consumption was high across all groups as most children, 5/6 in healthy children; 6/7 in undernourished on home diet and 3/4 in undernourished children on RUF, received milk daily.

The frequency of intake of pulses and legumes was high in children receiving home foods. Healthy children on home diet 86% (5) and undernourished children 83% (6) on home diet were given legumes at least once a day. In contrast, children on supplements were rarely given legumes 75% (3). On further probing most mothers reported giving broth only. For example if the mother had prepared beans, she would only add the bean broth to the child's food and not the actual beans.

Fruit and vegetable intake appeared to be high as more than half the caregivers reported giving these foods daily, regardless of the child's nutrition status. The most common fruits given bananas, avocados, oranges, watermelons and paw paws. Savoury and sweet snacks were rarely offered to children.



Graph 2.1: Frequency of consumption of animal source proteins in healthy children, undernourished (UN) children on home diet and undernourished children on ready to use food.

2.7.2.2 A description of meals observed in Kenya

Most children, 84% (16), were fed by their mothers. One healthy child was fed by his thirteen-year-old sister. One healthy child was fed by his aunt because his mother was away from home. A 15-month-old undernourished child was left to self-feed without assistance.

Most children 79% (15) were seated on the caregivers lap. The rest (4) were either seated on a chair, bed or on the floor. Children were usually not offered food at the same time as the family; in only one case was the family also having their meal. The child in this case

was offered the same meal as the rest of the family. All children had their own plate. Children on home diet were mostly fed using a spoon (11/13). Other feeding modes included use of a cup to feed porridge and hands. Ready to use therapeutic food on the other hand was fed directly from the packet in half the meal observations. On two occasions the supplement was mixed with warm water. The child was then fed using a spoon. One caregiver used her finger to scoop the supplement from the packet feed her child.

Undernourished children on home diet were more likely to be breastfed before and during meals 57% (4) than healthy children and children on supplements. Two children were breastfed during the meal, the other two were breastfed after refusing food. Only one undernourished child on supplements was breastfed. The mother would alternate between feeding the supplement and breastfeeding her child. On two occasions mothers would coax the child to open their mouth by offering her breast. When the child opened their mouth the mother would then try to feed the child.

The median [range] meal duration was 13 [8 to 50] minutes. Although undernourished children on home diet had a longer meal duration 20 [10 to 50] minutes than healthy children 12 [8 to 25] minutes and undernourished children on supplements 14 [9 to 21] minutes, this difference was not significant (P=0.561 Kruskal Wallis).

2.7.2.3 Types of foods given during meal observations

Meals offered to children were mainly carbohydrate based and consisted of boiled green bananas and Irish potatoes. Two children were offered Ugali, a Kenyan staple dish made out of maize flour (Figure 2.7). Only three children, one healthy and two undernourished, received protein source foods (Table 2.7). One mother gave her child milk; the other two gave plant proteins (mung beans and kidney beans). Intake of leafy vegetables in healthy children was poor, as none of them received leafy vegetables. Undernourished children on the other hand 43% (3) were offered vegetables such as spinach, amaranth and kale (Table 2.7). Other vegetables included in meals were tomatoes and onions. Avocado was also added to meals by caregivers of two healthy children. Healthy children were more likely to receive food cooked with oil (Table 2.7). Oil was used to fry onions and tomatoes. Carbohydrate foods (bananas, pumpkin or Irish potatoes) would then be added to this mixture and boiled till soft. Foods would then be mashed before feeding.

a. Ugali served with milk

b. Pumpkin cooked with tomatoes and a bit of oil

Figure 2.7: Complementary foods offered during meal observations

Table 2.7: Lunch time meal composition in individual children

Nutrition status	Protein	Leafy vegetables	Starch	Other vegetables	Food cooked with oil
Under-nourished	x	x	Pumpkin	Tomatoes	Yes
Under-nourished	Milk	x	Ugali	x	x
Under-nourished	x	x	Bananas and potatoes	x	x
Under-nourished	x	Spinach	Pumpkin and bananas	Onions and tomatoes	Yes
Under-nourished	Beans	Amaranth	Irish potatoes and bananas	x	x
Under-nourished	x	Kale	Ugali	Tomatoes	Yes
undernourished	x	x	Bananas and potatoes	Tomatoes	Yes
Healthy	Mung beans	x	Arrow roots	Onions and tomatoes	Yes
Healthy	x	x	Bananas and potatoes	x	x
Healthy	x	x	Pumpkin, potatoes, bananas	Onions and tomatoes	Yes
Healthy*	x	x	Rice	Avocado, onions and tomatoes	Yes
Healthy	x	x	Bananas and potatoes	x	Margarine and oil
Healthy	x	x	Bananas	Avocado, tomatoes, onions	Yes

*child was offered black tea with the meal.

2.7.2.4 Eating and feeding behaviour during meals

Healthy and undernourished children on supplements were more likely to show interest in food compared to undernourished children on home foods at the beginning and middle of the meal (Table 2.8). However, towards the end of the meal healthy children were more likely to show interest in food than undernourished children (Table 2.8). Healthy and undernourished children on RUF were more likely to be calm during meals compared to undernourished children on home diet at the beginning, middle and end of the meal.

Healthy and undernourished children on home diet were more likely to be distracted at the beginning, middle and end of the meal. In contrast, none of the undernourished children on RUF were distracted at the beginning and middle of the meal and only one child appeared to be distracted at the end of the meal (Table 2.8).

Two caregivers tried to divert the child's attention briefly during the meal by allowing the child to watch TV (undernourished on home diet) or playing with the child (healthy). Encouragement during meals was generally low across all groups at the beginning and end of the meal (Table 2.8). Nearly half of undernourished children on home foods 43% (3) were positively encouraged at the beginning of the meal. However, this changed 5 minutes into the meal as only two caregivers offered positive encouragement when feeding. Towards the end of the meal, there was low encouragement from caregivers of children eating home food. In contrast, encouragement among undernourished children on supplements increased (Table 2.8).

Negative actions included flat verbalizations such as "eat your food", threatening to beat the child and not talking to the child. All caregivers used negative actions during meals. At the beginning and middle of the meal, negative actions were common in caregivers of undernourished children (Table 2.8). This however changed at the end of the meal as nearly all caregivers showed negative actions. Compared to caregivers of healthy children, caregivers of undernourished children paid less attention to children during the meal. Caregivers were explaining how difficult it is to feed the child. In two cases the caregivers were watching TV.

2.7.2.5 Summary of child and caregiver action during meals

To summarize child and caregiver actions, the frequency of each action was counted. If an action occurred at least two times during the meal then it was scored as present. Summarized results are presented in (Table 2.8). Undernourished children on home foods were more likely to be sad during meals than children on supplements. All healthy children were calm. Compared to healthy children, undernourished children on home diet and undernourished children on RUF were less likely to be interested in their meal (Graph 2.2). Distraction during meals was more likely to occur in healthy children than in undernourished children on home foods and RUF. Positive encouragement during meals was low (Graph 2.3). Negative actions were common in all groups especially among undernourished children on home foods. All caregivers in this group showed negative actions during meals (Graph 2.3). Distraction during meals was common in caregivers of undernourished children on home diet. Only a small proportion of caregivers in the healthy and RUF group were distracted (Graph 2.3).

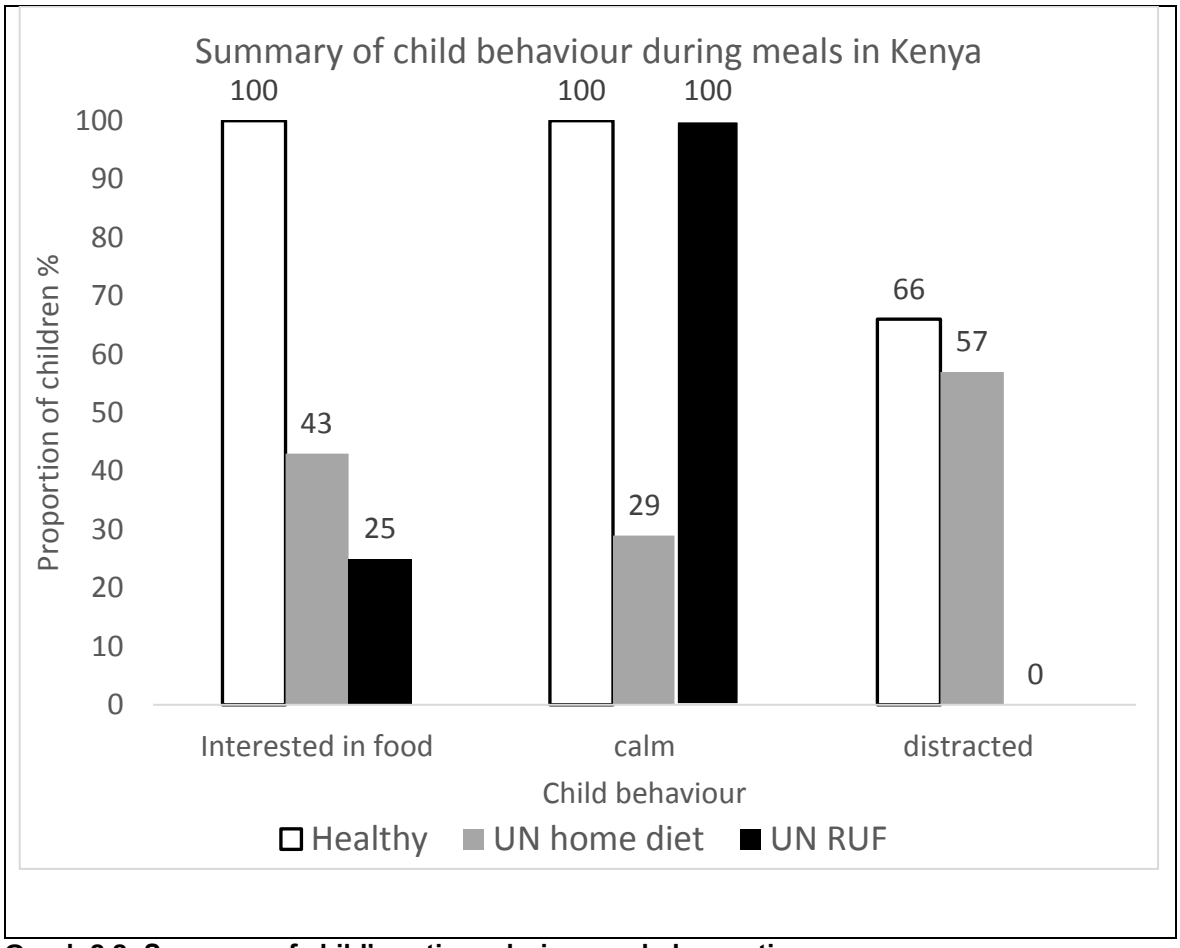
Table 2.8: Eating and feeding behaviour during meals in healthy and undernourished children on home diet and ready to use foods

Actions	**Pakistan**	**Kenya**		
	Healthy %(n)	Healthy %(n)	UN home diet %(n)	UN RUF* %(n)
Child Actions		(n= 6)	(n=7)	(n=6)
Beginning				
Interested in food	86(6)	83(5)	43(3)	67(4)
Calm	100(7)	100(6)	57(4)	67 (4)
Distracted	14 (1)	68(4)	43(3)	0
Middle				
Interested in food	100(7)	83 (5)	57(4)	75(3)
Calm	100(7)	100(6)	57 (4)	100 (4)
Distracted	14 (1)	100(6)	57 (4)	0
End				
Interested in food	71(5)	50 (3)	29(2)	0
Calm	71(5)	83 (5)	29 (2)	75 (3)
Distracted	43(3)	80 (4)	71 (5)	25 (1)
Summary				
Interested in food	100(7)	100(6)	43(3)	25(1)
Calm	100(7)	100 (6)	29 (2)	100(4)
Distracted	14 (1)	67 (4)	57 (4)	0
Caregiver's				
Beginning				
Encourage	100	17(1)	43 (3)	17(1)
Negative actions	57(4)	67(4)	100 (7)	100(6)
Distracted	57(4)	17(1)	57 (4)	67(4)
Middle				
Encourage	100	33(2)	29 (2)	0
Negative actions	57(4)	50 (3)	86 (6)	100(4)
Distracted	86(1)	33(2)	71 (5)	50 (2)
End				
Encourage	86(6)	0	14 (1)	75 (3)
Negative actions	57(4)	83 (5)	86 (6)	100(4)
Distracted	86(6)	33 (2)	86 (6)	25 (1)
Summary				
Encourage	100(7)	17(5)	29(2)	25(1)
Negative actions	57(4)	67(4)	100(7)	100(4)
Distracted	86(6)	17(1)	71(5)	50 (2)

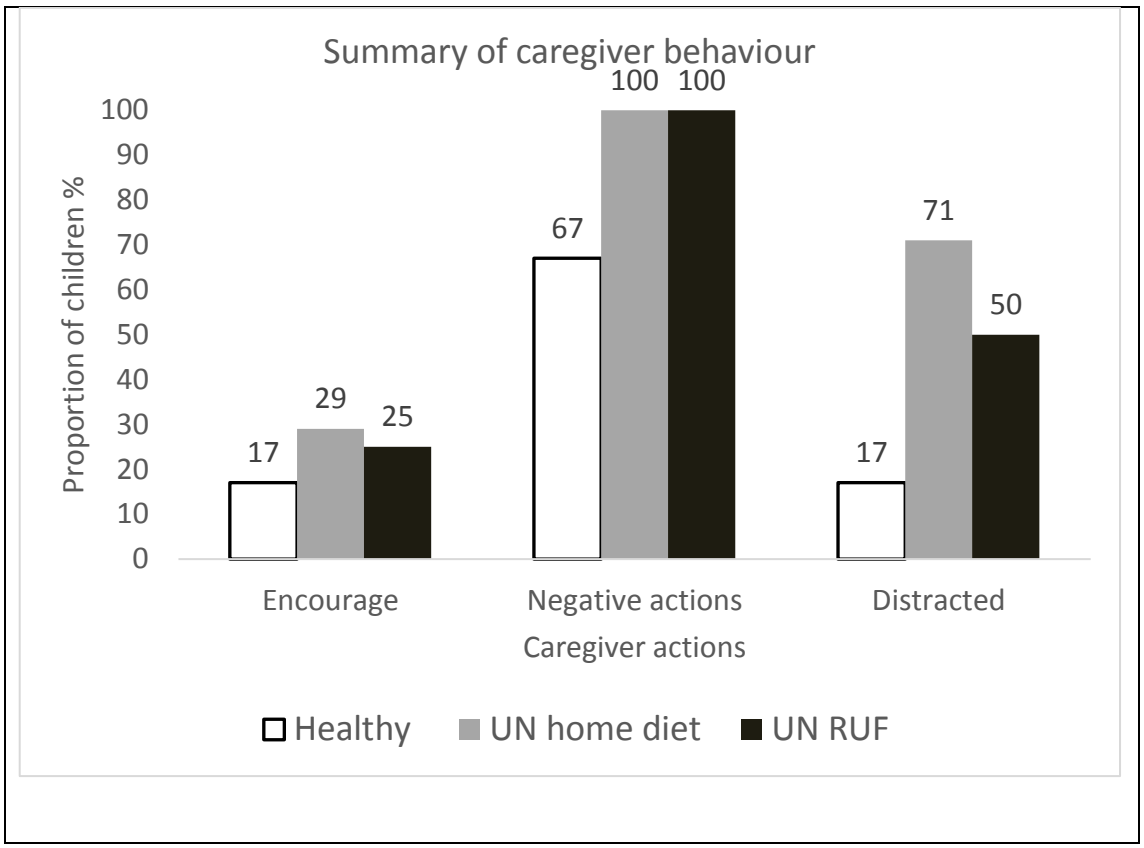
UN: Undernourished; RUF: Ready to use food; * n=4 at the middle and end of meals in undernourished children on RUF because one child refused to eat and the other had already eaten part of their food

2.7.2.6 Comparison between eating and feeding behaviour in Kenya and Pakistan (healthy children only)

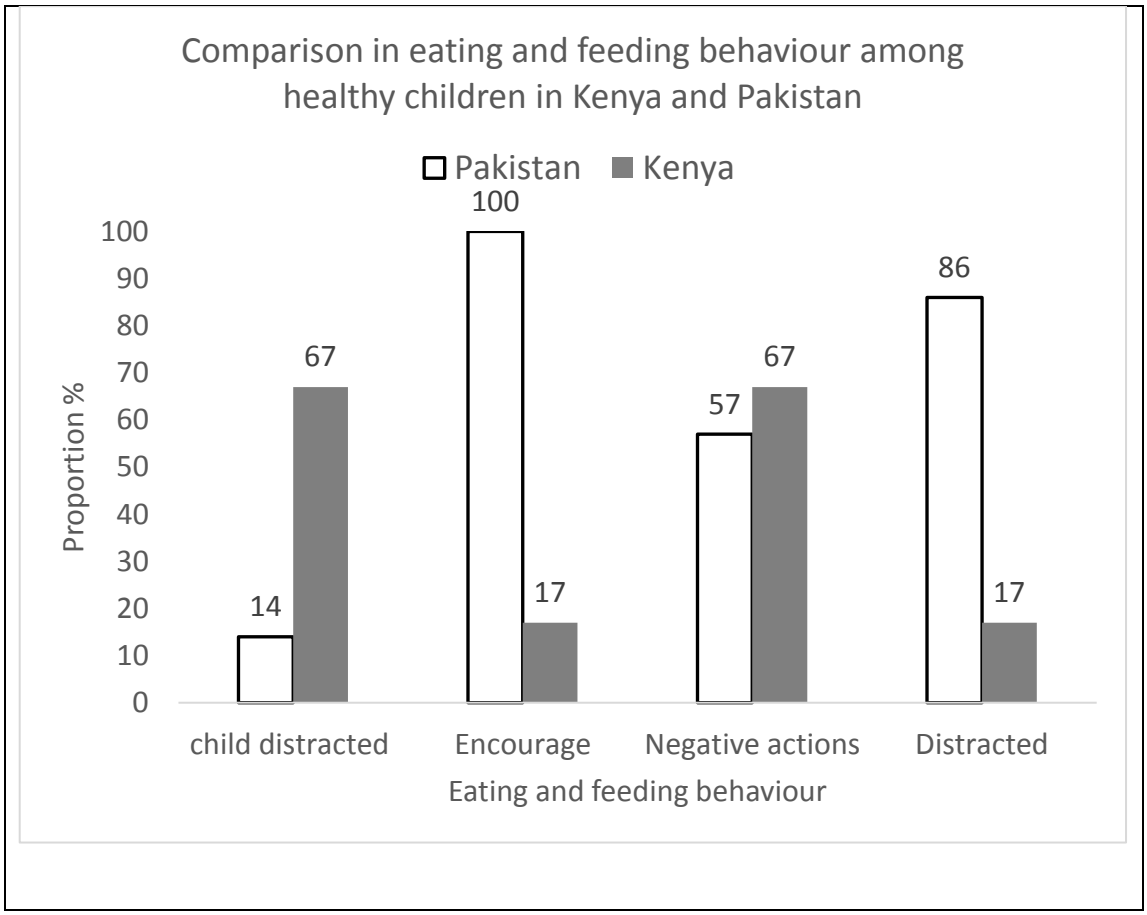
Healthy children in both Kenya and Pakistan were interested in food and were calm during meals (Table 2.8). In Kenya however, nearly all children were distracted. Compared to caregivers in Pakistan, caregivers in Kenya were less likely to encourage children during meals. They were however, more likely to order the child to eat or remain quiet during meals. Caregivers in Pakistan were more distracted during meals than caregivers in Kenya (Graph 2.4).



Graph 2.2: Summary of child's actions during meal observations



Graph 2.3: Overall caregiver's actions during meals.



Graph 2.4: Comparison between child eating and caregiver feeding behaviour in Kenya and Pakistan in healthy children.

2.7.2.7 Additional eating and feeding behaviours and hygiene practices

Spitting out food was common during feeding, especially among healthy 67% (4) and undernourished children 57% (4) on complementary foods. None of the undernourished children on supplements spit out the supplement during meal observations. Additional caregiver actions included offering the child food again; talking about food to the child; calming the child down and questions why the child is not eating; promises the child something; restrains child; forces to eat by either threatening or forcing their mouths open; offers something else and leaves the child alone. More than half of all caregivers in each group offered children food again after refusal (Table 2.9). Two caregivers of healthy children talked to the child about food. One of them told the child the food is sweet and the other reassured the child that have only a small amount to eat before the meal is complete. None of the caregivers of undernourished children talked about food.

Undernourished children on home diet were more likely to be offered either porridge or milk when they refused food 57% (4). Healthy children and undernourished children on RUF were not offered other foods.

Physical force during meals was characterized by restraining the child's hands firmly to restrict movement. This was common, especially among undernourished children receiving home foods 43% (3) and those on RUF 50% (3). Among healthy children, only two were restrained. One caregiver, a 13-year-old child tried to force open the child's mouth. Children who were force-fed would turn away when food was offered and spit out food. Threats were not very common during meals 3/19. One healthy child and two undernourished children on home diet were threatened. Caregivers threatened to either beat the child or switch of the TV.

Only one caregiver of a healthy child calmed down the child when the child became fussy. Questioning why the child did not want to eat was rare. Only one caregiver of a healthy child did this. Promises to either give the child a sweet or take the child outside were common in children on home foods especially in undernourished children on home diet (Table 2.9). Two caregivers (one undernourished on home diet and one undernourished on RUF) left the child alone when they refused to eat. Only one severely undernourished child, aged 15 months, was left to self-feed without assistance from the caregivers.

Table 2.9: Observed caregiver's actions during meals

Caregivers actions	Healthy (N=6)	Undernourished on home diet (n=7)	Undernourished on RUF (n=6)
	% (n)	% (n)	% (n)
Offers food again	67 (4)	57(4)	67(4)
Promises child	33(2)	57(4)	0
Restrains child	33(2)	43(3)	50 (3)

Lack of hand washing before feeding the child was common, especially in children receiving home foods where none of the caregivers washed their hands. In one case, the mother had just changed the child's soiled nappy and she proceeded to start preparing food for child without washing her hands. Hand washing was common during supplement meals: three caregivers washed their hands before feeding the child two of whom washed their hands with water and soap. One caregiver washed her hands with water only. Amongst those caregivers who washed their hands with soap and water, one caregiver changed another child's nappy during the meal and then continued to feed the child.

Children's hands were rarely washed before meals. Only two children (one undernourished on home diet and one on RUF) had their hands washed with warm water only. The undernourished on home diet was self -feeding and despite the fact that the child's hands were washed, the feeding environment was not clean. The child was seated on the floor on a piece of cloth, which he had soiled just before the meal started.

All caregivers used clean feeding utensils. All feeding areas were clean with the exception of two houses. There was no stagnant water around the house except in one of the homes visited. Only one household had an animal inside (kitten) and animal waste outside (rabbit droppings). There was a carpet of garbage outside two homes.

2.8 Discussion

The aim of these preliminary studies was to assess the feasibility of carrying out meal observation studies at household level. Meal observations proved to be problematic for several reasons. First, observations were labour intensive and only one meal could be observed per day. Consequently only a small non-representative sample of children were recruited and day to day variability in feeding practices could not be captured. Although findings from these observations are comparable to other studies, statistical analysis tests could not be carried out for most of the analysis because of the small sample sizes. Findings presented are therefore descriptive.

Second, in each setting only one meal was observed and because these were different meals, snack foods in Pakistan and lunch in Kenya, observations made in Pakistan could not be used to make inferences about feeding in Kenya and vice versa. Thirdly, reactivity was likely to be an issue. In Pakistan, the researcher (IS) felt that mothers prepared special foods for the observation. Reactivity on the first observation day has previously been reported (Gittelsohn et al., 1998). To overcome this, meal observations would need to be carried out on different days, however this was not possible. Limited space in most homes visited in Kenya meant that the caregivers had to change their seating position to create space for the researcher. This occurred, despite being encouraged to follow their normal feeding practices.

In other studies researchers spend up to 12 hours in homes and they also visit homes on different days in order to get a representative picture of feeding practices (Gittelsohn et al., 1998, Kamau-Thuita et al., 2002, Engle and Zeitlin, 1996). Although ideal, this was not possible due to harsh weather conditions in Pakistan and security concerns in Kenya. For example, during field visits in Kenya, we had gunshots; a fire broke out in a neighbouring house and on one occasion we were almost robbed. One caregiver decline to have a second observation done because she said her husband was against it.

Follow up of caregivers from the health facility to homes was a challenge. Although some caregivers were willing to participate in the study, tracing them back to their homes was a challenge because some did not have phones. Furthermore, some caregivers provided wrong contact information. Tracing homes was also a challenge because of the informal nature of the settlements. We were, however, able to trace homes using landmarks and shops. In some cases the caregivers were away from home on the scheduled observation days. A similar challenge was noted in a similar study (Kamau-Thuita et al., 2002).

There were some observed differences in eating and feeding behaviours in healthy and undernourished children. Compared to healthy children, undernourished children were more likely to cry and show low interest in food, a possible reflection of poor appetite. However, within the undernourished group, compared to children on home diet, children eating RUF were less likely to show aversive eating behaviour. A possible indication that either undernourished children prefer RUF. Preference for RUF has been reported in Malawi where 15-month-old moderately undernourished children were more likely to accept bites of Lipid Nutrient Supplement (LNS) than complementary foods (3.05 [1.98, 4.71 p=<0.001]) during meal observations. This was attributed to the taste and consistency of the supplement (Flax et al., 2013). To assess the impact of RUF on childcare practices, information on eating and feeding behaviour in the same child during RUF meals and home meals would be required.

Encouragement during meals in Pakistan appeared to be high and was accompanied by negative actions, such as orders to eat. In Kenya, although encouragement was generally low, it mostly occurred in undernourished children. Neutral actions were also relatively common, especially in undernourished children on home diet and in day-care centres. Differences in feeding behaviours in Kenya and Pakistan may reflect enhancement and compensatory care respectively. In Pakistan, the aim of encouraging children to eat is to enhance their wellbeing. In Kenya on the other hand encouragement appears to be used to get children back to an ideal healthy state. Similar observations have been reported by other studies in rural Kenya where caregivers are more likely to respond to children who are not well nourished (Sigman et al., 1988, Wachs et al., 1992). However, a larger study in Kenya comparing eating and feeding behaviour in healthy and undernourished children is needed to confirm this.

Compensatory care has been reported in Peru and Nicaragua (Bentley et al., 1991b, Engle and Zeitlin, 1996). In rural Peru, meal observations were done in children aged between 6 and 36 months at different stages of illness, when the child had diarrhoea, during the convalescent stage and when the child was healthy. Findings from this study showed that mothers were more likely to encourage children during illness phase than when the child was recovering 0.54 [0.35 to 0.82] or healthy 0.65 [0.46 to 0.93]. Similarly, in a low-income area in urban Nicaragua, Engle and Zeitlin (1996) found no association between active feeding and child anthropometry in moderately undernourished children aged 12-19 months (Engle and Zeitlin, 1996). This was an indication that active feeding occurred only in undernourished children.

Force-feeding was relatively common, as caregivers restrained children by holding their hands during meals regardless of their nutrition status. This could be an indication that caregivers generally restrain children during feeding. Other tactics used to get children to eat included distracting the child by giving toys or allowing them to watch television or threatening them. Mothers also used their breast to get their children to open their mouth. These behaviours have been reported by other observation studies (Nti and Lartey, 2007, Oni et al., 1991, Iuel-Brockdorf et al., 2016)

Low energy drinks such as milk and porridge were also offered when children refused to eat. This was probably because children are more likely to accept liquid and semi solid foods than solid foods which makes feeding easier (Bentley et al., 1991b, Engle and Zeitlin, 1996). Furthermore, undernourished children on home diet were breastfed before or during meals. Reports of decrease in child's appetite for non-breast milk foods with increase in breast milk intake was reported in Peru where breast milk intake was measured by weighing children before and after breast feeding (Bentley et al., 1991b).

Children were also not given opportunities to feed themselves and were mainly fed by their mothers during home observations. Low levels of self- feeding have been reported in other studies in Malawi and Bangladesh (Flax et al., 2010, Moore et al., 2006). Self-feeding appears to be influenced by the child's age and type of food offered (Engle and Zeitlin, 1996, Ha et al., 2002, Flax et al., 2013). In Nicaragua for example, children were more likely to self-feed during snacks than their midday meal (Engle and Zeitlin, 1996).

Time available for childcare also appears to influence feeding styles used (Bentley et al., 1991a, Affleck and Pelto, 2012). This was observed in day-care centres and during one home meal observation, where primary caregivers left children to feed themselves with little or no assistance or encouragement, an indication of laissez faire feeding. Such a feeding style can lead to low intake as children usually end up spilling and playing with their food. In cases where the feeding environment is dirty, food offered ends up being contaminated as observed in day-care centres. Intake of animal protein in both Kenya and Pakistan appeared to be low as over half the children were rarely offered these foods. Compared to Pakistan, children in Kenya were less likely to be offered sweet and savoury snack foods. Observations in Pakistan also revealed that children may not be offered the same foods as the rest of the family.

Poor hygiene practices were prevalent, especially in Kenya where caregivers were less likely to wash their hands before feeding the child. This could be an indication of general poor hygiene practices but assessment of hygiene practices in a larger more representative sample is required to confirm this. Handwashing during supplement meals was common probably because caregivers had received recent instructions on the importance of hand washing before meals. Eating and feeding behaviours appear to vary with setting, type of meal offered and the child's nutrition status. Single meal observations therefore do not capture all eating and feeding behaviours.

The time available for childcare also appeared to influence feeding styles used and should be considered. Although day-care centres in slums provide alternative care to children as mothers go work they could be doing more harm good, yet if well managed they have the potential to improve child growth and development (Taddei et al., 2000). In order to enhance their use as income generators for the owners and an alternative source of childcare, there is a need for intervention from either the government or non-governmental organizations.

The aim of these preliminary studies was to test the feasibility of using observations as a way to assess childcare practices in urban slums in Nairobi and in a semi-rural area in Pakistan. Meal observations were labour intensive and impractical. The whole process was time consuming and as a consequence only a small non representative sample of caregivers could be recruited, a relatively common characteristic of observation studies (Engle and Zeitlin, 1996, Moore et al., 2006, Bentley et al., 1991b). Thus this type of methodology

was not suitable for the population under study. The use of interviews might be more practical and might provide a more representative sample of interactions during meals as a relatively large sample of participants are recruited (Wondafrash et al., 2012).

Some of the key questions that came up from these studies included

1. Are eating and feeding behaviour different in healthy and undernourished children?
2. Does the type of food offered affect eating and feeding behaviour in undernourished children?

In order to answer these questions, a larger and more representative sample of healthy and undernourished children in slum areas was required.

2.8.1 Lessons learned

Meal observations were a valuable data collection method which enabled direct assessment of eating and feeding behaviour in homes and day-care centres. However, they were not practical because of several reasons.

- They were not representative because only one meal observed in a small sample of children. This was because observations were labour intensive and time consuming.
- Observations were intrusive and it is therefore possible that some caregivers changed their behaviour during meals
- Follow up of caregivers from the health facility to homes was a challenge, either because caregivers provided incorrect contact information or they did not have phones.
- Insecurity in the slums made movement in the slums difficult

3 Methods: Main study

This chapter provides a description of the study design, study sites and data collection procedures used for the main observational study undertaken as part of this PhD. It also includes a description of the variables used to collect information on sociodemographic characteristics, breastfeeding and complementary feeding practices. This is then followed by a description of analytical procedures.

This study aimed to quantifying the number and range of modifiable risk factors that undernourished children in slums areas are exposed to and the number of risks that were modifiable at health facility level. This study also assessed the association between risk factors, child nutrition status and severity. These risk factors included breastfeeding practices, feeding frequency, dietary diversity, child eating and maternal feeding behaviour and personal hygiene practices. We did however, acknowledge that modifiability was dependent on the family's socio economic status. Thus, other risk factors considered were socio economic factors such as number of assets, house construction, water sources for household use and toilet access, although these were considered to be unmodifiable at health facility level, because they required either a change of environment or community and government intervention. These risk factors are also associated with child nutrition status and are considered to be confounding factors (Victora et al., 1986, Checkley et al., 2004, Abuya et al., 2012).

Data was collected using a semi structured interview schedule because meal observations were not a practical data collection method for a large sample of children. One advantage of semi structured interviews is that they are fairly quick to conduct which means a larger and more representative sample can be obtained (Barriball and While, 1994). They are also easy to replicate and information collected using this method can easily be quantified. Interviews are also considered to be a relatively reliable measure of childcare practices and mother and child interactions during meals. In Bangladesh, for example, Moore et al. (2006) found that 85% of mothers who reported feeding problems encountered at least one refusal during meal observations (Moore et al., 2006). The validity of the data collected is also increased because semi structured interviews give room for probing and complex questions regarding eating and feeding behaviour could be clarified. Probing would also allow opportunities to explore sensitive issues and enable the interviewer to clarify inconsistencies within respondent responses. Semi structured interviews would further

allow opportunities to change words but not the meaning of questions because they acknowledge that not every word has the same meaning to every respondent, which was essential given the expected sociodemographic differences of the sample (Barriball and While, 1994). The interview schedule used was developed in English, translated to Swahili and then back to English to ensure the questions did not lose meaning (see Appendix 5).

The following hypothesis were formulated to test associations

1. Undernourished children are likely to come from more deprived homes than healthy children
2. There will be an association between nutrition status and hygiene practices
3. There will be an association between ownership of hygiene facilities and child nutrition status.
4. Compared to healthy children, undernourished are more likely to be introduced to complementary foods before 6 months
5. Undernourished children are more likely to have less diverse diets than healthy children
6. Undernourished children receive meals at a lower frequency

3.1 Ethics approval

Permission to carry out the study was first sought from the Kenyatta National Hospital/ University of Nairobi ethics review committee in Kenya (P651/11/2014) as well as the University of Glasgow ethics review committee in the United Kingdom (200140057). Further research approval was sought from the National Council of Science, Technology and Innovation (NACOSTI/P/15/9164/5185) in Kenya. Access to health facilities was granted by the Nairobi county health office, Makadara, Embakasi and Lang'ata sub county health offices. At facility level, either the medical superintendent or the nurse in charge were approached for approval. During my fieldwork, I was affiliated with African Population Health and Research Centre, a research institute in Nairobi that conducts policy-relevant research on population, health, education, urbanization and related development issues across Africa.

3.2 Study sites

The study was carried out in seven out of 80 health facilities in Nairobi: Mbagathi District hospital, Kayole II sub county hospital, Ruben Medical Clinic, Makadara health centre, Mukuru kwa Njenga health centre, Soweto PhC clinic which run child welfare clinics, outpatient therapeutic and supplementary feeding programs (Figure 3.1). The health facilities were selected because of their proximity to slum areas and ease of access. Ruben Medical Clinic and Soweto PhC, both faith based organizations, are in Mukuru kwa Ruben and Soweto slum respectively. The rest of the health facilities are government owned and are located on the periphery of major slums. Five out of the seven health facilities were located in Embakasi sub-county. The remaining health facilities were located in Lang'ata (one) and Makadara (one) sub counties.

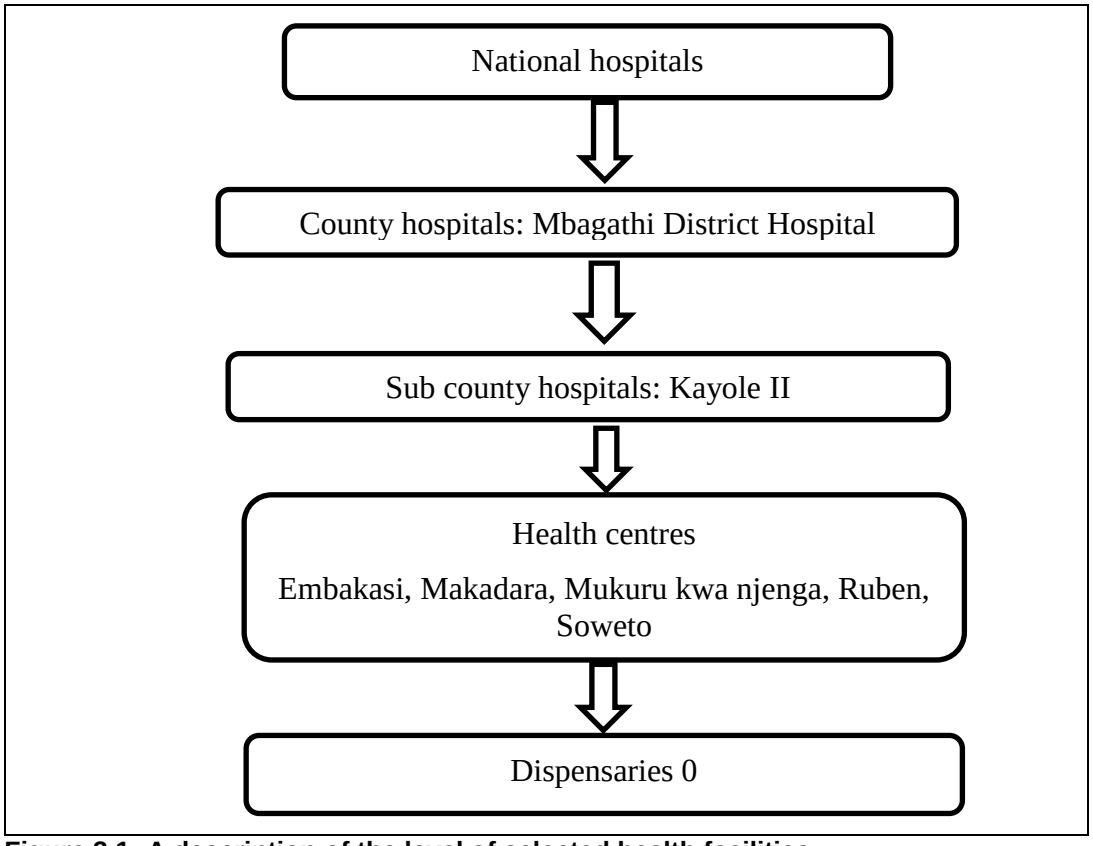


Figure 3.1: A description of the level of selected health facilities

3.2.1 Day to day activities in child welfare clinics and outpatient therapeutic and supplementary feeding programs

Child welfare clinics are run by a nutritionist and nurse and services are offered on a first come first serve basis. The nurse oversees immunizations while the nutritionist is responsible for growth monitoring and vitamin A supplementation. In health facilities that do not have a nutritionist, either a nurse, trained community health workers CHWs, or interns are left in charge. Growth monitoring and immunization sessions are recorded daily in child welfare and immunization registers provided by the ministry of health. This information is then summarized at the end of each month and is entered into the Kenya Health Information System. Data entered on this system is used for placing orders for medical and nutrition supplies. Individual child measurements are recorded in a mother child health booklet (MCH), which the mother keeps.

Screening for undernutrition takes place during growth monitoring sessions. Weight for age alone is used in 5/7 health facilities to identify new cases. Mid Upper Arm Circumference on the other hand is only used during nutrition clinics to monitor progress. In Ruben centre and Embakasi health centre, MUAC measurements are also taken during growth monitoring and are also used for screening.

Newly diagnosed children are usually requested to return to the clinic for further assessment during Outpatient Therapeutic Programmes (OTP) and Supplementary Feeding Programmes (SFP). During these feeding programs weight for length and MUAC are used to assess severity and monitor progress. Ideally, all OTP centres are supposed to run on the same day of the week (Wednesday) because if held on different days, some mothers visit different OTP clinics and collect RUF which they then sell. However, because of lack of coordination, OTP clinics are held on different days. Child progress was previously recorded in a special OTP card which was provided by the government with support from Concern International, but funding for this programme stopped which resulted in a lack of recording material. Child progress was therefore recorded in the child's MCH booklet during the data collection period in 6/7 health facilities. In Ruben centre, the nutritionist has one original copy of the OTP card which she photocopies and uses for record keeping.

During feeding clinics, a record of clinic attendance and RUF use is kept. This information is compiled at Sub County and county level and is summarized monthly in the Kenya

Health Information System. Orders for RUF are then placed based this information. Because Nairobi is classified as a non-emergency area, the supply of RUF tends to erratic. When there is a low supply of RUF in Nairobi, the county nutrition office sometimes borrows RUF from Arid and Semi-Arid programmes which are well stocked because they are classified as emergency areas.

3.2.1.1 Description of health facilities visited

A summary of the characteristics of health facilities visited is presented in Table 3.1. Study sites are ordered based on proportion of children recruited. Standard services offered in all health facilities include nutrition services, child welfare clinic, HIV testing and counselling, TB clinic, cervical and breast cancer screening, reproductive health, laboratory services and pharmacy. Five out the seven health facilities had a nutritionist.

Table 3.1: Characteristics of health facilities visited

Name	Type	County/location	Number of Nutritionists	Number of children seen per day	OTP/SFP run by	Nutrition day	Number of MAM	Number of SAM	Nutrition room
Kayole II	Government	Embakasi	1	Over 100	Nutritionist or interns	Wednesday	56	5	Yes
Ruben Centre	Faith based	Embakasi	1 works with 2 assistants	50-100	Nutritionist or student interns	Wednesday and Friday	89	25	Yes
Mbagathi	Government	Lang'ata	3 OTP	-	Students and interns	Daily	-	55	Yes
Makadara	Government	Makadara	1	50-100	Nutritionist or student intern	Tuesday	62	4	Yes
Soweto PhC	Faith based	Embakasi	0 run by nurse	50-60	CHW	Tuesday	-	-	No
Embakasi	Government	Embakasi	1	75	Nutritionist or CHW	Daily	31	21	No

OTP: Outpatient Therapeutic Program; SFP: Supplementary Feeding Program; CHWs: Community Health Workers; Number of Moderate Acute Malnutrition (MAM) and Severe Acute Malnutrition (SAM) children in treatment program data collected at the end of the study

3.2.1.2 Links between the between community and health facilities

A detailed description of services offered at the Ruben centre is provided to demonstrate strong links between the health facility and the community. This is followed by a brief description of the role of community health workers in health facilities that do not have strong links.

Ruben medical clinic is a faith based facility located inside Ruben centre in the heart of Mukuru kwa Ruben slum. Additional services offered at the health facility include dental services and occupational therapy. Apart from the clinic, located within the centre is a primary school, a day-care centre and various community based projects aimed at child protection, gender based recovery and economic development of vulnerable groups.

There is a relatively strong link between the community and health facility, due to active involvement of community health workers in feeding programmes. Caregivers of children who are admitted to the nutrition program provide their contacts and addresses for follow up into the community. Caregivers who do not attend clinics are usually contacted by community health workers (CHWs) by phone, to find out reasons for not attending. If the caregiver cannot be reached by phone, the CHWs try to trace them back to their homes. In cases where a child's condition is not improving, CHWs also carry out home visits and assess the child's environment. They then report back to nutritionist who refers to mothers to social workers for further support. In cases where employment is an issue, the centre sometimes hires mothers to do manual work in the centre in exchange for pay. This is usually a temporary measure until the mother can get back on her feet.

In the other health facilities, there was lack of a strong link between the health facility and the community, especially when it came to nutrition services. This was because of insufficient funds to support community health workers. Although community health workers participate in outreach immunization programs and family planning activities, which are well funded, they are mainly based at the health facility where they assist in taking anthropometric measurements during clinics.

3.3 Target population, sampling procedure, sample size estimation

The target population was caregivers of children aged between 6 and 24 months attending health facilities for either growth monitoring or treatment for undernutrition. Caregiver was defined as any person who brought the child to the clinic and is responsible for taking care of the child. The caregiver was required to have knowledge about how the child is cared for. Caregivers who did not have knowledge of child care practices were excluded from the study.

Quota sampling was used to recruit healthy and undernourished children. This involved deliberate selection of undernourished children based on severity and supplementation status and healthy children with an aim to see as many eligible children per day as possible. This sampling method ensured that equal numbers of healthy, moderately and severely undernourished children on and off RUFs were recruited in an efficient way.

The sample size was calculated based on expected values for the frequency of aversive eating behaviour, specifically the proportion of undernourished children that cried during meals. Findings from preliminary meal observations in Kenya showed that 70% of undernourished children on home diet cried during meals. With alpha 0.01 and power of 0.8 a sample size of 200 undernourished children (100 moderate, 100 severe) was required to detect differences in eating and feeding behaviour. At the time of data collection, RUF were not widely used for treatment of moderate undernutrition in Kenya. Therefore, only a small sample (n=25) moderately undernourished children were expected to be on supplements (Table 3.2). In contrast, in severely undernourished children, a large proportion of children were expected to be on ready to use foods, which is the recommended treatment for severe undernutrition (CMAM). The control group consisted of an equal number of healthy children.

Table 3.2: Sample size required for each recruited group

Type of subjects	Number of participants	Recruited from
Moderate cases		
Home diet	75	Child welfare clinics
Ready to use foods	25	Supplementary feeding programs
Severe cases		
Home diet	25	Child welfare clinics (newly diagnosed)
RUTF	75	Outpatient Therapeutic Programs
Healthy children	150	Child welfare clinics

3.3.1 Recruitment Strategy

Field work was undertaken in two rounds. In the first round, only undernourished children were recruited. This was because the initial aim of the study was to assess risk factors for undernutrition and to describe their prevalence in undernourished children. Results from preliminary analysis showed no association between severity of risk factors for undernutrition probably because all children had some degree of undernutrition. Healthy children were therefore recruited in order to determine if these characteristics were unique to undernourished children.

Recruitment of all caregivers was based on them having a child aged between 6 and 24 months, willingness to participate in the study and availability to do a complete interview. Potential participants were approached in most cases after growth monitoring and were provided with a brief description of the study. They were then asked for permission to use child anthropometric measurements to check for eligibility. Eligibility for the study was assessed using WHO Anthro software version 3.2. The interview date, child's date of birth, gender and raw anthropometric measurements were entered. Weight and height measurements were then converted into Z scores and interpreted by the researcher based on predefined inclusion and exclusion criteria described below. In cases where caregivers were approached before anthropometric measurements were taken, the researcher took the measurements first and then checked for eligibility.

Undernourished children were recruited between February and July 2015. Children were recruited if they had WAZ and WLZ $\leq$-2 Z scores. This criterion also included children who were moderately stunted. If a child was recruited based on their length for age Z score, they were required to have LAZ $\leq$-3 Z scores. This criteria was selected to reduce the risk of selecting a large sample of only stunted children. This was likely to occur

because of the high stunting levels in slum areas (Kimani-Murage et al., 2015, Abuya et al., 2012, Olack et al., 2011).

Children were further recruited based on treatment status (supplemented or not). Newly diagnosed children that is children who were newly admitted to program or were not yet receiving treatment for other reasons were recruited. During the first month of data collection, ready to use foods were out of stock in all health facilities. Only one mother recruited during this period reported having previously received RUF, the rest of the mothers were not on treatment. Recruitment during this period was therefore based only on severity. Children who were not on supplements were therefore either newly diagnosed or they were recruited when there was a supplement shortage in the clinics. After the supplement shortage, children who were receiving treatment were also recruited. Severely undernourished children with complications that required inpatient care, children with congenital disorders, disabilities and diseases requiring specialized care and hospitalization were excluded from the study. Caregivers who were not willing to participate or did not have knowledge about child care were also excluded from the study.

Healthy children were recruited between July and August 2016 in Reuben medical clinic and Kayole II sub county hospital. These two facilities were selected because a large proportion of undernourished children were recruited from them. Eligibility in this case was assessed using gender specific WHO weight for age growth charts first because we did not have access enough laptops, therefore research assistants did not have access to WHO Anthro software. Second low weight for age as an anthropometric measurement selects children who are either wasted, stunted or both. We therefore assumed that children with a WAZ >2SD were less likely to be either wasted or stunted and were therefore healthy. Children were excluded if they had WAZ≤-2SD or if they had congenital disorders, disabilities and diseases that required specialized. Nearly all anthropometric measurements were taken by health workers.

Caregivers who met the inclusion criteria were given an oral account of the study aim and procedures involved. They were also provided with information sheets and were given an opportunity to ask questions about the study. If they agreed to participate, they signed two consent forms. One copy of the consent form was kept by the researcher the other by the participant (see Figure 4.1 for recruitment flow chart).

3.3.2 Data collection procedures

Five research assistants, one during the first round of data collection (2015) and 4 during the second round (2016), were trained on data collection procedures. The first research assistant I worked with was a nutritionist recommended by the sub county nutritionist while the rest had previously worked with the African Population Health and Research centre and were highly recommended. All research assistants were educated beyond secondary level and had previous experience in conducting interviews.

Training involved taking anthropometric measurements, identification of potential participants using inclusion and exclusion criteria, approaching caregivers for consent and using the interview guide. Training on anthropometric measurements was based on WHO manual and standardization was done for length and MUAC measurements (World Health Organisation, 2008b). The aim of the study, roles and responsibilities were also communicated to the research assistants.

Weight, recumbent length and mid upper arm circumference (MUAC) were measured according to standardized procedures (Lohman et al., 1992, World Health Organization, 2008b). To ensure accurate measurements were taken, the researcher team was meant to weigh all children. However, this was not always possible due to lack of space, so the researcher had to sometimes rely on the facilities equipment. Anthropometric measurements were taken by the researcher (45.1%) and health workers.

Children were weighed naked and if temperatures are low, the child was allowed to wear light clothing of known weight. Weight was measured using a digital weighing scale (SECA 385 digital weighing scale III) to the nearest 0.1 kg when the researcher was taking measurements using their own equipment. The supine length of each study participant was measured to the nearest 0.1cm using a portable Rollameter (Raven Equipment Ltd Dunmow, U.K) or a UNICEF length board. The caregiver was requested to place the baby on the length board and hold the baby's head in position (Frankfort plane position). The researcher held down the child's legs with one hand and move the footboard with the other hand while applying gentle pressure to the knees to straighten the child's legs. Mid upper arm circumference was measured using MUAC tapes (S0145620 MUAC, Child 11.5 Red/PAC-50). The tape was placed on the left arm at the midpoint between elbow and

shoulder. The researcher then read measurement from the tape window and record to nearest 0.1 cm.

Caregivers were interviewed once using a semi structured interview guide. Interviews were supposed to be carried out in a private area in the clinic in order to ensure confidentiality, though this was not always possible because of lack of space. Some caregivers were therefore interviewed in a secluded area in the waiting room. During the first data collection round, interviews lasted about 30 minutes. At the end of the interview, caregivers were offered nutrition advice as appropriate and guided by key messages on the interview schedule. Three quarters 72.8% (163) of the interviews in the first round were carried out by the researcher while the rest were done by the research assistant. In the second round, all interviews were done by research assistants. Caregivers were not offered advice on feeding practices because, by definition, all children were healthy. Interviews in this case therefore took between 15 and 20 minutes. Additional information about child care practices reported by caregivers and general observations made during clinics were recorded by the researcher, but this was not done systematically.

3.4 Measures used to assess childcare practices

Measures used for data collection and analysis were based on the framework below (Figure 3.2). Childcare practices included in the interview schedule were selected based on their modifiability and applicability to key behaviour messages used in a responsive feeding intervention in Bangladesh (Aboud et al., 2009). These messages included:

1. Wash your child's hands before he or she picks up food
2. Self-feed: let the child pick up food and eat
3. Be responsive: watch listen and respond in words to your child's signals
4. When your child refuses, pause and question why don't force feed
5. Offer a variety of foods including eggs, fish fruit and vegetables.

Child health was assessed using three variables; any major illness since birth, hospital admission in the past month and mother's HIV status. Recurrent illnesses such as diarrhoea, respiratory infections, helminths and chronic infections such as HIV increase risk of undernutrition by increasing nutrient losses, reducing absorption (Checkley et al., 2008, Magadi, 2011). Socio economic status was assessed using assets, because they were easy to collect in a relatively short period of time (Gwatkin et al., 2007). The following

variables were used: house ownership, house construction, ownership of car, motorcycle, bicycle, refrigerator, television, radio and mobile phones. Maternal and paternal education, father's residential status, number of children in the household, number of children under 5 years and mothers' age were collected because of their association with child nutrition status (Shavers, 2007, Ntoimo and Odimegwu, 2014, Fall et al., 2015, Alam et al., 1989).

Hygiene was assessed using personal hygiene practices as well as access to hygiene facilities. Hand washing has important health benefits including prevention of diarrhoea and is influenced by the presence of a convenient source of water and soap (Billig et al., 1999, Nizame et al., 2013). Caregivers were therefore asked about occasions when they washed their hands with soap. This was done to avoid over reporting of positive behaviours. They were also asked if they washed their child's hands before meals and if they had soap and water close to the food preparation area. Information about sources of water for household and access to toilets was also collected.

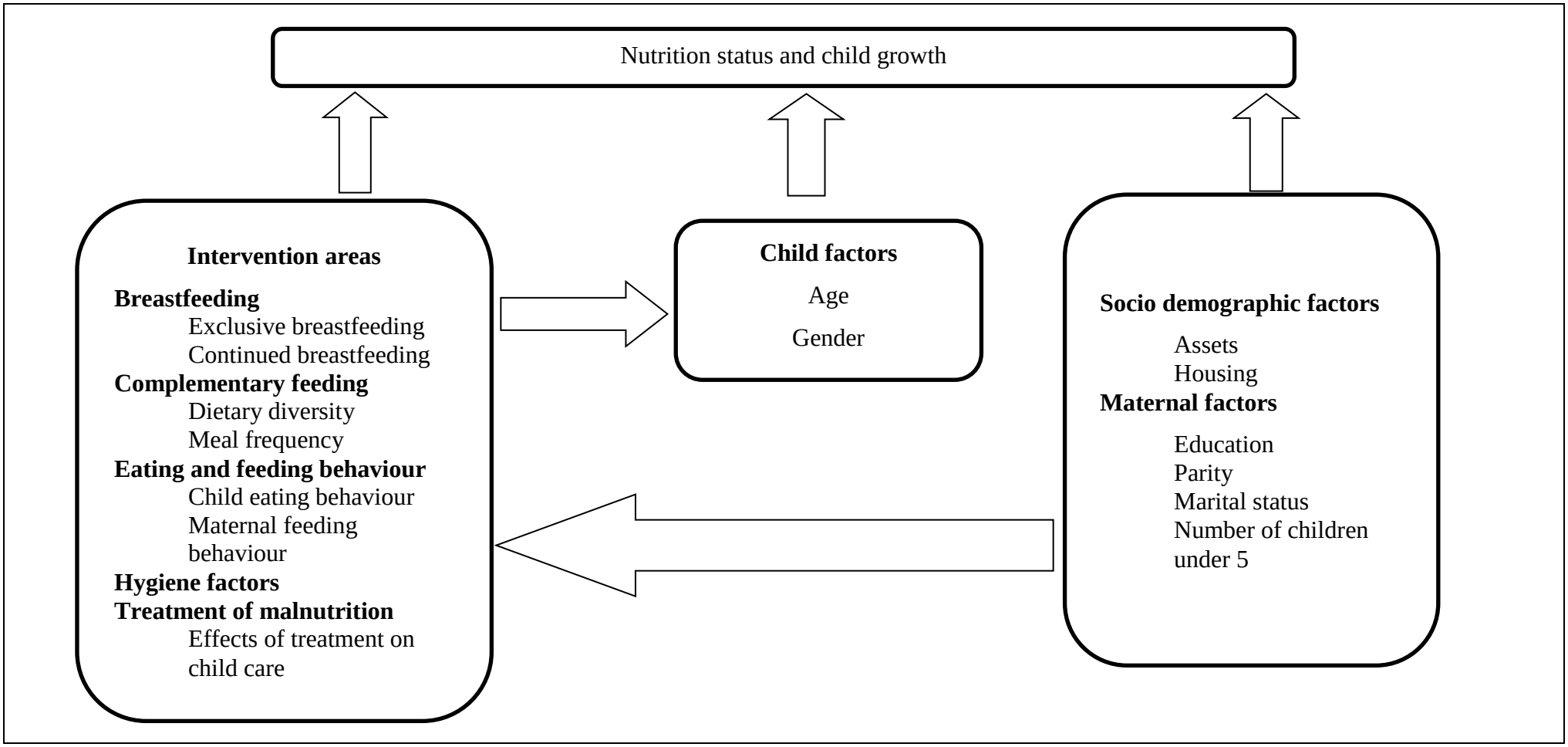


Figure 3.2: Analytical framework adopted from the 2013 maternal and child health series (Black et al., 2013)

3.4.1 Feeding practices

Feeding practices measured included, age of introduction of complementary foods; maintenance of breastfeeding, mother child interaction during meals, meal frequency and dietary diversity. The World Health Organization guidelines on feeding a breastfed child were used as a guide when designing the interview guide (PAHO, 2003). This section covers only breastfeeding practices, meal frequency and diversity. Mother-child interactions during meals is covered in chapter 5.

Breastfeeding practices were assessed using two variables: age of introduction of complementary foods and continued breastfeeding because of the benefits of both practices (see section 1.2.6.2 on breastfeeding). Due to lack of standardized measures of breastfeeding frequency, as well as difficulty in precise recall of frequency, especially in caregivers who breastfeed on demand, four options were used to quantify breastfeeding frequency: more than three feeds , two to three feeds , one feed and less than one feed per day.

Food frequency was used to assess dietary diversity because we anticipated that severely undernourished on supplements were not receiving home foods as recommended by the treatment protocol (Kenya Ministry of Medical Services and Ministry of Public Health and Sanitation, 2010). Other benefits of food frequency as a method of dietary assessment are discussed in (section 2.4). Food frequency responses adopted from Byers et al. (1983) were used to quantify how often different food groups were eaten by the child. These responses included never/rarely, at least once a month but not weekly, at least once a week but not daily, once daily and more than once daily. Dietary diversity was assessed using the following food groups:

1. Meat/ fish/ poultry/ organ meats
2. Eggs
3. Dairy (breast milk not included)
4. Legumes (beans, lentils, mung beans, and dried peas)
5. Fruits and leafy vegetables
6. Oil/fats/margarine
7. Starchy staples

Oils/fats were added in the food groups because of the diverse benefits of fats in the diet (PAHO, 2003). Starchy staples were not quantified because diets in many developing are mainly carbohydrate based (Arimond et al., 2005). We therefore assumed that starchy staples were offered daily and caregivers were instead asked to name starchy foods they offered their children.

Feeding frequency was assessed using a 24-hour recall. Caregivers were asked to report any type of food offered on five occasions: morning (6am to 10 am), mid-morning 10am-11am, afternoon 12 noon -2pm, evening 3pm-6pm and night 7pm onwards. Foods were classified as either plated foods, finger foods or drinks. Plated foods included any cooked foods served on a plate and which were considered to be meals by caregivers. Finger foods on the other hand included foods that a child would pick up and self-feed, such as pieces of fruit, biscuits, bread. Drinks in this case included thin porridge, yoghurt and tea. Porridge was classified as a drink because in many developing countries porridge tends to have a liquid consistency and is low in energy (Michaelsen et al., 2009, Kulwa et al., 2015b, Treche and Mbome, 1999).

3.4.2 Statistical methods and analysis

Data analysis was done using Statistical Package for Social Sciences (SPSS) version 22. Stat Calc in Epi Info version7 was also used to test the level of significance for cross tabulation results that could not be done in SPSS. Range and consistency checks were then done for quantitative data before the main analysis. Frequencies and percentages were used to present descriptive statistics for categorical variables, median and interquartile range were used to describe continuous data, because of the non-parametric nature of most of the data. Chi square analysis was used to test for associations in categorical variables where Pearson's chi square test was used for binary variables, chi square for linear trend was used to test for trends in ordinal data. Mann U Whitney test was used to assess differences in two independent groups in ordinal or continuous data, Kruskal Wallis test was used to test for differences in more than two independent groups. The level of significance was set at $P<0.05$. Logistic regression was used to assess the independence of predictors of nutrition status and severity.

3.4.2.1 Data processing and summaries

Data was processed and summarized because of small numbers in some response categories and to reduce the number of statistical tests done. When too many statistical tests are done spurious associations are likely to occur. Children were classified by nutrition status (healthy vs undernourished) and severity (healthy, moderate and severe). This was done to test the hypothesis that undernourished children were exposed to more risk factors than healthy and that the likelihood of exposure increased with severity. Children were classified as healthy if they had WAZ, WLZ and LAZ >-2SD. Undernutrition on the other was defined as WAZ or WLZ or LAZ ≤-2SD of the WHO growth standards. Severe undernutrition was defined as any WAZ, WLZ or LAZ measurement ≤-3SD while moderate undernutrition was defined as WAZ, WLZ and LAZ between -2SD and -3SD.

Child age was calculated using the difference between the interview date and date of birth recoded in the mother child health booklet. The calculated age was then classified into 3 categories: 6-9 months, 9-12 months and 12-24 months. Gender and age were used as covariates in chi square analysis due to their influence on childcare practices.

3.4.2.2 Sociodemographic and hygiene characteristics

Father's presence was also classified into two categories: contributing to household and no contact because single parent homes are more deprived because of single source of income. Education level was classified into two categories, primary education and secondary education or higher, because of low numbers in tertiary education and less than 5 years groups and because of the association between low parental education and child nutrition status. The number of children under five years was transformed into a categorical variable with two categories: one child under five years and more than one child under five years. The variables house ownership and house construction were also transformed into two categories: owned by family or rented and permanent or semi-permanent respectively.

Social risk was assessed by looking at ownership of either a television or radio, maternal and paternal education and the number of children under five years in the household. A score of 0 was assigned to households that had the following characteristics; owned either a television or radio, both parents educated beyond primary level and only one child under

the age of five years. The rest were scored 1 (Table 3.3). In cases where the child had one or more risk factors, the contribution made by each risk was assessed using cross tabulation. A count of the number of risks present was done. High social risk was defined as one or more risks present while low risk was defined as the absence of social risks (0 risks). These categories were used to test for associations with nutrition status and severity.

Due to the lack of a standardized hygiene measure, hygiene scores were computed with reference to (Webb et al., 2006). Two hygiene measures were created; a personal hygiene score which assessed hand-washing practices and a hygiene facilities score which assessed access to water and sanitation facilities. Personal hygiene measured using child and caregiver hand washing practice before meals. The frequency of washing the child's hands with soap was recoded to three variables all the time (combination of all the time and most of the time), sometimes (combination of sometimes and rarely) and not at all.

Mention of hand washing during key times: after using the toilet, after changing the baby's nappy, before handling and preparing food, before feeding the child was used to assess personal hygiene (Billig et al., 1999). For each handwashing occasion, a score of 0 was assigned to caregivers who mentioned the occasion and 1 for those who did not. The number of occasions were then counted for each caregiver. Caregivers who did not mention any of the key occasions ended up with a score of four while those who mentioned all scored 0. To test for associations between hand washing practices and child nutrition status, hand washing occasions were classified into three groups reflecting degree of risk. Low risk was defined as a score of between 0 and 1; borderline risk 2 occasions and high risk 3 to 4 occasions (Table 3.3).

Source of water for household use was transformed into two categories piped into household vs other sources based on the hypothesis that caregivers who had piped water in their houses had access more water which enhanced their hygiene practices (Billig et al., 1999). The type of toilet was classified into two categories flush toilet and other. Ownership of a flush toilet with a proper drainage system is ideal, but considering that toilets are shared by many households, their functionality and use might be limited. Because toilet use and functionality was not assessed, this variable was used for descriptive purposes only. Garbage disposal was also recoded into two categories collected by company and thrown by household. However, some parts of the slums are covered in litter,

therefore having organized solid waste collection would only benefit households that had litter free environment but environmental cleanliness was not assessed. This variable was therefore used for descriptive purposes only.

Associations between all individual measures of hygiene and child nutrition status were tested before creating a summary measure for hygiene risk. Hygiene risk was assessed using caregiver's hand washing practices, toilet ownership and access to piped water in the household where positive practices/access was scored 0 while negative 1. The number of risks present were counted and overlap between risk factors was assessed using cross tabulation. Low hygiene risk was defined as 0-1 risks present, borderline line risk was defined as two risks present and high risk was defined as all three risk factors present. This classification was used to test for associations with child characteristics.

Table 3.3: Variables used to assess social and hygiene risks

Hygiene	Components	Scores assigned	Risk categories
Social risks	owns either a television or radio	1:lacks both a television and radio	Low risk: no risks present
	parental education	Both parents educated up to primary level	High risk: 1 or more risks present
	number of children under 5 years	More than one child under 5 years	
Personal hygiene	Washes child's hands before meals	Not at all=0 Sometimes = 1 All the time=2	
Caregiver washes hands	After using toilet		Low(0-1times)=0
	After changing baby	Yes= 0 No=1	Borderline (2)= 1
	Before feeding child or eating		High risk (3-4)=2
	Before preparing food		
Hygiene facilities	Source of water for household use	Piped into house = 0 Public tap= 1	
	Toilet ownership	Shared=1 Owned by household=0	

3.4.2.3 Feeding practices

Timing of introduction of complementary foods was recoded into two groups reflecting early (below 6 months) and timely introduction (6 months and above). Breastfeeding frequency was transformed into three categories reflecting high (more than three feeds per day), borderline (1-3 feeds) and low frequency (0 feeds).

Dietary diversity was assessed by measuring the frequency of intake of animal sources of protein and total number of food groups eaten. The six food groups, meat/fish/poultry, eggs, dairy products, legumes, fruits and leafy vegetables and starchy foods, were first summarized into three groups reflecting daily, weekly and monthly intake for descriptive purposes. Food groups eaten rarely, weekly and daily were scored zero, one and two respectively. Food groups eaten daily and weekly were counted to determine adequacy. The WHO standards were used as guide to determine adequacy (World Health Organisation, 2008a). High dietary diversity was defined as at least four food groups offered on a daily basis. Borderline diversity was defined as at least four food groups eaten on a weekly basis. This was done to capture children who met recommendations on some days during the week but not daily. Low dietary diversity was defined as less than four food groups.

Reported intake of meat/fish/poultry, eggs and dairy products was used to assess intake of animal proteins. Based on findings from the preliminary studies, we expected some caregiver to offer their children broth only. Broth in this case is defined as clear liquid produced by cooking meat, fish, poultry, sea food or vegetables in water with other ingredients such as onions, tomatoes, salt and oil (Lukmanji et al., 2008). The protein content of broth was therefore assessed using milk as reference. This was done because milk is considered as an animal source of protein despite its relatively low protein content 3.2g per 100g. If protein content in meat/fish/poultry broth was higher than wet milk, then the child was considered to have eaten the food in question. The protein content of different broths were obtained from Tanzanian food composition tables because broth in the Kenyan food composition table was not clearly defined (Sehmi, 1993, Lukmanji et al., 2008). Some of the foods in the two tables are comparable because of similar preparation methods.

The protein content of nearly all common broths offered to children had either similar or slightly higher protein content than milk. All children who received broth were therefore considered to have received animal proteins (Table 3.4). The World Health Organization recommends that a child should have at least one animal source of protein daily or as often as possible (PAHO, 2003). Children were therefore classified into three groups reflecting adequate intake (at least one source daily); borderline (more than one weekly) and low (not offered). These three groups were used to test for associations with age, gender and nutrition status and severity.

Table 3.4: Protein content of different broths in comparison to milk.

Sources	Protein (g)
Milk	3.2
Beef broth	3.9
Chicken broth	4.2
Small dried fish	5.9
Fish broth	1.7

Values per 100g

3.4.2.4 Feeding frequency

Feeding frequency was assessed using the total number of plated foods, finger foods and drinks offered on five different occasions (morning, mid-morning, afternoon, evening and night) using a 24-hour recall. A score of 1 was assigned for each occasion a child was offered food, snacks or drinks. Total plated food frequency was the sum of plated foods offered in the morning, midmorning, afternoon, evening and at night. Children offered plated foods on all occasions would therefore end up with a score of 5. A summary score meal frequency was created by adding up total plated meals and total snacks.

Age specific WHO recommendations were then used to define adequacy of plated meals, snacks and meal frequency as shown in Table 3.5 (PAHO, 2003). All children regardless of their age should receive between one and two snacks (Table 3.5). There are currently no recommendations for drink intake and drinks were therefore classified as 0-2 low and 3-5 high. The categories formed were then used to test for associations with gender, nutrition status and severity for all children.

A second analysis that excluded children on RUF was also carried out. This was done because the frequency of intake of RUF was not collected. It was therefore difficult to conclude on the adequacy of their meal frequency. Furthermore, we expected that children on RUF would receive fewer home meals which was likely to affect the associations between meal frequency and nutrition status and severity.

Breastfeeding status, dietary diversity and meal frequency were used to assess the number of dietary risk factors and their overlap. Children who met the set standards received a score of 0 while those who did not were scored 1. A count of the number of dietary risk factors was done and overlap between risk factors was assessed using cross tabulation. Low dietary risk was defined as a score between 0 and 1 while high risk was defined as 2 or more risks. This classification was used to test for associations with child characteristics.

Table 3.5: Age specific recommendations for meal frequency

	6-9 months	**9-24 months**
Plated meals		
Low	0 times	0-1
Borderline	1 times	2 times
Adequate	2-3 times	3-4 times
Snacks		
Low	No snacks	No snacks
Adequate	1-2 times	1-2 times
All meals (plated + snacks)		
Low	0-1	0-2 times
Borderline	2 times	3 times
High	More than 3 times	4-5 times

4 Results: Main Study

Findings from this thesis are divided into three chapters. This chapter will focus on socio demographic and economic characteristics as well as complementary feeding practices. The next two chapters will focus on eating and feeding behaviour and childcare practices in undernourished children. At the end of each results chapter there is a discussion section.

In the current chapter the following questions are addressed

1. What are the anthropometric characteristics of children attending well baby clinics and outpatient therapeutic centres in government and faith based health facilities?
    - How do these characteristics vary by child's age, gender, nutrition status and severity?
2. What are the demographic and hygiene characteristics of caregivers attending health facilities?
    - Where do they live and what are their household characteristics?
3. What are the breastfeeding practices?
    - Are children still breastfeeding?
    - At what age were complementary foods introduced?
4. What are the complementary feeding practices
    - Dietary diversity: What are they fed and is it adequate?
    - Meal frequency: How often are they fed? Is it enough?
5. Do these vary with age, gender, nutrition status and severity?
    - Are risk factors more prevalent in undernourished than healthy children?

Descriptive analysis are presented first to provide general information on characteristics of the study population. These are followed by bivariate analyses of the association between age, gender, nutrition status, severity and childcare practices.

4.1 Child characteristics

Out of the 450 child-caregiver pairs approached, 415 were recruited (Figure 4.1). Reasons for exclusion included: the child did not meet the inclusion criteria (n=24), caregivers did not have time to complete the interview (n=4), four children required specialized care, one had cleft lip pallet, one had a heart condition and two had oedematous malnutrition. One caregiver was mentally ill and could not be interviewed. Half the children were recruited from Kayole II sub-county hospital and about one third from Ruben centre clinic. A small proportion of children were recruited from Mbagathi District Hospital 4.8% (20), Makadara health centre 4.3% (18), Soweto Phc 1.9% (8), Mukuru health centre 1.4% (6) and Embakasi health centre. Nearly all respondents 98.1% (407) were the child's mother; the rest were either relatives or friends of the family (Table 4.1). Half the children were female, 41.4% were healthy and one third were severely undernourished (Table 4.1). The distribution of all children based on weight for length and length for age Z scores is shown in Graph 4.1. Nearly all undernourished children, apart from a small proportion (4.3%) who had low weight for age only, were either wasted, stunted or both wasted and stunted (Graph 4.1). Characteristics of undernourished children are further explored in chapter 6.

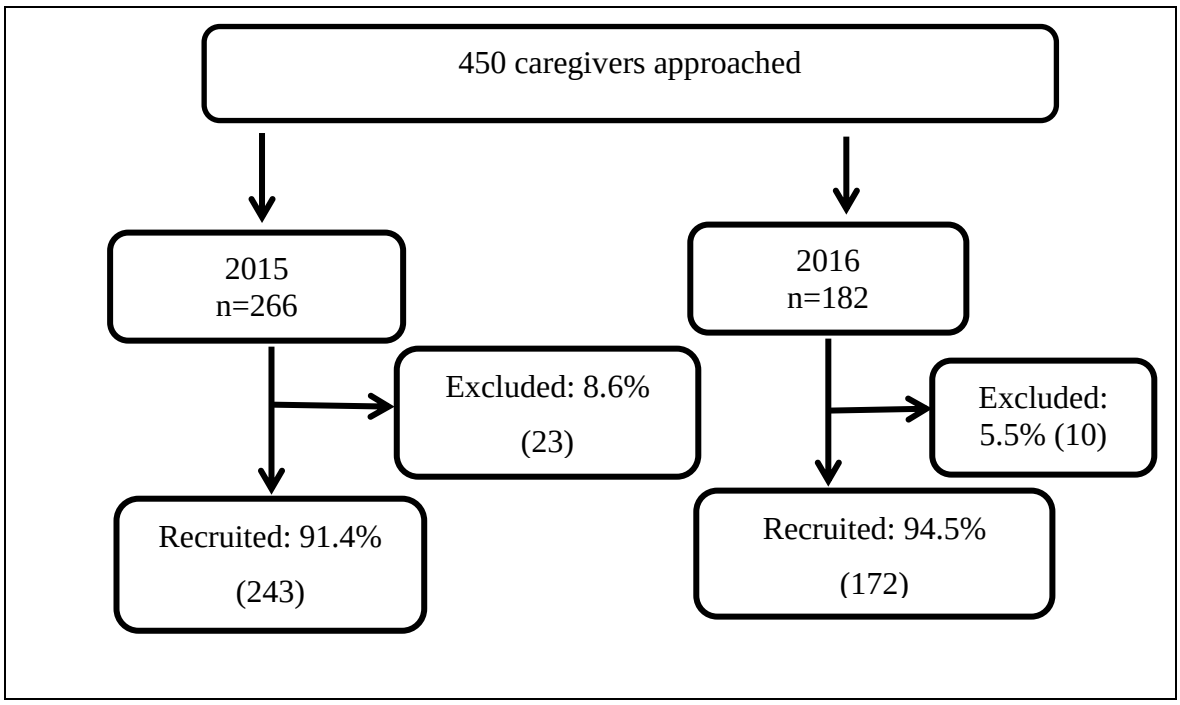


Figure 4.1: Flow chart showing participant recruitment

Table 4.1: Child characteristics

Child characteristics	%	N (n=415)
Health facilities		
Kayole II	50.1	208
Ruben	36.4	151
Gender		
Male	45.5	189
Female	54.5	226
Age		
6-9 months	30.6	127
9-12 months	34.7	144
12-24 months	34.7	144
Nutrition status		
Healthy	41.4	172
Undernourished	58.6	243
Severity		
Healthy	41.4	172
Moderate	29.2	122
Severe	29.4	121
Nutrition state		
Healthy	41.4	172
Underweight only	4.3	18
Wasted only	22.2	92
Stunted only	16.9	70
Wasted and stunted	15.2	63

Graph 4.1: Distribution of children based on their weight for length and length for age z scores

4.1.1 Association between age, gender and child anthropometric characteristics

Associations between anthropometric measures, child age and gender are shown in Table 4.2. Severely undernourished children were on average older than healthy children (P=0.020). There was, however, no association between age and nutrition status (Table 4.2). Older children, 12-24 months, had lower length for age measurements than young children (P=0.028). Compared to female children, male children had higher unadjusted weight, length and MUAC measurements (Table 4.2). However, when adjusted for age there were no gender differences in anthropometric measurements. There was also no association between weight for age, weight for height, MUAC Z scores and child age (Table 4.2).

Table 4.2 Unadjusted and age adjusted anthropometric characteristics of all children presented as median [inter-quartile range]

	Gender		**Age**			**Nutrition status (n=415)**		**Severity**	
Child characteristics	**Male (n=189)**	**Female (n=226)**	**6-9 months (n=127)**	**9-12 months (n=144)**	**12-24 months (n=144)**	**Healthy (n=172)**	**Under-nourished (n=243)**	**Moderate (n=122)**	**Severe (n=121)**
Age	10.0 [8.64 to 14.5]	9.97 [8.69to14.1]	7.91 [7.19 to8.57]	9.88 [9.37 to 10.7]	16.0 [14.0 to 18.0]	**9.65 [8.44 to 12.9]**	10.1 [8.9 to 14.6]	**9.95 [8.71to13.3]**	**10.7 [9.03 to 16.2]**
Anthropometry									
Weight (kg)	7.80 [6.7 to 8.7]	7.10 [6.2 to 8.3]	6.90 [6.00 to8.20]	7.0 [6.40 to 8.20]	7.90 [7.02 to 9.38]	8.60 [8.10 to 9.67]	6.6 [6.0 to 7.1]	6.8 [6.3 to 7.3]	6.4 [5.8 to 6.4]
Length (cm)	70.3 [67.9 to 73.8]	69.0 [66.5to72.5]	67.4 [65.0 to 69.5]	69.0 [66.9 to 71.7]	74.0 [71.5 to 77.8]	71.9 [69.0 to74.8]	68.4 [65.5to72.0]	68.5 [66.5to72.0]	68.1 [64.4 to 72.5]
MUAC (cm)	13.0 [12.0 to 14.2]	12.6 [12.0to13.8]	12.7 [11.8 to 14.0]	12.7 [12.0 to 13.7]	12.9 [12.1 to 14.2]	14.0 [13.5 to 14.8]	12.1 [11.0to12.6]	12.3 [11.9to12.8]	11.9 [11.4 to 12.4]
Z scores									
Weight for age	-2.02 [-3.00 to -0.39]	-2.06[-2.73to-0.54]	-1.75[-2.77to -0.26]	-2.10[-2.86 to -0.61]	-2.19 [-3.00 to -0.69]	-0.28[-0.75 to 0.60]	-2.75[-3.28 to -2.20]	-2.25[-2.58 to -2.04]	-3.28 [-3.70 to -2.96]
Weight for length	-1.52 [-2.51 to -0.10]	-1.39 [-2.32 to -0.09]	-1.29 [-2.34 to 0.23]	-1.61 [-2.34 to -0.19]	-1.49 [-2.57 to -0.24]	0.07[-0.71 to 0.85]	-2.26[-2.87 to -1.70]	-2.09[-2.38 to-1.51]	-2.73[-3.36 to -1.92]
Length for age	-1.38 [-2.43 to -0.34]	-1.27[-2.21 to -0.39]	**-0.96[-2.07 to -0.26]**	**-1.36 [-2.33 to -0.38]**	**-1.64 [-2.59 to -0.74]**	-0.41[-1.08 to 0.30]	-2.08[-2.90 to -1.28]	-1.79[-2.23 to -1.12]	-2.84[-3.67 to-1.73]
MUAC for age	-1.45 [-2.49 to -0.33]	-1.40 [-2.13 to -0.30]	-1.41 [-2.34 to -0.23]	-1.47 [-2.31 to -0.49]	-1.41 [-2.28 to -0.29]	-0.19[-0.84 to 0.37]	-2.16 [-2.65 to -1.57]	-1.88[-2.27 to -1.42]	-2.53 [-2.97 to -1.89]

Nutrition status: healthy vs undernourished; Severity: healthy vs moderate vs severe; Bold values are statistically significant P<0.05

4.2 Association between nutrition status, severity and socio demographic characteristics

Associations between demographic characteristics, nutrition status and severity are presented in Table 4.3. The youngest caregiver was 17 years while the oldest was 39 years. Most caregivers (85%) reported living with their partners. Literacy rates appeared to be high in this population, as more than half the caregivers and their spouses were educated beyond primary school (Table 4.3). Compared to healthy children, undernourished children were more likely to be brought to facilities by 'other' caregivers (P=0.016) and their fathers were more likely to be educated to primary level (P=0.033) (Table 4.3). They were also more likely to come from homes with more than one child below the age of 5 years (P=0.005). This likelihood increased with severity where severely undernourished children were two times more likely to have siblings under the age of 5 years than healthy children (P=0.004). They also had mothers who were on average older (P=0.033) and although they were also more likely to come from single parent homes, this difference was not statistically significant (P=0.065). There was no association between caregiver's age and child nutrition status. There was also no association between maternal education level father's age, number of children and nutrition status or severity (Table 4.3).

Socioeconomic characteristics are presented in Table 4.4. Half the caregivers (51.1%) lived in permanent houses and more than three quarters of the respondents lived in rented, one-roomed houses that served as bedroom and kitchen. Most caregivers owned radios, mobile phones and televisions but very few owned cars, motorcycles, bicycles and refrigerators (Table 4.4). Compared to healthy children, undernourished children were more likely to come from homes without a television (P=0.008) and radio (P=0.009). They were also more likely to live in one roomed houses but this difference had only borderline significance (P=0.056). The likelihood of owning a television (P=0.001) or radio (P=0.001) decreased with increased severity (Table 4.4). Healthy children were more likely to live in homes owned by their family than severely undernourished although this difference did not reach statistical significance (P=0.057).

Table 4.3 Association between nutrition status, severity and demographic characteristics % (n)

		Nutrition status		Severity*	
Demographic characteristics	**All children**	**Healthy (n=172)**	**Undernourished (n=243)**	**Moderate (n=122)**	**Severe (n=121)**
Relation to child	**%(n)**	**%(n)**	%(n)	%(n)	%(n)
Child's mother	98.1(407)	100 (172)	96.7 (235)	96.7 (118)	96.7 (117)
Other	1.9 (8)	0	3.3 (8)	3.3 (4)	3.3(4)
P value		0.016[a]		0.711[b]	0.033[c]
Father present (n=403)					
Present	85.0 (347)	92.7(152)	88.5 (215)	91.0 (111)	86.0(104)
No contact	4.9 (20)	7.3 (12)	11.5 (28)	9.0 (11)	14.0 (17)
P value		0.163[a]		0.154[b]	0.065[c]
Maternal education (n=408)					
Primary or lower	39.6 (164)	35.5 (61)	42.6 (103)	41.0 (50)	44.2 (53)
Secondary and higher	60.4 (250)	64.5 (111)	57.4 (139)	59.0 (72)	55.8 (67)
P value		0.146[a]		0.711[b]	0.128[c]
Paternal education (n=351*)					
Primary	25.9 (91)	20.1 (30)	30.2 (61)	34.3 (35)	26.0 (26)
Secondary and higher	74.1 (260)	79.9 (119)	69.8 (141)	65.7 (67)	74.0 (74)
P value		0.033[a]		0.379[b]	0.202[c]
Number of children< 5 years					
One child	76.5 (316)	83.5 (142)	71.6 (174)	73.8 (90)	69.4 (84)
More than 1 child	23.5 (97)	16.5 (28)	28.4 (69)	26.2 (32)	30.6 (37)
P value		0.005[a]		0.372[b]	0.004[c]
Age			**Median[range]**		
Caregiver	26[23 to 29]	25[16 to 38]	26[16 to 39]	25[16 to 38]	27[17 to 39]
P value		0.195[d]		0.033[e]	
Number of children	2 [1 to 8]	1 [1 to 6]	2[1 to 8]	2 [1 to 4]	2 [1 to 8]
P value		0.266 [d]		0.249 [e]	

P values [a] Pearson's chi square healthy vs undernourished; [b] Pearson's chi square moderate vs severe; [c] chi square for linear trend healthy compared to moderate, severely undernourished children [d] Mann-u Whitney test [e] Kruskal Wallis test *Analysis done for mothers who are in contact with their spouses *Severity: undernourished children classified based on the seriousness of their condition (n=243)

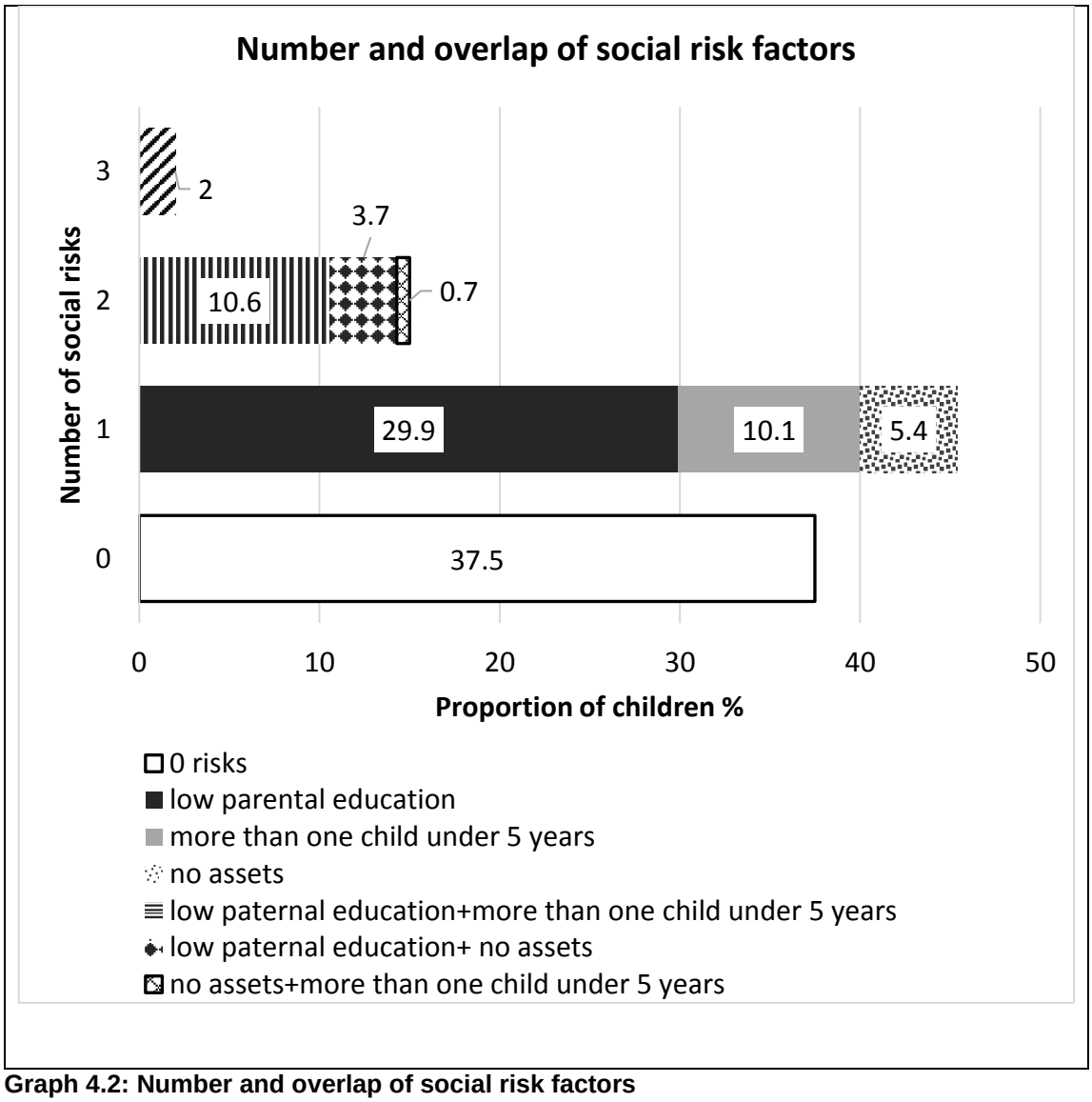
Table 4.4 Association between child nutrition status, severity and socio-economic characteristics

		Nutrition status		Severity*	
Socio economic characteristics	**All (n=415)** % (n)	**Healthy (n= 172)** % (n)	**Undernourished (n=243)** % (n)	**Moderate (n=122)** % (n)	**Severe (n=121)** % (n)
Construction					
Permanent	58.1(241)	58.1 (100)	58.0 (141)	60.7 (74)	55.4 (67)
Semi-permanent	41.9(174)	41.9 (72)	42.0 (102)	39.3 (48)	44.6 (54)
P value		0.981 [a]		0.336[b]	0.686 [c]
Number of rooms					
Single room	71.3(296)	66.3 (114)	74.9 (182)	76.2 (93)	73.6 (89)
More than one room	28.7(119)	33.7 (58)	25.1 (61)	23.8 (29)	26.4 (32)
P value		0.056 [a]		0.530[b]	0.138 [c]
House ownership (n=414)					
Rented	98.3(407)	97.1(166)	99.2 (241)	98.4 (120)	100(121)
Owned by family	1.7 (7)	2.9 (5)	0.8 (2)	1.6 (2)	0
P value		0.103 [a]		0.057 [b]	
Assets (n=414)					
Car	2.9 (12)	4.1 (7)	2.1 (5)	2.5 (3)	1.7 (2)
P value		0.225 [a]		0.211 [b]	
Motorcycle	4.1 (17)	2.9 (5)	4.9 (12)	5.7 (7)	4.1 (5)
P value		0.310 [a]		0.541 [b]	
Bicycle	7.2 (30)	7.6 (13)	7.0 (17)	5.7 (7)	8.3 (10)
P value		0.815 [a]		0.887 [b]	
Refrigerator	6.0 (25)	5.8 (10)	6.2 (15)	7.4 (9)	5.0 (6)
P value		0.891 [a]		0.808 [b]	
Television	73.2(303)	80.1 (137)	68.3 (166)	74.6 (91)	62.0 (75)
P value		0.008 [a]		0.001 [b]	
Radio	76.6(317)	83.0 (142)	72.0 (175)	78.7 (96)	65.3 (79)
P value		0.009 [a]		0.001 [b]	
Mobile phone	95.4(395)	96.5 (165)	94.7 (230)	95.9 (117)	93.4 (113)
P value		0.379 [a]		0.225 [b]	

P values: [a] Pearson's chi square: healthy vs undernourished; [b] Pearson's chi square moderate vs severe; [c] Chi square for linear trend healthy compared to moderate and severely undernourished children; *Severity: undernourished children classified based on the seriousness of their condition

4.2.1.1 Number and overlap of social risk factors and their association with nutrition status and severity

Social risk was assessed by looking at ownership of either a television or radio, maternal and paternal education and the number of children under 5 years in the household. The number and overlap of social risk factors are presented in Graph 4.2. One third of the population had no risks meaning both parents were educated beyond primary level, they owned either a television or radio and they only had one child below the age of 5 years. Among caregivers with one risk factor, a large proportion had low education. Only a small proportion of caregivers (2%) had all three social risks present (Graph 4.2). High social risk was defined one or more risk factors present. Compared to healthy children, undernourished (P=0.003) and severely undernourished (P=0.004) were more likely to come from high social risk households (Table 4.5).



Graph 4.2: Number and overlap of social risk factors

Table 4.5: Association between nutrition state, severity and social risk factor categories

	Nutrition status (n=406)		Severity*	
	Healthy (n=164)	**Undernourished (n=242)**	**Moderate (n=122)**	**Severe (n=121)**
	% (n)	% (n)	% (n)	% (n)
Low risk (0 risks)	46.3 (76)	31.8 (77)	33.6 (41)	30.0 (36)
High risk (1-3 risks)	53.7 (88)	68.2(165)	66.4 (81)	70.0 (84)
P value	0.003[a]		0.460[b]	0.004[c]

P values: [a] Pearson chi square: healthy vs undernourished [b] Pearson's chi square moderate vs severe; [c] Chi square for linear trend healthy compared to moderate and severely undernourished children; *Severity: undernourished children classified based on the seriousness of their condition

4.3 Hygiene facilities and practices

A description of hygiene facilities and practices and associations between hygiene facilities, personal hygiene, nutrition status and severity are presented in Table 4.6. The main source of water in homes was a public tap (83.6%) and most caregivers reported sharing latrines that did not have a flush system. A small proportion of caregivers (16.2%) paid between 3-5 Kenyan shillings (2-3 British pence) for toilets. A small proportion (16.4%) also reported throwing rubbish in a river that flows through the slum while the rest, reported having their collected by a private company weekly at a fee. Mothers were less likely to mention washing their hands after changing their baby's nappy (65%), before preparing food (55%) and after using the toilet (45.9%). Three quarters (75.3%) of caregivers reported washing their hands before eating or feeding the child. Overall, only 4.6% caregivers mentioned washing their hands on all four key occasions, after changing the baby, after using the toilet, before eating or feeding the baby and before preparing food. Low hand hygiene risk was therefore defined as lack of handwashing no more than one occasion and only one third of children were at low risk of pathogen exposure (Table 4.6).

Compared to healthy children, undernourished children were more likely to come from homes with piped water (P=0.003). Their caregivers were also less likely to pay for toilets (P=0.047). There was no association between severity and toilet payment. There also was no association between child nutrition status, severity and hygiene practices, type of toilet, toilet ownership and garbage disposal (Table 4.6).

One third of the mothers did not wash their child's hands with soap before meals. Because of age was likely to affect child hand washing behaviour, the association between age and child hand washing practice was assessed (Table 4.7). Compared to younger children, mothers of older children were more likely to wash their child's hands before meals (P<0.001). There was however no association between child hand washing practices, nutrition status and severity (Table 4.7).

Table 4.6: Association between nutrition status, severity and hygiene practices and facilities

		Nutrition state		Severity*	
Hygiene facilities	**All**	**Healthy (n=172)** % (n)	**UN (n=243)** % (n)	**Moderate (n=122)** % (n)	**Severe (n=121)** % (n)
Water source					
Piped into house	16.4 (68)	9.9 (17)	21.0 (51)	23.0 (28)	19.0 (23)
Public tap	83.6(347)	90.1(155)	79.0 (192)	77.0 (94)	81.0 (98)
P value		0.003 [a]		0.363[b]	0.022 [c]
Toilet type					
Flush toilet	13.7(57)	13.4 (23)	14.0 (34)	14.8 (18)	13.2 (16)
Latrine	86.3(358)	86.6(149)	86.0 (209)	85.2 (104)	86.8 (105)
P value		0.857 [a]		0.597[b]	0.999 [c]
Toilet ownership					
Owned by family	17.1(71)	19.3 (33)	15.6 (38)	16.4 (20)	14.9 (18)
Shared	82.9(343)	80.7(138)	84.4 (205)	83.6 (102)	85.1 (103)
P value		0.331 [a]		0.616[b]	0.314 [c]
Pay for toilet					
Yes	16.2(67)	20.5 (35)	13.2 (32)	10.7 (13)	15.7 (19)
No	83.8(347)	79.5(136)	86.8 (211)	89.3 (109)	84.3 (102)
P value		0.047 [a]		0.331[b]	0.205 [c]
Garbage Disposal					
Collected by private firm	84.6(351)	83.7(144)	85.2 (207)	85.2 (104)	85.1 (103)
Other	16.4 (64)	16.3 (28)	14.8 (36)	14.8 (18)	14.9 (18)
P value		0.684 [a]		0.836[b]	0.727 [c]
Personal hygiene risk [@]					
Lowrisk:0-1 occasions	34.0(140)	36.5 (62)	32.2 (78)	35.2 (43)	29.2 (35)
Moderate:2 occasions	40.0(165)	41.8 (71)	38.8 (94)	35.2 (43)	42.5 (51)
High risk:3-4 occasions	26.0(107)	21.7 (39)	29.0 (71)	29.5 (36)	28.3 (35)
P value		0.258 [a]		0.514[b]	0.124 [c]

P values: [a] Pearson chi square: healthy vs undernourished (UN); [b] Pearson's chi square: moderate vs severe; [c] Chi square for linear trend: healthy compared to moderate, severely undernourished children [@]personal hygiene risk: number of occasions the caregiver does not wash their hands; *Severity: undernourished children classified based on the seriousness of their condition

Table 4.7: Association between gender, age, nutrition status, severity and child hand washing

	Age(months)			Nutrition state		Severity*	
	6-9	**9-12**	**12-24**	**Healthy**	**UN**	**Moderate**	**Severe**
Hygiene practices Washes child's	**(n=126)**	**(n=144)**	**(n=143)**	**(n=172)**	**(n=243)**	**(n=122)**	**(n=121)**
All the time	33.3(42)	34.0(49)	51.7(74)	37.2(64)	41.9(101)	40.8(49)	43.0 (52)
Sometimes	19.0(24)	27.1(39)	25.9(37)	26.7(46)	22.4(54)	25.8(31)	19.0 (23)
Not at all	47.6(60)	38.9(56)	22.4(32)	36.0(62)	35.7(86)	33.3(40)	38.0 (46)
P value	<0.001 [a]			0.560[b]		0.766[c]	0.679[d]

P values: [a] Chi square for linear trend; [b] Pearson's chi square; healthy vs undernourished (UN); [c] Pearson's chi square: moderate vs severe; [d] Chi square for linear trend: healthy compared to moderate, severely undernourished children; *Severity: undernourished children classified based on the seriousness of their condition

4.3.1.1 Social and hygiene characteristics compared with Nairobi Cross Sectional Slum Survey (NCSS) and Kenya Demographic and Health Survey (KDHS) and number and overlap of hygiene risk factors

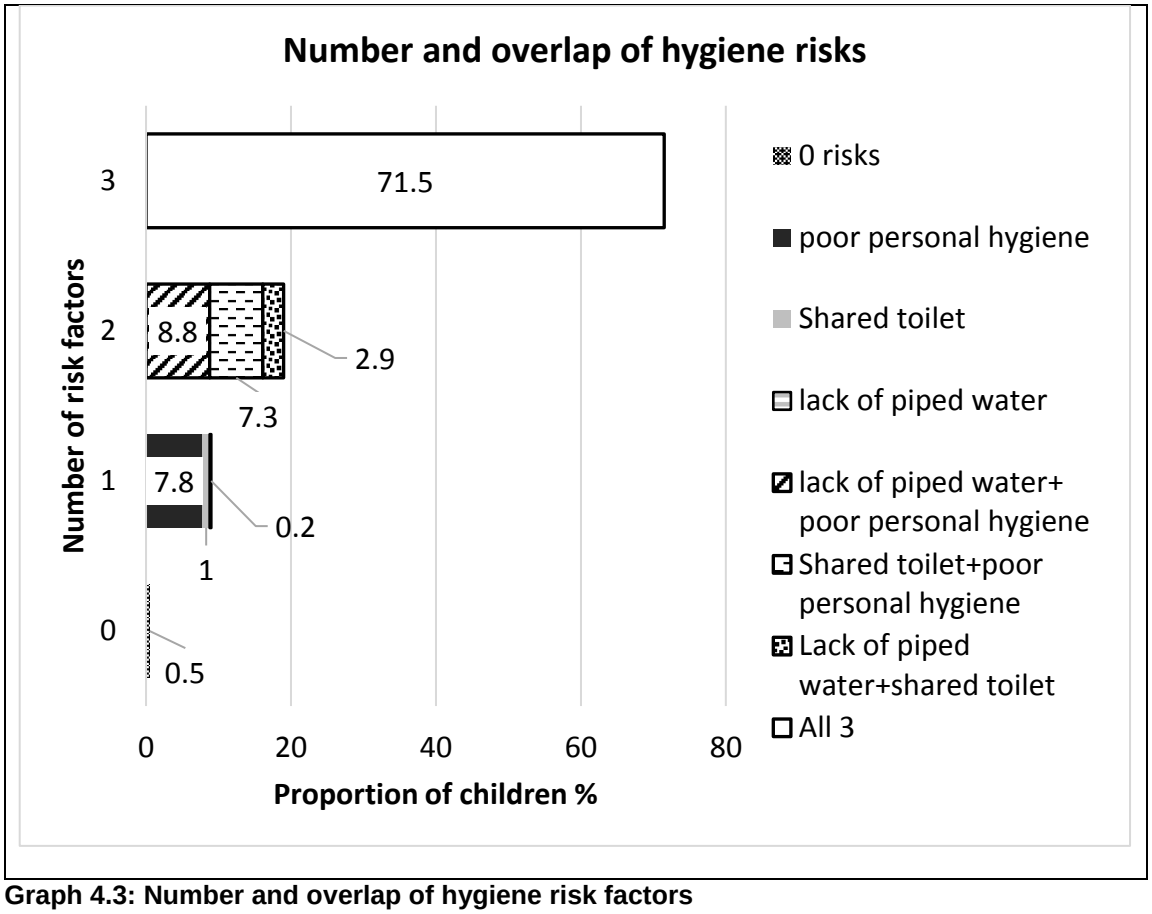
Compared to previous surveys of households in the slum areas, far fewer households in this sample had access to flush toilets and piped water in their house. However, they were more likely to own television sets, radios and motorbikes (Table 4.8). Compared to all urban populations in the KDHS, they were more likely to own television sets and share toilets. They were however less likely to own cars, bicycles, motorbikes and refrigerators. There was no difference in education level.

Hygiene risk was quantified using the following variables mother's hand washing practices, toilet ownership and access to piped water in the household water. The number and overlap of hygiene risks are presented in Graph 4.3. Three quarters of caregivers 71.5% shared toilets, had poor hand hygiene and lacked piped water in their houses (Graph 4.3). High hygiene risk was defined as more than 2 risk factors present. There was no significant association between hygiene risk and nutrition status or severity (Table 4.9).

Table 4.8: Socio economic characteristics of current sample compared to Nairobi Cross sectional Slum Survey and Kenya Demographic Health Survey

Socio economic characteristics	Current study (n=415)	Healthy	UN	Slum survey 2012 (n=5,489)	KDHS 2014 (Urban) (n=7,280)
	%			%	%
Water source for drinking					
Piped into house	16.4	9.9	21.0	27.6	
Ownership of goods					
Car	2.9	4.1	2.1	1.9	7.2
Motorcycle	4.1	2.9	4.9	2.1	6.0
Bicycle	7.2	7.6	7.0	9.5	16.2
Refrigerator	6.0	5.8	6.2	4.1	12.7
Television	73.2	80.1	68.3	49.2	56.0
Radio	76.6	83.0	72.0	66.0	73.5
Mobile phone	95.4	96.5	94.7	91.7	94.2
Toilet type and ownership					
Flush toilet	13.7	13.4	14.0	46.2	-
Shared toilet	82.9	80.7	84.4	-	50.4 *
Female education					
No education	1.2			2.0	1.7[#]
Secondary and higher	60.4	64.5	57.4	50.5	66.1

*n=15,290; [#] Nairobi only n=3,770; UN: undernourished



Graph 4.3: Number and overlap of hygiene risk factors

Table 4.9: Association between nutrition state, severity and degree of exposure to hygiene risks

	Nutrition state		Severity*	
	Healthy (n=169) % (n)	**Undernourished (n=242)** % (n)	**Moderate (n=122)** % (n)	**Severe (n=120)** % (n)
Hygiene				
Low risk (0-1 risks)	15.4 (26)	16.6 (40)	19.7 (24)	13.3 (16)
Borderline risk (2 risks)	26.0 (44)	28.9 (70)	30.3 (37)	27.5 (33)
High risk (3 risks)	58.6 (99)	54.5 (132)	50.0 (61)	59.2 (71)
P value	0.716[a]		0.092[b]	0.895[c]

P values: [a] Pearson chi square: healthy vs undernourished; [b] Pearson's chi square: moderate vs severe; [c] Chi square for linear trend: healthy compared to moderate, severely undernourished children *Severity: undernourished children classified based on the seriousness of their condition

4.3.2 Child health as risk factor for undernutrition

Associations between HIV status, hospital admission in the past month, rickets, nutrition and severity are presented in Table 4.10. Only 4% of children were admitted in hospital in the past month, but compared to healthy children, undernourished children were more likely to have been admitted (P=0.008). This association increased with severity (Table 4.10). Reasons for hospital admission included pneumonia 55% (n=10), diarrhoea and vomiting (n=2), meningitis (n=2) and fainting episodes (n=2). Rickets was relatively common in this sample (13%) and was more likely to be reported in undernourished children (P<0.001). Compared to healthy children, severely undernourished children were more likely to have rickets (Table 4.10). Only 3% of children were either exposed to or infected with the HIV virus and there was no association between HIV status and nutrition status or severity. Compared to moderately undernourished children, severely undernourished were more likely to have been recently admitted in hospital. They were also more likely to have rickets and to be HIV positive.

Table 4.10: Association between child health, nutrition status and severity

		Nutrition status		Severity*	
	All (n=415)	**Healthy (n=172)**	**Undernourished (n=243)**	**Moderate (n=122)**	**Severe (n=121)**
	%n	%n	%n	%n	%n
Hospital admission					
Yes	4.3 (18)	1.2 (2)	6.6 (16)	2.5 (3)	10.7 (13)
No	95.7(397)	98.8 (170)	93.4 (227)	97.5 (119)	89.3 (108)
P value		0.008 [a]		0.019[b]	<0.001 [c]
Rickets					
Yes	13.0 (54)	1.2 (2)	21.4 (52)	10.7 (13)	32.2(39)
No	87.0 (361)	98.8 (170)	78.6 (191)	89.3 (109)	67.8 (82)
P value		<0.001 [a]		<0.001[b]	<0.001 [c]
HIV status					
Negative	80.0 (332)	97.2(137)	95.6 (195)	98.1 (101)	93.1(94)
Positive	3.1 (13)	2.8 (4)	4.4 (9)	1.9 (2)	6.9 (7)
P value		0.450 [a]		0.039[b]	0.125 [c]

P values: [a] Pearson chi square: healthy vs undernourished; [b] Pearson's chi square: moderate vs severe; [c] Chi square for linear trend: healthy compared to moderate, severely undernourished children *Severity: undernourished children classified based on the seriousness of their condition

4.3.3 Association between breast feeding status and age of introduction of complementary foods child characteristics

Associations between breastfeeding frequency, child self-feeding and child age and gender are presented in Table 4.11. Continued breastfeeding after 6 months in this sample was high, as three quarters of mothers were still breastfeeding more than three times a day (Table 4.11). Only a small proportion (8.9%) were not breastfeeding at all. Compared to young children, older children were more likely not to be breastfeeding (P<0.001). There was no association between age of introduction of complementary foods and gender (Table 4.11).

Table 4.11: Associations between breastfeeding, feeding practices and child gender and age

		Gender		Age in months		
	All children	**Male (n=189)**	**Female (n=226)**	**6-9 (n=127)**	**9-12 (n=144)**	**12-24 (n=144)**
		% (n)	% (n)	% (n)	% (n)	% (n)
Breastfeeding frequency (per day)						
More than 3 feeds	82.4(342)	81.0 (153)	83.6 (189)	89.8 (114)	88.9 (128)	69.4 (100)
Less than 3 feeds	8.7 (36)	9.5 (18)	8.0 (18)	6.3 (8)	6.9 (10)	12.5 (18)
Not breastfeeding	8.9 (37)	9.5 (18)	8.4 (19)	3.9 (5)	4.2(6)	18.1 (26)
P value		0.529 [a]		<0.001 [b]		

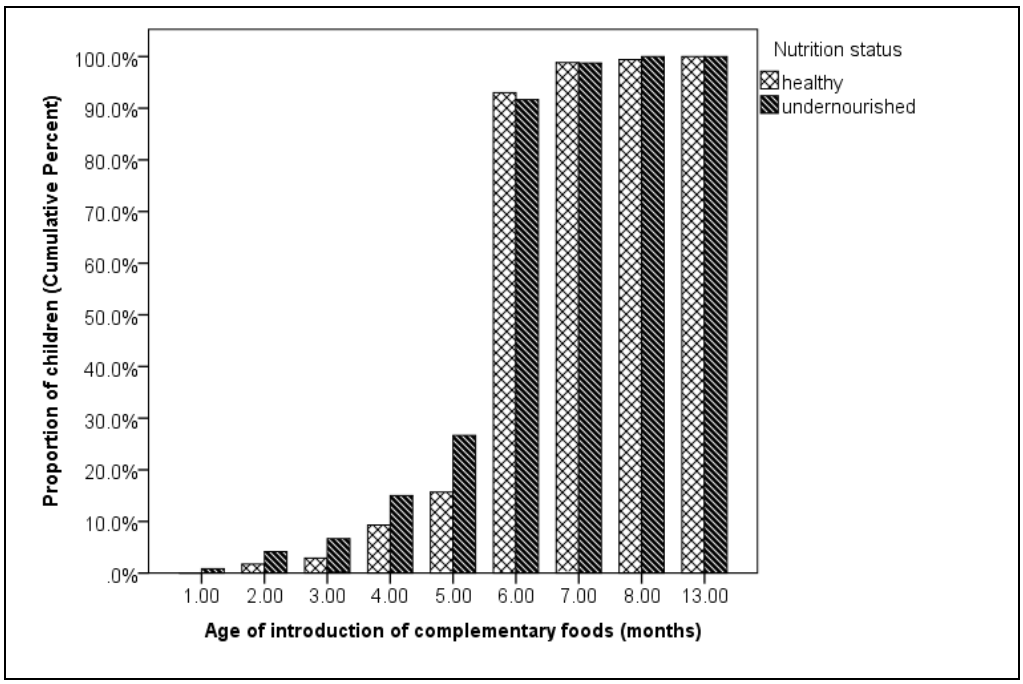
[a] Pearson chi square P value [b] Chi square for linear trend P value

4.3.3.1 Association between breastfeeding status and age of introduction of complementary foods, nutrition status and severity and comparison of breastfeeding practices with Kenya Demographic and Health Survey

Associations between age of introduction of complementary foods, breastfeeding frequency and nutrition status and severity are presented in Table 4.12. The average age of introduction of complementary foods was 6 months but foods were introduced as early as one month and as late as 13 months (Graph 4.4). Early introduction of complementary foods was reported by 22% (91) of the caregivers. Only 8.7% reported introducing foods after six months. Among caregivers who introduced foods after six months, 21, introduced foods at seven months while two introduced food at 8 months and one at 13 months. The World Health Organization recommends introduction of complementary foods at 6 months (PAHO, 2003). Depending on the mother's and health workers interpretation of this recommendation, 6 months could be at the beginning of the sixth month or at the end, that is at seven months. Children who were introduced to foods at 7 months were therefore considered to be introduced to foods on time, which left only three children. Children were therefore classified into two categories, less than 6 months and 6 months and above. This classification was used to test for associations.

Compared to healthy children, undernourished children were more likely to receive foods before 6 months (P=0.008) (Table 4.12 and Graph 4.4). This likelihood increased with severity (P=0.023). Compared to healthy children, undernourished children were also more likely not to be breastfeeding (5.2% vs 11.5% P=0.002). This was more likely to be reported in severely undernourished children (Table 4.12). There was no difference between moderate and severely undernourished children.

A higher proportion of children aged between 6-18 months in the current study were not breastfeeding (3.9%) compared to children in the Kenya Demographic Health Survey (1.6%) (Table 4.13). Among children aged 6-8 months all the children who were not breastfeeding were undernourished. In the 18-23 month age group, a larger proportion of children in the KDHS were not breastfeeding (38.6%) compared to children in the current survey (25.6%).



Graph 4.4 Age of introduction of complementary foods in healthy and undernourished children as a cumulative percent

Table 4.12: Association between nutrition status, severity and breastfeeding status and age of introduction of complementary foods %(n)

	Nutrition state		**Severity***	
	Healthy	**Undernourished**	**Moderate**	**Severe**
Breastfeeding frequency (per day)	(n=172)	(n=243)	(n=122)	(n=121)
More than 3 feeds	89.5(154)	77.4 (188)	79.5 (97)	75.2 (91)
less than 3 feeds	5.2 (9)	11.1 (27)	13.1(16)	9.1 (11)
Not breastfeeding	5.2 (9)	11.5 (28)	7.4 (9)	15.7 (19)
P value	0.002[a]		0.121[b]	0.001[c]
Age of complementary feeding (n=412)		(n=240)		(n=118)
Less than 6 months	15.7 (27)	26.7 (64)	27.0 (33)	26.3 (31)
6 months and above	84.3 (145)	73.3 (176)	73.0 (89)	73.3 (87)
P value	0.008[a]		0.778[b]	0.023 [c]

P values [a] Pearson chi square: healthy vs undernourished; [b] Pearson's chi square: moderate vs severe; [c] Chi square for linear trend: healthy compared to moderate, severely undernourished children *Severity: undernourished children classified based on the seriousness of their condition

Table 4.13: Proportion of children not breastfeeding in current study compared to findings from the Kenya Demographic Health Survey

	Current study (n=415)			**KDHS n=2,748**	
Age in months	All %	Healthy (n=172)	Undernourished (n=243)	**(%)**	
6-8	3.9	0	7.4	1.6	457
9-11	4.2	1.8	5.7	2.3	454
12-17	15.2	10	18.5	12.4	952
18-23	25.6	23.5	27.3	38.6	885

4.3.3.2 Logistic regression analysis assessing the association between nutrition status, severity and breastfeeding frequency

Logistic regression was carried out to assess if breastfeeding frequency was an independent predictor nutrition status and severity. An unadjusted model was first run with only one predictor in the model (Table 4.14). In the adjusted models, nutrition status (healthy vs undernourished) and severity (healthy vs severe) were entered as outcomes and breastfeeding status and age as predictors. The model was run with age both as a continuous and categorical variable. Breastfeeding more than three times a day was used a reference category. Breastfeeding frequency was an independent predictor of nutrition status when age was entered as a continuous and categorical variable (Table 4.14). Both models were significant and explained 4% of the variance in nutrition status (age as a continuous variable X^2 (3) =11.5 P=0.009, NagelkerkeR^2= 3.7%; age categorical X^2 (4) =12.4 P=0.014, NagelkerkeR^2= 4%). Adjustments made little or no difference to the size of the odds ratio.

When severity was entered as an outcome, breastfeeding frequency was an independent predictor of severity as children who were not breastfeeding had higher odds of being severely undernourished (Table 4.14). Both models were significant and explained 6% of the variance in severity (age continuous variable X^2 (3) =14.1 p=0.002, NagelkerkeR^2= 6.3%; age categorical X^2 (4) =13.4 P=0.010, NagelkerkeR^2= 6.0%).

Table 4.14: Logistic regression analysis assessing the relationship between breastfeeding frequency and nutrition status/ severity adjusted for age

	Univariate			Adjusted for age		
Predictors (reference)	**Odds ratio**	**95%CI**	**P value**	**Odds ratio**	**95%CI**	**P value**
Nutrition status (undernourished)						
Age in months (continuous)	1.04	0.99 to 1.09	0.107			
Breastfeeding frequency*						
Breastfeeding 1-3 times	2.45	1.12 to 5.38	0.025	2.34	1.05 to 5.24	0.038
Not breastfeeding	2.56	1.17 to 5.56	0.019	2.38	1.08 to 5.23	0.031
Age categorical (6-9 months)						
9-12 months	1.36	0.84 to 2.21	0.209			
12-24 months	1.32	0.82 to 2.15	0.254			
Breastfeeding frequency*						
Breastfeeding 1-2 times	2.45	1.12 to 5.38	0.025	2.48	1.23 to 5.47	0.024
Not breastfeeding	2.56	1.17 to 5.56	0.019	2.61	1.17 to 5.81	0.019
Severity (severe)						
Age (continuous)	1.08	1.02 to 1.143	0.008			
Breastfeeding frequency*						
Breastfeeding 1-2 times	2.07	0.83 to 5.18	0.121	1.76	0.69 to 4.51	0.240
Not breastfeeding	3.57	1.55 to 8.23	0.003	2.92	1.22 to 6.95	0.016
Age categorical (6-9 months)						
9-12 months	1.53	0.83 to 2.78	0.166			
12-24 months	1.79	0.99 to 3.20	0.052			
Breastfeeding frequency*						
Breastfeeding 1-2 times	2.07	0.83 to 5.18	0.121	1.93	0.77 to 2.62	0.169
Not breastfeeding	3.57	1.55 to 8.23	0.003	3.42	1.44 to 8.07	0.005

*Breastfeeding frequency: reference is more than three times a day; Severity (healthy vs severe)

4.4 Dietary diversity

The most common starchy foods offered included boiled bananas, pumpkin, potatoes, ugali and rice. Beef and fish were the most common sources of animal proteins reported by caregivers, while spinach was the most common leafy vegetable offered. Children were more likely to be offered dairy, food cooked with oil and fruits and vegetables daily than meat, eggs and legumes (Table 4.15). One third of caregivers (31.9%) reported giving children meat broth only (see section 3.4.5 for definition). These children were therefore considered to have received the protein source in question. Only 14.8% of children were offered other sources of animal source proteins apart from dairy on a daily basis. Only 12.0% of children met the threshold for dietary diversity, that is at least four food groups daily, while three quarters of the children met their dietary diversity of recommendations at least once a week (Table 4.15).

4.4.1.1 Proportion of children offered at least 4 food groups in current study compared to Kenya Demographic and Health Survey

Dietary diversity in the current study was compared to dietary in the Kenya Demographic and Health Survey (KDHS). In the KDHS, dietary diversity is assessed using seven food groups measured using 24-hour recall. The seven groups include

1. Milk and other milk products,
2. Grains, roots, and tubers
3. Vitamin A-rich fruits and vegetables
4. Other fruits and vegetables
5. Eggs
6. Meat, poultry, fish, and shellfish (and organ meats)
7. Legumes and nuts.

Three food groups are considered the minimum number of groups appropriate for breastfed children (Kenya National Bureau of Statistics, 2015). Compared to children in the KDHS, children in the current study were less likely to meet dietary diversity recommendations, especially the older undernourished children (Table 4.16).

Table 4.15: Frequency of consumption of different food groups

Food groups	%	N
Meat/fish/poultry		
At least once a day	4.30	18
At least once a week	37.4	242
Rarely	58.4	155
Eggs (N=413)		
At least once a day	2.90	12
At least once a week	41.2	170
Rarely	55.9	231
Legumes (n=409)		
At least once a day	11.0	45
At least once a week	61.4	251
Rarely	27.6	113
Dairy (n=410)		
At least once a day	63.4	260
At least once a week	20.5	84
Rarely	16.1	66
Fruits		
At least once a day	64.6	268
At least once a week	29.4	122
Rarely	6.00	25
Leafy Vegetables (n=412)		
At least once a day	43.2	178
At least once a week	42.7	176
Rarely	14.1	58
Foods cooked with oil (n=414)		
At least once a day	82.4	342
At least once a week	3.10	13
Rarely	14.3	59
Animal proteins		
Low (not given)	18.5	74
Borderline (1 or more source weekly)	66.8	267
High (1 or more daily)	14.8	59
Dietary diversity daily (n=400)		
Low	19.0	76
Borderline (4 or more food groups weekly)	69.1	276
Meets recommendation (4 or more food groups daily)	12.0	48

Diversity groups: meat, eggs, dairy, legumes, fruits or leafy vegetables, starchy foods; n=415 unless stated

Table 4.16: Proportion of children offered at least four food groups in current study compared to Kenya Demographic and Health Survey

	KDHS* (n=2,593)	**Current study n=415)**		
Age in months	%	All	**Healthy**	**Undernourished**
6-8	21.3%	6.5%	5.3%	7.5%
9-11	32.2%	10.7%	9.1%	11.8%
12-17	47.7%	15.4%	5.0%	21.9%
18-23	49.0%	24.3%	31.3%	19.0%

*Kenya Demographic and Health Survey data collected using 24-hour recall

4.4.2 Associations between dietary diversity and child characteristics

Associations between dietary diversity and child characteristics are presented in Table 4.17. Older children, were three times more likely to meet the WHO recommendations for dietary diversity (P<0.001) than younger children (Table 4.17). This likelihood increased with severity (P=0.026). There was however, no association between gender and child nutrition status and dietary diversity (Table 4.17). Within the undernourished group, there was no difference between moderate and severely undernourished.

4.4.2.1 Logistic regression assessing the association between dietary diversity and severity

Age and dietary diversity were associated with severity in univariate analysis. To assess if age and dietary diversity were independent predictors of severity, logistic regression analysis was carried out. The model included severity as the outcome (healthy vs severe) and age as a continuous variable and dietary diversity as predictors. Meets dietary diversity recommendation was used as the reference category. This model was significant (X^2 (3) =9.621 p=0.017) and explained 4.5% (NagelkerkeR^2) of variance. Age was an independent predictor of severity but dietary diversity was not. That is, older children were more likely to be severely undernourished and to eat more diverse diets. A one month increase in age was associated with increased odds of severity (Table 4.18). When age was entered as categorical variable, both age and dietary diversity were not predictors of severity.

Table 4.17: Association between gender, age, nutrition state, severity and dietary diversity

	Gender		Age			Nutrition state		Severity*	
	Male (n=178)	**Female** (n=222)	**6-9months** (n=123)	**9-12months** (n=140)	**12-24months** (n=137)	**Healthy** (n=165)	**Undernourished** (n=235)	**Moderate** (n=121)	**Severe** (n=116)
Dietary diversity									
Meets recommendation	12.2 (22)	11.6 (26)	6.5 (8)	10.7(15)	17.7 (25)	8.9 (15)	13.9 (33)	10.7 (13)	17.2 (20)
Borderline	68.5(124)	69.6(156)	56.5 (70)	72.9 (102)	76.6 (108)	69.6(117)	68.8 (163)	69.4 (84)	68.1 (79)
Low dietary diversity	19.3 (35)	18.8 (42)	37.1 (46)	16.4 (23)	5.7 (8)	21.4 (36)	17.3 (41)	19.8 (24)	14.7 (17)
P value	0.969[a]		<0.001[b]				0.227[c]	0.136[d]	0.027[e]
Animal proteins									
Low (0)	18.5(33)	18.5(41)	33.3(41)	13.6(19)	10.2(14)	19.4 (32)	17.9(42)	22.7(27)	12.9(15)
Borderline (1 or more ASP weekly)	65.7(117)	67.6(150)	42.3(52)	70.7(99)	84.7(116)	66.1(109)	67.2(158)	63.9(76)	70.7(82)
High (1 or more ASP daily)	15.7(28)	14.0(31)	24.4(30)	15.7(22)	5.1(7)	14.5(24)	14.9(35)	13.4(16)	16.4(19)
	0.878[a]		0.626[b]				0.749[c]	0.070[d]	0.287[e]

[a] Pearson chi square P value; [b] P value chi square for linear trend; [c] Pearson chi square: healthy vs undernourished; [d] Pearson's chi square: moderate vs severe; [e] P value chi square for linear trend: healthy compared to moderate, severely undernourished children ASP: Animal source proteins *Severity: undernourished children classified based on the seriousness of their condition

Table 4.18: Logistic regression analysis assessing dietary diversity as a predictor of severity, adjusted for age

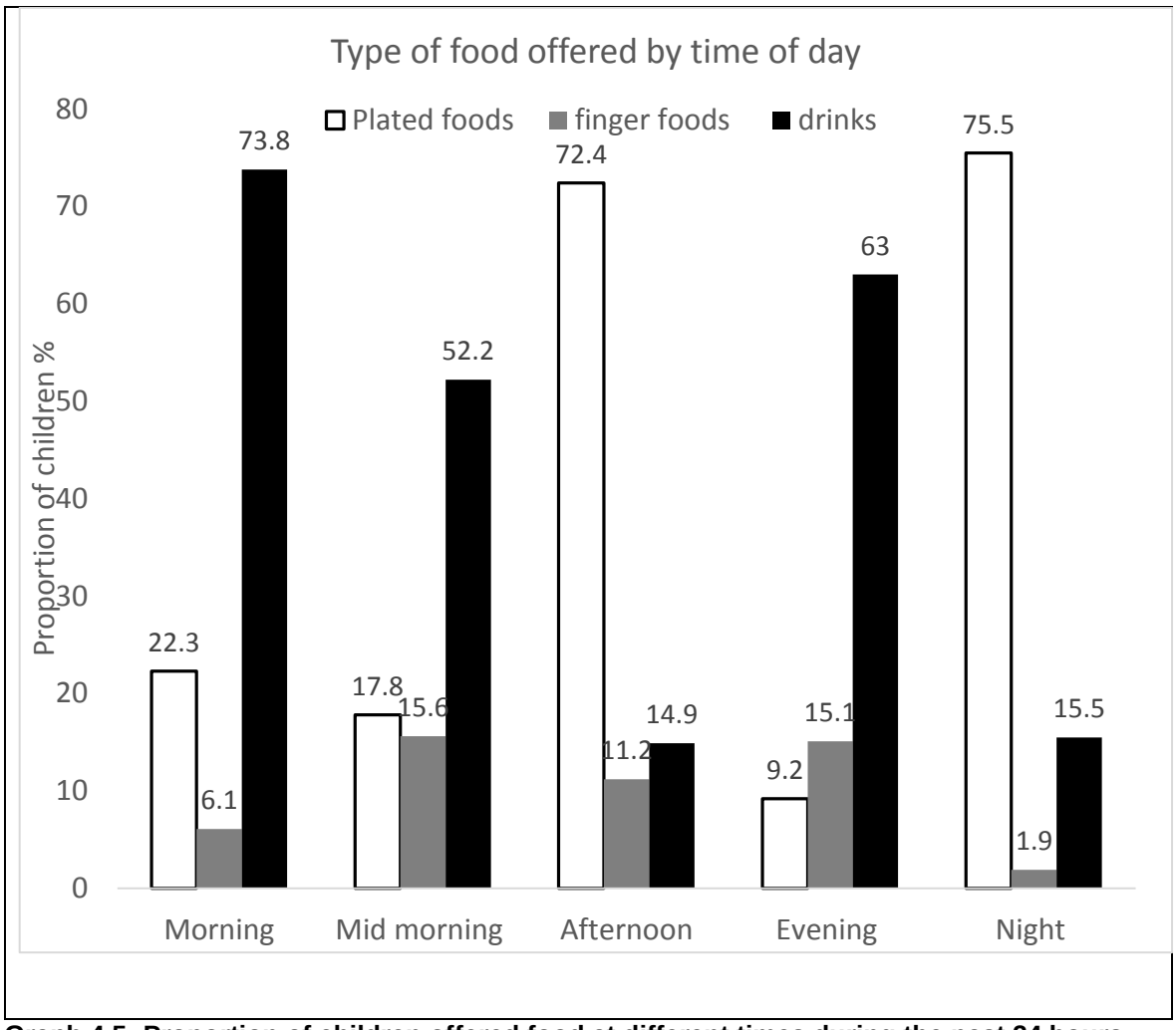
	Univariate			Adjusted for age		
Predictor (reference)	**Odds**	**95%CI**	**P value**	**Odds ratio**	**95% CI**	**P value**
Age* (continuous)	1.08	1.02 to 1.14	0.008			
Diversity(meets recommendation)						
Borderline	0.51	0.25 to 1.08	0.078	0.47	0.19 to 1.19	0.110
Low diversity	0.35	0.14 to 0.86	0.021	0.55	0.26 to 1.15	0.112
Age categorical (6-9 months)						
9-12 months	1.53	0.84 to 2.78	0.166			
12-24 months	1.79	0.99 to 3.20	0.052			
Diversity(meets recommendation)						
Borderline	0.51	0.25 to 1.08	0.078	0.43	0.17 to 1.07	0.070
Low diversity	0.35	0.14 to 0.86	0.021	0.52	0.25 to 1.09	0.082

$Model adjusted for age; *Age in months

4.5 Feeding frequency

Intake of plated foods, snacks and drinks on five possible eating occasions was used to assess feeding frequency. This information was collected using a 24-hour recall. Plated foods consisted of foods such as ugali, boiled potatoes, bananas and pumpkin. Finger foods mainly consisted of fruits in a few cases biscuits and although fruits were classified as 'finger foods', most caregivers reported mashing fruits and feeding them with a spoon. Drinks included tea, yoghurt, milk, porridge.

Children were offered plated foods mostly in the afternoon and at night. Drinks on the other hand were offered in the morning, mid-morning and evening while finger foods although not frequently eaten were offered mid-morning and in the evening (Graph 4.5). Plated foods frequency in this sample was low as most children were offered plated meals twice on the day before the interview (Table 4.19). Drinks were offered as often as plated meals (Table 4.19 and Graph 4.6). Intake of finger foods on the other hand was low (Table 4.19 and Graph 4.6). Close to half the children met their recommendations for plated foods (42.5%) and snacks (43.8%). However, only about a third (28.1%) met their recommendation for meal frequency (for definition see Table 3.5).

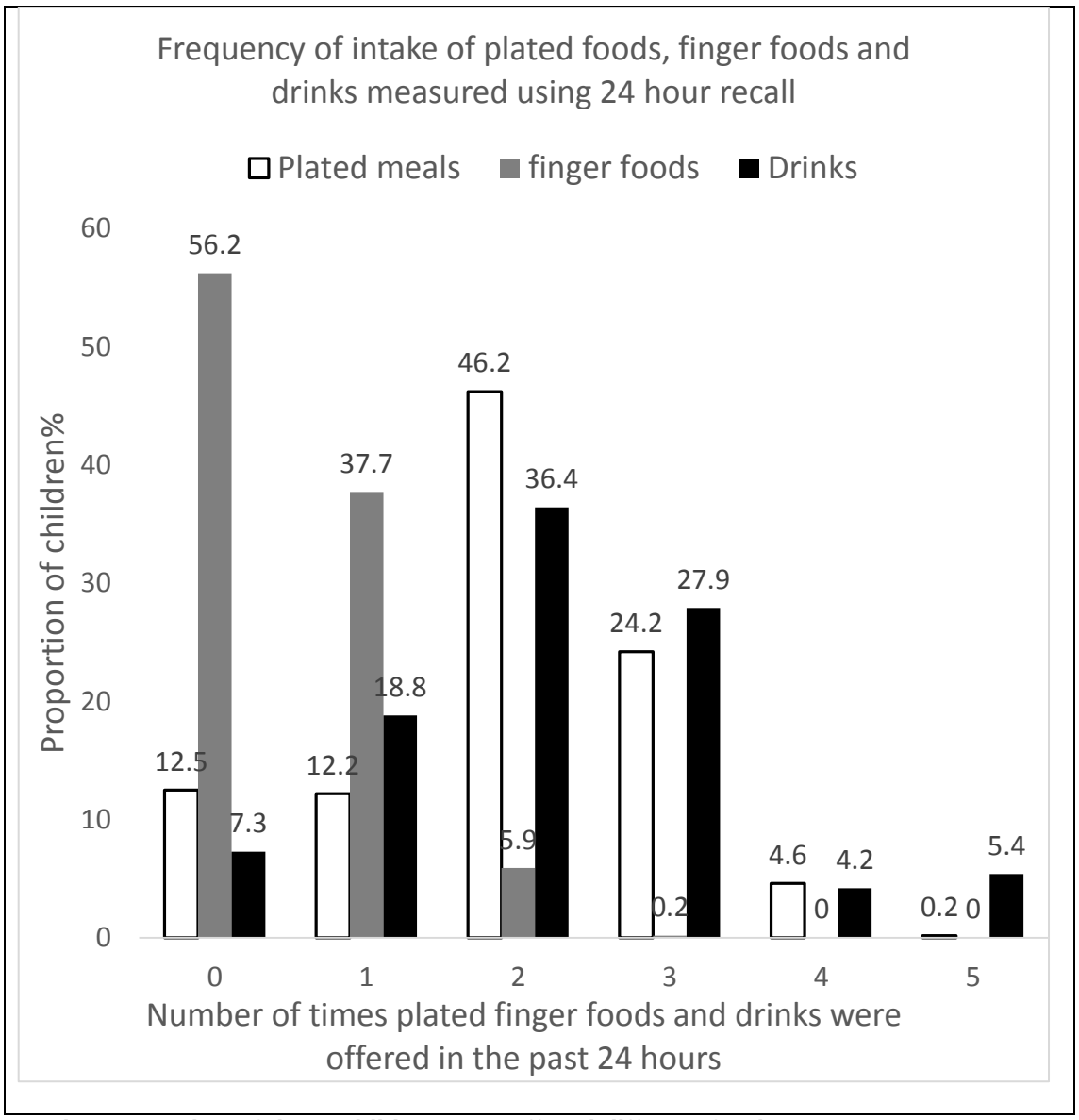


Graph 4.5: Proportion of children offered food at different times during the past 24 hours.

Table 4.19: Feeding frequency and average consumption of different foods measured using 24-hour recall

	%	N (n=411)	Median [IQR]
Plated foods only *			
Low	20.3	83	2 [2 to 3]
Borderline	37.2	154	
Meets recommendation	42.5	174	
Finger foods			
Low	56.2	230	0 [0 to 1]
Meets recommendation	43.8	179	
Feeding frequency (plated + finger foods)*			
Low	36.7	150	3 [2 to 3]
Borderline	35.2	144	
Meets recommendation	28.1	115	
Drinks (n= 409)			
Low (0-2 times)	65.3	143	2 [1 to 3]
High (3-5 times)	34.7	76	

Plated foods, finger foods and meal frequency classifications are based on WHO recommendations (PAHO).*Plated foods and meal frequency categories are adjusted for child's age



Graph 4.6: Number of times children were offered different foods

4.5.1 Association between child gender, age, nutrition status, severity and feeding frequency

Young children, were two times more likely to meet their age specific plated meal recommendations than older children (P=0.001), while older children were more likely to meet their finger food recommendations (P<0.004) and on average received finger foods more often than young children (Table 4.20). There were no gender differences in snack and feeding frequency (plated foods + snacks) (Table 4.20). To assess if including undernourished children on RUF underestimated the number of meals offered undernourished children on RUF were excluded from the analysis. When children on RUF were excluded from the analysis, the association between gender number of plated meals and finger foods remained the same. There was however, no association between feeding frequency and age (Table 4.20).

Associations between feeding frequency, nutrition status and severity in all children and in children who are not on RUF are presented in Table 4.21 . Compared to healthy children, undernourished children were two times more likely to have low plated food frequency (P=0.002). This difference was also reflected in distribution of their plated meal frequency (P=0.005). Similarly, compared to healthy children, severely undernourished were twice as likely to have a lower plated food frequency (P<0.001). This linear trend remained significant when children on RUF were excluded. There was, however, no association between plated food frequency and child nutrition status when children on RUF were excluded, a possible indication that including children on RUF led to an underestimation of the plated food frequency (Table 4.21).

There was also no association between feeding frequency (snacks + plated meals), nutrition status and severity (Table 4.21). When all children were included, although severely undernourished appeared to have a lower feeding frequency than healthy children, this trend had only borderline significance (P=0.057). There was no association between snacking frequency, nutrition status and severity (Table 4.21). However, when children on supplements were excluded, compared to healthy children, undernourished children were more likely to have a high snack frequency (P=0.009). This likelihood increased with severity but the association had borderline significance (P=0.042). Within the undernourished group there was no difference between moderate and severely undernourished children.

Table 4.20: Association between gender, age and feeding frequency in all children and in children not on supplements

	All children (n=409)					Excluding children on RUF (n=319)				
	Gender		Age in months			Gender		Age in months		
	Male (n=187)	**Female (n=222)**	**6-9 (n=125)**	**9-12 (n=142)**	**12-24 (n=142)**	**Male (n=153)**	**Female (n=166)**	**6-9 (n=105)**	**9-12 (n=111)**	**12-24 (n=103)**
Plated foods										
Low	18.5 (29)	18.5 (36)	20.0 (25)	25.4 (36)	15.5 (22)	18.3(28)	13.9 (23)	19.0 (20)	18.9 (21)	9.7 (10)
Borderline	36.7 (57)	38.5 (75)	14.4 (18)	38.7 (55)	55.6 (79)	37.3 (57)	40.4 (67)	15.2 (16)	39.7 (44)	62.1 (64)
Recommended	44.6 (70)	43.1 (84)	65.6 (82)	35.9 (51)	28.9 (41)	44.4 (68)	45.8 (76)	65.7 (69)	41.4 (46)	28.2(29)
P value	0.952[a]		0.001[b]			0.545[a]		0.005[b]		
Median	2[2 to3]	2[2to3]	2[1 to2]	2[2 to3]	2 [2 to3]	2[2 to3]	2[2to3]	2[1 to2]	2[2 to3]	2 [2 to3]
P value	0.355[c]		0.003[d]			0.550 [b]		0.001 [c]		
Finger foods										
Low	52.9 (83)	58.5(114)	64.0 (80)	59.2 (84)	46.5 (66)	52.9 (81)	56.6 (94)	66.7 (70)	56.8 (63)	40.8 (42)
Recommended	47.1 (74)	41.5 (81)	36.0 (45)	40.8 (58)	53.5 (76)	47.1 (72)	43.4(72)	33.3 (35)	43.2 (48)	59.2(61)
P value	0.293[a]		0.004[b]			0.509[a]		<0.001[b]		
Median	0[0 to1]	0[0to1]	0[0 to1]	0[0 to 1]	1[0 to 1]	0[0 to1]	0[0to1]	0[0 to1]	0[0 to 1]	1[0 to 1]
P value	0.176[c]		0.001[d]			0.346 [b]		<0.001 [c]		
Feeding frequency*										
Low	34.8 (65)	38.3 (85)	25.6 (32)	46.5 (66)	36.6 (52)	32.7 (50)	32.5 (54)	24.8 (26)	41.4 (46)	31.1 (32)
Borderline	33.2 (62)	36.9 (82)	34.4 (43)	33.8 (48)	37.3 (53)	34.0 (52)	41.6 (69)	38.1 (40)	35.1 (39)	40.8 (42)
Recommended	32.1(60)	24.8 (55)	40.0 (50)	19.7 (28)	26.1 (37)	33.3 (51)	25.9 (43)	37.1 (39)	23.4 (26)	28.2 (29)
P value	0.173[a]		0.016[b]			0.260[a]		0.158[b]		
Median	3[2 to3]	3[2 to3]	2[1 to3]	3[2 to3]	3[2 to4]	3[2 to3]	3[2 to3]	2[1 to3]	3[2 to3]	3[2 to4]
P value	0.182[c]		<0.001[d]			0.404 [b]		<0.001 [c]		

[a] Pearsons chi square, [b] Chi square for trend, [c] Mann-u Whitney test, [d] P value Kruskal Wallis test, *Feeding frequency: plated foods + finger foods

Table 4.21: Age specific differences in nutrition status, severity and feeding frequency

	All children (n=409)				Excluding children on RUF (n=319)			
	Healthy (n=172) % (n)	**Undernourished[a] (n=237) % (n)**	**Moderate (n=119) % (n)**	**Severe (n=118) % (n)**	**Healthy (n=172) % (n)**	**Undernourished[a] (n=147) % (n)**	**Moderate (n=86) % (n)**	**Severe (n=61) % (n)**
Plated foods								
Low	12.2 (21)	26.2 (62)	23.5 (28)	28.8 (34)	12.2 (21)	20.4 (30)	16.3 (14)	26.2 (16)
Borderline	39.5 (68)	35.4 (84)	32.8 (39)	38.1 (45)	39.5 (68)	38.1 (56)	34.9 (30)	42.6 (26)
High	48.3 (83)	38.4 (91)	43.7 (52)	33.1 (39)	48.3 (83)	41.5 (61)	48.8 (42)	31.1 (19)
P value		0.002[a]	0.987[b]	<0.001[c]		0.067[a]	0.702[b]	0.009[c]
Median	2 [2to3]	2[1 to3]	2[1 to3]	2[1 to2]	2 [2to3]	2[2 to3]	2[2 to3]	2[1 to2]
P value		0.005 [d]	0.333[e]	0.012[f]		0.088 [d]	0.181[e]	0.017[f]
Finger foods								
Low	61.6 (106)	52.3 (124)	50.4 (60)	54.2 (64)	61.6 (106)	46.9 (69)	44.2 (38)	50.8 (31)
High	38.4 (66)	47.7 (113)	49.6 (59)	45.8 (54)	38.4 (66)	53.1 (78)	55.8 (48)	49.2 (30)
P value		0.061 [a]	0.647[b]	0.164 [c]		0.009 [a]	0.532[b]	0.042[c]
Median	0[0 to1]	0 [0to1]	0[0to1]	0[0to1]	0[0 to1]	1 [0to1]	1[0to1]	0[0to1]
P value		0.063 [d]	0.602[e]	0.155 [f]		0.008 [d]	0.447[e]	0.021 [f]
Feeding frequency*								
Low	30.8 (53)	40.9 (97)	35.3 (42)	46.6 (55)	30.8 (53)	34.7 (51)	27.9 (24)	44.3 (27)
Borderline	40.7 (70)	31.2 (74)	34.5 (41)	28.0 (33)	40.7 (70)	34.7 (51)	37.2 (32)	31.1 (19)
High	28.5 (49)	27.8 (66)	30.3 (36)	25.4 (30)	28.5 (49)	30.6 (45)	34.9 (30)	24.6 (15)
P value		0.069[a]	0.158[b]	0.057 [c]		0.843 [a]	0.165[b]	0.296[c]
Median	3[2 to3]	3[2 to3]	3[2 to 3]	2[2 to3]	3[2 to3]	3[2 to3]	3[2 to 3]	2[2 to3]
P value		0.156 [d]	0.346[e]	0.217 [f]		0.975 [d]	0.162[e]	0.322 [f]

P values [a] Pearson chi square: healthy vs undernourished; [b] Pearson's chi square: moderate vs severe; [c] Chi square for linear trend: healthy compared to moderate, severely undernourished children; [d] Mann-u Whitney test: healthy vs undernourished [e] Mann-u Whitney test: moderate vs severe; [f] P value Kruskal Wallis test *feeding frequency plated foods + finger foods

4.5.1.1 Logistic regression analysis assessing the relationship between nutrition status, severity and plated food frequency

To assess if plated food frequency and age were independent predictors of nutrition status and severity, logistic regression was carried out using nutrition status and severity as outcomes and age and plated food frequency as predictors. Plated food frequency remained an independent predictor of nutrition status after adjusting for age both as continuous variable and categorical variable. Compared to children with high plated food frequency, children with a low frequency had high odds of being undernourished (Table 4.22). Both models were significant and explained 5% of the variance in nutrition status. Age and plated food frequency were also independent predictors of severity when age was entered as a continuous and categorical variable (Table 4.22). When children on RUF were excluded, plated food frequency remained an independent predictor of severity, explaining 7% (Nagelkerke R^2) of the variance in severity (Table 4.23). However, snack frequency was an independent predictor of severity (Table 4.23).

Table 4.22: Logistic regression analysis assessing the relationship between nutrition status and severity and plated food frequency in all children

Predictors (reference)	Odds ratio	95%CI	P value
	Adjusted for child's age		
Nutrition status			
Adjusted for age in months, (continuous)			
Plated food frequency (high)			
Borderline	1.02	0.64 to 1.62	0.949
Low	2.62	1.46 to 4.67	0.001
Adjusted for age categories (6-9, 9-12, 12-24 months)			
Plated food frequency (high)			
Borderline	1.01	0.63 to1.61	0.983
Low	2.58	1.44 to 4.61	0.001
Severity			
Adjusted for age in months, continuous			
Plated meal frequency (High)			
Borderline	1.07	0.60 to 1.89	0.820
Low	3.45	1.76 to 6.77	<0.001
Adjusted for age categories (6-9, 9-12, 12-24 months)			
Plated meal frequency (High)			
Borderline	1.15	0.65 to 2.03	0.628
Low	3.32	1.69 to 6.49	<0.001

Table 4.23: Logistic regression analysis assessing the relationship between severity, plated food and snack frequency

Predictors (reference)	Odds ratio	95%CI	P value
	Adjusted for child age		
Adjusted for age in months, continuous			
Plated meal frequency (high)			
Borderline	1.36	0.67 to 2.77	0.400
Low	3.39	1.48 to 7.74	0.004
Adjusted for age categories (6-9, 9-12, 12-24 **months)**			
Plated meal frequency (high)			
Borderline	3.26	1.43 to 7.46	0.005
Low	1.42	0.69 to 2.88	0.340
Adjusted for age in months, continuous			
Snack frequency (low)	0.79	0.49 to 1.29	0.363
Adjusted for age categories (6-9, 9-12, 12-24 **months)**			
Snack frequency(low)	0.77	0.48 to 1.25	0.291

* n=319 children on RUF excluded

4.5.1.2 Minimum number of plated foods in current survey compared to Kenya Demographic Health Survey

The proportion of children who met their plated meal frequency in the current study was compared to findings from the Kenya Demographic and Health Survey. In the KDHS, meal frequency was assessed using a 24-hour recall. A similar proportion of children aged 6-8 months in the current study and in the KDHS met their plated meal recommendations (Table 4.24). However, in children aged between 12 and 24 months, healthy and undernourished children were less likely to meet their plated meal recommendations, compared to KDHS sample (Table 4.24).

Table 4.24: Proportion of children in the current study who meet their plated food recommendation compared to children in the Kenya Demographic and Health Survey

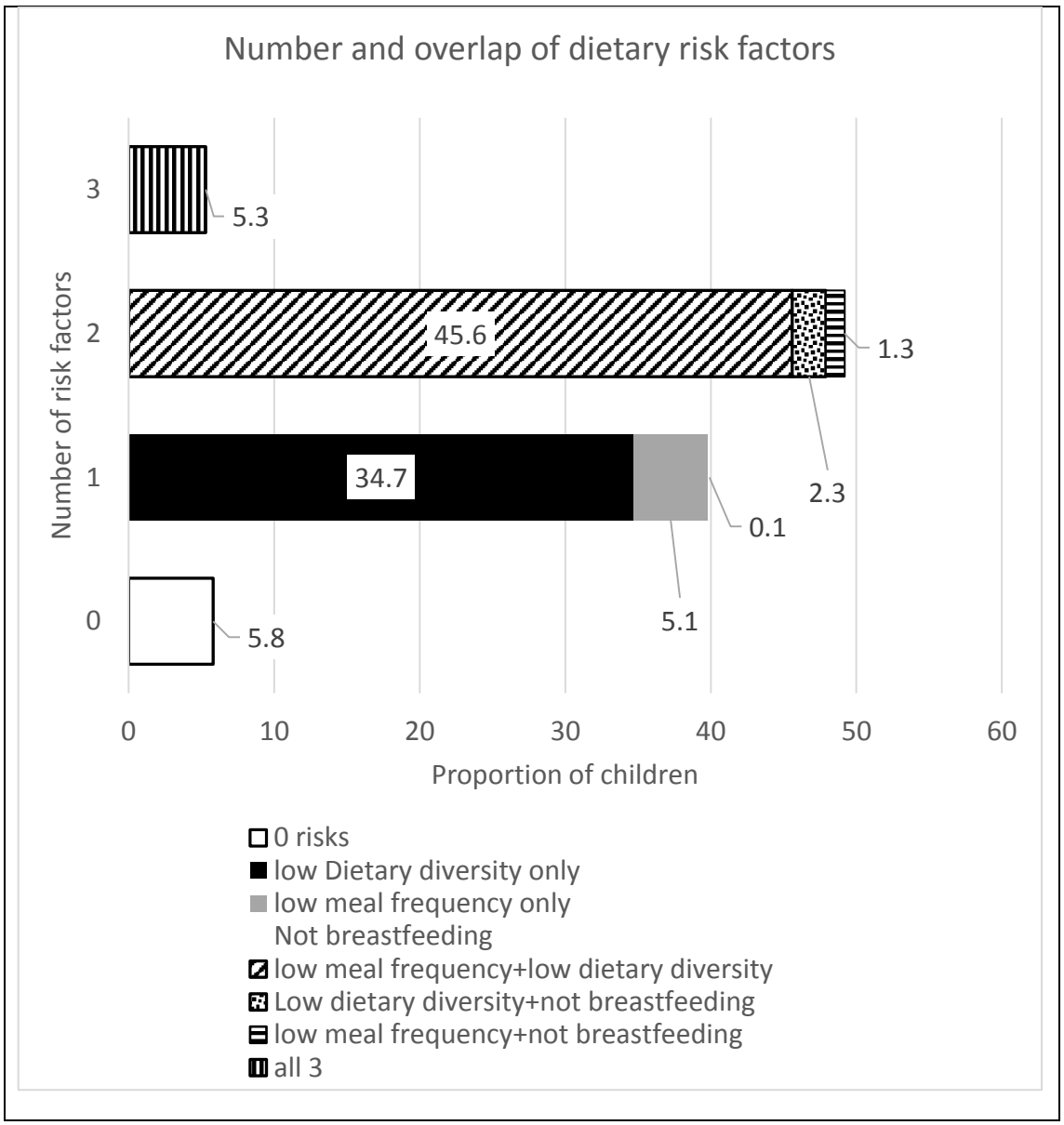
	KDHS(n=2,593)	**Current study (n=409)**		
Age in months	**%**	**All**	**Healthy**	**Undernourished**
6-8	61.9	65.6	66.1	65.2
9-11	41.4	35.9	44.6	30.2
12-17	48.1	30.8	35.0	28.1
18-24	52.9	23.7	29.4	19.0

KDHS: Kenya Demographic and Healthy Survey

4.5.2 Number of dietary risk factors and their associations with gender, age, nutrition status and severity

Breastfeeding status, dietary diversity and plated food frequency were used to assess the number and overlap of dietary risk factors. Only 5.8% of children did not have feeding as a risk factor meaning they were breastfeeding and they met their plated food and dietary diversity recommendations (Graph 4.7). Among children who had one feeding risk, most had low dietary diversity and none had “not breastfeeding” as a risk (Graph 4.7). Low plated food frequency and dietary diversity were the most common risks among children with 2 risk factors.

Older children and severely undernourished children were more likely to have high risk feeding practices when all children were included in the analysis. However, when undernourished children on supplements were excluded only age was associated with feeding risk (Table 4.25). To assess if feeding risk was an independent predictor of severity, logistic regression analysis was carried out with severity (healthy vs severe) as the outcome and feeding risk and age as predictors. When adjusted for age, feeding risk had a borderline association with severity, an indication that the association was mainly influenced by age (Table 4.26). The model was also significant and explained 6% of the variance in severity.



Graph 4.7: Number and overlap of dietary risk factors children with missing information excluded

Table 4.25: Association between, gender, age, nutrition status, severity and number of feeding risks in all kids and excluding children on supplements

	Gender		Age			Nutrition state		Severity	
All kids	**Male (n=177)**	**Female (n=218)**	**6-9months (n=121)**	**9-12months (n=138)**	**12-24months (n=136)**	**Healthy (n=165)**	**Undernourished (n=230)**	**Moderate (n=117)**	**Severe (n=113)**
Feeding practices									
Low risk	44.6 (79)	46.3(101)	63.6 (77)	39.9 (55)	35.3 (48)	50.9(84)	41.7 (96)	47.0 (55)	36.3 (41)
High risk	55.4 (98)	53.7(117)	36.4 (44)	60.1 (83)	64.7(88)	49.1(81)	58.3(134)	53.0 (62)	63.7(72)
P value	0.737[a]		<0.001[b]				0.071[c]	0.075[d]	0.019[e]
Excluding supplemented	(n=145)	(n=162)	(n=102)	(n=108)	(n=97)		(n=142)	(n=84)	(n=58)
Low risk	44.1(64)	52.5(85)	64.7(66)	45.4(49)	35.1(34)	50.9(84)	45.8(65)	52.4(44)	36.2(21)
High risk	55.9(81)	47.5(77)	35.3(36)	54.6(59)	64.9(63)	49.1(81)	54.2(77)	47.6(40)	63.8(37)
	0.145[a]		<0.001[b]				0.396[c]	0.039[d]	0.105[e]

P values: [a] Pearson chi square; [b] chi square for linear trend; [c] Pearson chi square: healthy vs undernourished; [d] Pearson's chi square: moderate vs severe; [e] chi square for linear trend: healthy compared to moderate, severely undernourished children; Children with missing information excluded; Low risk: 0 and 1 risks High risk: 2 or more risks; all kids =395; children on supplements excluded n=307;

Table 4.26: Logistic regression analysis assessing the relationship between feeding risk and severity, adjusted for age

	Univariate			Adjusted for age		
Predictor (reference)	**Odds**	**95%CI**	**P value**	**Odds ratio**	**95% CI**	**P value**
Adjusted for age in months, continuous	1.10	1.03 to 1.17	0.003			
Feeding risk (low risk)						
High risk	1.82	1.12 to 2.97	0.017	1.67	1.02 to 2.75	0.044

4.6 Discussion

The aim of the main study was to identify the number and frequency of modifiable risk factors for undernutrition in order to better plan for prevention and treatment interventions for undernourished children in urban slums in Kenya. Childcare practices were assessed through interviews in a population of children attending health facilities that offered outpatient therapeutic and supplementary feeding programmes.

The known association between child age and anthropometric characteristics could not be examined because of sampling criteria which involved quota selection of healthy and undernourished children. However, there was still some variation in some anthropometric measurements with age. A trend in stunting was observed, as median length for age Z scores decreased with an increase in age an indication that stunting was more likely to occur in older children. It was thus important to adjust for age where significant associations between risk factors and nutrition status were found. This finding is in line with other studies which report high levels of stunting in children aged between 18 months and 35 months (Kenya National Bureau of Statistics, 2015, Kimani-Murage et al., 2015, Olack et al., 2011). Overall, there were no gender differences in child anthropometric measurements.

4.6.1.1 Association between socioeconomic factors and nutrition status

Literacy rates appeared to be high in this sample as over half the caregivers were educated beyond primary level. Interestingly, it was fathers and not mother's education that was associated with nutrition status, although this association had only borderline significance. Similar findings have been reported by other studies (Semba et al., 2008, Rahman and Chowdhury, 2007, Victora et al., 1986). For example, a secondary analysis of data from the nutritional surveillance system in Indonesia and Bangladesh that aimed to assess the effect of parental formal education on risk of childhood stunting showed that although both maternal and paternal education were strong predictors of childhood stunting in both settings, paternal education appeared to a be a stronger predictor in Bangladesh where men have a higher standing in society (Semba et al., 2008). These associations are probably a reflection of poverty as low education levels are associated with low income earnings (Shavers, 2007).

Gender roles within the household might also be a contributing factor. Although mothers tend to be primary caregivers, the father still plays a major role in childcare especially when it comes to utilization of income. If the father determines how income is spent within the household, then only a small proportion of income is likely to be allocated to food and health promoting activities (Engle, 1993, Kennedy and Peters, 1992).

Undernourished children were more likely to come from homes with more than one child under five years of age. Short birth intervals are associated with negative child outcomes, although the actual mechanism is not clear. Some authors suggest that competition for limited maternal resources and spread of infectious diseases between children might explain these associations (Conde-Agudelo et al., 2012). Similar findings have been reported by other authors although this association is likely to be confounded by socio economic factors (Alam et al., 1989, Huttly et al., 1992, Conde-Agudelo et al., 2012). A longitudinal study in an urban area in Brazil showed that children who were born after a short birth interval (less than 24 months) had lower weight for age (0.07 vs 0.27 P=<0.001) and height for age z scores (-0.93 vs 0.64 P=0.001) at 19 months than children who born after a long birth interval (Huttly et al., 1992). Shorter birth intervals were also associated with increased intrauterine growth retardation, a possible indication that the mother's nutrition state during pregnancy also plays a role (Conde-Agudelo et al., 2012).

There was no association between ownership of most household goods and nutrition status probably because of the homogeneous nature of the sample. That is, nearly all caregivers came from deprived households. Overall, undernourished children were more likely to come from high social risk homes than healthy children, an indication of the role that poverty plays in undernutrition. Similar associations have been reported by other studies where children from deprived households are at high risk of undernutrition (Mohsena et al., 2010, Kenya National Bureau of Statistics, 2015, Black et al., 2013).

4.6.1.2 Association between hygiene factors and nutrition status

The lack of association between hygiene facilities and child nutrition status again reflects universal poor access to hygiene facilities in this sample. This does not mean that poor access to hygiene facilities is not an important risk factor, but it is a possible indication of "ecological fallacy" which describes biases that may occur when the association that exists between variables at an aggregate level may not represent the true association that exists at

an individual level (Piantadosi et al., 1988). This is a common feature of studies which focus specific geographical areas. Over three quarters of the sample did not have access to a private toilet and piped water, a common characteristic of slums in Kenya (Corburn and Hildebrand, 2015, Muoki et al., 2008). Although poor hand washing practices were also high, caregivers were more likely to report washing their hands with soap before meals. This is an indication that hand washing before meals is a customary practice and is therefore widely practiced (Aunger et al., 2010). It is also possible that caregivers in the current study understood the importance of this practice but this might not always be a protective strategy.

There is also a likelihood that caregivers over reported hand washing behaviour because during meal observations none of the caregivers offering home foods washed their hands. Over reporting of good hygiene practices is a relatively common practice (Curtis et al., 1993). Poor handwashing practices have been reported in Kenya (Aunger et al., 2010, Muoki et al., 2008). For example, a study assessing psychological determinants of handwashing in Kenya found that only one third of caregivers washed their hands with soap after cleaning the child's bottom after defaecation, while only about 15% washed their hands before feeding the child or serving food (Aunger et al., 2010).

The lack of association between nutrition status and hygiene was also reported in a study in rural Ethiopia that aimed to characterize breastfeeding and complementary feeding practices and behaviours and the energy and micronutrient intakes, the quality of complementary foods of young children and their association with stunting (Gibson et al., 2009). Gibson et al. (2009) found no association between source of drinking water, garbage disposal, hygiene and sanitation practices and stunting, probably because a relatively large proportion of the population (45%) lacked hygiene facilities (Gibson et al., 2009).

Other studies have shown associations between hygiene facilities and practices and child nutrition status and morbidity (Checkley et al., 2004, Nti and Lartey, 2008, Armar-Klemesu et al., 2000). A longitudinal study in a peri urban area in Peru assessing the effects of water and sanitation on linear growth and diarrhoea in a birth cohort of 230 children. They showed that children from households that lacked piped water, a large container for water storage and a sewerage connection grew less in height than children with the best conditions (Checkley et al., 2004). This findings might however been

confounded by poverty as richer families are more likely to have better access to water and sanitation facilities. Similarly, in Ghana, Nti and Lartey (2008) observed that mothers of healthy children had better hygiene practices and were more likely to keep their environment clean than mothers of undernourished children (97% vs 31% P=0.001) (Nti and Lartey, 2008). This association however cannot entirely be attributed to good hand washing practices because caregivers who are likely to have good hygiene practices are also more likely to have good childcare practices (Nti and Lartey, 2008). Poor hygiene practices are a reflection of the high levels of exposure to environmental and food contaminants, all of which are likely to cause frequent episodes of diarrhoea and sub clinical conditions such as environmental enteric disorder, both of which have a negative impact on child growth (Checkley et al., 2008). There is therefore a need for hygiene and sanitation interventions in this setting.

Caregivers of undernourished children were more likely to come from homes with piped water in their households. This result remained significant after controlling for the number of children in the household as a proxy measure of family size. Considering that undernourished children were recruited during a cholera outbreak in the slums, it is possible that piped water was contaminated.

Tap water contamination in slums has been reported by other studies (Muoki et al., 2008). Caregivers who had access to piped water were probably working mothers which meant that children were cared for by alternative carers who might not have the capacity and resources to provide quality care. There is evidence to show that maternal economic empowerment does always translate to improved child health and that poor child care practices are prevalent in alternative childcare settings such as day-care centres (Amugsi et al., 2017a, Mwase et al., 2016). It is also possible that families that had access to piped water did not see the need to treat drinking water before offering it to children, which meant that these children were more likely to suffer from frequent episodes of diarrhoea. There is however evidence to show that acute diarrhoea is not associated with poor growth in children and therefore this result cannot be attributed to acute diarrhoea (Briend et al., 1989). Although all the above reasons are plausible, the actual reason for this association cannot be established based on findings from this thesis. Further research in this setting is therefore required to assess if these findings are replicable or if they occurred by chance.

4.6.1.3 Association between child health and nutrition status

Hospital admission in the past month was associated with undernutrition, with pneumonia being the most common reason for hospital admission. This supports findings that infection and nutrition are closely related (Bejon et al., 2008, Checkley et al., 2008). They were also more likely to have rickets, a condition caused by either Vitamin D, phosphorous or calcium deficiencies. Associations between rickets and low child anthropometric measurements, have been reported by other studies in low income areas in Nairobi (Jones et al., 2017, Edwards et al., 2014). In a case review study in Kibera slum that aimed to describe demographic, social and clinical characteristics of 125 children presenting with rickets, 29% of children who had rickets had weight for age below -2SD of the WHO growth standard, while 39% had low MUAC <12.5 cm (Edwards et al., 2014). The association between rickets and undernutrition can be explained by deficient mineralization at the growth plate of long bones which in turn leads to retarded growth (Sahay and Sahay, 2012).

Possible causes of rickets in this setting include poor exposure to sunlight because of cultural and religious beliefs and dark skin pigmentation (Elder and Bishop, 2014, Edwards et al., 2014). Housing structures might also play a role caregivers as caregivers do not have space to sit and bask (Molla et al., 2000). It is also possible that children who suffer from rickets do not get enough dietary calcium either because their diets are low in calcium or because the high phytate content of complementary foods limits the bioavailability of calcium which in turn leads to calcium deficiency (Pettifor, 2004, Ferguson et al., 2015).

4.6.1.4 Association between breastfeeding practices and nutrition status

Associations between breastfeeding practices and child nutrition were assessed using the age of introduction of complementary foods and breastfeeding frequency. We hypothesized that undernourished children were more likely to be introduced to complementary foods early and they were also more likely to be breastfed at a lower frequency than healthy children.

Early introduction of complementary foods was reported by one third of the caregivers and was associated with undernutrition. Early introduction of complementary foods especially in unhygienic environments exposes the child to microbial contamination which in turn

leads to diseases such as diarrhoea which compromise the child's health and nutrition status (PAHO, 2003, Kramer and Kakuma, 2002, Kramer and Kakuma, 2012). Although plausible, there is a likelihood that the rates of exclusive breastfeeding in this sample were over reported as studies in similar settings have reported exclusive breastfeeding rates of less than 2% despite knowledge that complementary foods are supposed to be introduced at 6 months (Kimani-Murage et al., 2011). Over reporting of exclusive breastfeeding in the current study might have been because the study took place in a health facility and mothers felt pressure to report positive behaviour.

Late introduction of complementary foods has also been shown to be associated with undernutrition (Beka et al., 2009, Tessema et al., 2013). However, this could not be assessed in the current study because only a small proportion of children were introduced to complementary foods after seven months. All children who were introduced to complementary foods after six months were therefore classified in one category.

Continued breastfeeding was also relatively high, as only 9.0% of the children were not breastfeeding. Reasons for not breastfeeding included mother being HIV positive, lack of enough milk, pregnancy and child refusal to breastfeed. Children who were not breastfeeding were two times more likely to be undernourished. Furthermore, when compared to findings from the Kenya Demographic and Health Survey, a larger proportion of young children (6-11 months) in the current study were not breastfeeding. This difference was so large that all the children in the 6-8 month age group who were not breastfeeding were undernourished. Breastmilk in younger children provides a significant amount of energy to the child's diet in developing countries, especially during illness when intake of non-breastmilk sources decreases (Brown et al., 1990, Brown et al., 1995a). It is therefore likely that children who were not breastfeeding were not meeting their energy requirements, which led to undernutrition.

Other authors have suggested a possibility of reverse causation where the small size of the child influenced the mother stop breastfeeding so that the child can eat other foods (Onyango et al., 1998, Kimani-Murage et al., 2011). A longitudinal study in two slums in Nairobi that assessed patterns and determinants of breastfeeding and complementary feeding practices showed that children who were perceived to be larger than normal were 40% less likely to stop breastfeeding before 12 months (Kimani-Murage et al., 2011). This is in contrast to studies which show that small size is associated with delayed

complementary feeding and prolonged continued breastfeeding (Simondon and Simondon, 1998, Marquis et al., 1997, Kramer et al., 2011). Cessation of breastfeeding might also be a reflection of the time the mother spends with child. Due to the informal nature of work mothers do in this setting, it is possible that mothers need to go back to work early which limits lactation.

4.6.1.5 Association between nutrition status and dietary diversity and feeding frequency

Dietary diversity was assessed by looking at the number of food groups offered in the past month. A diverse diet was defined as at least 4 groups offered daily. We hypothesized that undernourished children were more likely to have low dietary diversity than healthy children and that older children had more diverse diets than younger children. Dietary diversity in the current sample appeared to be very low as only 12% of children met the set cut off of at least four food groups per day and only 14% of children were offered meat and eggs on a daily basis. Low intake of animal sources of protein has been reported by other studies in Kenya (Mueni, 2007, Korir, 2013).

Low dietary diversity in the current study may be attributed to cultural beliefs about complementary foods. Studies assessing factors that influence complementary food choices show that beliefs such as animal proteins and some leafy vegetables are inedible because children are not able to chew or that animal proteins are too strong for children, limit the variety of foods offered to children (Nankumbi and Muliira, 2015, Paul et al., 2012, Kram et al., 2015). Regardless of the urban setting, cultural diversity and access to health care, cultural beliefs largely influence feeding practices, because of tribal segregation where slums are divided into small villages which are inhabited by specific communities (Wanjohi et al., 2016, Watson, 2013, Wanjiru and Matsubara, 2017). There is therefore a likelihood that negative cultural practices are reinforced. This shows a need to assess factors which influence feeding practices in low income areas.

There was no association between dietary diversity and nutrition status in this sample. Lack of associations between dietary diversity have been reported by other studies (Amugsi et al., 2017b, Amugsi et al., 2014). In a recent analysis of demographic health survey data from 5 African countries, Nigeria, Democratic Republic of Congo, Ghana and Mozambique, there was no association between dietary diversity and length for age Z scores in Kenya (Amugsi et al., 2017b). In contrast, positive associations between dietary diversity and nutrition status have also been reported (Arimond and Ruel, 2004, Amugsi et al., 2017b, Onyango et al., 1998). In a secondary analysis of Demographic Health Surveys from Africa and Latin America, Arimond and Ruel (2004) reported a positive association between length for age and dietary diversity. Amugsi et al. (2017b) also reported a conditional positive association but only in two out of the five countries included in the analysis. That is a strong association between dietary diversity and length for age was observed but only in children at the lower end of the length for age distribution (5^{th} centile). The authors therefore concluded that dietary diversity interventions in some settings are likely to benefit children at high risk of undernutrition (Amugsi et al., 2017b).

The lack of association between dietary diversity and nutrition status and severity in the current study was probably because nearly all the children did not reach the set threshold and therefore no differences could be detected. Another possible reason is that the measure used in this study was not sensitive enough to detect differences because the WHO standard for dietary diversity is meant to assess adequacy at population level (World Health Organization, 2008a). Other studies assessing dietary diversity studies measure diversity using either 24-hour recalls or 7-day food frequency (Arimond and Ruel, 2004, Ruel, 2003), but in the current study these recall periods would not have provided a clear picture of the child's diet especially in severely undernourished children who were exclusively on RUF. Although food frequency questionnaires minimize intra individual day to day variability without relying on multiple assessments, they have also been shown to underestimate intake and are therefore not entirely reliable (Kristal et al., 1992). There is therefore a need to validate the use of food frequency questionnaires in slum areas.

The lack of a standard measure of dietary diversity in Kenya also presented a challenge when assessing dietary diversity. Compared to the Kenya Demographic Health Survey, children in the current study appeared to have less diverse diets. This was because, the KDHS used three food groups as a cut off for assessing diversity while in the current study 4 food groups were used (Kenya National Bureau of Statistics, 2015). The content of the

food groups also varied. Feeding frequency was assessed by counting the number of plated foods, drinks and finger foods offered during five possible eating occasion. This information was collected using a 24-hour recall and was probably not representative of usual intake, given day to day variations in food intake (Block, 1989). Plated meals were offered at a low frequency in this setting. Drinks, porridge, tea, yoghurt, milk, were offered at the same frequency as plated meals and in extreme cases children were not offered any plated foods. These children were reported to have a preference for drinks. Finger foods on the other hand, were offered at a relatively low frequency. This pattern of feeding is a possible indication of low energy intake in this population, but a measure of actual energy intake would be required to confirm this.

There was no association between feeding frequency (plated meals and snacks) and nutrition status. Other studies report conflicting findings about associations between meal frequencies nutrition status. For example, in a secondary analysis of multi-country data assessing the patterns of associations between WHO infant and young child indicators and height for age and weight for height in children aged 6-23 months, no associations between meal frequency and height for age were reported in nearly all countries. However, in Uganda, there was a positive association between meal frequency and weight for height (Jones et al., 2014).

Although meal frequency is used as proxy measure of energy intake, in cases where the energy content of food is low, the set WHO recommendation might underestimate the needs of children who are offered low energy dense foods which may explain the lack of associations with child growth (Dewey and Brown, 2003). This particularly applies to young children who were more likely to meet their meal frequency recommendations yet their diets are mainly made up of drinks. Meal frequency in the current study might also have reflected attempts made to feed the child which do not necessarily translate to intake. Information on the food composition of each eating occasion and the amount eaten would have provided a clearer picture of energy intake, but this information was not recorded. There is therefore a need to consider the types and quantities of foods eaten when assessing feeding frequency.

Low dietary diversity and feeding frequency were the most common combination of dietary risk factors among children recruited for this study and might be an indication of food insecurity but food security was not measured. Children recruited in the current study are exposed to extreme poverty levels and unhygienic living conditions which makes them vulnerable to infectious diseases. Although continued breastfeeding is high and might be beneficial to the child especially during illness, most of the children are offered diets which are carbohydrate based and of low energy density, which puts them at risk of undernutrition.

5 Eating and feeding behaviour

This chapter addressed the following questions

1. Who feeds the child?
2. How are children fed and are they willing to eat?

5.1 Methods

Questions used to assess child eating and maternal feeding behaviour were derived from the Gateshead Millennium Study (GMS), a prospective cohort study set up by my supervisor Professor Wright. The study examined the relationship between child eating, maternal feeding behaviour and growth in white British mother-child pairs in Gateshead, United Kingdom (Wright et al., 2006). The GMS study was selected first, because caregiver child interactions during meals were assessed using questionnaires as opposed to meal observations and second because it provided a relatively detailed description of possible eating and feeding behaviours during meals which was lacking in Kenya.

In the GMS study, 923 mothers and their infants were recruited at birth during which basic demographic information was collected. Mothers then received questionnaires on child eating and maternal feeding behaviour at six weeks, 4, 8 and 12 months. Child behaviours that were assessed included appetite and avoidant eating behaviour while maternal behaviour included feeding anxiety and response to food refusal. A summary of the measures used are presented in (Table 5.1). Infants were also weighed at regular intervals between birth and 13 months, and again at 30 months.

Findings from this cohort study showed that avoidant eating behaviours increased with age, and although most mothers considered their children to have good appetite, they were still anxious about their child's eating habits. Low appetite rating at six weeks and 12 months as well as a high response to food refusal score at eight months were independent predictors of sustained weight faltering. At 12 months, response to food refusal was the only predictor of weight faltering. The authors therefore concluded that child eating behaviour and maternal response might be important determinants of weight faltering.

Based on findings from this study and other studies on eating and feeding behaviour, we hypothesized that food refusal and force-feeding would be risk factors for undernutrition, while self-feeding and high interest in food would be protective against undernutrition, (Ha et al., 2002, Wright et al., 2006). Because the target population for the current study was infants and young children aged 6-24 months, questions were only derived from the 8 and 12 month follow up questionnaire and were adjusted based on relevance of the questions and observations made during the preliminary studies in Kenya as described below.

Table 5.1: Variables used to assess eating and feeding behaviour in the Gateshead Millennium Study

Behaviour		**Ratings**
Appetite	How is your child's appetite?	very good to very poor
Avoidant eating behaviour	Pushes food away, turns head, closes mouth, gags, holds food in mouth, spits food, throws food, cries	Rarely, sometimes, often
Maternal anxiety	Is your baby getting enough to eat	Yes, not always, no
	Are feeding times stressful	5 point scale: Very relaxed to very stressful
Response to food refusal	Encourage, offer something else, offer something else later, offer the same food later, makes the child eat	Rarely, sometimes, often

5.1.1.1 A description of eating and feeding behaviour variables used for data collection and transformations made

Child eating behaviour was assessed using 10 variables, which provided a description of self-feeding, interest in food and food refusal (Table 5.2). Child self-feeding was assessed by asking caregivers if they allowed children to feed themselves during meals and snacks. Responses were coded as entirely self feeds, mostly self feeds, half and half, carer mostly feeds and carer always feeds. Instead of asking caregivers to rate their child's appetite, we attempted to describe and quantify behaviours that reflect good appetite. Caregivers were therefore asked how often they felt their child was easy to feed, loved food, ate slowly and was easily satisfied. Most of the avoidant eating behaviours used in the GMS study were retained, but with slight modifications to the wordings to improve clarity (Table 5.2).

Response to food refusal was measured using seven behaviours, two of which, encourages child to eat and offers something, were retained from the cohort study (Table 5.2). Because the cohort study lacked a detailed description of force-feeding behaviour, additional controlling behaviours observed during meals in preliminary studies (see chapter 2) were included in the interview schedule for this purpose. These included

- Restrains child by holding hands,
- Pours food into child's mouth
- Forces the child's mouth open

To assess laissez faire feeding, caregivers were asked if they left their child alone when they refused to eat. Caregivers were also asked if they found feeding their child stressful and if they were worried their child was not eating enough. Additional behaviours reported by mothers were also recorded. All responses were coded using a five-point Likert scale that ranged from all the time to not at all (Table 5.2).

Individual eating and feeding behaviour variables were summarized into three groups, all the time, sometimes and not at all, reflecting how often the behaviour occurred during meals. All the time was a combination of all the time and most of the time, while sometimes was a combination of sometimes and rarely (Table 5.2). These three groups were used only for descriptive purposes for eating and feeding behaviour variables but for the self-feeding variable, these categories were used to test for associations.

Table 5.2: A description of child eating and caregiver feeding behaviour

Eating and feeding behaviours	Likert scale used	Transformations /summaries
Self-feeding	Entirely self feeds	All the time
Meals	Mostly self feeds	
Snacks	Half and half	sometimes
	Carer mostly feeds	
	Carer always feeds	Not at all
Food acceptance		
child was easy to feed		
loves food		
eats slowly	All the time	All the time
is easily satisfied	Most of the time	
Food refusal		
Pushes food away		
Turns away from food	Sometimes	Sometimes
Spits out food	Rarely	
Cries/screams during meals		
Holds food in mouth		
Response to food refusal	Not at all	Not at all
encourages child		
offers something else		
restrains child by holding hands		
pours food into child's mouth		
forces the child's mouth open		

5.1.1.2 Correlation between individual child eating and caregiver feeding behaviour and creation of eating and feeding behaviours scores and indices

Spearman's correlation was used to assess the strength and direction of relationships of individual child and caregiver variables. Variables which were strongly correlated were then combined to create eating and feeding behaviour scores and indices, a method adopted from previous studies (Bentley et al., 1991b, Gittelsohn et al., 1998, Wright et al., 2006). Eating behaviour scores were constructed to summarize interest in food, food refusal while force-feeding and maternal anxiety scores feeding were used to summarize feeding behaviour. This was done to reduce the number of analytical tests that were to be carried out.

Scores were created by either getting the difference between individual variables as was the case for interest in food or by summing up individual variables in each summary behaviour as shown in Table 5.3. They were then used to assess the distribution of eating and feeding behaviour variables and were therefore analysed as continuous variables. Indices on the other hand were used to assess the degree/severity of interest in food, food

refusal, force-feeding and maternal anxiety. The number of behaviours that occurred either all the time or most of the time were therefore counted (Table 5.3). This was done based on the assumption that children and caregivers were likely to experience these behaviours at one point or the other during meals but only the frequency of occurrence and the number of behaviours during meals are a likely indicator of extreme behaviour (Dettwyler, 1989). For example, all children show signs of food refusal during meals when they are either satisfied or ill, but children who show these behaviours all the time are likely to have poor appetite. Categories reflecting high, moderate and low occurrence were then created and used to test for associations with child characteristics.

Table 5.3: Eating and feeding behaviour scores and indices

	Behaviour variables		**Total**
Scores		Scores assigned	
Interest in food	Eats slowly- loves food	0. Not at all	2
Food refusal	Turns away+ Pushes food away+ Cries during meals+ Holds food in mouth+ Spits out food	1. Rarely 2. Sometimes 3. Most of the time 4. All the time	20
Force-feeding	Restrains child+ Forces mouth open+ Pours food into child's mouth		12
Maternal anxiety	Worry that child does not get enough to eat+ Finds feeding stressful		8
Indices			
Food refusal			5
Force-feeding	Number of behaviours that occur all the time or most of the time		3
Maternal anxiety			2

The variables loves food and eats slowly were inversely correlated meaning children who loved food were less likely to eat slowly. In order to measure overall interest in food, the variable loves food was subtracted from the variable eats slowly. A high score then meant that a child had high interest in food while a low score reflected low interest in food (see Table 5.4). The difference between the two variables was used as a score, to present the distribution if interest in food in this sample and an index, to classify children into categories reflecting the degree of interest.

Table 5.4: Creation of interest in food variable

Loves food	Eats slowly	Difference	Interpretation
4	0	4	High interest
3	1	2	
2	2	0	Moderate interest
1	3	-2	Low interest
0	4	-4	

0: not at all; 1: rarely; 2: sometimes; 3: most of the time 4: All the time

The relationship between eating and feeding indices was also assessed. Frequencies and percentages were used to present descriptive statistics for categorical variables, while median and interquartile range were used to describe continuous data. Chi square analysis was used to test for associations in categorical variables. Pearson's chi square test was used for binary variables, while chi square for trend was used to test for trends in ordinal data. Mann U Whitney test was used to assess differences in two independent groups in ordinal or continuous data, while Kruskal Wallis test was used to test for differences in more than two independent groups.

Linear regression was used to assess the relationship between eating and feeding behaviour indices and weight for age, weight for length and length for age Z scores. Weight for age, Weight for height and length for age Z scores were entered as the dependent variables while interest in food, food refusal, force-feeding and maternal anxiety were entered as predictors. Logistic regression was also used to assess if eating and feeding behaviour indices were independent predictors of nutrition status (healthy vs undernourished) and severity (healthy vs severe). High interest in food, low food refusal, low force-feeding and low maternal anxiety were used as reference categories.

5.2 Results

5.2.1 Who feeds the child? Association between nutrition status, severity and child self-feeding

Self-feeding was generally not common especially during meals (Table 5.5). Compared to young children, older children were more likely to feed themselves meals (P<0.001) and snacks (P<0.001) (Table 5.5). Compared to healthy children, undernourished children were less likely to feed themselves snacks (P=0.008) this likelihood increased with severity (P<0.002). There was however, no association between nutrition status, severity and the person who fed the child meals (Table 5.5). Within the undernourished group, there was no difference in self-feeding behaviour in moderate and severe cases.

Logistic regression was used to assess if self-feeding of snacks was an independent predictor of nutrition status. When adjusted for child's age, self-feeding remained a predictor of nutrition status. Compared to children who fed themselves snacks, children who did not feed themselves had higher odds of being undernourished (Table 5.6). The adjusted model was significant (X^2 (3) =18.6 P<0.001) and explained 6% (Nagelkerke R^2) of the variance in nutrition status. Adjusting for age in this case led to an increase in odds of being undernourished.

When severity (healthy vs severe) was used as an outcome after adjusting for child's age, the odds of being severely undernourished were high in children who did not feed themselves snacks (Table 5.6). This model was significant X^2 (3) =32.9 P<0.001 and explained 14% of the variance in severity.

Table 5.5: Association between nutrition status and severity and child self-feeding during snacks and meals

		Gender		Age in months			Nutrition status		Severity*	
Self-feeding	**All (n=414)**	**Male (n=189)**	**Female (n=226)**	**6-9 (n=127)**	**9-12 (n=144)**	**12-24 (n=144)**	**Healthy (n=172)**	**Undernourished (n=242)**	**Moderate (n=122)**	**Severe (n=120)**
meals	%(n)	%(n)	%(n)	%(n)	%(n)	%(n)	%(n)	%(n)	%(n)	%(n)
All the time	4.1 (17)	4.8 (9)	3.6 (8)	1.6 (2)	0.7 (1)	9.7 (14)	4.7 (8)	3.7 (9)	4.1 (5)	3.4 (4)
Sometimes	16.2 (67)	15.9 (30)	16.4 (37)	7.1 (9)	11.1 (16)	29.2 (42)	13.3 (23)	18.2 (44)	15.6 (19)	20.8 (25)
Not at all	79.7 (330)	79.4(150)	80.0 (180)	91.3(115)	88.2 (127)	61.1 (88)	82.0 (141)	78.1 (189)	80.3 (98)	75.8 (91)
P value		0.718 [a]		<0.001[b]			0.568 [c]		0.301 [d]	0.444 [e]
snacks										
All the time	38.9(161)	42.6 (78)	37.6 (83)	15.4 (18)	22.2 (32)	56.6 (81)	40.5 (66)	27.0 (65)	31.4 (38)	22.5(27)
sometimes	27.7(112)	27.3 (50)	28.1 (62)	26.5 (31)	29.2 (42)	27.3 (39)	25.2 (41)	29.5 (71)	29.8 (36)	29.2 (35)
Not at all	32.2(131)	42.6 (78)	34.4 (76)	58.1 (68)	48.6 (70)	16.1(23)	34.4(56)	43.6 (105)	38.8 (47)	48.3 (58)
P value		0.267 [a]		<0.001[b]			0.008 [c]		0.283[d]	0.002 [e]

P values: [a] Pearson chi square; [b] chi square for linear trend; [c] Pearson's chi square healthy vs undernourished; [d] Pearson's chi square moderate vs severe; [e] chi square for linear trend healthy compared to moderate, severely undernourished children *Severity: undernourished children classified based on the seriousness of their condition

Table 5.6: Association between nutrition status severity and self-feeding of snacks adjusted for age

	Univariate*			Adjusted for child's age		
Predictor (reference)	**Odds ratio**	**95% confidence interval**	**P value**	**Odds ratio**	**95% confidence interval**	**P value**
Healthy vs undernourished						
Self-feeding (all the time)						
Some times	1.19	0.65 to 2.17	0.571	1.41	0.76 to 2.62	0.281
Does not self-feed	1.90	1.22 to 2.95	0.004	2.66	1.61 to 4.38	<0.001
Severity						
Self-feeding (all the time)						
Sometimes	1.43	0.68 to 3.03	0.346	2.12	0.94 to 4.79	0.069
Does not self-feed	2.44	1.41 to 4.22	0.001	5.05	1.09 to 1.56	<0.001

5.2.2 Descriptive statistics summarizing individual eating and feeding behaviour

The frequency of occurrence of individual child behaviour during meals is presented in Table 5.7. Based on caregiver reports, over half the children were easy to feed and appeared to love food all the time. One third turned away from food and pushed food away all the time. Crying during meals, holding food in mouth without swallowing occurred all the time in 20% and 16% of children respectively.

Table 5.7: Frequency of occurrence of individual child eating behaviour

Child's actions	%	N
Easy to feed (n=414)		
All the time	61.8	256
Sometimes	28.3	117
Not at all	9.9	41
Loves food		
All the time	56.4	234
Sometimes	27.2	113
Not at all	16.4	68
Eats slowly		
All the time	49.9	207
Sometimes	34.0	141
Not at all	16.1	67
Easily satisfied		
All the time	45.1	187
Sometimes	25.8	107
Not at all	29.2	121
Turns away		
All the time	35.7	148
Sometimes	45.3	188
Not at all	19	79
Pushes food away		
All the time	30.6	127
Sometimes	39.0	162
Not at all	30.4	126
Cries/screams		
All the time	20.7	86
Sometimes	33.0	137
Not at all	46.3	192
Holds food in mouth		
All the time	15.9	66
Sometimes	21.9	91
Not at all	62.2	258
Spits out food		
All the time	22.7	94
Sometimes	41.9	174
Not at all	35.4	147

A summary of the frequency of occurrence of individual caregivers behaviour during meals are presented in Table 5.8. Over half the caregivers reported encouraging the child all the time during meals while one third reported restraining the child. Eleven mothers (2.7%) reported threatening to beat the child if they refused food.

Table 5.8: Frequency of occurrence of individual caregiver's feeding behaviour

Caregiver's actions	%	N
Encourages child		
All the time	58.3	242
Sometimes	33.7	140
Not at all	8.0	33
Offers something else (n=412)		
All the time	40.0	165
Sometimes	36.7	151
Not at all	23.3	96
Restrains the child		
All the time	32.3	134
Sometimes	28.7	119
Not at all	39.0	162
Pours food into child's mouth (n=404)		
All the time	10.7	43
Sometimes	20.5	83
Not at all	68.8	278
Forcefully opens child's mouth (n=414)		
All the time	15.9	66
Sometimes	24.9	103
Not at all	59.2	245
Threatens to beat child		
All the time	2.7	11
Sometimes	7.7	32
Not at all	89.6	371
Leaves child alone (n=413)		
All the time	16.5	68
Sometimes	52.5	217
Not at all	31.0	128
Stress when feeding child (n=414)		
All the time	22.0	91
Sometimes	21.0	87
Not at all	57.0	236
Worry child does not eat enough (n=414)		
All the time	32.9	136
Sometimes	29.0	120
Not at all	38.1	158

5.2.3 Correlation between individual child eating and caregiver feeding behaviour.

Correlation results for child behaviour when eating home foods are presented in Table 5.9. Although 'easy to feed' positively correlated to loves food (0.481), it had a weak negative correlation with all the other variables and was therefore used for descriptive purposes only. Easily satisfied weakly correlated with other variables and was also excluded in further analysis (Table 5.9). A child who ate slowly was also likely to turn away when offered food, push food away, hold food in their mouth, cry and scream during meals and spit out food. They were also less likely to love food. Only three caregiver's actions were strongly correlated (Table 5.10). Caregivers who restrained their child were more likely to pour food in the child's mouth and force the child's mouth open during feeding an indication of force-feeding. There was also a relatively strong correlation between worry that the child does not get enough to eat and find feeding stressful an indication of anxiety.

Interest in food was assessed using two variables, loves food and eats slowly, which were inversely correlated. A child who loved food was less likely to eat slowly. Food refusal was assessed using five variables, turns away from food, pushes food away, cries during meals, holds food in mouth and spits out food all of which were positively correlated. Cronbach's alpha was used to test the internal consistency of the variables before a food refusal score and index were created (Table 5.11). When all the variables were included in the analysis the Cronbach alpha was 0.703. The alpha coefficient decreased when all variables when excluded apart from hold food in mouth which when excluded led to a small increase (0.017) in the alpha coefficient. All the five variables were therefore used in score and index creation. Force-feeding was assessed using three variables, restrains child, forces child's mouth open and pours food into child's mouth, while maternal anxiety was assessed using two variables, worry that that child does not get enough to eat and finds feeding stressful.

Table 5.9: Correlations between child behavioural characteristics when eating home foods

Child characteristics	Loves food	Eats slowly	Easily satisfied	Turns away	Pushes food away	Cries/ screams	Holds food in mouth	Spits out food
Easy to feed	**0.48**	**-0.20**	-0.09	-0.13	-0.14	-0.17*	-0.13	-0.15
Loves food	-	**-0.29**	**-0.11**	**-0.22**	**-0.27**	**-0.24**	**-0.23**	**-0.24**
Eats slowly	-	-	0.06	**0.31**	**0.33**	**0.27**	**0.21**	**0.22**
Easily satisfied	-	-	-	0.12	0.04	0.07	-0.03	0.05
Turns away	-	-	-	-	**0.49**	**0.44**	**0.20**	**0.34**
Pushes food away	-	-	-	-	-	**0.38**	**0.18**	**0.36**
Cries/screams	-	-	-	-	-	-	**0.21**	**0.24**
Holds food in mouth	-	-	-	-	-	-	-	0.18

P values two tailed Spearman's correlation; bold values represent P=0.01 *P=0.05

Table 5.10: Correlations between caregivers' actions when giving home foods

	Offers something else	Restrain child	Pours food into mouth	Forces mouth open	Hold nose	Threaten child	Leaves child alone	stressful feeding child	Worry child does not get enough to eat
Encourages child	**0.16**	0.04	-0.17	-0.08	0.07	0.07	0.10*	0.01	0.06
Offers something else	-	0.11*	0.03	-0.02	0.03	0.02	-0.07	0.12*	0.22*
Restrains child	-	-	**0.37**	**0.40**	0.06	0.04	0.08	**0.18**	**0.20**
Pours food into mouth	-	-	-	**0.44**	0.13	0.02	-0.03	**0.23**	**0.31**
Forces mouth open	-	-	-	-	0.08	0.07	0.05	**0.17**	**0.24**
Holds nose	-	-	-	-	-	0.19*	0.00	-0.03	0.01
Threatens child	-	-	-	-	-	-	0.09	0.02	-0.04
Leaves child alone							-	**0.19**	-0.01
Stressful feeding								-	**0.47**

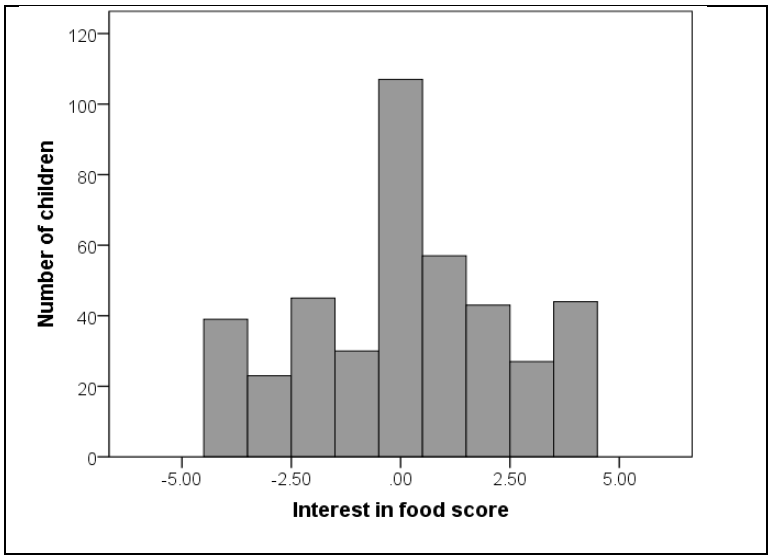
P values two tailed Spearman's correlation; bold values P=0.01 * P=0.05

Table 5.11: Internal reliability of food refusal variables if each item is excluded from the scale

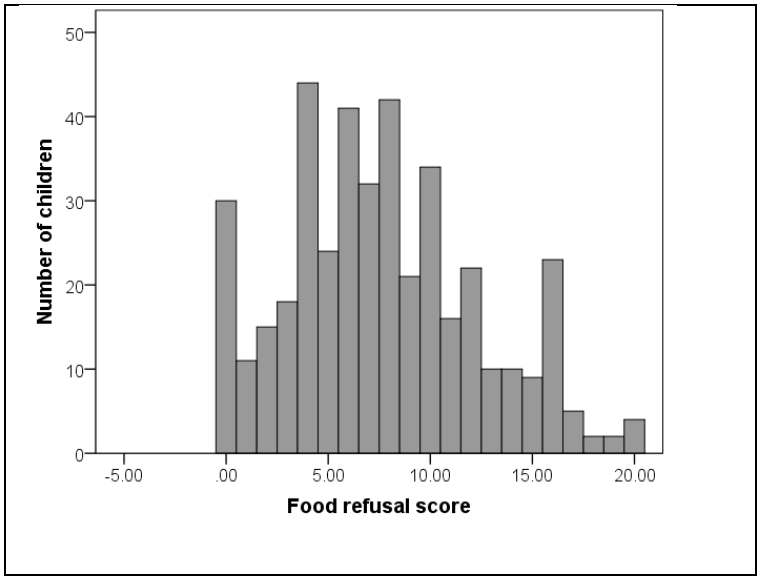
Refusal variables	Cronbach's alpha if item is deleted
Turns away	0.607
Pushes food away	0.619
Cries during meals	0.640
Holds food in mouth	0.720
Spits out food	0.671
Overall	0.703

5.2.4 Distribution of eating and feeding behaviour scores

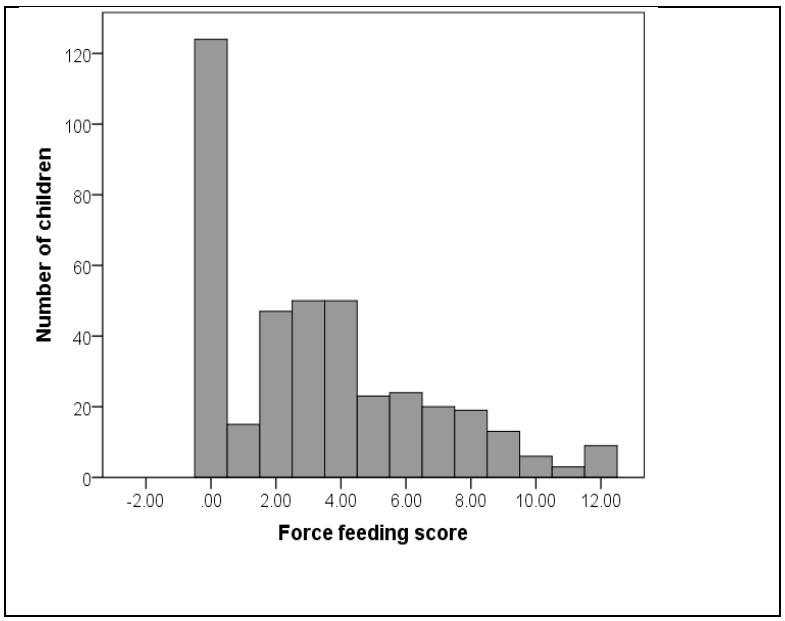
The distribution of eating and feeding behaviour scores are presented in Graph 5.1, Graph 5.2, Graph 5.3 and Graph 5.4. All eating and feeding behaviour scores were skewed.



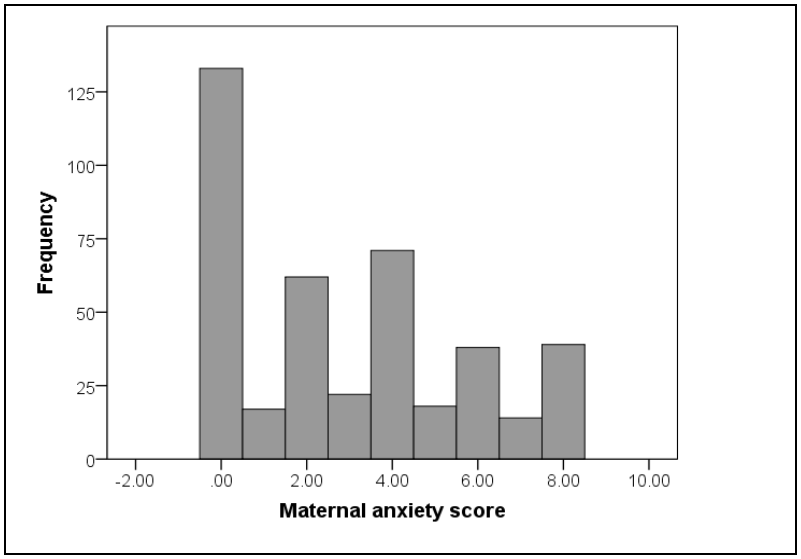
Graph 5.1: Distribution of interest in food score. High score reflects high interest in food



Graph 5.2: Distribution of food refusal score. High score reflects high food refusal



Graph 5.3: Distribution of force-feeding score. High score reflects high maternal anxiety



Graph 5.4: Distribution of force-feeding score. High score reflects high force-feeding.

5.2.5 A description of eating and feeding behaviour indices

Eating and feeding behaviour index categories are presented in Table 5.12. High food refusal was defined as three or more behaviours occurring all the time while high force was defined as two or more force-feeding behaviours occurring all the time. High maternal anxiety was defined as two behaviours; worry that the child does not get enough to eat and finds feeding stressful, occurring all the time. These categories were formed based on the distribution of the number of behaviours. One fifth of the children had low interest in food and high food refusal and 14% were force fed (Table 5.12).

The relationship between eating and feeding behaviour variables is presented in Table 5.12. As expected, interest in food inversely correlated with food refusal, force-feeding and maternal anxiety. Thus as interest in food decreased food refusal, force-feeding and maternal anxiety increased (Table 5.13). Maternal anxiety and force-feeding on the other hand increased with increased food refusal.

Table 5.12: Eating and feeding behaviour index categories

Index	Definition	%(n)
Interest in food		
High	1 to2	27.5 (114)
Moderate	-1 to1	46.7 (194)
Low	-1 to-2	25.8 (107)
Food refusal		
High	3 or more behaviours	22.5 (93)
Moderate	1-2 behaviours	30.8 (128)
Low	0 behaviours	46.7 (194)
Force-feeding		
High	2 or more behaviours	14.4 (58)
Moderate	1 behaviour	24.1 (97)
Low	0 behaviours	61.5 (248)
Maternal anxiety		
High	2 behaviours	22.0 (91)
Moderate	1 behaviour	45.9 (190)
Low	0 behaviours	32.1 (133)

Number of behaviours occurring all the time or most of the time

Table 5.13: Relationship between eating and feeding behaviour variables

	Food refusal	Force-feeding	Maternal anxiety
Interest in food	-0.42	-0.34	-0.34
Food refusal	-	0.42	0.61
Force-feeding	-	-	0.33

P=0.01 for all correlations Spearman's Rho

5.2.5.1 Associations between age, gender and eating and feeding behaviour scores and indices

Associations between age, gender and eating and feeding behaviour scores and indices are presented in Table 5.14. Compared to male children, female children were more likely to have low interest in food (P=0.033). This difference was reflected in the distribution of interest in food scores (Table 5.14). There was, however, no association between gender and food refusal, force-feeding or maternal anxiety (Table 5.14). There was also no association between eating and feeding behaviour and child's age.

5.2.5.2 Relationship between eating and feeding behaviour and weight for age, weight for height and length for age

Interest in food was associated with weight for age and weight for height (Table 5.15). This explained 4% of the variance in weight for age and weight for length. There was an inverse correlation between weight for age, weight for length, length for age and food refusal. Meaning as weight for age and weight for height z scores decreased food refusal increased. This explained 7%, 6% and 3% of the variance in WAZ, WLZ and LAZ respectively. Similarly, as weight for age and weight for length decreased the number of force-feeding behaviours increased. There was however no significant correlation between interest in food, force-feeding and length for age Z scores (Table 5.15). There was a relatively strong correlation between WAZ, WLZ and maternal anxiety. This explained 10% and 9% of the variance in WAZ and WLZ respectively. Although length for age also inversely correlated with maternal anxiety, this only explained 3% of the variance in LAZ.

Table 5.14: **Association between age, gender and eating and feeding behaviour scores and indices**

	Gender		Age in months		
	Male (n=189)	**Female** (n=226)	**6-9 months** n=127	**9-12 months** (n=144)	**12-25 months** (n=144)
Interest in food	% (n)	% (n)	% (n)	% (n)	% (n)
Low	20.1 (38)	30.5 (69)	32.3 (41)	26.4 (38)	27.8 (40)
Moderate	48.1 (91)	45.6 (103)	44.9 (57)	49.3 (71)	45.8 (66)
High	31.7 (60)	23.9 (54)	22.8 (29)	24.3 (35)	26.4 (38)
P value	0.033[a]		0.234[b]		
Median [IQR]	0[-1 to 2]	0[-2 to 1]	0[-1 to 2]	0[-2 to 1]	0[-2 to 2]
P value	0.017[c]		0.466[d]		
Food Refusal					
Low	47.6 (90)	46.0 (104)	42.5 (54)	46.5 (67)	50.7 (73)
Moderate	31.7 (60)	30.1 (68)	32.2 (41)	33.3 (48)	27.1 (39)
High	20.6 (39)	23.9 (54)	25.2 (32)	20.1 (29)	22.2 (32)
P value	0.536 [a]		0.256 [b]		
Median [IQR]	7[4 to 11]	8[4 to 10]	7[4 to 11]	7[5 to 10]	7[4 to 11]
P value	0.903 [c]		0.825 [d]		
Force-feeding (n=403)	n=184	n=219	n=125	n=138	n=140
Low force-feeding	63.6 (117)	59.8 (136)	59.2 (74)	67.4 (93)	57.9 (81)
Moderate	21.2 (39)	26.5 (60)	26.4 (33)	23.2 (32)	22.9 (32)
High	15.2 (28)	13.7 (30)	14.4 (18)	9.4 (13)	19.3 (27)
P value	0.460 [a]		0.447 [b]		
Median [IQR]	3[0to5]	3[0 to 5]	3[0 to 5]	3[0 to 4]	3[0 to 6]
P value	0.961 [c]		0.543 [d]		
Maternal anxiety					
Low	61.9 (117)	58.4 (132)	59.8 (76)	57.6 (83)	62.5 (90)
Moderate	22.8 (43)	27.4 (62)	29.1 (37)	22.2 (32)	25.0 (36)
High	15.3 (29)	14.2 (32)	11.0 (14)	20.1 (29)	12.5 (18)
P value	0.750 [a]		0.850 [b]		
Median [IQR]	2[0 to 5]	3[0 to 5]	2[0 to 4]	3[0 to 6]	2[0 to 5]
P value	0.656 [c]		0.142 [d]		

P values: [a] Pearson's' chi-square; [b] Chi square for linear trend [c] Mann u Whitney test; [d] Kruskal Wallis test(n=415)

Table 5.15: Linear regression analysis showing the relationship between eating and feeding behaviour and child anthropometric measurements

Behaviour variables	R^2	B coefficient	P value
Interest in food			
Weight for age z score	0.036	0.189	<0.001
Weight for length z score	0.042	0.210	<0.001
Length for age z score	0.005	0.085	0.084
Food refusal			
Weight for age z score	0.069	-0.262	<0.001
Weight for height z score	0.063	-0.251	<0.001
Length for age z score	0.029	-0.170	<0.001
Force-feeding			
Weight for age z score	0.017	-0.132	0.008
Weight for height z score	0.020	-0.142	0.004
Length for age z score	0.008	-0.088	0.078
Maternal anxiety			
Weight for age z score	0.093	-0.305	<0.001
Weight for height z score	0.089	-0.289	<0.001
Length for age z score	0.028	-0.169	0.001

5.2.5.3 Association between eating and feeding behaviours, nutrition status and severity

Associations between eating and feeding behaviour, nutrition status and severity are presented in Table 5.16. Compared to healthy children, undernourished children were more likely have low interest in food, high food refusal and their caregivers were more likely to be worried about their eating habits. These were also reflected in their continuous scores (Table 5.16). Although they were also more likely to be force fed this difference was not statistically significant (Table 5.16). Low interest in food (P=0.010), high food refusal (P<0.001) and high maternal anxiety (P<0.001) were more likely to occur in severely undernourished children than in healthy children. Although force-feeding was two times more likely to occur in severely undernourished children, this difference did not reach statistical significance (Table 5.16).

Table 5.16: Association between eating and feeding behaviour, nutrition status and severity of undernourishment

	Nutrition status		Severity	
Behaviour	**Healthy (n= 172)** % (n)	**Undernourished (n= 243)** % (n)	**Moderate (n=122)** % (n)	**Severe (n=121)** % (n)
Interest in food				
Low	14.0 (24)	34.2 (83)	32.0 (39)	36.4 (44)
Moderate	54.1 (93)	41.6 (101)	41.0 (50)	42.1 (51)
High	32.0 (55)	24.3 (59)	27.0 (33)	21.5 (26)
P value	<0.001 [a]		0.848 [b]	<0.001 [c]
Median[IQR]	0[0to2]	0[-2 to 1]	0[-2 to 1]	0[-2 to 1]
P value	0.001 [d]		0.430[e]	0.001[f]
Food Refusal				
Low	59.3 (102)	37.9 (92)	40.2 (49)	35.5 (43)
Moderate	30.2 (52)	31.3 (76)	30.3 (37)	32.2 (39)
High	10.5 (18)	30.9 (75)	29.5 (36)	32.2 (39)
P value	<0.001[a]		0.441 [b]	<0.001 [c]
Median[IQR]	6[3 to 8]	8[5 to 12]	9[5 to 12]	8[6 to 12]
P value	<0.001 [d]		0.965[e]	<0.001[f]
Force-feeding (n=403)*	n=171	n=232	n=119	n=113
Low	65.5 (112)	58.6 (136)	56.3 (67)	61.1 (69)
Moderate	24.6 (42)	23.7 (55)	27.7 (33)	19.5 (22)
High	9.9 (17)	17.7 (41)	16.0 (19)	19.5 (22)
P value	0.087 [a]		0.969 [b]	0.090 [c]
Median[IQR]	3[0 to 4]	3[0 to 6]	3[0 to 6]	3[0 to 6]
P value	0.007 [d]		0.935[e]	0.025 [f]
Maternal anxiety				
Low	78.5 (135)	46.9 (114)	45.9 (56)	47.9 (58)
Moderate	15.1 (26)	32.5 (79)	33.6 (41)	31.4 (38)
High	6.4 (11)	20.6 (50)	20.5 (25)	20.7 (25)
P value	<0.001 [a]		0.816 [b]	<0.001 [c]
Median[IQR]	0[0 to 3]	4[2 to 6]	4[2 to 6]	4[2 to 6]
P value	<0.001 [d]		0.728[e]	<0.001 [f]

*12 children had missing information (n=403); P values: [a] Pearson's chi square healthy vs undernourished; [b] Pearson's chi square moderate vs severe; [c] chi square for linear trend healthy compared to moderate, severely undernourished children; [d] Mann u Whitney test: healthy vs undernourished; [e] Mann u Whitney test: moderate vs severe [f] Kruskal Wallis test

5.2.5.4 Logistic regression analysis assessing the association between eating and feeding behaviour and nutrition status/ severity

Binary logistic regression was used to assess if interest in food, food refusal, force-feeding and maternal anxiety were associated with nutrition status and severity of undernourishment. The first model assessed individual eating and feeding behaviour variables as predictors of nutrition status (Table 5.17). All variables were independent predictors of nutrition status and explained 1.7% (force-feeding), 9.5% (food refusal), 7.2% (interest in food) and of the variance in nutrition status (Table 5.17). However, when all variables were entered into the model together, only interest in food and maternal anxiety remained independent predictors of nutrition status. Compared to children with high interest in food, children with low interest had higher odds of being undernourished (Table 5.17). Mothers with moderate and high anxiety also had higher odds of having undernourished children. Overall, force-feeding (Wald 2.85 P=0.240) and food refusal (Wald 4.30 P=0.116) had no effect on the model, but children with high food refusal had higher odds of being undernourished. This model was significant X^2 (8) =58.9 P<0.001; explained 18.3% (Nagelkerke R^2) of the variance in nutrition status.

The second model assessed individual eating and feeding behaviour variables as predictors of severity of undernourishment. In the unadjusted model, interest in food, food refusal and maternal anxiety were independent predictors of severity (Table 5.18). However, when all the variables were put in together their predictive power decreased and only food refusal was an independent predictor (Table 5.18). Although the children with low interest had high odds of being severely undernourished, this difference had borderline significance (Table 5.18). The odds of having a severely undernourished child were high in caregivers with moderate anxiety and high anxiety only the moderate group had significantly higher odds (Table 5.18). This model was significant X^2 (8) =44.04 P<0.001; explained 18.8% (Nagelkerke R^2) of the variance.

Table 5.17: Logistic regression analysis assessing the association between eating and feeding behaviours and nutrition status (healthy vs undernourished)

	Univariate*			Adjusted for all other variables shown		
Predictor (reference)	**Odds ratio**	**95% confidence interval**	**P value**	**Odds ratio**	**95% confidence interval**	**P value**
Healthy vs undernourished						
Interest in food (high)						
Medium	1.01	0.64 to 1.61	0.958	0.83	0.49 to 1.36	0.452
Low	3.22	1.79 to 5.78	<0.001	1.99	1.00 to 3.95	0.049
Food refusal (Low)						
Medium	1.62	1.03 to 2.55	0.036	1.23	0.73 to 2.07	0.435
High	4.62	2.57 to 8.31	<0.001	2.28	1.04 to 4.97	0.039
Force-feeding (low)						
Medium	1.08	0.67 to 1.73	0.754	0.68	0.38 to 1.15	0.144
High	1.99	1.07 to 3.69	0.030	0.61	0.28 to 1.32	0.210
Maternal anxiety (low)						
Medium	3.59	2.16 to 5.98	<0.001	2.72	1.51 to 4.89	0.001
High	5.38	2.68 to 10.8	<0.001	3.08	1.35 to 7.01	0.008

*only one variable in the model Interest in food: Difference between eats slowly and loves food; Food refusal: turns away, spits out food, holds food in mouth, pushes food away and cries and screams all the time or most of the time; Force-feeding: restrains child, pours food into mouth, forcefully opens mouth; Maternal anxiety: worries child is not getting enough food and finds feeding stressful

Table 5.18: Logistic regression analysis assessing the association between eating and feeding behaviours and severity (healthy vs severe cases)

	Univariate*			Adjusted for all other variables in the model		
Healthy vs Severe	**Odds ratio**	**95% confidence interval**	**P value**	**Odds ratio**	**95% confidence interval**	**P value**
Interest in food (high)						
Medium	1.16	0.65 to 2.07	0.615	0.87	0.47 to 1.63	0.670
Low	3.88	1.96 to 7.67	<0.001	2.20	0.98 to 4.95	0.056
Food refusal (Low)						
Medium	1.78	1.03 to 3.06	0.039	1.41	0.77 to 2.57	0.269
High	5.14	2.65 to 9.97	<0.001	2.97	1.22 to 7.23	0.016
Force-feeding (low)						
Medium	0.85	0.47 to 1.54	0.594	0.65	0.34 to 1.25	0.199
High	2.10	1.04 to 4.23	0.038	0.59	0.24 to 1.44	0.246
Maternal anxiety (low)						
Medium	3.40	1.89 to 6.11	<0.001	2.35	1.21 to 4.55	0.011
High	5.29	2.44 to 11.5	<0.001	2.27	0.89 to 5.83	0.088

*only one variable in the model Interest in food: Difference between eats slowly and loves food; Food refusal: turns away, spits out food, holds food in mouth, pushes food away and cries and screams all the time or most of the time; Force-feeding: restrains child, pours food into mouth, forcefully opens mouth; Maternal anxiety: worries child is not getting enough food and finds feeding stressful

5.2.5.5 Association between interest in food and nutrition status by level of force-feeding (low, moderate and high)

Force-feeding was not a predictor of nutrition status and severity yet it had a strong correlation with interest in food and food refusal. We therefore hypothesized that caregivers who were high force feeders were more likely to be anxious about their child's eating habits and they were more likely to have children with low interest in food and high food refusal and that these behaviours were more likely to be present in undernourished children. Chi square analysis was therefore used to test for associations between nutrition status interest in food, food refusal and maternal anxiety within different levels of force-feeding.

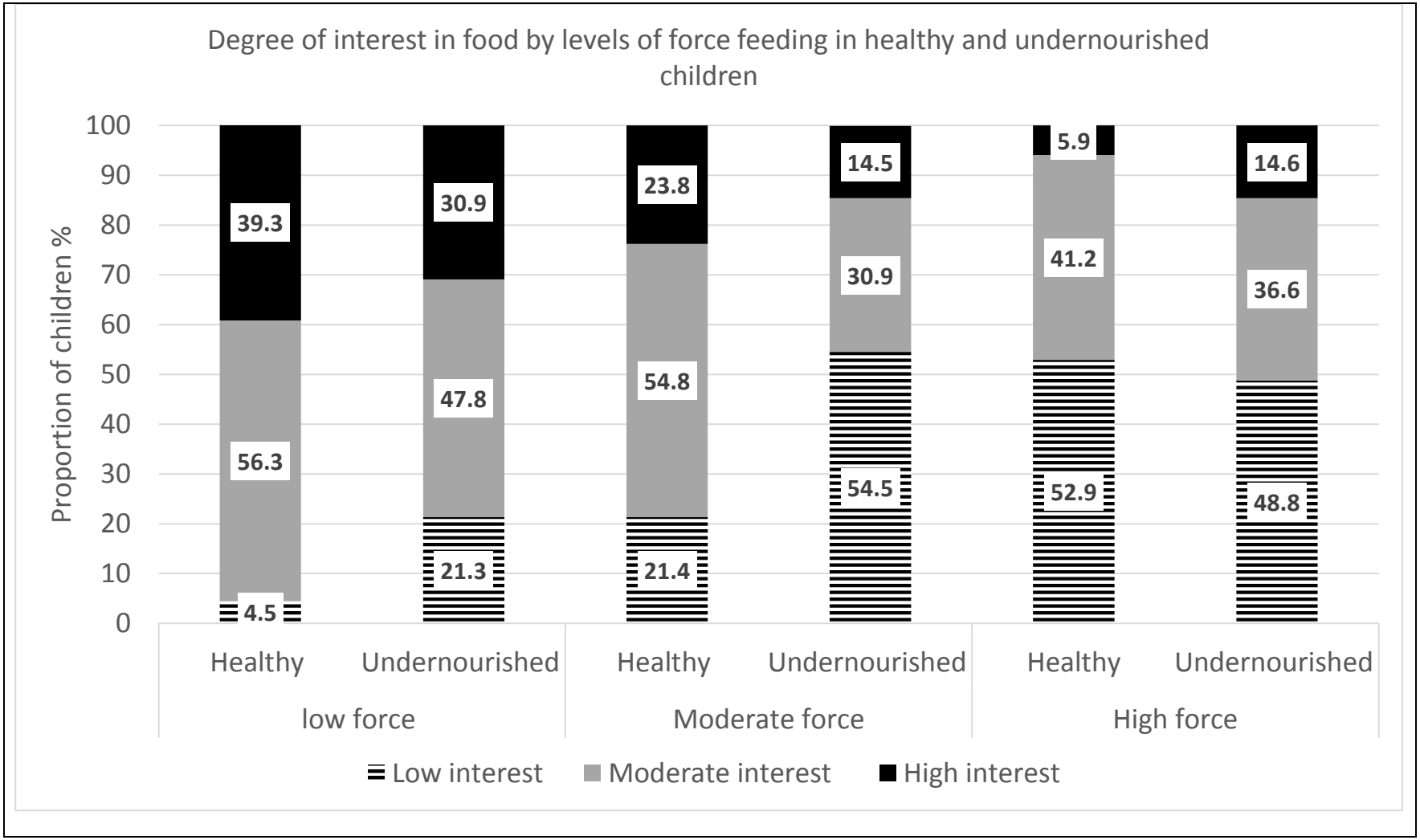
Associations between nutrition status, interest in food, food refusal and maternal anxiety within different levels of force-feeding are presented in Table 5.19 and Graph 5.5, Graph 5.6, Graph 5.7. The proportion of children with low interest in food increased with force-feeding (Graph 5.5). Among caregivers who reported low (P=0.004) and moderate force (P=0.009), undernourished children were more likely to have low interest in food than healthy children (Graph 5.5). There was however no association between interest in food in healthy and undernourished children in the high force-feeding group because half the caregivers in both groups reported low interest in food. High food refusal was more likely to be reported in undernourished children across all levels of force-feeding (Graph 5.6). High food refusal was more likely to be reported by caregivers of undernourished children in the moderate (P=0.007) and high force (P=<0.001) group. Compared to healthy children, caregivers of undernourished children were more likely to report high anxiety about their child's eating in low (P<0.001) and moderate (P=0.024) force-feeding groups. In the high force-feeding group there was a borderline difference (P=0.057) in maternal anxiety although caregivers of undernourished children were more likely to report high anxiety (Graph 5.7).

In the healthy group, children with low interest in food (P<0.001) and high food refusal (P<0.001) were more likely to be force-fed (Table 5.19). Caregivers with high anxiety were also more likely to force feed their children (P=0.031). Similarly, in undernourished low interest in food (P<0.001), high food refusal (P=0.005) and high anxiety (P<0.001) were associated with high force-feeding (Table 5.19).

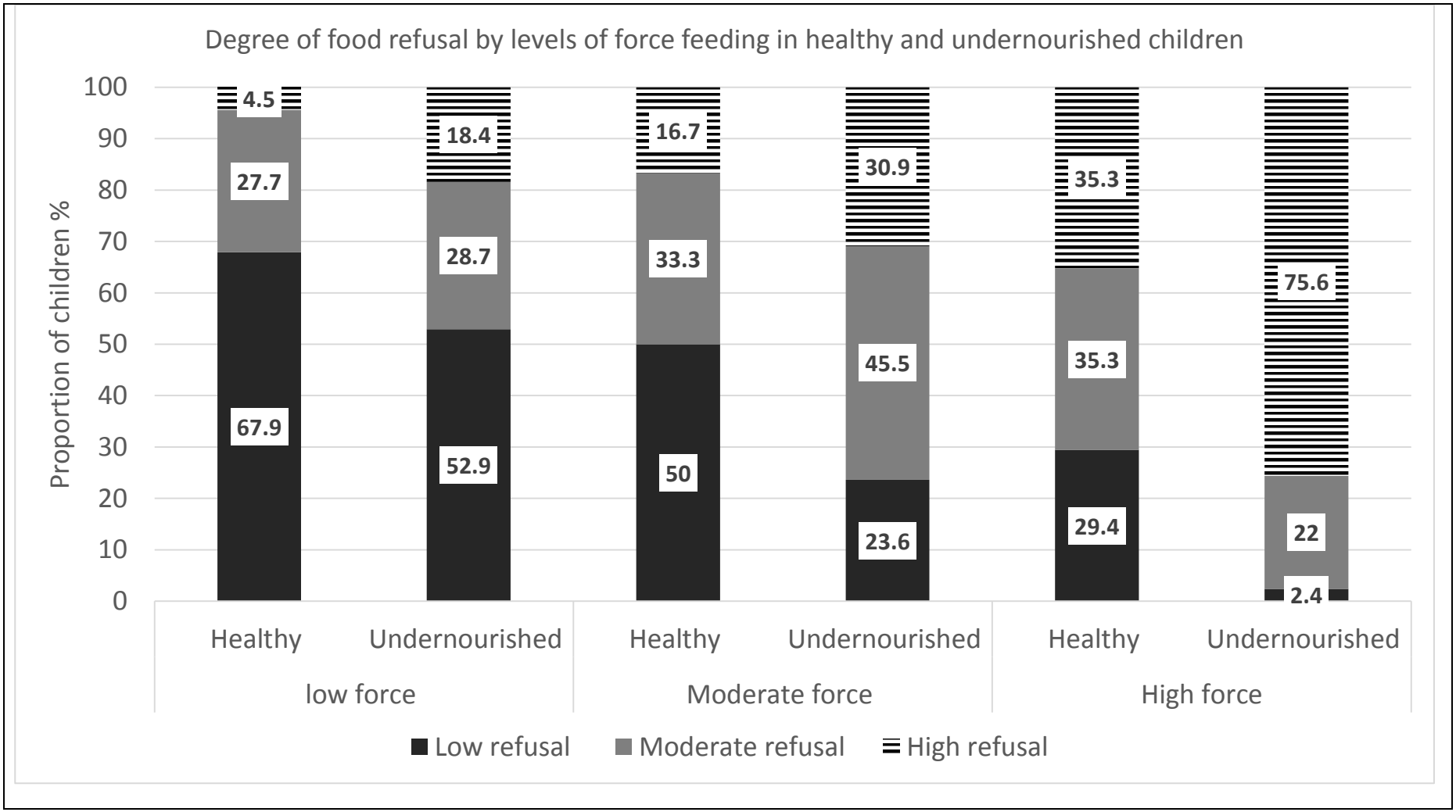
Table 5.19: Association between force-feeding and interest in food, food refusal, maternal anxiety in healthy and undernourished children.

	Healthy (n=171)			Undernourished (n=232)		
	Low force (n=112)	**Moderate (n=42)**	**High (n=17)**	**Low force (n=136)**	**Moderate (n=55)**	**High (n=41)**
Interest in food	%(n)	%(n)	%(n)	%(n)	%(n)	%(n)
Low	4.5 (5)	21.4 (9)	52.9(9)	21.3(29)	54.5 (30)	48.8(20)
Moderate	56.3 (63)	54.8 (23)	41.2(7)	47.8 (65)	30.9 (17)	36.6(15)
High	39.3 (44)	23.8 (10)	5.9(1)	30.9 (42)	14.5 (8)	14.6(6)
P value	<0.001			<0.001		
Refusal						
Low	67.9 (76)	50.0 (21)	29.4(5)	5.9 (8)	23.6 (13)	2.4 (1)
Moderate	27.7 (31)	33.3 (14)	35.3(6)	83.1 (113)	45.5 (25)	22.0 (9)
High	4.5 (5)	16.7 (7)	35.3(6)	11.0 (15)	30.9 (17)	75.6 (31)
P value	<0.001			0.005		
Maternal anxiety						
Low	83.9 (94)	78.6(33)	41.2(7)	59.6 (81)	38.2(21)	12.2(5)
Moderate	12.5 (14)	16.7(7)	29.4(5)	27.2 (37)	36.4(20)	51.2(21)
High	3.6 (4)	4.8(2)	29.4(5)	13.2 (18)	25.5(14)	36.6(15)
P value	0.031			<0.001		

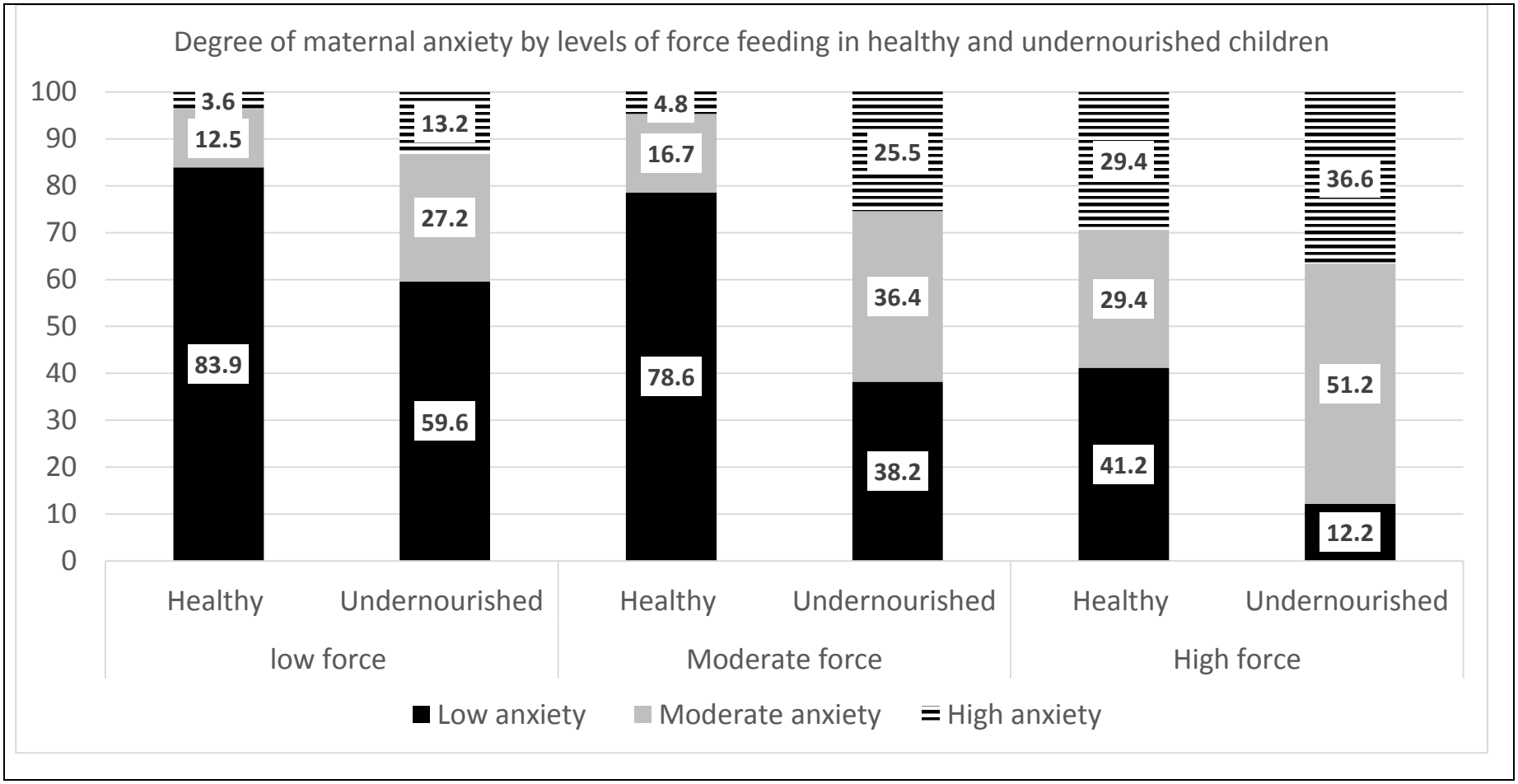
P values: Chi square for linear trend: low force vs moderate vs high force



Graph 5.5: Degree of interest in food by levels of force-feeding in healthy and undernourished children



Graph 5.6: Degree of food refusal by levels of force-feeding in healthy and undernourished children



Graph 5.7: Degree of maternal anxiety by levels of force-feeding in healthy and undernourished children

5.2.5.6 Logistic regression analysis assessing the relationship between force-feeding and food refusal

Binary logistic regression was carried out to assess if interest in food, food refusal and maternal anxiety were associated with force-feeding. The model was significant and explained 25.0% of the variance in force-feeding. Low interest, moderate and high food refusal were independent predictors of force-feeding (Table 5.20). Compared to children with high interest in food, children with low interest in food had higher odds of being force fed. The odds of force-feeding were also high in children with moderate and high food refusal. Maternal anxiety and child nutrition status were not predictors of force-feeding (Table 5.20).

Logistic regression was also used to assess if interest in food, force-feeding, maternal anxiety and nutrition status were associated with food refusal. This was based on the hypothesis that maternal anxiety and force-feeding can lead to food refusal (Wright et al., 2006). Findings from this analysis are presented in (Table 5.21). Interest in food, force-feeding and maternal anxiety were independent predictors of food refusal. Compared to children with high interest in food, children with low interest in food had high odds of refusing food (Table 5.21). Compared to caregivers who reported low force-feeding and low maternal anxiety, caregivers who reported high force-feeding and anxiety also had high odds of having children with high food refusal (Table 5.21).

Table 5.20: Logistic regression assessing the association between interest in food, food refusal and maternal anxiety and force-feeding

	Univariate			**Adjusted**		
Predictor (reference)	Odds ratio	95% CI	P value	Odds ratio	95% CI	P value
Low vs high force-feeding						
Interest in food (high)						
Medium	1.66	0.97 to 2.86	0.063	1.23	0.70 to 2.16	0.467
Low	6.88	3.75 to 12.6	<0.001	3.72	1.94 to 7.16	<0.001
Food refusal (Low)						
Medium	2.85	1.73 to 4.69	<0.001	2.24	1.31 to 3.84	0.003
High	7.52	4.30 to 13.1	<0.001	4.83	2.39 to 9.78	<0.001
Maternal anxiety (low)						
Medium	2.76	1.71 to 4.44	<0.001	1.19	0.67 to 2.15	0.545
High	4.33	2.38 to 7.92	<0.001	1.26	0.59 to 2.68	0.549
Nutrition status (Healthy**)**	1.34	0.89 to 2.02	0.161	0.72	0.44 to 1.18	0.195

Adjusted: mutual adjustment for eating and feeding behaviours and nutrition status

Table 5.21: Logistic regression assessing the association between interest in food, force-feeding and maternal anxiety and food refusal (Low vs high refusal)

	Unadjusted			**Adjusted**		
Predictor (reference)	Odds ratio	95% CI	P value	Odds ratio	95% CI	P value
Interest in food (high)						
Medium	3.85	1.75 to 8.44	0.001	3.10	1.02 to 9.41	0.046
Low	19.1	8.10 to 44.8	<0.001	4.28	1.27 to 14.5	0.019
Force-feeding (Low)						
Medium	3.48	1.81 to 6.69	<0.001	3.16	1.18 to 8.44	0.022
High	30.4	11.7 to 78.5	<0.001	12.7	3.47 to 46.1	<0.001
Maternal anxiety (low)						
Medium	29.0	13.2 to 64.1	<0.001	15.7	6.40 to 38.7	<0.001
High	144.2	43.6 to 477.6	<0.001	59.0	13.8 to 251.4	<0.001
Nutrition status (Healthy**)**	4.62	2.57 to 8.31	<0.001	2.43	0.96 to 6.12	0.058

Adjusted: mutual adjustment for eating and feeding behaviours and nutrition status

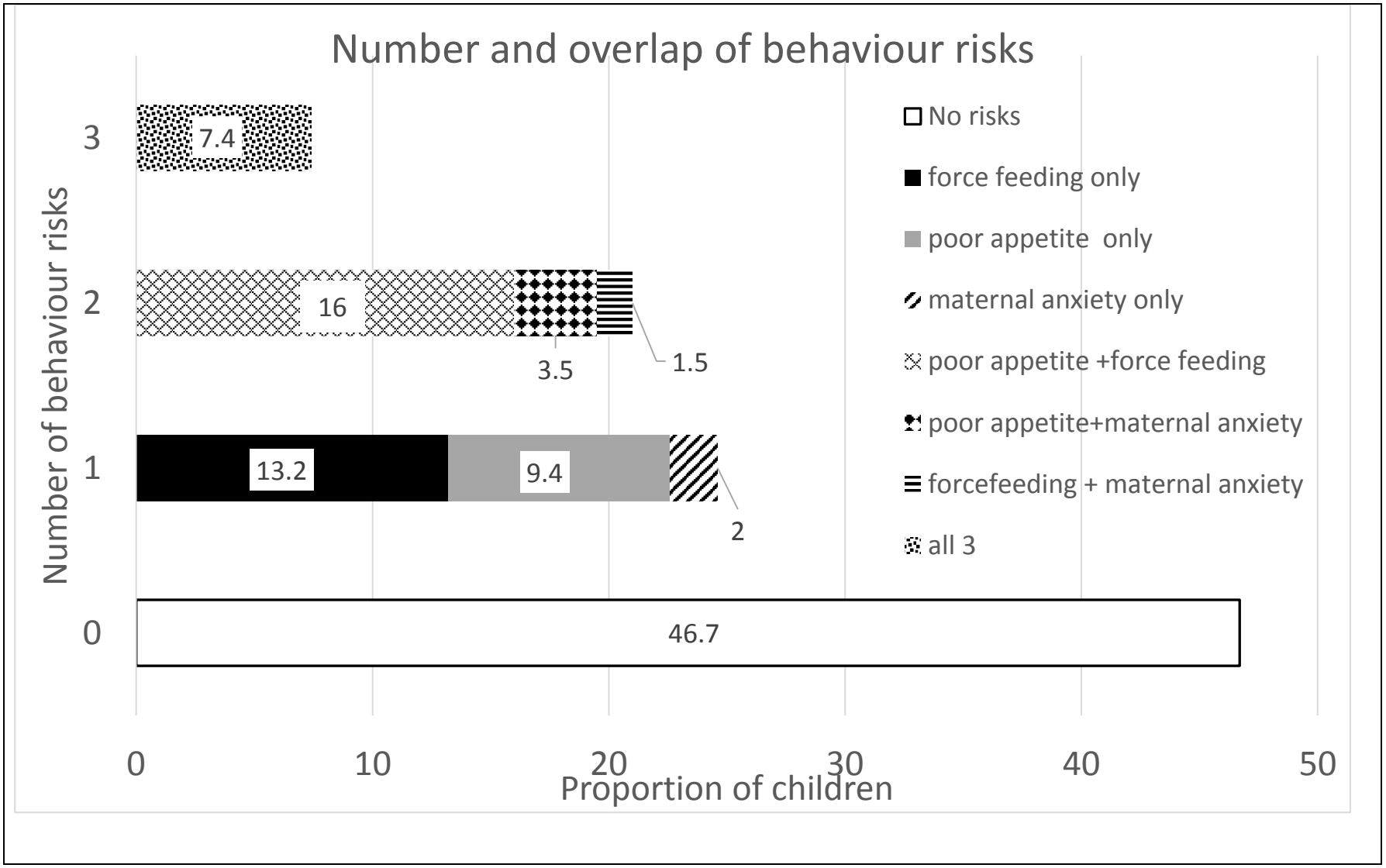
5.2.6 Number and overlap of high risk eating and feeding behaviours

To assess the overall prevalence and overlap of behaviour risks and how these differed by nutritional status, interest in food and food refusal were combined to form one variable to reflect overall "appetite". This was done because both variables are a measure of appetite. Poor appetite in this case was defined as low interest in food or high food refusal. Based on this definition 37.1% had poor appetite.

High risk behaviours were then defined as poor appetite, high force-feeding and high maternal anxiety all of which were scored 1 if present and 0 if absent. These behaviours were then counted. In cases where the child had one or more risk factors, the contribution made by each risk was assessed using cross tabulation. Based on the number of behaviour risks, children were further classified as low or high risk to assess if the number of behaviour risks was associated with nutrition status. Low risk was defined as the absence of eating and behaviour risks while high risk was defined one or more behaviour risk present.

The number and overlap of behaviour risks are presented in Graph 5.8. Half the children had one or more behaviour risks present, of which 24.6% had one risk and 7.4% had all three behaviour risks present. Among those with one risk factor, high force-feeding was the most common risk, while poor appetite and high force-feeding was the most common combination among children with two behaviour risks Graph 5.8.

Associations between gender, age, nutrition status, severity of undernourishment and behaviour risks are presented in Table 5.22. Female children and undernourished were more likely to fall in the high risk category. Although severely undernourished children were also more likely to have high risk there was no linear increase. Logistic regression analysis was not done in this case because there was no association between gender and child nutrition status or severity.



Graph 5.8: Number and overlap of behaviour risks *poor appetite: children with either low interest or high food refusal

Table 5.22: Association between gender, age, nutrition state, severity and eating and feeding behaviour

	Gender		**Age in months**			**Nutrition state**		**Severity***	
	Male (n=184)	**Female** (n=219)	**6-9 months** (n= 125)	**9-12 months** (n=138)	**12-24 months** (n=140)	**Healthy** (n=171)	**Undernourished** (n=232)	**Moderate** (n=119)	**Severe** (n=113)
	% (n)	% (n)	% (n)	% (n)	% (n)	% (n)	% (n)	% (n)	% (n)
Behaviour risk									
Low risk	52.7 (97)	41.6 (91)	43.2 (54)	51.4 (71)	45.0 (63)	59.1 (101)	37.5 (87)	37.0 (44)	38.1(43)
High risk	47.3 (87)	58.4 (128)	56.8 (71)	48.6 (67)	55.0 (77)	40.9 (70)	62.5 (145)	63.0 (75)	61.9(70)
P value	0.025[a]		0.363[b]			<0.001[c]		0.973[d]	<0.001[e]

Low risk: 0 behaviour risks present high risk: one or more behaviours present P value: [a] Pearson's chi square; [b] P value chi square for linear trend [c] Pearson's chi square: healthy vs undernourished; [d] Pearson's chi square: moderate vs severe; [e] Chi square for linear trend healthy compared to moderate, severely undernourished children * Undernourished children classified based on the seriousness of their condition

5.3 Discussion

Child eating and caregiver feeding behaviour play an important role in food intake, yet there is little information on eating and feeding behaviour in slum areas in Nairobi. Most of the studies assessing caregiver child interactions during meals are meal observation studies carried out in rural areas. We attempted to describe and quantify child eating behaviour and caregiver feeding behaviour and their associations with nutrition status using a structured interview guide that was initially developed, tested and used in the United Kingdom as a self-administered questionnaire. Assessment of mother child interactions during meals using interviews proved to be relatively successful. We were able to characterize and quantify different behaviours that reflect appetite and caregiver force-feeding. When assessing appetite, it was easier to measure food refusal than food acceptance. This was because of the ambiguous meaning of terms used to describe food acceptance as well as the possible influence of the caregiver on food acceptance. For example, a child who is easy to feed can either have a good appetite or is considered easy to feed because the caregiver uses excess pressure which limits opportunities for food refusal.

Self-feeding was generally low in this setting and compared to healthy children, undernourished children were more likely to have low interest in food and high food refusals. Their caregivers were also more likely to force feed them during meals. Caregivers were more likely to feed children meals regardless of their nutrition status, an indication that self-feeding during meals was generally low. However, during snacks children were given more autonomy. This is consistent with findings from the preliminary meal observations in Kenya as well as other studies meal observation studies in developing countries (Moore et al., 2006, Oni et al., 1991, Armar-Klemesu et al., 2000). In rural Bangladesh for example, only 26% (14/54) of children fed themselves three or more mouthfuls (Moore et al., 2006). Differences in caregiver feeding by type of meal offered was probably because children were more likely to be offered finger foods during snacks, while meals were more likely to be mashed foods that required spoon feeding (see Figure 2.7). Low self-feeding during meals might also have been because feeding the child reduces the time spent on feeding (Bentley et al., 1991a).

Older children were more likely to feed themselves regardless of the type of food offered, an indication that some caregivers followed child's development cues. Low self-feeding of snacks was an independent predictor of undernutrition and severity a possible indication that undernourished children were less likely to feed themselves either because they had poor appetite or because of delayed developmental milestones, but this was not assessed in the current study. Self-feeding during meals is associated with higher food acceptance and caregivers should be encouraged to provide more opportunities for self-feeding in this setting (Dearden et al., 2009). However, close supervision and assistance is required to ensure the child gets enough to eat, especially in cases where the child has poor appetite.

Compared to the Gateshead Millennium Study, children in the current study were more likely to show signs of food refusal during meals, regardless of their nutrition status. For example children in the current study were more likely turn away from food (44% v 81%), cry during meals (11% v 54%), hold food in their mouth (27% v 38%) and spit out food (54% v 65%) (Wright et al., 2006). This is a possible indication that poor appetite was universal in the current study.

Overall, undernourished children were more likely to have low interest in food and higher food refusal than healthy children. This is consistent with other studies which have attempted to measure appetite (Wright et al., 2006, Nti and Lartey, 2007). In the GMS study for example, appetite and food refusal were associated with weight gain at 12 months. Similarly, in an observation study in rural Ghana, 8 month old mildly undernourished children (mean WAZ -1.85±1.10) were more likely to have low interest in food (24% vs 3% P=0.05) and refuse food (17% vs 3% P=0.05) than healthy children (Nti and Lartey, 2007). In the Ghanaian study, undernutrition was defined based on the median WAZ and LAZ of the study population rather than the WHO definition but given low weight for age Z scores of children in the undernourished group, these findings were relatively comparable to ours. Although the terms used to describe appetite were similar, highly interested, disinterested and food refusal, the authors did not define actual behaviours observed (Nti and Lartey, 2007). In Nicaragua, demand for bottle feeds was positively associated with height for age and weight for age, a possible indication that children who were growing well had better appetite (Engle and Zeitlin, 1996).

Low interest in food and high food refusals in especially undernourished children in the current study can be explained by the presence of infections (Brown et al., 1990). Given

that environmental enteropathy might be prevalent in this setting, might also explain why poor appetite was also present in apparently healthy children. Micronutrient deficiencies can also lead to poor appetite and are also likely to be prevalent in this setting given monotonous diets offered (Ferguson et al., 2015).

Encouragement during meals in the GMS and in the current study was high and comparable (90% vs 92%). High encouragement during meals was also reported in a cross sectional study in rural Ethiopia, that assessed feeding styles using interviews. In Ethiopia, mothers were more likely to encourage their children to eat during meals than other caregivers who favoured laissez faire feeding (Wondafrash et al., 2012). It is possible that because majority of the respondents in the current study were the child's mothers, they were more likely to report high encouragement. These are inconsistent with findings from meal observations (see chapter 2) where caregivers offered little encouragement during meals. Possible reasons for these inconsistent results include reactivity, where caregivers changed their behaviour during meal observations. It is also possible that caregivers in the current study over reported this behaviour as other observation studies report low levels of encouragement during meals (Moore et al., 2006, Engle and Zeitlin, 1996, Armar-Klemesu et al., 2000). Meal observations should have been used to validate findings from interviews, but they were not a feasible data collection method.

Measurement of encouragement during meals appears to be a challenge as other studies report low internal consistency of measures used (Moore et al., 2006, Wright et al., 2006, Engle and Zeitlin, 1996). This was observed in the current study as encouragement during meals and offers something else to eat, weakly correlated with other caregiver behaviour. A small proportion of caregivers reported not offering encouragement during meals. Some of the reasons given for not doing so included: their perception that the child did not understand what was being said or that the child might associate encouragement with play and would in turn refuse to eat. Meal time provides a great opportunity for psychosocial stimulation and caregivers should be encouraged to make feeding situations more interactive and friendly (Engle, 1995, Sigman et al., 1988).

One third of the caregivers reported using force during meals, but there was no association between force-feeding and nutrition status. Regardless of the child's nutrition status, high force-feeding was associated with low interest in food and high food refusal, a possible indication that either caregivers are more likely to use force when the child is not eating

well or that caregivers force-feeding leads to food refusal. Similar findings have been reported by other studies (Nti and Lartey, 2007, Oni et al., 1991, Ha et al., 2002, Moore et al., 2006). In Ghana for example, mildly undernourished children were more likely to have low interest in food and their caregivers were more likely to force feed children during meals (Nti and Lartey, 2007). The atmosphere during meals in Ghana was described as non-cordial, an indication of just how hostile and stressful meals can be for both the caregiver and the child. This explains the relationship between interest in food, food refusal, force-feeding and maternal anxiety in the current study. Apart from food refusal, there is evidence to show that caregivers use force as a strategy to reduce time spent on feeding (Bentley et al., 1991a). There is therefore a need to consider time available for childcare practices when assessing caregiver child interactions during meals.

Although force-feeding is not considered an ideal feeding method, its effects on food intake might not always be negative (Ha et al., 2002). In the current study, when interest in food and food refusal were assessed by the degree of force-feeding, in the low force-feeding group, 20% of children showed signs of poor appetite. Low force-feeding in such a case could be a reflection of laissez faire feeding and one could argue that there is a missed opportunity to increase food intake. In cases where children have poor appetite, moderate force-feeding might be necessary to increase intake. Caregivers should also be taught how to monitor food intake which can be achieved by establishing a routine feeding environment (Bentley et al., 1995). They should also be encouraged to be on the lookout for changes in the infants eating habits and seek assistance from health-care providers (Bentley et al., 1995).

The complexity of measuring behaviour is demonstrated in the current study by the relatively strong correlation between eating and feeding behaviour variables as shown in Figure 5.1. It was difficult to distinguish individual contributions of each behaviour to the outcomes because the information provided by each variable overlapped with other covariates therefore leading to multicollinearity (Tu et al., 2005). Although all eating and feeding behaviours were correlated, causation cannot be inferred from this study because of the cross sectional and observational nature of the study.

Questions included in the interview guide were adapted from a questionnaire which was initially used in the United Kingdom and although they were modified and translated to suit the current setting, there is a need to assess the validity and reliability of questionnaire in a similar setting.

Child self-feeding in the current sample was low while poor appetite, high force-feeding and maternal anxiety were relatively common. All these behaviours have been shown to affect food intake. In order to improve child and caregiver interactions during meals, a better understanding of eating and feeding behaviour factors that influence them in this setting is required.

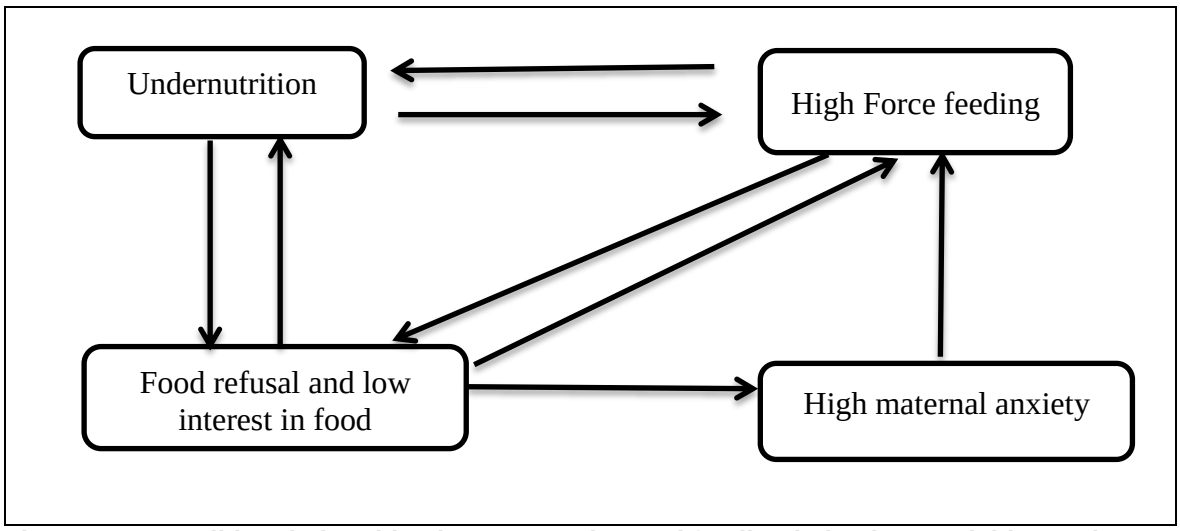


Figure 5.1: Possible relationships between eating and feeding behaviour variables and undernutrition

6 Childcare practices in undernourished children

This chapter provides a description of childcare practices in undernourished children as well the association between ready to use foods and eating and feeding behaviour and frequency. The rationale for this chapter is discussed in chapter 1. The following questions are addressed

1. Are risk factors specific to particular nutrition states?
2. Do ready to use foods affect the number of meals offered to children moderately undernourished children?
3. Do ready to use foods affect eating and feeding behaviour in moderately undernourished children?

The following hypothesis were tested

1. Children on treatment for moderate acute malnutrition are offered home foods at a lower frequency than those who are not on treatment
2. Moderately undernourished children on ready to use foods (RUF) show more interest in food during RUF meals than home meals

6.1 Methods

Undernourished children were classified by their weight for height and length for age Z scores in order to assess if risk factors were specific to particular nutrition state and if children who were both wasted and stunted were at greater risk. Wasting and stunting were defined as weight for length (WLZ) and length for age Z scores (LAZ) ≤-2SD respectively. The occurrence of both wasting and stunting in the same child was defined as a WLZ and LAZ ≤-2SD. These classifications were used to test for associations with risk factors described in chapter 4 and 5 and number and overlap of risk factors in undernourished children was also assessed. Children who were classified as underweight only (WAZ≤-2SD) were not included in this analysis because they had borderline measures for weight for length and length for age.

To assess the effects of RUF on feeding frequency, the distribution of the number of plated meals was assessed in moderately and severely undernourished children. Differences in eating and feeding behaviour during home meals and ready to use meals were assessed using the same behaviours described in chapter 5. Scores were used instead of categorical classifications in this analysis, first because of the relatively small sample size (n=90) and second because we wanted to assess the distribution of different behaviours based on the type of meal rather than overall behavioural risk. All behaviour analysis were done at child level, meaning differences in interest in food, food refusal and force-feeding behaviour were assessed within the same child during home meals and RUF. The Wilcoxon signed-rank test was used to test the level of significance for paired data because of the non-parametric nature of the data. This comparison was done based on severity due to expected differences in eating and feeding behaviour in moderate and severely undernourished children.

6.1.1.1 Modifiable risk factors for undernutrition

To determine the number of modifiable risk factors, all risk factors which had a direct impact on child nutrition status in this setting were counted. Risk factors included low maternal education, having more than one child under five years, single parent, lack of piped water in household, lack of hand washing at key times. Dietary practices included early introduction of complementary foods, not breastfeeding, low dietary diversity, low feeding frequency, moderate to low interest in food, moderate to high food refusal and moderate to high force-feeding.

The above risk factors were further classified into three categories reflecting level of intervention. Risk factors which had the potential to be modified by behaviour change interventions at facility level included handwashing practices, dietary diversity, meal frequency, interest in food, food refusal and force-feeding. Introduction of complementary foods, continued breastfeeding and number of children under five years were classified as interventions for future pregnancies, while maternal education, father absent and access to water and sanitation facilities were classified as interventions that required either a change of environment or community and national level interventions. Children with missing information for any of the variables were excluded because including them would create an impression that the child is exposed to few risk factors. The distribution of the number of risk factors was assessed by nutrition state.

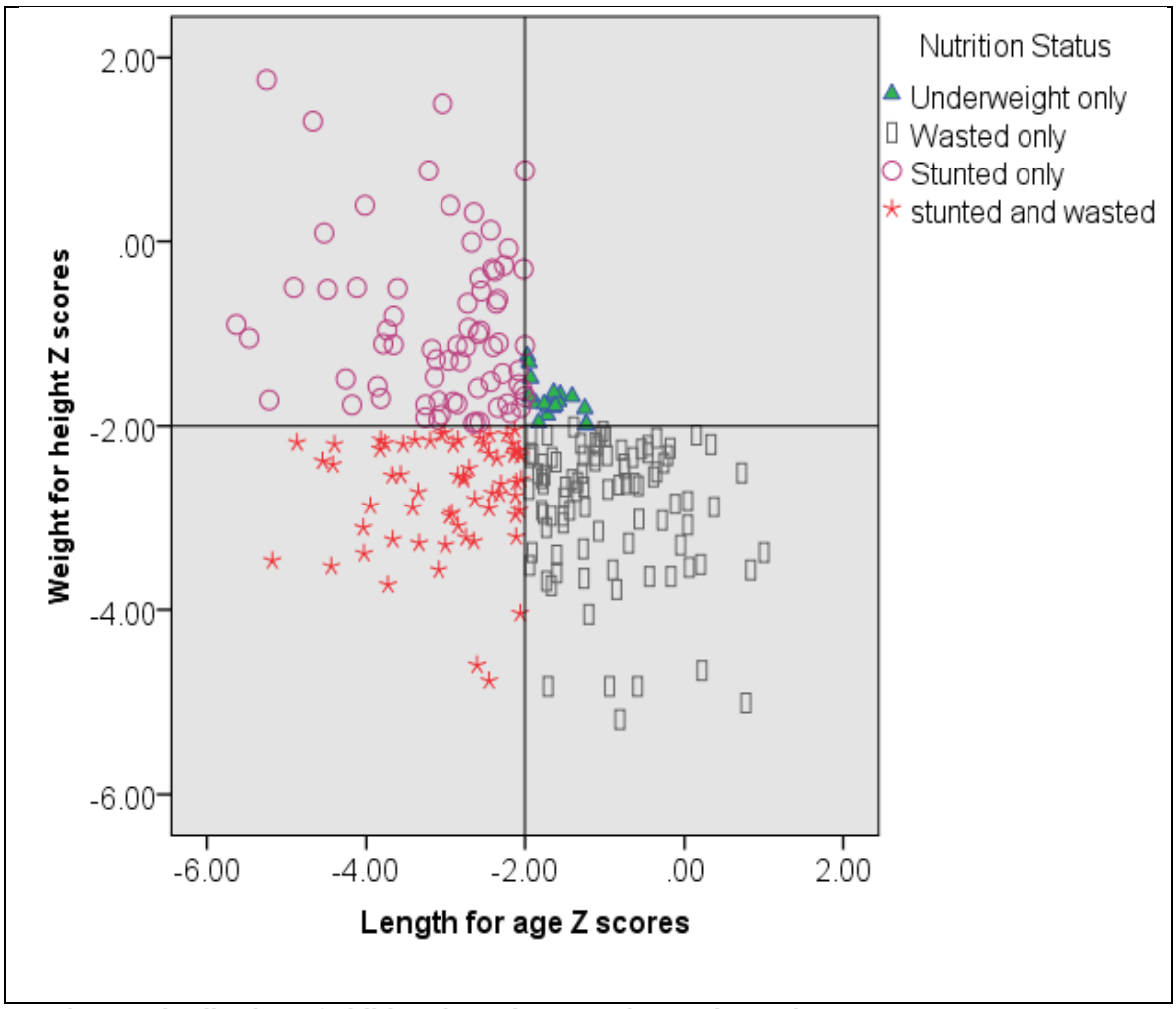
6.2 Results

Child characteristics are presented in Table 6.1. Children classified as underweight only had weight for age as the only measure below-2SD, their weight for height and length for age Z scores on the other hand were borderline (Graph 6.1). This group was therefore excluded from subsequent analysis assessing risk factors for wasting and stunting. During the first month of recruitment, RUF were out of stock in all health facilities and 44.4% (n=68) of children who were not on ready to use foods were recruited at this time. The rest, were newly diagnosed cases.

Table 6.1: Characteristics of undernourished children

Child characteristics	%	N
Gender		
Male	43.6	106
Age		
6-9 months	28.0	68
9-12 months	36.2	88
12-24 months	35.8	87
Severity		
Moderate	50.6	123
Severe	49.4	120
Nutrition status		
Underweight only	7.4	18
Wasted only	37.9	92
Stunted only	28.8	70
Wasted and stunted	25.9	63
Treatment status		
On RUF	37.0	90
Home diet	63.0	153

n=243



Graph 6.1: Distribution of children based on wasting and stunting status

6.2.1 Anthropometric characteristics

Male children had lower weight for age (<0.001), length for age (P=0.007) and MUAC (0.002) Z scores than female children (Table 6.2). There was however no gender difference in weight for height Z scores. Similarly, there were no age differences in the distribution of weight for age, weight for height, length for age and MUAC Z scores (Table 6.2).

Table 6.2: Age and gender differences in anthropometric measurements in undernourished children

	Overall	**Gender**		**Age in months**		
Child characteristics		Male (n=106)	Female (n=137)	6-9 (n=62)	9-12 (n=82)	12-24 (n=80)
Age	10.1 [8.90 to 14.7]	10.1 [9.01 to 15.5]	10.3 [8.71 to 14.3]			
Anthropometry						
Weight	6.60 [6.00 to 7.10]	6.80 [6.30 to 7.50]	6.40 [5.90 to 7.00]	6.00 [5.58 to 6.40]	6.50[6.10 to 6.90]	7.20 [6.90 to 7.80]
Length	68.4 [65.5 to 72.0]	69.1 [66.1 to 72.9]	68.0 [65.0 to 71.9]	65.5 [63.1 to 67.9]	67.5 [65.6 to 69.3]	72.9 [70.0 to 75.8]
MUAC	12.1 [11.6 to 12.6]	12.1 [11.8 to 12.8]	12.0[11.5 to 12.5]	11.9 [11.4 to 12.4]	12.0 [11.8 to 12.6]	12.3 [11.9 to 12.9]
Z scores						
Weight for age	-2.75 [-3.28 to -2.20]	**-2.91 [-3.55 to -2.44]**	**-2.53 [-3.12 to -2.13]**	-2.54 [-3.22 to -2.11]	-2.73[-3.17 to -2.19]	-2.87 [-3.41 to -2.25]
Weight for length	-2.26 [-2.87 to -1.70]	-2.34 [-3.06 to -1.76]	-2.21 [-2.66 to -1.67]	-2.31 [-2.78 to -1.80]	-2.20 [-2.71 to -1.73]	-2.30 [-3.03 to -1.57]
Length for age	-2.08 [-2.90 to -1.28]	**-2.24 [-3.28 to -1.58]**	**-1.95 [-2.66 to -1.16]**	-2.00 [-2.61 to -0.81]	-2.04 [-2.93 to -1.31]	-2.26 [-3.14 to -1.60]
MUAC	-2.16 [-2.65 to -1.57]	**-2.34 [-2.79 to-1.73]**	**-1.97 [-2.50 to -1.44]**	-2.45 [-2.93 to -1.57]	-2.05 [-2.49 to -1.58]	-2.16 [-2.65 to -1.55]

Values: median [Interquartile range]; P value: Man u Whitney test; Bold values P<0.05

6.2.1.1 Association between nutrition state and socio economic characteristics

Associations between nutrition state and socio economic characteristics are presented in Table 6.3. Compared to children who were wasted only (WLZ≤-2SD), children who were both wasted and stunted were more likely to be severely undernourished (P=0.001) and their mothers were more likely to be older (P=0.030). Although they also had more children, this difference was not statistically significant (P=0.064). There was no association between nutrition state, presence of the father, education level and the number of children under 5 years (Table 6.3).

Compared to children who were wasted only, children who were both wasted and stunted were more likely to live in semi-permanent houses (P=0.002). Their caregivers were also less likely to own television sets (P=0.013). There was no association between nutrition state, number of rooms in house, house ownership and ownership of cars, motorcycles, bicycles, refrigerators, radios and mobile phones (Table 6.4).

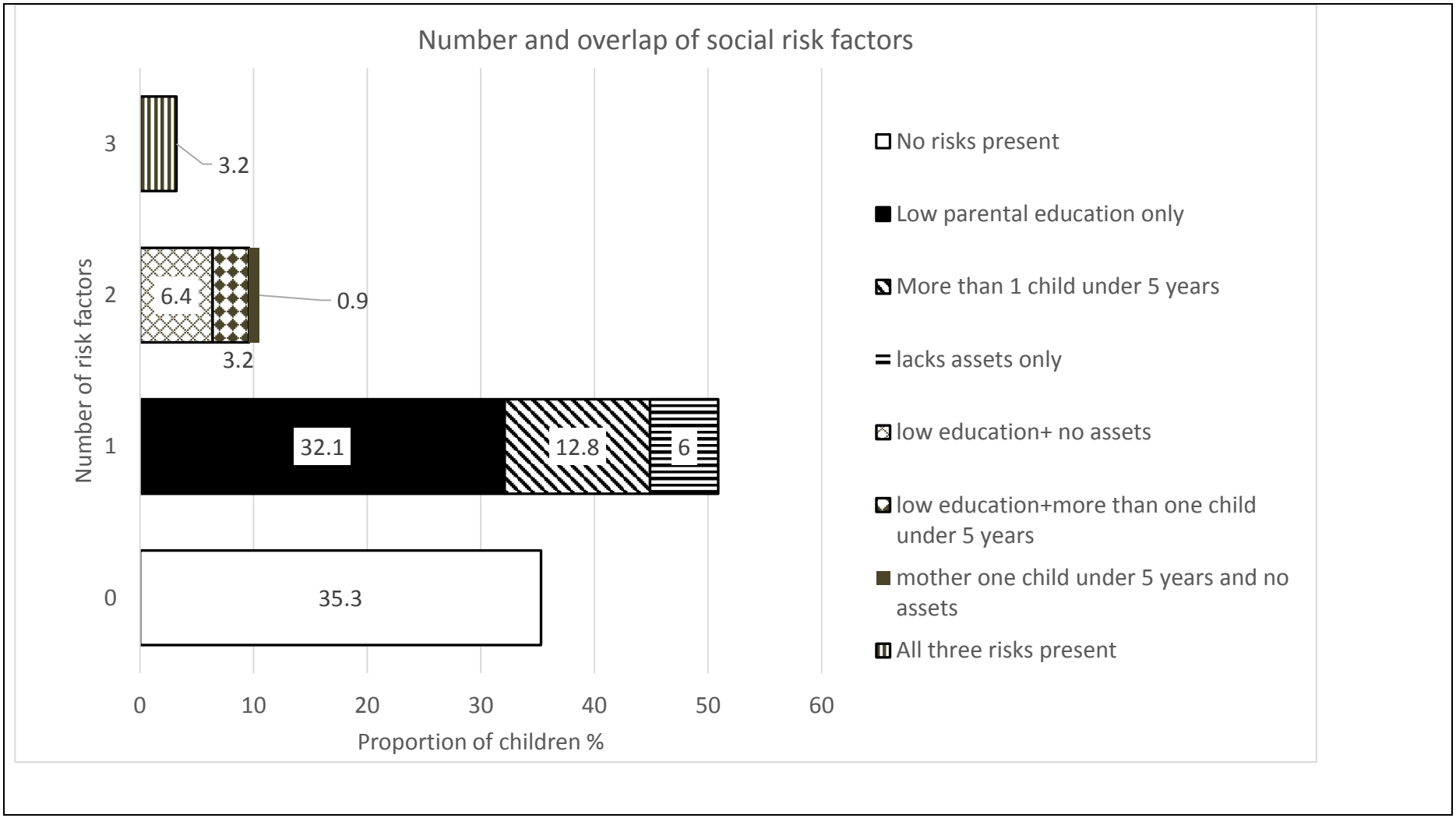
The number and type of social risks are presented in Graph 6.2. One third of undernourished children came from low social risk households, meaning parents were educated, they had only one child under the age of 5 years and they owned either a TV or a radio. Low education was the most common reported social risk (Graph 6.2).

Table 6.3: Association between nutrition state and socio economic characteristics

Household characteristics	Wasted (n= 92)	Stunted (n=70)	Wasted and stunted (n=63)
	% (n)	% (n)	% (n)
Father present (n=202)			
No contact	12.0 (11)	7.1 (5)	14.3 (9)
P value	0.752		
Education level			
Caregiver (N=235)			
Primary	59.8 (55)	52.9 (37)	53.2 (33)
Secondary and higher	40.2 (37)	47.1 (33)	46.8 (29)
P value	0.388		
Spouse (N= 187)			
Primary	26.0 (20)	30.5 (18)	33.3 (17)
Secondary and higher	74.0 (57)	69.5(41)	66.7(34)
P value	0.362		
Number of children under 5			
More than one	27.2(25)	27.1(19)	33.3 (21)
P value	0.433		
Age in years			
Caregiver (n=)	25[22 to 28]	26[23 to30]	27[24 to 32]
P value	0.030		
Spouse (n=)	30[27 to 33]	30[27 to 35]	30.5[27 to 34]
P value	0.778		
Family characteristics			
Number of children	1[1 to2]	2[1 to2]	2[1 to3]
P value	0.064		
Construction			
Semi-permanent	31.5 (29)	42.9 (30)	57.1 (36)
P value	0.002		
Number of rooms			
Single room	71.7 (66)	72.9 (51)	77.8 (49)
P value	0.418		
House ownership			
Rented	98.9 (91)	98.6 (69)	100.0 (63)
P value	0.521		
Ownership of household goods			
Car	3.3 (3)	0	1.6 (1)
Motorcycle	4.3 (4)	5.7 (4)	3.2 (2)
Bicycle	3.3 (3)	10.0 (7)	9.5 (6)
Refrigerator	9.8 (9)	4.3 (3)	3.2(2)
Television	78.3 (72)	61.4 (43)	60.3 (38)
	0.013		
Radio	70.7(65)	74.3%(52)	71.4(45)
Mobile phone	97.8 (90)	94.3 (66)	92.1 (58)

P value: chi square for trend; Wasted: weight for length ≤-2SD Stunted: length for age ≤-2SD

Wasted and stunted: Weight for length and length for age ≤-2SD



Graph 6.2: Number and type of social risk factors in undernourished children

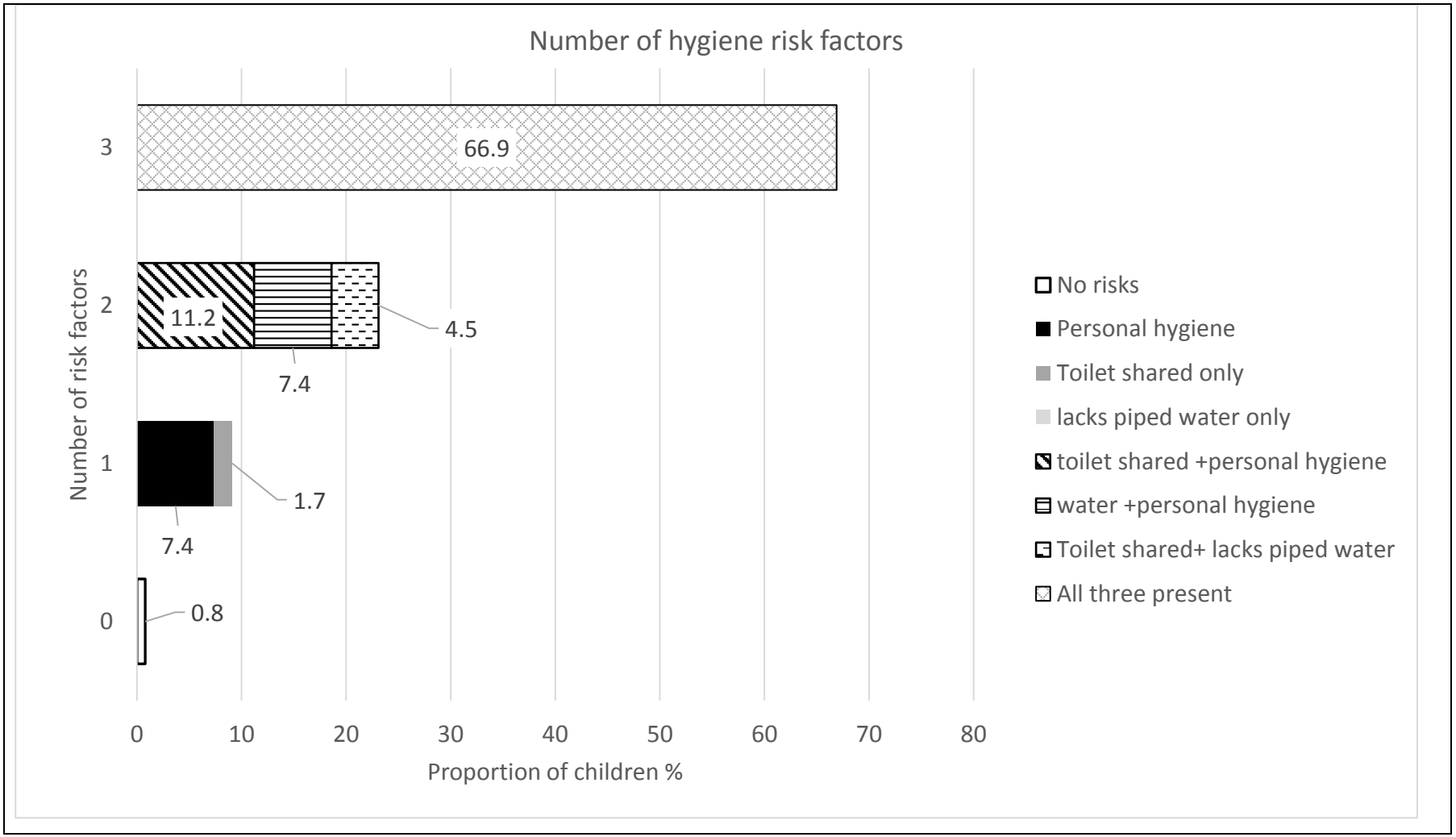
6.2.1.2 Association between nutrition state and hygiene practices and facilities

There was no association between nutrition state and hygiene characteristics (Table 6.4). The number and type of hygiene risks are presented on Graph 6.3. Over half the children (67%) lacked all three measures of hygiene risk and only 2 children were at low risk meaning they came from homes that had piped water and the caregivers had good personal hygiene (Graph 6.3).

Table 6.4: Association between nutrition state and hygiene practices and facilities

Hygiene practices	**Wasted (n=92)**	**Stunted (n=70)**	**Wasted&stunted (n=63)**
	% (n)	**% (n)**	**% (n)**
Washes child's hands with soap before feeding			
Not at all	31.9(29)	42.0 (29)	34.9 (22)
Sometimes	22.0 (20)	21.7 (15)	23.8 (15)
All the time	46.1 (42)	36.3 (25)	41.3 (26)
P value	0.495		
Personal hygiene risk			
Low (0-1)	28.6 (26)	32.9 (23)	25.4 (16)
Borderline (2)	38.4 (35)	38.6 (27)	44.4 (28)
High (3-4)	33.0 (30)	28.4 (20)	30.2 (19)
P value	0.958		
Water for household			
Piped into house	23.9 (22)	20.0 (14)	14.3 (9)
Public tap	76.1 (70)	80.0 (56)	85.7 (54)
P value	0.144		
Toilet type			
Flush toilet	17.4 (16)	18.6 (13)	6.3 (4)
Latrine	82.6 (76)	81.4 (57)	93.7 (59)
P value	0.076		
Toilet ownership			
Owned by family	19.6 (18)	15.7(11)	9.5 (6)
Shared	80.4(74)	84.3(59)	90.5 (57)
P value	0.094		
Pay for toilet			
Yes	8.7 (8)	17.1(12)	17.5 (11)
No	91.3 (84)	82.9 (58)	82.5 (52)
P value	0.100		
Garbage Disposal			
Collected by private firm	90.2 (83)	81.4 (57)	82.5(52)
Other	9.8 (9)	18.6(13)	17.5 (11)
P value	0.152		

P value: chi square for linear trend: wasted vs stunted vs wasted and stunted



Graph 6.3: Number and overlap of hygiene risk factors in undernourished children

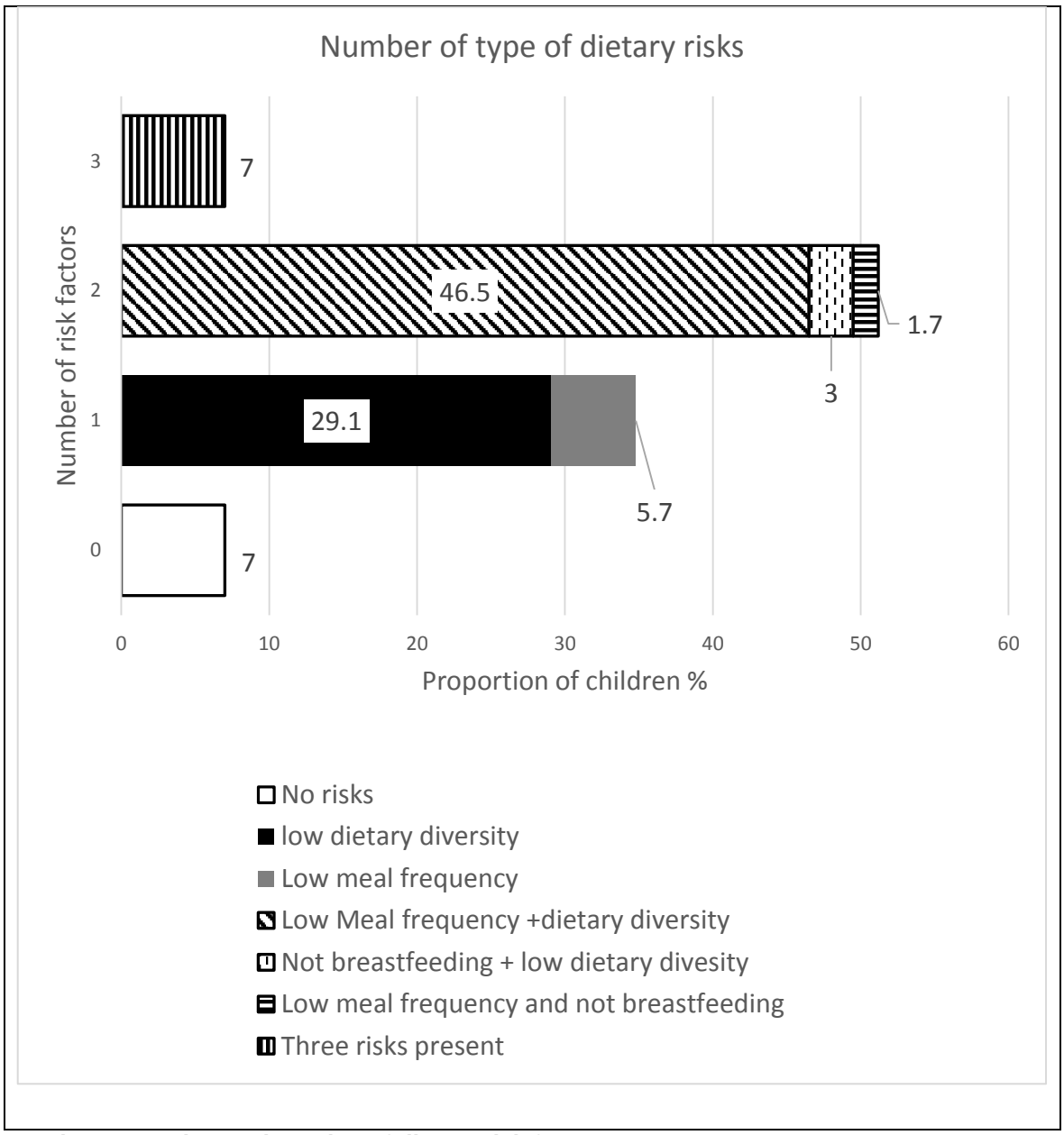
6.2.1.3 Association between breastfeeding, complementary feeding practices, dietary diversity and nutrition state

There was no association between nutrition state and breastfeeding practices, dietary diversity and feeding frequency (Table 6.5). The number and overlap of dietary risk factors are presented in Graph 6.4 Nearly all children were exposed to one or more dietary risks, a large proportion of whom (47%) had low feeding frequency and low dietary diversity (Graph 6.4).

Table 6.5: Association between nutrition state and breastfeeding and complementary feeding practices

	Wasted (n=92)	**Stunted (n=70)**	**Wasted and stunted (n=63)**
Breastfeeding frequency			
Not breastfeeding	8.7 (8)	12.9 (9)	12.7 (8)
Less than 3 feeds	12.0 (11)	7.1 (5)	15.9 (10)
More than 3 feeds	79.3 (73)	80.0 (56)	71.4 (45)
P value	0.285		
Complementary feeding			
Below 6 months	25.0 (23)	23.2 (16)	29.5 (18)
6 months and above	75.0 (69)	76.8 (53)	70.5 (43)
P value	0.579		
Dietary diversity (n=217)	(n=88)	(n=69)	(n=60)
Meets recommendation	17.0 (15)	10.1 (7)	13.3 (8)
Does not meet recommendation	44.3 (39)	47.8 (33)	38.3 (23)
Low diversity	38.6 (34)	42.0 (26)	48.3 (29)
P value	0.231		
Plated foods (n=219)	(n=91)	(n=68)	(n=60)
Low	25.3 (23)	25.0 (17)	28.3 (17)
Borderline	38.5 (35)	35.3 (24)	33.3 (20)
Meets recommendation	36.3 (33)	39.7 (27)	38.3(23)
P value	0.973		
Median	2[1 to2]	2[1 to3]	2[1 to3]
P value	0.615		
Finger foods (n=218)	(n=90)		
Low	48.9 (44)	57.4 (39)	50.0 (30)
Meets recommendation	51.1 (46)	42.6 (29)	50.0 (30)
P value	0.798		
Median	1[0 to1]	0[0to1]	0[0to1]
P value	0.610		
Family solids (n=219)			
Low	38.5 (35)	45.6 (31)	40.0 (24)
Borderline	37.4 (34)	27.9 (19)	26.7 (16)
Meets recommendation	24.2 (22)	26.5 (18)	33.3 (20)
P value	0.631		
Median	2[2 to3]	3[2 to3]	3[2 to 3]
P value	0.958		

P value: chi square for linear trend



Graph 6.4: Number and overlap of dietary risk factors

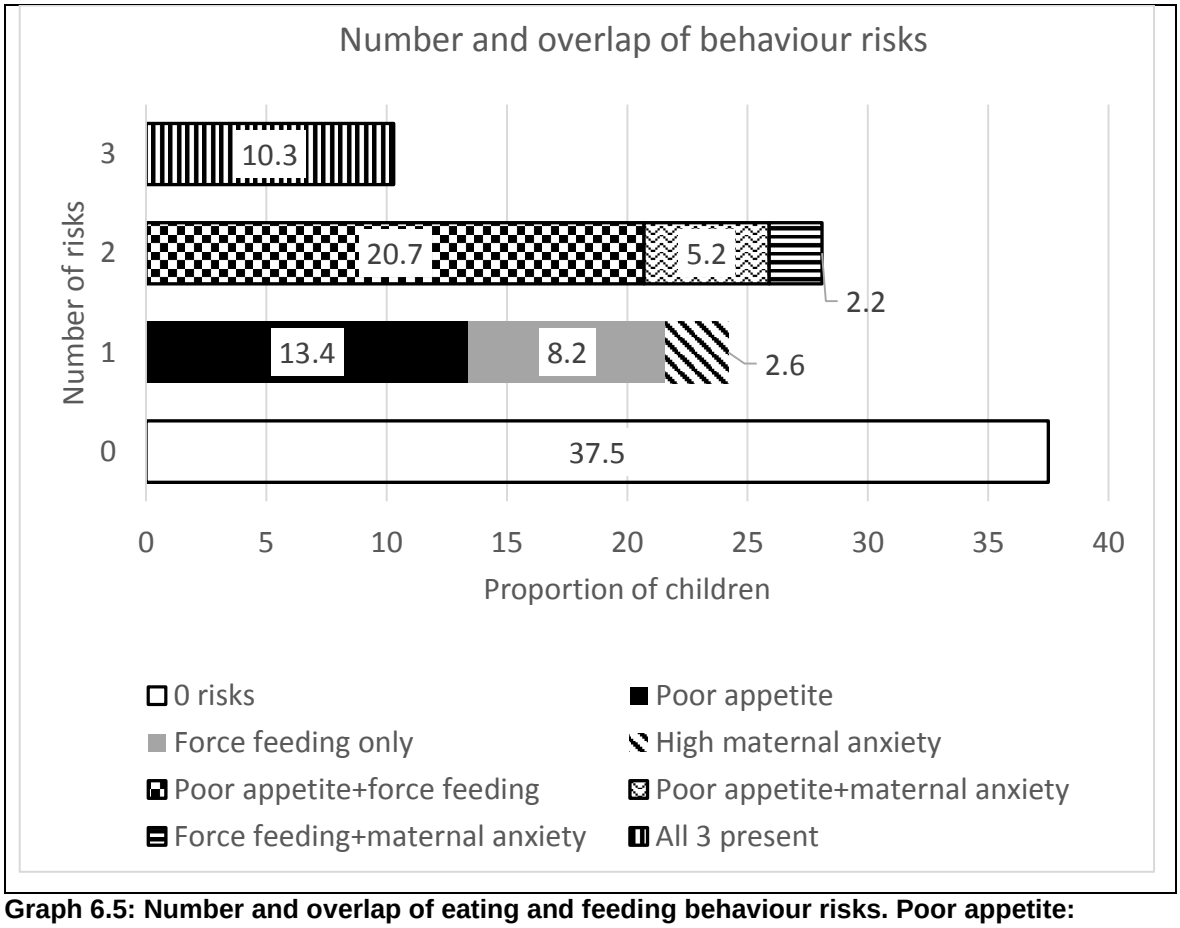
6.2.1.4 Association between eating and feeding behaviour and nutrition state

There was no association between nutrition state, interest in food and food refusal and maternal force-feeding (Table 6.6). There was no association behaviour risk and nutrition state. Graph 6.5 shows the number of overlap of eating and feeding behaviour risks. Three quarters of children had one or more behaviour risks. The most common combination was low interest in food and high force-feeding (Graph 6.5).

Table 6.6: Association between nutrition state and eating and feeding behaviour

	Wasted (n=92)	Stunted (n=70)	Wasted and stunted (n=63)
	% (n)	% (n)	% (n)
Interest in food			
Low	31.5 (29)	25.7 (18)	38.1 (24)
Moderate	46.7 (43)	40.0 (28)	41.3 (26)
High	21.7 (20)	34.3 (24)	20.6 (13)
P value [β]	0.681		
Refusal			
Low	35.9 (33)	42.9 (30)	36.5 (23)
Moderate	32.6 (30)	37.1 (26)	23.8 (15)
High	31.5 (29)	20.0 (14)	39.7 (25)
P value	0.717		
Force-feeding			
Low	57.6 (53)	58.6 (41)	55.6 (35)
Moderate	26.1 (24)	28.6 (20)	22.5 (14)
High	16.3 (15)	12.9 (9)	22.2 (14)
P value	0.574		
Maternal anxiety			
Low	44.6 (41)	58.6 (41)	41.3 (26)
Moderate	35.9 (33)	21.4 (15)	42.9 (27)
High	19.6 (18)	20.0 (14)	15.9 (10)
P value	0.873		

P value: chi square for linear trend



Graph 6.5: Number and overlap of eating and feeding behaviour risks. Poor appetite: children with either high food refusal, low interest in food or both

6.2.1.5 Association between nutrition state and summary of risk factors

There was no association between social, hygiene, dietary, behaviour risk and nutrition state (Table 6.7).

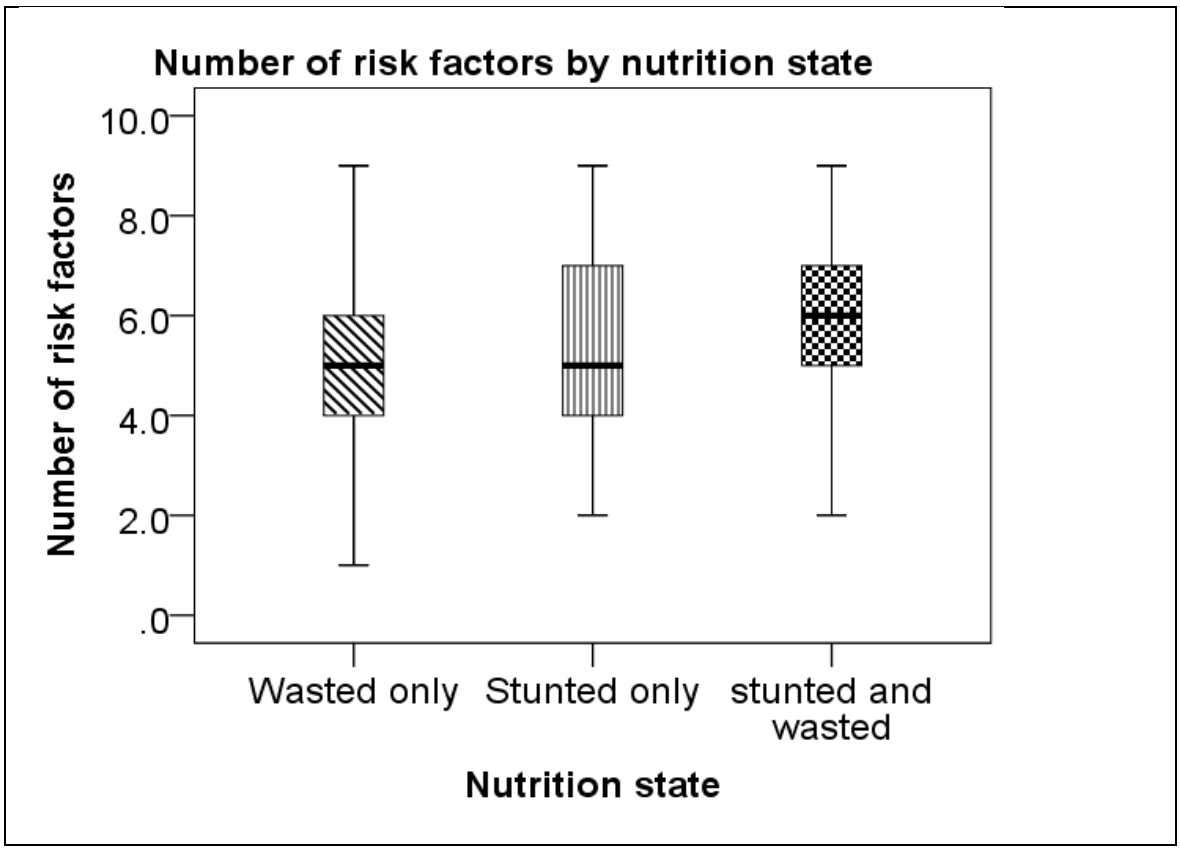
Table 6.7: Association between nutrition state and socio economic characteristics

	Wasted (n=92)	Stunted (n=70)	Wasted and stunted (n=63)
	% (n)	% (n)	% (n)
Social risk factors			
Low risk (0-1 risks)	35.9 (33)	32.9(23)	22.6(14)
High risk (3-4 risks)	64.1 (59)	57.1 (47)	77.4(48)
P value	0.091		
Hygiene risks			
Low risk (0-1 risks)	18.7 (17)	18.6 (13)	7.9 (5)
Borderline 2 risks	30.8 (28)	21.4 (15)	31.7 (20)
High risk (3-4 risks)	50.5 (46)	60.0 (42)	60.3 (38)
P value	0.093		
Dietary risks			
Low risk (0-1 risks)	44.3 (39)	40.3 (27)	36.8 (21)
High risk (3-4 risks)	55.7 (49)	59.7 (40)	63.2 (36)
P value	0.366		
Behaviour risk			
Low risk (0 risks)	38.6 (34)	44.6 (29)	32.8 (20)
High risk (1-3 risks)	61.4 (54)	55.4 (36)	67.2 (41)
P value	0.549		

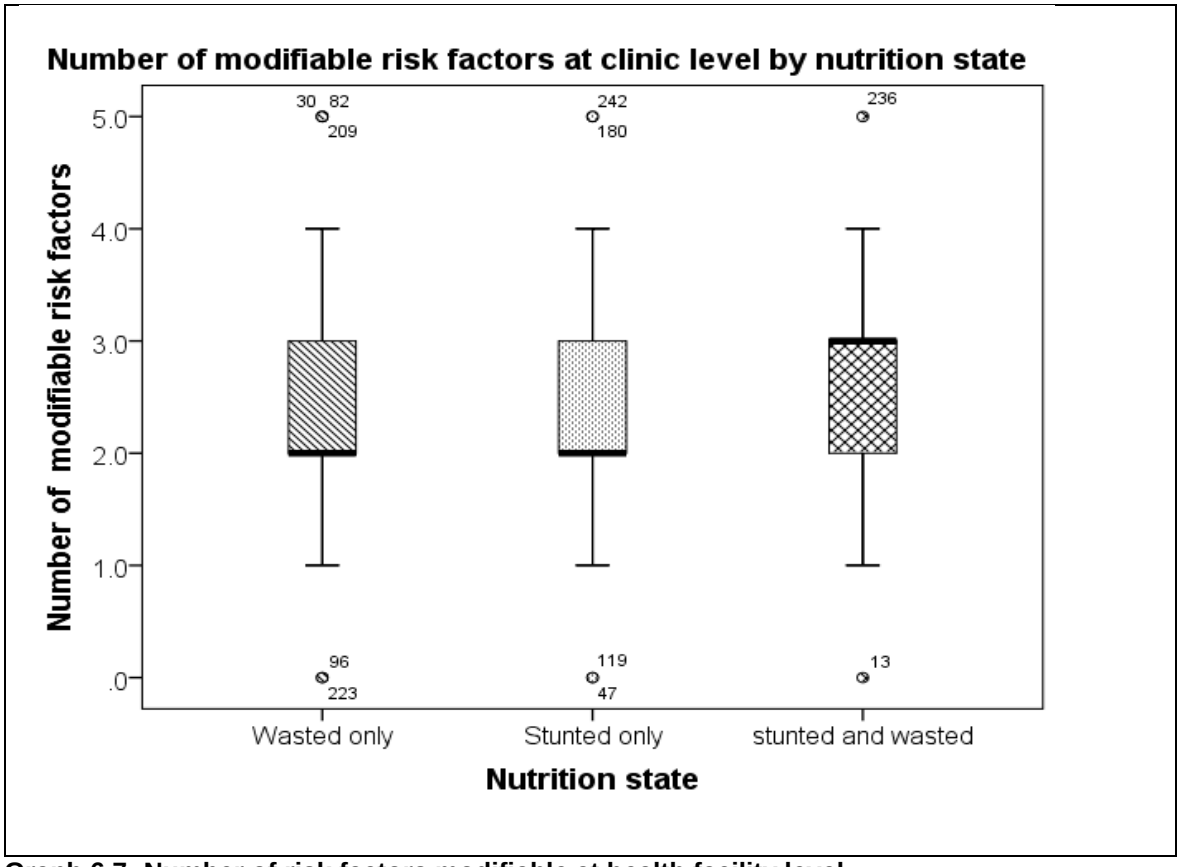
P value: chi square for linear trend;

6.2.2 Number of modifiable risk factors in undernourished children

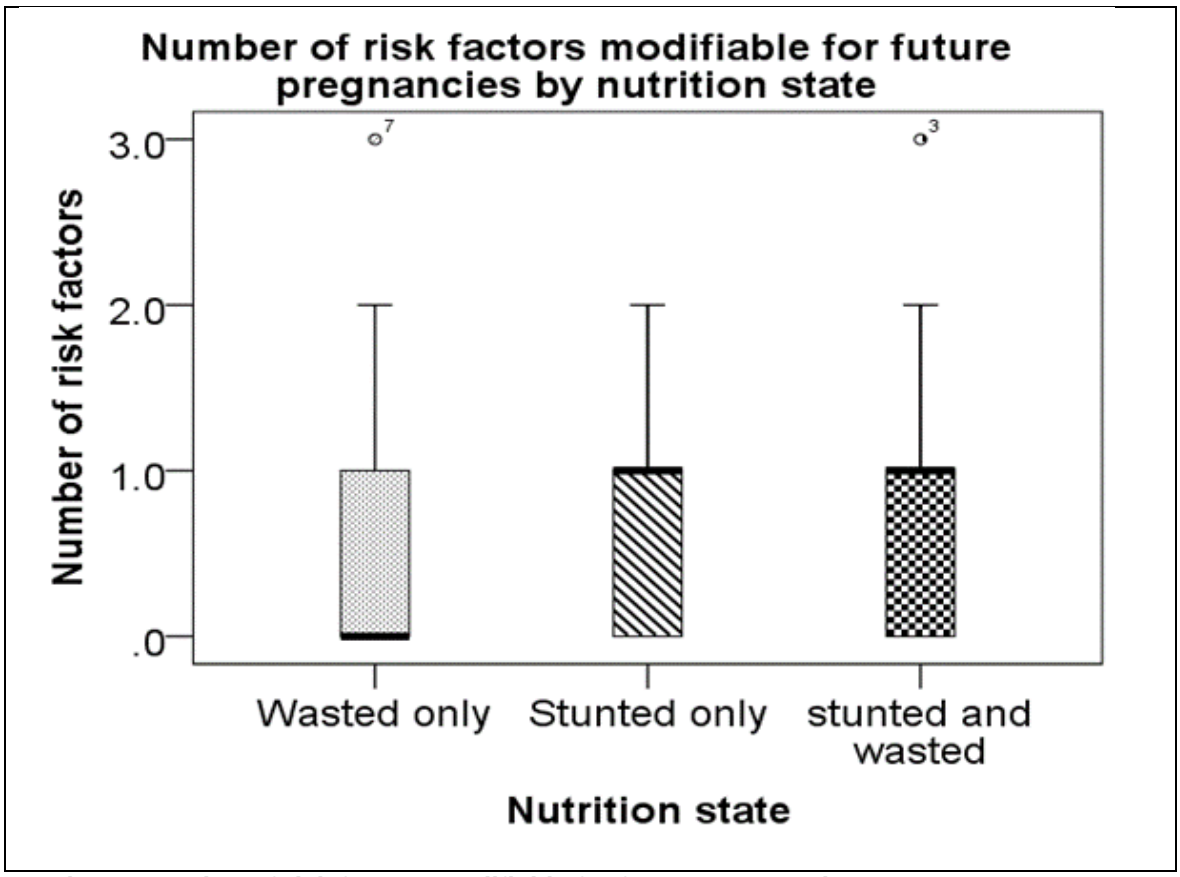
The distribution of the number of risk factors by nutrition state is shown in the graphs below. Nine children had incomplete information and were therefore excluded when assessing the number of risk factors. Compared to children who were wasted only, the distribution of risk factors among children who were stunted and children who were both wasted and stunted was on the higher side (5[4 to 6] vs 5[4 to 7] vs 6[5 to 7] Kruskal Wallis P=0.031) (Graph 6.6). Similarly, the distribution of risk factors modifiable by change of environment was on the higher side in children who were stunted only and those who were both wasted and stunted (P=0.036) (Graph 6.9). There was however, no significant difference in the distribution of the number of risk factors modifiable at health facility level and for future pregnancies although children who were both wasted and stunted had higher median values (Graph 6.7 and Graph 6.8).



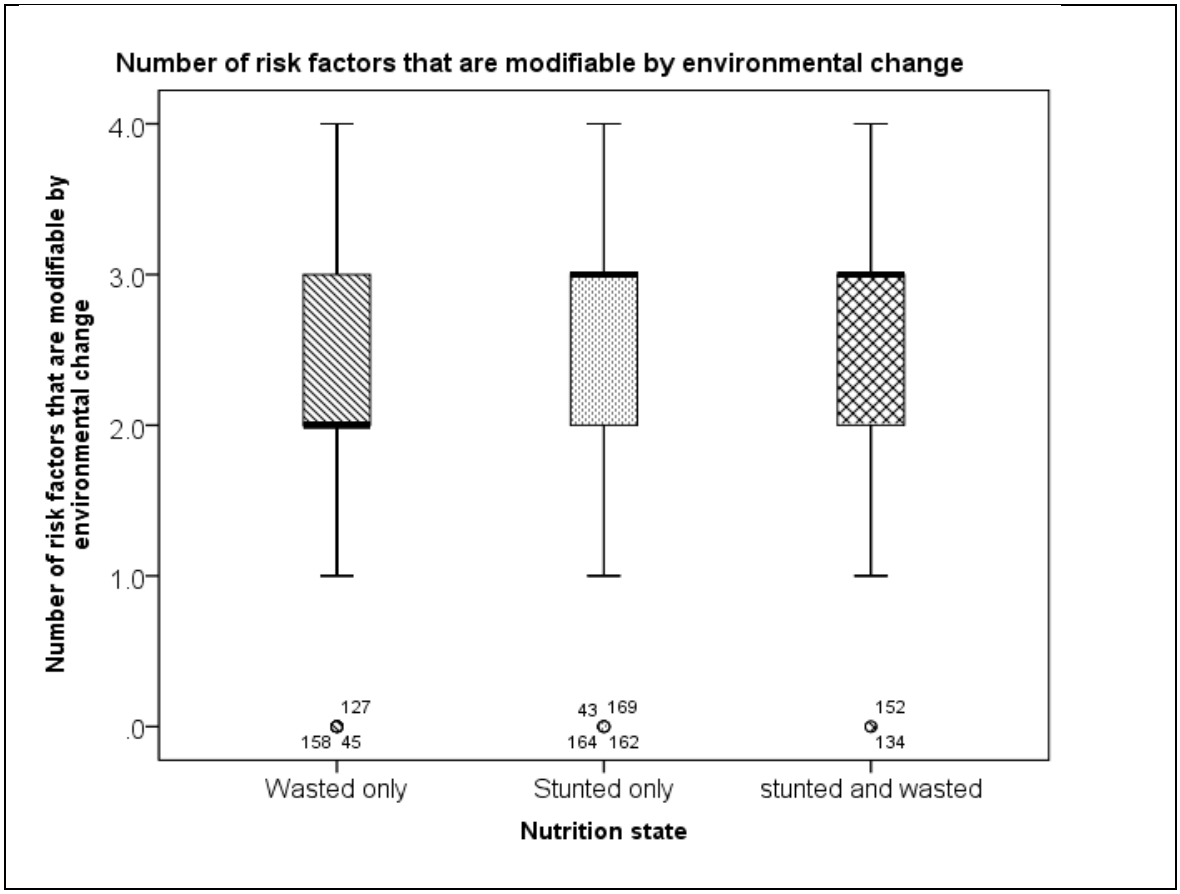
Graph 6.6: Number of risk factors modifiable



Graph 6.7: Number of risk factors modifiable at health facility level



Graph 6.8: Number of risk factors modifiable for future pregnancies



Graph 6.9: Number of risk factors modifiable by change of environment

6.3 Ready to use foods, feeding frequency and eating and feeding behaviour

This section focuses on ready to use foods. It provides a description of

1. Characteristics of undernourished children on supplements
2. Types of supplements offered
3. Effects of supplements on feeding frequency and eating behaviour

Information on the type, dose and serving of RUF is presented in Table 6.8. Ready to use therapeutic foods were manufactured by either Instapaste or USAID whereas RUSF was manufactured by Nutriset. Half the children were fed supplements from a cup/bowl with a spoon rather from the packet. A small proportion of caregivers (10%) reported squeezing the supplement from the packet on to their finger and then feeding the child with their finger. Half the caregivers reported mixing the supplement with either water, porridge or food (Table 6.8).

Table 6.8: Characteristics of supplements meals

Characteristic	%	n
Type of supplement		
RUTF	57.8	52
RUSF	42.2	38
Dose offered per day		
500kcal (1 sachet)	32.2	29
1000kcal (2 sachets)	20.0	18
1250 kcal (2.5 sachets)	38.9	35
1500kcal (3 sachets)	8.9	8
Supplement offered		
Direct from packet	38.9	35
Using finger from packet	10.0	9
From a cup/bowl using a spoon	51.1	46
Supplement served		
Diluted always	7.8	7
Diluted sometimes	2.2	2
Added to food always	27.8	25
Added to food sometimes	6.7	6
Unchanged	55.6	50
Sharing		
Shared	15.9	14
Not shared	84.1	74

n=90

6.3.1 Ready to use foods and plated food frequency

There is no formal recommendation on the quantity of RUF that should be offered moderately undernourished children but overall, treatment is supposed to include home foods (WHO, 2012). Severely undernourished children on the other hand are supposed to receive RUF exclusively with the exception of breastmilk which should be offered on demand and water, which should be offered at regular intervals (Kenya Ministry of Medical Services and Ministry of Public Health and Sanitation, 2010). We hypothesized that children on treatment for MAM are offered plated meals at a lower frequency than children who are not on treatment. To test this hypothesis, children were first classified by the study's definition of moderate (WAZ/WLZ/LAZ between ≤-2SD and ≥-3SD) and severe undernutrition (WAZ/WLZ/ LAZ ≤-3SD). However, the treatment offered did not match the severity classification used. Close to one third of children classified as moderately undernourished were receiving treatment for severe undernutrition (two or more sachets of RUF) and close to half the children classified as severely undernourished were on treatment for moderate undernutrition (Table 6.9). Overall one third of children were misclassified.

To assess if the type of treatment offered was based on the WHO classification for moderate (WLZ or MUAC of between <-2SD and -3SD) and severe undernutrition (WLZ or MUAC of between < -3SD) which is meant to be in use in the health facilities, children were also classified based on their weight for length and MUAC measurements. Interestingly, 8.9 % (8) of the children did not meet the criteria for severity, meaning they had WLZ>-2SD and or MUAC >12.5cm. Among children receiving treatment for moderate malnutrition half (62.1%) were moderately undernourished based on WHO standard and less than half (59.0%) the children on treatment for severe acute malnutrition were classified as severely undernourished based on WHO standard (Table 6.9). The current study's definition of severity appeared to be relatively more accurate in classifying children was therefore used in the analysis. The distribution of the number of plated meals was assessed by the number RUF offered in moderate and severely undernourished children.

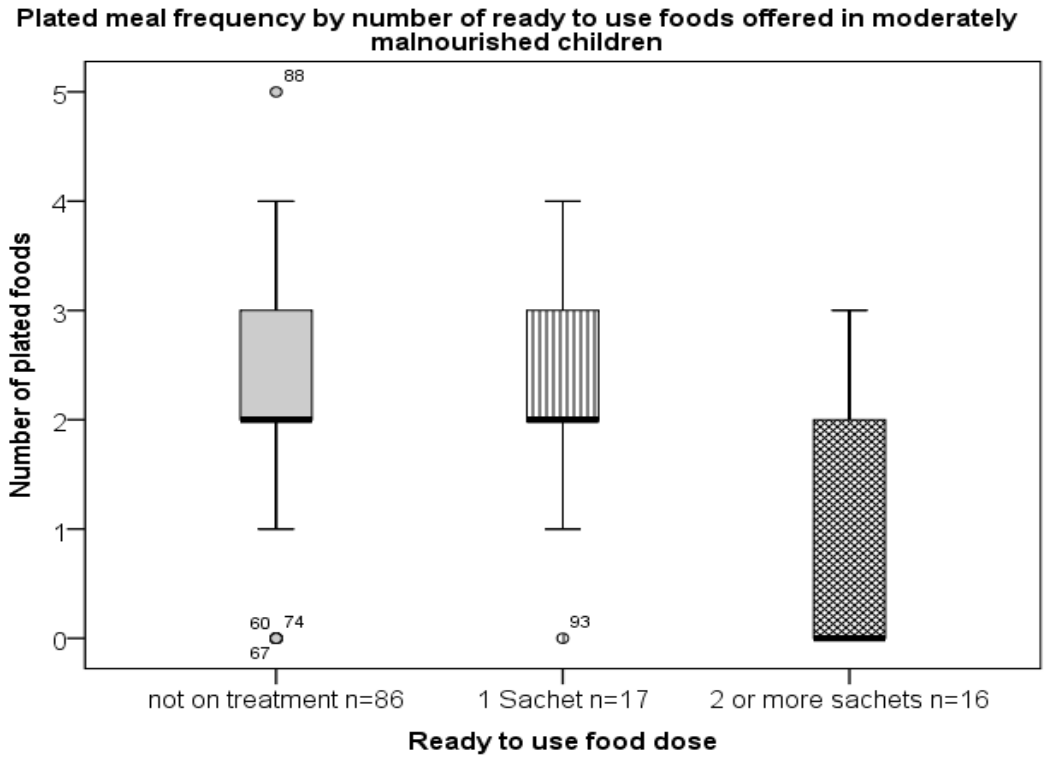
Table 6.9: Classification of children based on the current study and WHO definitions of moderate and severe malnutrition and treatment offered

	Treatment offered	
	Moderate (n= 29)	Severe (n=61)
Current study classification		
Moderate	**58.6 (17)**	26.2 (16)
Severe	41.4 (12)	**73.8 (45)**
WHO classification*		
Moderate	**62.1 (18)**	34.4 (21)
Severe	24.1 (7)	**59.0 (36)**
Neither¥	13.8 (4)	6.6 (4)

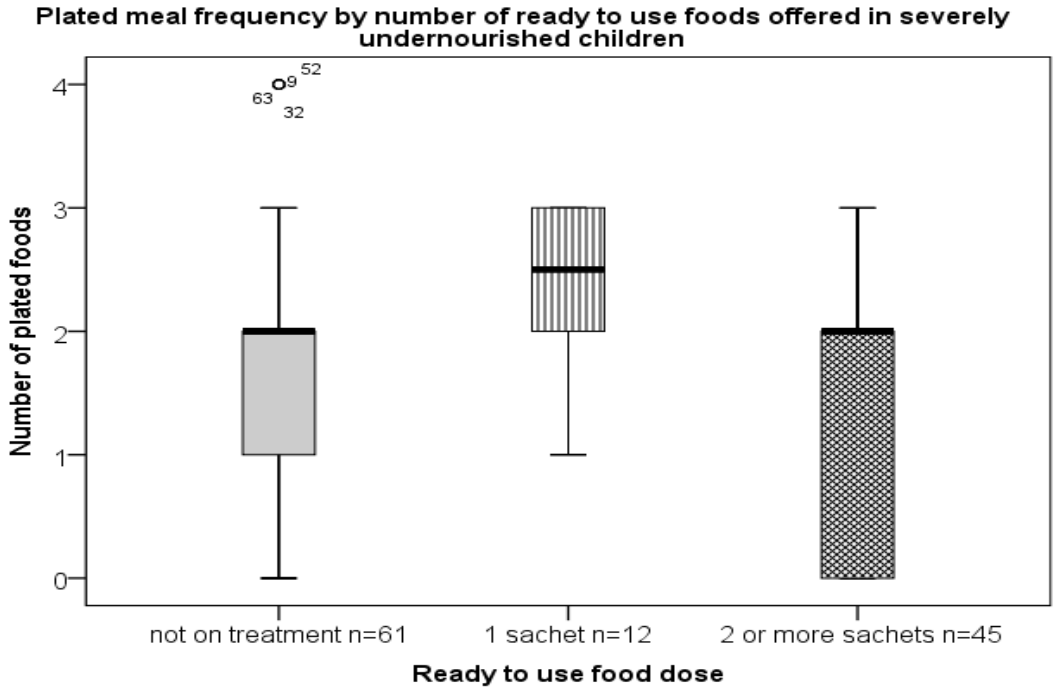
*Either low MUAC or WLZ ¥: MUAC>12.5 cm or WLZ>-2SD; Moderate: 1 sachet of RUF; Severe: 2 or more sachets

The number of plated meals offered in moderate and severely undernourished are presented in Graph 6.10 and Graph 6.11 respectively. In the moderate group, children not on treatment and children on 1 sachet were offered plated meals at the same frequency median [interquartile range] 2[2 to 3] while children receiving more than one sachet of RUF were offered plated meals at a lower frequency 0[0 to 2] (P=0.001 Kruskall Wallis). In the severe group, children who were not on treatment were offered plated meals at a lower frequency than those on 1 sachet of RUF 2[1 to 2] vs 3[2 to 3]. However, their median plated meal frequency was the same as children on more than one sachet of RUF although the distribution of plated meals in this group was on the low side 2[1 to 2] vs 2[0 to 2].

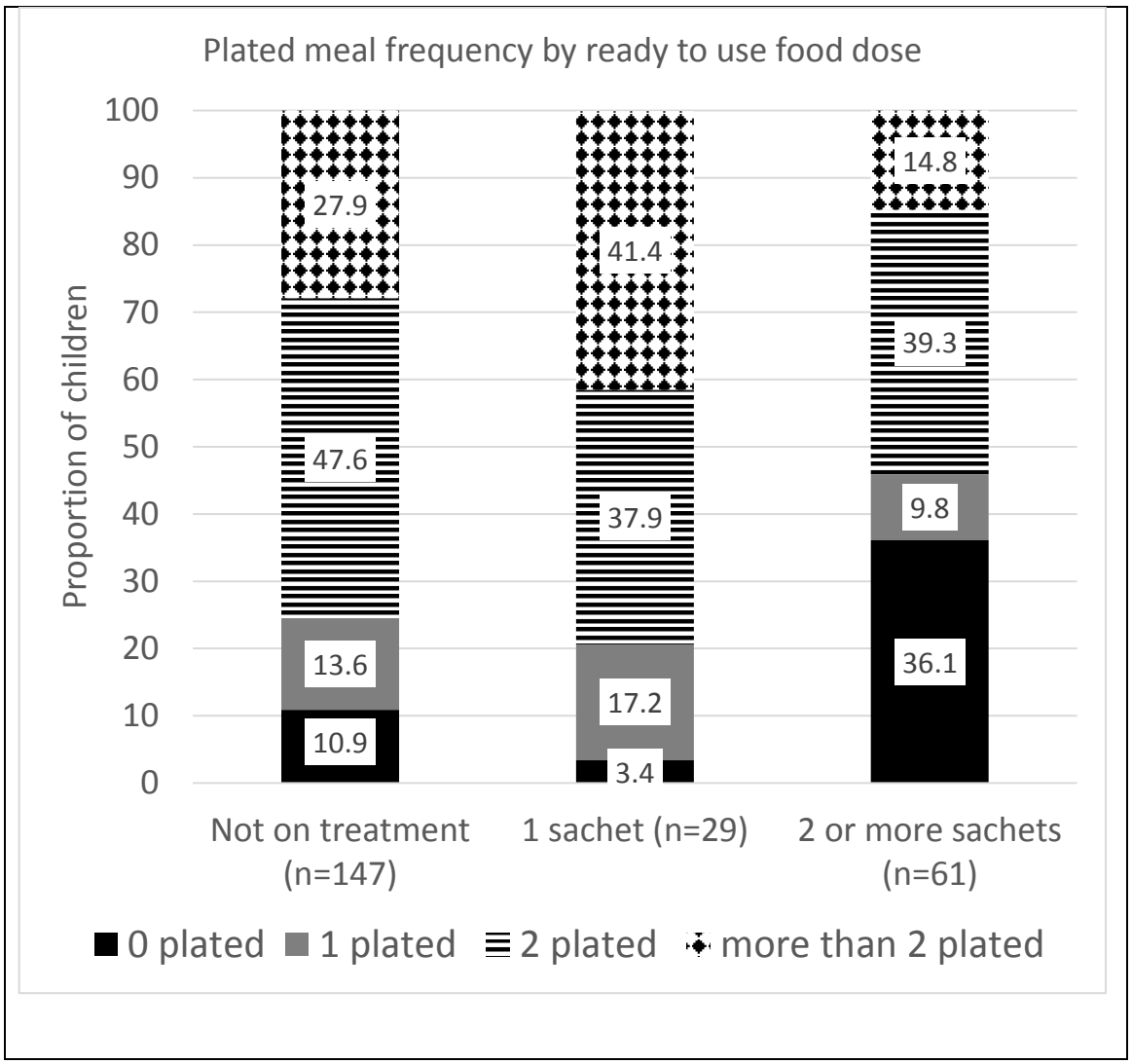
Overall, the difference in plated meal frequency across the three groups had borderline significance (P=0.046 Kruskal Wallis). Among children who were not on supplements, a quarter (24.5%) were offered plated meals on less than 2 occasions (Graph 6.12). Among children receiving more than one sachet of RUF, only 36.1% were not offered any plated meals.



Graph 6.10: Plated food frequency by ready to use food dose in moderately undernourished children



Graph 6.11: Plated food frequency by ready to use food dose in severely undernourished children



Graph 6.12: Plated food frequency by treatment offered in all undernourished children

6.3.2 Ready to use foods and eating and feeding behaviour

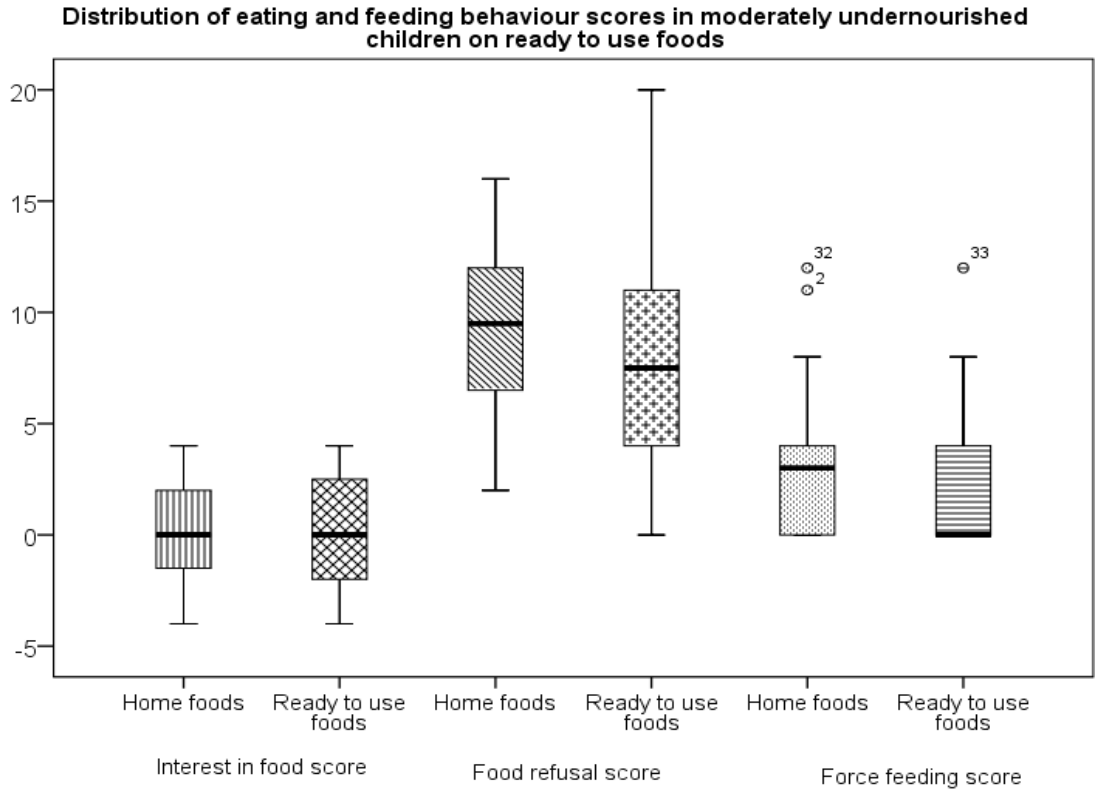
There was no difference in the correlation of eating and feeding behaviour when children were eating home foods and RUF. Comparisons made are within the same child during RUF and home meals. The P value (Wilcoxon signed-rank test) represents the difference in scores during ready to use foods and home foods. The distribution of eating and feeding behaviour scores in moderate and severely undernourished children are presented in Table 6.10, Graph 6.13 and Graph 6.14. Moderately undernourished children had a higher median food refusal score when eating home foods than ready to use foods (Table 6.10). Their caregivers also had lower force-feeding scores when giving ready to use foods but this difference was not statistically significant (P=0.157). There was however no difference in interest in food scores during home meals and RUF meals (Table 6.10).

In severely undernourished children, although there was no significant difference in the distribution of their eating and feeding behaviour scores, the distribution of their food refusal scores during home meals was higher than during RUF meals (Table 6.10).

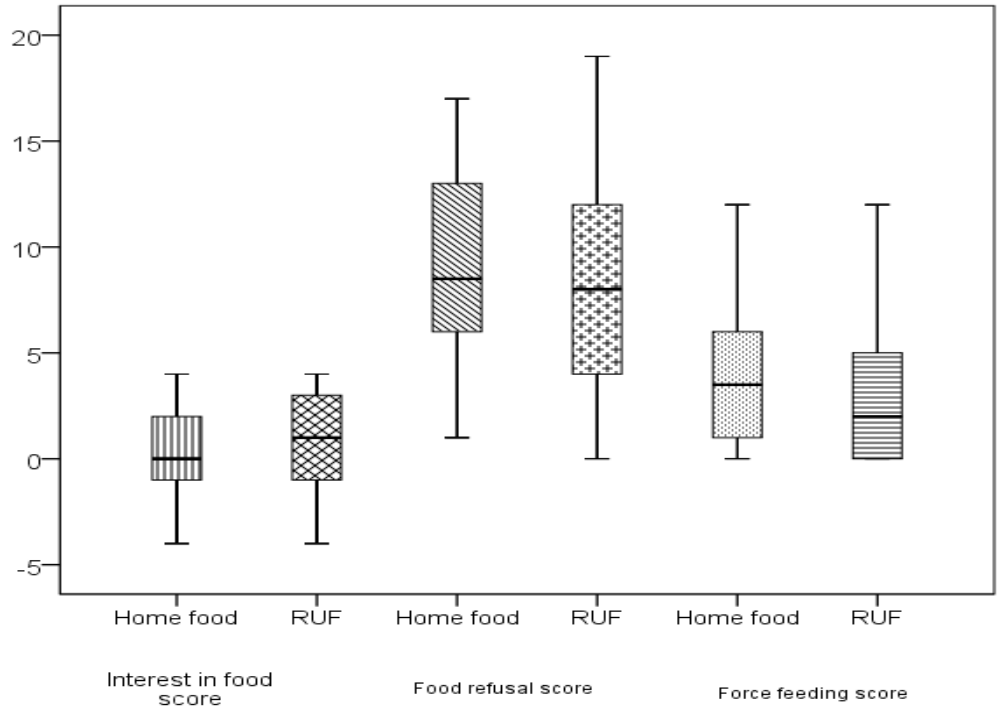
Table 6.10: Comparison of eating and feeding behaviour scores in moderately and severely undernourished children by type of food offered in children receiving RUF

Eating and feeding behaviour	Home meals	Ready to use food meals	P value
Moderate (n=32)			
Interest in food	1[0 to 2]	0[-2 to 3]	0.234
Food refusal	9[6 to 12]	7[4 to 11]	0.023
Force-feeding	3[0 to 4]	0[0 to 4]	0.157
Severe (n=50)			
Interest in food	1[0 to1]	1[1 to 3]	0.851
Food refusal	8[6 to13]	8[2 to 12]	0.050
Force-feeding	3[0 to 6]	2 [0 to 6]	0.461

P value: Wilcoxon signed ranks test



Graph 6.13: Distribution of eating and feeding behaviour scores in moderately undernourished children on ready to use foods by type of food offered



Graph 6.14: Distribution of eating and feeding behaviour scores in severely undernourished children on ready to use foods by type of food offered

6.3.3 Barriers to treatment

Some of the observed barriers to treatment included; lack of information about the importance of supplements. Mothers did not understand the importance of supplements especially mothers of severely undernourished children who felt that supplements were not adequate to meet their child's energy requirements. Stigmatization was also an issue in one of the clinics. Clinic attendance reduced because of rumours that mothers who are receiving supplements were HIV positive. Access to health facilities located within slums was also a challenge especially during the rainy season. Some caregivers also reported that their husbands did not want their children to eat supplements.

Advice given to caregivers was not always practical and in cases where the caregiver was attended to by different people conflicting information was provided. For example, student interns would provide advice without considering the mother's socio economic status. One mother was advised to give her child Ribena as a source of Vitamin C. A bottle of Ribena costs about £2 which is what the mother earns on a daily basis.

Lack of one on one sessions with mothers and poor relationship between caregivers and health workers also appeared to be a barrier. Due to low staffing and high patient load, nutritionists rarely had time for one on one sessions with caregivers. Mothers were therefore given the same advice. There are also cases where health workers publicly scolded mothers. Some of the mothers who experienced this said they would stop going for clinics. This also made mothers afraid to approach health workers for advice.

6.4 Discussion

This chapter focused on undernourished children and explored the association between risk factors described in the previous chapters and nutrition state as well as the effect of ready to use foods on meal frequency and eating and feeding behaviour. We hypothesized that children on treatment for MAM will be offered home foods at a lower frequency than those who are not on treatment and that moderately undernourished children on ready to use foods (RUF) will show more interest in RUF than home meals.

Among undernourished children, male children had lower WLZ, LAZ and MUAC Z scores than female children. Similar findings have been reported in population studies in Kenya (Masibo and Makoka, 2012, Kenya National Bureau of Statistics, 2015, Matanda et al., 2014a, Kimani-Murage et al., 2015) and in 16 African countries (Wamani et al., 2007). In a longitudinal study on maternal health in two slums in Nairobi, Kimani-Murage et al. (2015) reported a higher prevalence of stunting (51.1% v 39.6% P<0.001), wasting (3.2% v 1.7% P=0.005) and underweight (13.1% v 8.7% P<0.0001) in boys compared to girls.

Similarly, a review assessing gender differences in stunting using demographic health survey from 16 African countries showed that male children had significantly lower mean (SD) z scores than girls (-1.46 (1.57) vs 1.59 (1.56) P=0.001) in 12 out of 16 studies. Average stunting rates were also higher in male (40%) than female (36%) children P <0.001 (Wamani et al., 2007). Gender differences in nutrition status in slum areas are probably because of difference in childcare practices that exposes boys to more risk factors. For example, boys are more likely to be introduced to low energy dense complementary foods earlier than girls therefore putting them at higher risk of diseases such as diarrhoea (Kimani-Murage et al., 2011).

In contrast, other studies in Kenya have reported higher vulnerability in girls. In Kibera slum for example, after the post-election violence, a survey assessing the nutrition status of children found that girls were more likely to be wasted than boys but only in older children (Olack et al., 2011). Similarly in a cross sectional survey assessing gender inequalities in food intake and nutritional status in 629 children below 5 years in a rural area in Kenya; Ndiku et al. (2011) found that girls on average had significantly lower HAZ, WAZ and WHZ and were more likely to be stunted, underweight and wasted than boys (Ndiku et al., 2011). This was attributed to lower intake of energy from grains in girls. Differences in findings can be explained first by the lack of representative sample in Kibera as the most vulnerable groups had probably migrated to safer areas and second by the influence of cultural practices on childcare in rural settings (Ndiku et al., 2011).

The occurrence of wasting and stunting in the same child shows exposure to both recent and chronic nutrition deficits. We therefore expected to find that children who were both wasted and stunted were at higher risk than children who were either wasted or stunted. However, there was no association between social, hygiene, dietary and behaviour risk factors and nutrition state. This was probably because the causes of wasting and stunting are similar as demonstrated by the UNICEF conceptual framework of undernutrition (Engle, 1997). Wasting and stunting have been shown to be associated with the same risk factors in India and Guatemala (Martorell and Young, 2012). Martorell and Young (2012) showed that both wasting and stunting were related to wealth and maternal characteristics such as short stature but the contribution of the different factors varied between contexts. The two conditions are also thought to be linked. Children who are wasted early in life are more likely to be stunted later on but the evidence used is mainly based on prevalence studies which greatly underestimate the effects of wasting (Khara and Dolan, 2014). Although the linkage between wasting and stunting is not clear, both conditions are associated with high infant and young child mortality and they should therefore be addressed simultaneously using comprehensive context specific interventions.

6.4.1.1 Ready to use food meal frequency and eating and feeding behaviour

The effect of ready to use foods on meal frequency and eating behaviour was assessed by comparing these practices in children who were on and off treatment. Although a relatively large sample of children on treatment were recruited, there was a discrepancy in the number of RUF foods offered and the child's severity classification. That is, some children classified as moderately undernourished were receiving treatment for severe undernutrition and vice versa. Possible reasons for this discrepancy include: undernourished children were recruited based on the current study's definition of undernutrition which included weight for age, weight for length and length for age Z scores rather than the health facility definition which includes low weight for length and or a low mid upper arm circumference. It is also possible that inaccurate measurement of mid upper arm circumference and height led to misclassification of children. For example, MUAC tapes were either loosely positioned or tightly pulled and estimation of the midpoint on the child's left upper arm was not done, which is likely to lead to measurement errors (Ulijaszek and Kerr, 1999). To confirm the extent to which these measurement procedures lead to misclassification, health staff measurements should have been compared with the researcher's measurements and the admission criteria used by health staff should have been noted by the researcher, but this was not done.

It is also possible that the condition of some of the moderately undernourished children was deteriorating and some of the severely undernourished children were getting better and as a result it looked like they were on the wrong treatment. To confirm this, information on the length of time the child was on treatment would be required, but this information was not collected in this study.

Utilization of RUF within the household was assessed by asking caregivers how they offered these foods. Only one third of caregivers reported squeezing RUF directly from the packet to the child's mouth, the recommended feeding method. The rest served the supplement from a cup or bowl with a spoon or used their fingers as a spoon. Given the prevalence of poor hygiene practices in slum areas (Muoki et al., 2008), there is a likelihood that ready to use foods end up being contaminated which in turn leads to increased diarrhoea cases during treatment which are then attributed to RUF (Ali et al., 2013, Flax et al., 2009).

The safety of ready to use foods is further compromised by mixing RUF with other foods and drinks, a relatively common practice that was attributed to the thick consistency and sweetness of RUF. Some caregivers felt these characteristics made RUFs inedible on their own. Similar findings have been reported by other studies (Flax et al., 2009, Ali et al., 2013, Iuel-Brockdorf et al., 2016). For example, a study assessing the acceptability of RUFs reported in 149 caregivers of undernourished children in an urban slum in Bangladesh found that half the caregivers (52%) mixed RUF with other foods. A relatively large proportion of caregivers in the Bangladesh study felt that RUF were too sweet (53%) and had a thick consistency (Ali et al., 2013). Similarly, in rural Malawi, 27% of the children were given RUFs mixed with porridge, a practice that was associated with a high likelihood of having left overs and low weight for age (Flax et al., 2008, Flax et al., 2010). Left overs in the Malawi studies were usually eaten by other family members or discarded, a possible indication that children on treatment do not meet their energy and nutrient requirements. Mixing RUF with other foods can also limit the bioavailability of nutrients given that most complementary foods in this setting mainly consist of unprocessed cereals which are high fibre and anti-nutritive factors (Michaelsen et al., 2009). Sharing of RUF was also relatively common in the current study, as 16% of caregivers reported offering left over RUF to siblings.

Ready to use foods appeared not to reduce plated meal frequency in moderately undernourished children, as children on treatment for MAM (1 sachet of RUF) were offered plated meals at the same frequency as children who were not on treatment, a possible indication that ready to use foods provide extra energy and nutrients required in the child's diet. Similar findings were reported in Malawi in a longitudinal observation study assessing the use of fortified spreads (250 kcal) within households in moderately underweight 13 month old children. Flax et al. (2008) found there was no difference in the frequency of feeding of home foods before and during supplementation with a fortified spread of lower energy content. In a study that aimed to compare the efficacy of ready to use foods (500 kcal) and blended flours, Maleta et al. (2004) reported the same energy intake from staple foods before and during treatment in 52 month old children on RUF. However, compliance to treatment in this study was low as only approximately 30% of RUF dose was offered to children (Maleta et al., 2004).

Displacement of energy has been reported by other studies (Walker et al., 1991, Bhandari et al., 2001). In Jamaica, for example, in a longitudinal study on growth and development,

in 129 stunted and 32 non-stunted children aged 9-24 months, children receiving an energy dense milk based formula (750kcal) had a significant reduction in their intake of home diet as compared to non-supplemented children P<0.001 (Walker et al., 1991). The net increase in energy intake in the supplemented group was 106 kcal. Displacement in that study occurred despite poor compliance as at 6 months. Children received on average less than half the energy (345kcal) from the supplement. Considering there was stigma attached to RUF in some health facilities, it is possible that moderately undernourished children in the current study were not offered RUF as required and hence the lack of meal displacement. It is important to note that caregiver's reports of feeding frequency could be a reflection of attempts made to feed the child and not actual intake. In order to accurately determine the level of displacement, a measure of actual energy intake before during and after treatment would be required taking into account poor appetite, which is likely to influence intake.

Children receiving treatment for severe undernutrition were offered meals at more or less the same frequency as those who were not on treatment, an indication of poor compliance to treatment. Poor compliance in this study was probably because of conflicting information provided by clinic staff about how RUF should be offered, as well as maternal perception about the adequacy of RUF. Some mothers felt that RUF alone were not adequate to promote child growth. Poor appetite might have also resulted in poor compliance, as shown by the relatively high food refusal scores during home and RUF meals in severely undernourished children. The fact that mothers offered both RUF and home foods and that they were more likely to use force during home meals might be a reflection of their efforts to get the child to eat.

Moderately undernourished children, appeared to prefer RUF to home foods, probably because of the sweet taste of the supplement. This might explain why their caregivers were also more likely to use force when giving home foods than RUF. Similar findings on high acceptability of LNS have been reported when compared to complementary foods (Flax et al., 2013) and other supplementary foods (Flax et al., 2009). In a videotaped meal observation study in MAM in rural Malawi children, Flax et al. (2013) found that children had higher odds of accepting a bite containing RUF than complementary foods 3.05 [1.98 to 4.71 P<0.001] which was attributed to the taste of the RUF (Flax et al., 2013). It is however possible that there was high acceptance of RUF was because caregivers were more likely to use force when giving these foods.

Although findings from the current study are plausible, caution must be taken when interpreting them given the challenges faced when it came to classifying children on treatment as well as the observational nature of the study. Treatment options for undernutrition should be affordable, acceptable, safe and sustainable. However, ready to use foods in urban slums in Kenya appear not to meet most of these criteria. The fact that RUF were out of stock during the first month of data collection is a reflection of how unsustainable this treatment option is especially for moderately undernourished children. Stigma associated with these foods is also an indication that they are not entirely acceptable (Ali et al., 2013, Appleford et al., 2015). This is likely to affect compliance to treatment and in the long run the child's recovery. There is therefore a need to educate the community as well as mothers attending health facilities on the causes of undernutrition as well as the purpose of ready to use foods.

Ready to use foods have a modest effect on child growth when used for treatment of moderate acute malnutrition (Lazzerini et al., 2013). Efforts should be put towards improving hygiene and sanitation, the quality of local diets and food accessibility given that a large proportion of undernourished children are exposed to multiple risk factors. Poor appetite also appears to be an issue which needs to be addressed.

7 Discussion, recommendations and conclusion

This thesis aimed to quantify modifiable high-risk caring practices in undernourished children in low-income areas in Nairobi, Kenya. Preliminary studies tested the feasibility of using observations to assess childcare practices and revealed that eating and feeding behaviours varied between cultures. Compared to caregivers in Kenya, caregivers in Pakistan offered more encouragement during meals. In Kenya, encouragement was mainly in response to food refusal and undernourished children were more likely to show aversive eating behaviour. Their caregivers responded to this behaviour by either restraining the child or simply leaving them alone. In day-care centres, laissez faire feeding was common as children were left to feed themselves with little or no assistance (Mwase et al., 2016). Poor hygiene practices were also common, especially in Kenya where caregivers did not wash their hands before feeding their children. This is in line with observation studies in other low-income settings which report low child interest in food, low caregiver encouragement, force-feeding and poor hygiene practices during meals (Moore et al., 2006, Engle and Zeitlin, 1996, Bentley et al., 1991b, Oni et al., 1991).

Meal observations proved not to be representative as only one meal could be observed. Other studies show that eating and feeding behaviour vary depending on the type of meal offered (Engle and Zeitlin, 1996). Caregivers were also likely to change their behaviours during observations and only a small sample of children who were not randomly selected were recruited for observations. Furthermore, observations were not practical because of insecurity in some of the slums that were visited.

Based on these preliminary studies, a cross-sectional study, carried out in health facilities located close to slum areas was designed to assess childcare practices in a larger sample of children. Healthy children and newly diagnosed undernourished children were recruited from well-baby clinics during growth monitoring. Undernourished children on treatment were also recruited from outpatient therapeutic programs. During the first month of recruitment, RUFs were out of stock in all health facilities and therefore the first group of children recruited (n=68) were not receiving RUFs. This made it possible to study malnourished children not on RUTF, but also demonstrates how unsustainable RUF are as a treatment option especially in Nairobi, which is not considered a high priority area by most donors (UNICEF, 2009, Appleford et al., 2015).

Caregivers and their children recruited in this study came from disadvantaged backgrounds characterized by poor access to hygiene and sanitation facilities. They predominantly lacked piped water and had shared toilets which are common characteristics of Nairobi slums (Corburn and Hildebrand, 2015, African Population and Health Research Center, 2014). Interestingly, undernourished children were more likely to come from homes with piped water which is counterintuitive. It is therefore possible that the cause of undernutrition in these children was either related to water contamination, poor child care practices or environmental pollution (see section 4.6.1.2 for more details) but some of this factors were not assessed because they were beyond the scope of this study.

Compared to healthy children, undernourished children were more likely not to be breastfeeding. Continued breastfeeding is encouraged after 6 months because in many developing countries, breastmilk provides a significant amount of energy to the child's diet and it reduces the risk of infectious diseases and death (PAHO, 2003, Briend and Bari, 1989). Undernourished children also received few plated meals but overall all children mainly ate carbohydrate based foods. This was consistent with findings from other studies in Kenya and other low-income countries which show that children are offered monotonous diets at a low frequency (Bwibo and Neumann, 2003, Onyango et al., 1998, Kenya National Bureau of Statistics, 2015, Arimond and Ruel, 2004). This is a possible indication that children in this setting do not meet their energy and micronutrient requirements, but information on energy intake is required to confirm this.

Child eating behaviour and caregiver feeding behaviour were assessed using questions initially developed for the United Kingdom and this is the first time behaviours that reflect appetite and caregiver force-feeding have been quantified in this setting. A quarter of all children showed low interest in food and high food refusal. All these were more common in undernourished children. Their mothers were also more likely to be anxious about feeding them. Force-feeding was common in both groups particularly in children with low interest in food or high food refusal, and therefore its relationship with undernutrition was unclear. These findings are consistent with findings from studies in other low and middle-income countries, which show that poor appetite is a relatively common problem in children (Moore et al., 2006, Bentley et al., 1991b, Dettwyler, 1989). Feeding a child who does not want to eat can be a frustrating process which can partly explain why force-feeding and high maternal anxiety were relatively common among children who had poor appetite in this study.

Children appeared to prefer ready to use foods to home foods, but a single sachet of RUF appeared not to displace family meals in moderately undernourished children, Studies that have assessed the effect of high energy ready foods on energy intake have reported conflicting results (Walker et al., 1991, Maleta et al., 2004, Bhandari et al., 2001) but research on energy regulation suggests that children are able to internally regulate energy intake (Cohen et al., 1995, Brown et al., 1995b). It is therefore possible that RUF displace home foods in moderately undernourished children, but more research is required to confirm this.

7.1.1 Strengths and limitations

This study focused on child care practices and their association with nutrition status, an area which receives little attention. Focus is usually on diet and disease, which are considered to be immediate causes of undernutrition, yet childcare plays a very important role on child growth and development (Engle, 1997). Childcare practices were split into different related components namely: socioeconomic, hygiene and dietary factors and eating and feeding behaviour. This enabled assessment of the role of each component, as well as the overlap between various factors, which were presented using simple graphical representations. This provided a relatively clear picture of the most common risk factors in undernourished children which is important for nutrition advocacy. Caution must however, be taken when interpreting these findings as causation cannot be inferred due to the observational nature of the study.

Poor appetite frequently occurs in children in many LMIC yet few studies assess its prevalence caregiver coping strategies and possible solutions to this problem (Dettwyler, 1986). This study specifically assessed eating and feeding behaviour in low income areas in Kenya and it therefore contributes to the growing evidence of caregiver child interaction during meals and its impact on food intake and child growth development. Although findings from this thesis are plausible, it was not possible to determine if behaviours were a cause or consequence of undernutrition and if mothers were responding to child behaviour or vice versa. This is a common limitation of studies assessing mother child interactions during meals (Bentley et al., 2011).

It is also the first study in this setting to assess the relationship between RUF, meal frequency and eating and feeding behaviour. This is important because RUF are

increasingly being used for prevention and treatment of moderate acute malnutrition (Lazzerini et al., 2013).

The feasibility of using meal observations as a way of assessing childcare practices was tested, but meal observations were not practical, because of insecurity in the slums, the high time commitment required and the difficulty of ensuring that they were representative. However, they provided valuable information on cross-cultural aspects of childcare practices as well childcare practices in homes and day-care centres in slum areas in Nairobi. Observations made also provided a more detailed description of mother child interactions during meals, which is usually absent in studies assessing eating and feeding behaviours (Nti and Lartey, 2008, Ha et al., 2002, Dearden et al., 2009). This informed the design of the main study.

Quota sampling provided an opportunity to describe childcare practices in a large sample of children in a cost-effective way given the time limit for data collection and limited funding for the study. Recruiting from multiple health facilities also enabled sampling from different slum areas and a relatively more diverse sample of caregivers was obtained. However, the study was not entirely representative of Nairobi, first because of the highly selective nature of the sample and second because the study was carried out in only 7/80 health facilities that offer outpatient therapeutic and supplementary feeding programmes in Nairobi. Oversampling of undernourished children also meant differences in some risk factors, which are prevalent in only undernourished children, could not be detected unless comparisons were made with healthy children. This made it necessary to go back and recruit healthy children later. Although the socioeconomic conditions in the slums were probably the same the following year, there is a possibility that healthy and undernourished children were exposed to slightly different conditions. For example, in 2015, when undernourished children were recruited, there was a cholera outbreak in the slum.

Semi-structured interviews proved to be an efficient data collection method. Maternal reports on childcare practices, particularly child eating and feeding behaviour proved to be informative, but there is a possibility that caregivers over reported positive behaviours and underreported negative behaviours because of the child's current condition and the study setting (health facilities). Ideally, meal observations would have been used to validate interviews, however, they were not practical because of the limitations discussed in chapter 2.

Assessment of dietary quality was a challenge because of a lack of population specific definition of dietary diversity, but WHO cut off points were used for reference. The validity of the food frequency questionnaire used in the current study was not clear. Energy intake was also not measured and therefore adequacy of diets provided could not be assessed. The effect of RUF was assessed by comparing plated food frequency in supplemented and non-supplemented moderately undernourished children but actual energy intake was not measured in this study and further research on energy intake is needed (See section 7.1.2).

Eating and feeding behaviour was assessed using a set of questions adopted from a questionnaire that was designed and tested in the United Kingdom. The questions used were modified based on meal observations in Kenya and were translated to Swahili and checked via back translation to English to ensure that childcare practices were presented in a way that was familiar to the target audience. Caregivers were able to understand and respond to these questions, but, it is possible that cultural, linguistic and functional equivalence, of some of the questions was not achieved given differences between Kenya and the United Kingdom and cultural differences within the Kenyan sample. Further research is needed into culture pure measure of eating and feeding behaviour as discussed in section 7.1.2. Eating and feeding behaviours in slums in Kenya and in GMS study in the United Kingdom were not obviously comparable given differences in socio economic status, cultural practices and child nutrition status, but we were able to detect some similarities and differences and in some eating and feeding behaviours.

The World Health Organization growth standards were used in the current study to identify study participants, and definitions for moderate (weight for age or weight for length or length for age <-2SD) and severe undernutrition (weight for age/weight for length/length for age <-3SD) were used, which makes findings from this study comparable to other studies. However, because of high stunting rates in urban slum areas (Kimani-Murage et al., 2015, Olack et al., 2011), the inclusion criteria were modified to avoid recruiting a large sample of children who were genetically short but healthy. Anthropometric measurements were taken by both the researcher and health workers mainly because of lack of space in the health facilities. This reduces the accuracy and reliability of anthropometric measurements taken, but attempts were made to ensure that measurements were accurate. For example, the research team assisted in taking some of the measurements and in cases where measurements appeared to be questionable, a second set of

measurements were taken. Although research assistants were trained on data collection methods, further validation of anthropometric measurements and interviews should ideally have been done.

Assessment of interrater agreements for interviews would have been desirable especially during the second round of data collection where data was predominantly collected by research assistants. However, this was not possible to limited time available for data collection. A portable rollameter was used in some cases to take length measurements and it can be difficult to take accurate measurements especially when the child is moving. Mid Upper Arm Circumference (MUAC) measurements were not used for screening due to anticipated measurement errors. This presented a challenge when it came to assessing the effect of RUF on child care practices (see chapter 6) mainly because treatment is prescribed based on weight for length or MUAC measurements only, whereas we recruited on the basis of WFH and weight for age and to some extent height.(Kenya Ministry of Medical Services and Ministry of Public Health and Sanitation, 2010). Attempts were made to reclassify children based on the WHO classification (WLZ and or MUAC<-2SD) but the treatment offered still did not match the child's characteristics. We were not able to determine reasons for this discrepancy, but it suggests that either measurement accuracy was low in the clinics or that screening protocols were not adhered to. A comparison of health staff measurements with the researcher's measurements would have provided information about accuracy of measurements, but this information was not collected.

Other factors that affect childcare practices such as food insecurity and cultural beliefs were brought up by some caregivers. However, this information was not systematically collected, therefore their prevalence could not be estimated.

7.1.2 Recommendations for research

The role of RUF as a treatment option for MAM also needs to be further studied to assess the effects of RUF on energy intake, eating and feeding behaviour. A three phase intervention study focusing on energy intake, dietary quality and eating and feeding behaviour in moderately undernourished children, before, during and after interventions could be informative. To do this effectively, the 24 hour recall tool used should be validated against weighed food records. This may then enable detection of changes in energy intake as well as eating and feeding behaviour. There is a need to assess the effect

of ready to use foods on food preference given that undernourished children appear to prefer RUF to home foods. Increased availability and preference for sweet snack foods in children aged 6-24 months has been reported in low and middle income countries which have a high prevalence of undernutrition, but there is limited evidence about the effects of these eating practices on nutrition status (Huffman et al., 2014). More research is therefore required to assess the impact of these feeding practices on child growth.

There is also a need to assess the acceptability of RUF in slum areas. This could be achieved by using qualitative methods such as focus group discussions with caregivers of undernourished and healthy children as well as the community at large. The impact of mixing ready to use with other foods on micronutrient bioavailability as well as factors affecting treatment compliance also need to be assessed. In order to determine if undernutrition is a cause or consequence of poor eating and feeding behaviour, longitudinal studies assessing child-caregiver interactions during meals and their association with child nutrition status are also required. These would provide information on when eating and feeding difficulties start and possibly causative factors in this population (Piwoz et al., 1994). Force feeding appeared to be protective against undernutrition and there is evidence to show that it increases food acceptance in some children (Ha et al., 2002). More research is therefore required to assess the effect of force feeding on child eating behaviour.

The validity of the interview guide needs to be further assessed as it is possible that cultural, linguistic and functional equivalence, of some of the questions was not achieved. There is a need for better measures of child appetite. In order to efficiently measure and identify poor appetite in children, video recordings of children having meals can be used to assess caregivers' perceptions of appetite.

Given that RUF are expensive and unsustainable, health economic studies assessing the cost of alternative intervention packages that include water, hygiene and sanitation, provision safe nutritious foods, nutrition counselling and follow up would be important.

A better understanding of factors that influence various child care practices is required for the design of sustainable interventions. Ethnographic studies in slum areas can provide insight on challenges, opportunities for intervention and potential barriers from an

'insider's' perspective (Ferguson et al., 2015, Pelto and Armar-Klemesu, 2015). This method has been shown to be effective in rural areas in Kenya.

7.1.3 Implications for practice and policy

The current diagnosis and treatment protocol offers a convenient way of managing undernutrition. However, this protocol is not personalized to the needs of individual children which tend to vary as demonstrated by the observation that children had multiple risk factors but few had the same combinations. This shows the need for a more comprehensive personalized treatment approach. The assessment of current child care practices as well as resources available for care at household and community level should be done as part of diagnostic and treatment process to allow a problem solving approach to treatment, which aims to not only improve diets and prevent infections, but also to address behaviours which influence child care at an individual level. This might be a more cost effective and sustainable approach than the provision of RUF. To implement such an approach, significant investment in behaviour change interventions and programs development is required.

Although only a small proportion of children were not breastfeeding, most of those who weren't were undernourished. Continued breastfeeding after 6 months is important because breastmilk provides immune protection to children and reduces rates of infant mortality (Briend and Bari, 1989). There is therefore a need to support and promote continued breastfeeding especially in children below the age of one year. Factors that affect continued breastfeeding should also be assessed.

Intake of plated meals was low especially among undernourished children and diets offered were also mainly watery carbohydrate based foods. There was no association between dietary diversity and nutrition status in this study but other studies have shown associations between poor dietary diversity and undernutrition (Arimond and Ruel, 2004, Sawadogo et al., 2006). Caregivers should therefore be encouraged to offer diverse and energy dense diets at a higher frequency. However, the child's age and breastfeeding status should be taken into consideration as there is a risk that high meal frequencies in children aged 6-10 months can displace breastmilk (PAHO, 2003). Dietary practices have the potential to be improved through interventions which provide nutrition education and complementary foods (Lassi et al., 2013, Bhutta et al., 2013).

Poor appetite appeared to be common especially among undernourished children. There is therefore a need to improve child and caregiver interactions during meals. Responsive feeding interventions show that it is possible to modify behaviour but for behaviour change to be sustainable, there is a need to take into account potential barriers and factors that promote practice (Affleck and Pelto, 2012, Aboud et al., 2009). Caregivers and health workers should also be taught how to identify and manage poor eating and feeding behaviour through use of video demonstrations (Bentley et al., 1995). Feeding practices ensure that malnourished children get the food they need without creating aversion need to be developed. Poor appetite in this setting is also likely to stem from infectious diseases, micronutrient deficiencies and monotonous diets (Dettwyler, 1989, Brown et al., 1995a). Strategies which involve active prevention and treatment of infections, micronutrient supplementation and provision safe varied nutritious diets should be scaled up to address underlying causes of poor appetite.

Children who receive RUF may develop a preference for sweet foods which is likely to have a negative impact on intake of home foods during and after treatment and RUF are an unsustainable treatment option for MAM, given the shortage in supply. Ready to use foods need to be selectively prescribed to children who are likely to benefit from them and not to all moderately undernourished children. When it comes to treatment of moderate acute malnutrition, focus should be on behaviour change interventions. Results from this study also showed that mothers did not give ready to use foods as prescribed. This shows the need to emphasise the importance of RUF especially to caregivers of severely undernourished.

Preliminary observation studies in and day-care centres in low income areas in Nairobi showed that a relatively large proportion of children were undernourished while, non-responsive feeding styles and poor hygiene practices were common (Mwase et al., 2016). This shows a need for regulation of these childcare facilities either by the government or non-governmental organizations within the slums. Regulations should include caregiver child ratio and provision of hygiene and sanitation facilities. This will ensure that quality care is provided to children attending these facilities.

Findings from the main study showed that undernourished children were more likely to come from homes with more than one child under 5 years. High fertility rates and low contraceptive use previously been reported in slum areas in Nairobi (Mberu et al., 2016).

Efforts should also be made to promote family planning to allow pregnancy spacing in this setting, a strategy which has been shown to be a predictor of reduced undernutrition (Gillespie et al., 2013).

Community health workers play an important role in health facilities, especially in child welfare clinics and outpatient therapeutic programmes where they assist in taking anthropometric measurements. However, some of them do not take accurate measurements. Provisions should be made to ensure they are well trained and compensated for the services they offer. Students on internships also make a significant contribution to the healthcare system, but they require close supervision and on job training in order to ensure that they provide accurate and practical information to mothers. There is also a need to ensure that curriculum equips them with practical skills and knowledge required to interact with caregivers attending clinics. Positive interactions between health workers and caregivers as well as improved service delivery is also required in order to improve access and utilization of health facilities (Appleford et al., 2015).

Poor access to hygiene and sanitation in slum areas remains a problem. Given the negative impact that poor hygiene has on child health, there is an urgent need for customized hygiene and sanitation interventions, which have the potential to reduce diarrhoea and in the long run childhood stunting (Bhutta et al., 2008, Curtis and Cairncross, 2003). Interventions aimed at improving access to toilets and safe water are required. Although provision of individually owned toilets is ideal, this is not a practical option in slum areas, given limited space and haphazard housing layouts (Schouten and Mathenge, 2010). More toilets should be constructed with the aim of reducing the number of people sharing toilets and distance from toilets (Corburn and Hildebrand, 2015). The type of toilets constructed should be socially and environmentally acceptable and target communities should therefore be involved when designing interventions. A better understanding of factors that motivate hygiene practices is also required as provision of infrastructure alone might not translate into practice (Aunger et al., 2010, Schlegelmilch et al., 2016).

There is also a need for wider public engagement when it comes to infant and young child care. Infant and young child feeding interventions target mothers, yet relatives, friends and the community at large play a significant role especially when it comes to implementation of public health messages. Messages on infant feeding should also be all inclusive and not tailored for mothers alone. These messages should take into account cultural and religious

beliefs, which are likely influence childcare practices. For example, in cases where the mother associates undernutrition with witchcraft, offering nutrition education and counselling will not necessarily translate to changes in childcare practices if the mother believes the solution lies spiritual rituals (Mull, 1991, Abubakar et al., 2011). Affected populations should be treated as drivers of change rather than targets and should be actively involved in designing interventions (Pelletier et al., 2013).

7.1.4 Conclusion

Results from this thesis suggest that poor child care practices are prevalent in both homes and day-care centres in low income areas. Suboptimal feeding practices characterised by lack of continued breastfeeding and infrequent intake of energy dense meals were common especially in undernourished children. Low dietary diversity was also common in healthy and undernourished children. A better understanding of factors that motivate feeding practices are required in this setting.

Poor appetite was common in both healthy and undernourished children, a possible indication that the problem is prevalent, but the causes were not assessed. Although there was an association between poor appetite and undernutrition, it was not possible to determine if poor appetite led to undernutrition or vice versa. Non responsive feeding styles were also common in homes and day care centres. This shows the need for more research on the influence of eating and feeding behaviours on child growth and development as well as interventions which aim to improve these behaviours.

This study also suggests that MAM children eat RUF better than family meals, which may have important implications for intake after treatment has stopped. More research is needed to assess if RUF truly displace complementary foods. Provision of RUF as a treatment option does not address poor child care practices. There is therefore a need for more responsive problem solving interventions. The findings in this thesis, provide a better understanding of childcare practices in slum areas and can inform the design of future interventions and programmes in low-income areas in Nairobi.

Appendices

Appendix 1

Meal observation schedule used in Pakistan

Observation Schedule

Time Meal Started: Who feeds the child:

Location of the mother/feeder: Child has own plate: □Yes □ No

How many foods are given to the child?

Is the family having their meal at the same time?

Foods and drinks served to the rest of the family but not to the child?

Food consistency: 1. Liquid 2. Thin spoon able 3.Thick spoon-able 4. Moist lumpy 5. Dry solid

Mode of feeding: 1. Spoon 2. Hand (mother/caregivers hand) 3. Both hand and spoon 4. Other

Child behavior

Interest in food (look at how readily the child accepts food) 1.Very interested 2. Moderately interested 3. Interested 4. Less interested 5. Not at all interested

Mood 1. Excited 2. Very happy 3. Calm 4. Sad 5.Crying

Child self feeds 1. Self feeds entirely 2. Self feeds most of the meal 3. Self feeds half of the meal 4. Self feeds less than half the meal 5. Fed throughout the meal

Child's physical actions: _____

Child's verbal actions: _____

Caregiver behaviour

Caregiver actions

Verbally encourages child to eat:

Encourages child to eat more when child is eating well:

Motivates the child to eat more

Physically forces the child to eat

Distracted during feeding

Mechanical verbalizations from caregiver

Child completes food served? □Yes □No Care giver serves more food? □Yes □No

Who ends the meal? □Child □ Caregiver Time meal ends?

Was this a typical meal? □Yes □No

Appendix 2

Interview and observation schedule used in Kenya and Pakistan

Complementary feeding practices in urban slums in Nairobi: Interview and observation schedule home visits

BASELINE SURVEY

Family Number…… └┴┘ Area number……..... └┴┘

Mother's Age:_____

Child's Sex: ☐Male ☐Female Date of birth: _____

Birth Order_____Weight (kg):_____Length (cm):_____MUAC (cm):_____

Total number of persons living with the family…… └┴┘

S. No	Relation to head of family(I)	Age*	Gender (II)	Education (No of years at school) (III)	Occupation (IV)	Marital Status (V)
1						
2						
3						
4						
5						
6						
7						
8						
9						
10						
11						
12						
13						

I	**Relationship to head of family**			**II**	**Gender**	**IV**	**IV Occupation**		
1	Him/Herself	**11**	Daughter	**1**	Male	**1**	Professional	**10**	Unemployed
2	Father	**12**	Sister-in-law	**2**	Female	**2**	Executive	**11**	Living abroad
3	Mother	**13**	Son-in-law	**III**	**Education**	**3**	Junior Executive	**12**	Not Applicable
4	Father-in-law	**14**	Daughter-in-law	**90**	Can read & write	**4**	Big Business	**V**	**Marital status**
5	Mother -in-law	**15**	Grand Father	**91**	can read newspaper	**5**	Small Business	**1**	Unmarried
6	Husband	**16**	Grand Mother	**92**	Illiterate	**6**	Skilled Labourers	**2**	Married
7	Wife	**17**	Nephews	**93**	Other specify	**7**	Unskilled Labourers	**3**	Widow/widower
8	Brother	**18**	Nieces			**8**	Daily Wages	**4**	Divorced
9	Sister	**19**	Grand Son			**9**	Housewife	**5**	Separated
10	Son	**20**	Grand daughter						

Socio-Demographic Information:

Total income of the family from all sources per month……..... └┴┴┴┴┴┴┘

(As estimated after in-depth probing)

Number of years since living in this house…….. └┴┘

The house is (**1**=owned by the family,**2**=rented,**3**=Shared)...…….. ⌊__⌋

House construction (**1**=Permanent (stone built), **2**=Semi permanent (iron sheets, mud),**3**=

Temporary structures(tents, plastic paper),**4=**any other)...……. ⌊__⌋

Total number of rooms in the house…..…….... ⌊__⌋

Type of water supply (**1**=Piped into house,**2**=Public Tap/ Hand pump,

3=Wells,**4**=Springs,**5=**other)……... ⌊__⌋

Type of bathroom(**1**= Flush system,**2**=Latrine,**3**=Open place,**4=**Any other)…….. ⌊__⌋

Garbage disposal(**1**=in the dump,**2**=outside the house,**3**=inside the house)…

…….. ⌊__⌋

Sewage disposal

(**1**=Closed,**2**=Open,**3=**None)…..……..... ⌊__⌋

Vaccination History:

For children under **five (05)** years of age:

To be verified by the vaccination card

Sr. No	Sex	Age(yrs)	BCG	Penta+OPVI	Penta+OPVII	Penta+ OPVIII	Measles	Others
1								
2								
3								
4								
5								

Childcare and feeding

Who decides what the child should and should not eat?

□Mother □ Grandmother □ Sibling □ An aunt □ A neighbor/friend □ Father □ Other, specify:

Who usually feeds the child?

□Mother □Grandmother □ Sibling □ An aunt □ A neighbor/friend □ Father □ Other, specify

When the mother is away who usually feeds the child?

□Grandmother □ Sibling □ An aunt □ A neighbor/friend □ Father □ Other, specify:

At what age did you feed the child her/his first food (solid or semisolid)?

What was the food or preparation that you first gave to your child?

Generally speaking, how is the child's appetite when healthy? □Excellent □Very good □ Good □ Moderate □Poor

If your child stops eating, and you think she is still hungry or did not eat enough, what do you do?

How many meals does the child receive in a day?_____

How many snacks does the child receive in a day? _____

Foods given

How often does the child eat (*please tick one answer for each*):

	Once a day	More than once a day	Once a week	More than once a week	Monthly	Rarely/ never
Meat/fish/poultry						
Eggs						
Milk						
Pulses (beans, lentils ndengu)						
Fruits						
Leafy Vegetables (Sukuma wiki, spinach, cabbage, terere, managu, pumpkin leaves,)						
Starchy vegetables (sweet potatoes, peas, pumpkin, maize)						
Savory snack foods (crisps, chips, nuts, popcorn)						
sweets snack foods (chocolates, sweets, chewing gum)						

If child is undernourished

Type of ready to use food given to the child _____

Prescribed Dose:_____ Energy provided:_____

Is the ready to use food shared with other siblings? _____

Observation Schedule

Time Meal Started: _____ Who feeds the child:_____

Location of the mother/feeder: _____

What does the meal consist of? List in order of largest ingredients

1. Ingredient:_____
2. Ingredient:_____
3. Ingredient: _____
4. Ingredient:_____

Child has own plate: □Yes □ No Is the family having their meal at the same time?_□Yes □ No

If yes then what foods and drinks served to the rest of the family but not to the child?

_____

Food consistency:

□ Liquid □ Thin spoon able □Thick spoon-able □Moist lumpy □Dry solid

Mode of feeding:

□Spoon □ Hand (mother/caregivers hand) □Both hand and spoon □ Other_____

Action when child refuses food:

□Offers food again □Encourages child to eat □Shouts at child □Physically forces the child to eat (restrains child) □Stops feeding

Child eats all food served?

□Does not eat □ Less than half □Half □ More than half □ All

Care giver serves more food? □Yes □No

Who ends the meal? □Child □ Caregiver

Time meal ends?_____

Is this what you usually feed the child? □Yes □No

Comments

_____

_____

_____

	Yes		Yes
Personal hygiene Household has soap and water within reach? Caregiver washes her hands before feeding child? Caregiver wash the child's hands before feeding? **Food hygiene** Use of clean feeding utensils? Dishes are clean and covered? Feeding area is clean? All food is covered?		**Household hygiene** Trash outside the house? Trash inside the house? Stagnant water around the house? Presence of animals inside the house? Presence of animal waste inside the house? Presence of animal waste outside the house?	

Child Actions	**Beginning of meal**	**5 minutes into the meal**	**End of meal**
Interest in food (look at how readily the child accepts food)	□Very interested □Moderately interested □Neutral □Less interested □Not at all interested	□Very interested □Moderately interested □Neutral □Less interested □Not at all interested	□Very interested □Moderately interested □Neutral □Less interested □Not at all interested
Mood	□Excited □Very happy □Calm □Sad □Crying	□Excited □Very happy □Calm □Sad □Crying	□Excited □Very happy □Calm □Sad □Crying
Distracted during feeding (Playing with object, playing with someone else, looking at someone else)	□ Not at all □ Rarely □Sometimes □ Most of the time □ All the time	□ Not at all □ Rarely □Sometimes □ Most of the time □ All the time	□ Not at all □ Rarely □Sometimes □ Most of the time □ All the time
Self feeds	□ Not at all □ Rarely □Sometimes □ Most of the time □ All the time	□ Not at all □ Rarely □Sometimes □Most of the time □ All the time	□ Not at all □ Rarely □Sometimes □ Most of the time □ All the time

Mothers Action	**Beginning of meal**	**5 minutes into meal**	**End of meal**
Positively encourages child to eat: (smiles at child, praises child, demonstrates to child how to eat, touches the child)	□ Not at all □ Rarely □Sometimes □ Most of the time □ All the time	□ Not at all □ Rarely □Sometimes □ Most of the time □ All the time	□ Not at all □ Rarely □Sometimes □ Most of the time □ All the time
Neutral actions (Flat verbalization e.g. “eat your food”, does not talk to child)	□ Not at all □ Rarely □Sometimes □ Most of the time □ All the time	□ Not at all □ Rarely □Sometimes □ Most of the time □ All the time	□ Not at all □ Rarely □Sometimes □ Most of the time □ All the time
Distracted during feeding: (talking to another person, looking at another person, doing something else)	□ Not at all □ Rarely □Sometimes □ Most of the time □ All the time	□ Not at all □ Rarely □Sometimes □ Most of the time □ All the time	□ Not at all □ Rarely □Sometimes □ Most of the time □ All the time

Appendix 3

Day-care Centre paper

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Original Paper

OXFORD

Poor Infant Feeding Practices and High Prevalence of Malnutrition in Urban Slum Child Care Centres in Nairobi: A Pilot Study

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ABSTRACT

Little is known about the style and quality of feeding and care provided in child day-care centres in slum areas. This study purposively sampled five day-care centres in Nairobi, Kenya, where anthropometric measurements were collected among 33 children aged 6–24 months. Mealtime interactions were further observed in 11 children from four centres, using a standardized data collection sheet. We recorded the child actions, such as mood, interest in food, distraction level, as well as caregiver actions, such as encouragement to eat, level of distraction and presence of neutral actions. Of the 33 children assessed, with a mean age of 15.9 ± 4.9 months, 14 (42%) were female. Undernutrition was found in 13 (39%) children with at least one Z score <−2 or oedema (2): height for age <−2 (11), weight for age <−2 (11), body mass index for age <−2 (4). Rates of undernutrition were highest (9 of 13; 69%) in children aged 18–24 months. Hand-washing before the meal was lacking in all centres. Caregivers were often distracted and rarely encouraged children to feed, with most children eating less than half of their served meal. Poor hygiene coupled with non-responsive care practices observed in the centres is a threat to child health, growth and development.

KEYWORDS: early years, responsive feeding, hygiene practices, severe undernutrition, nursery, Kenya

INTRODUCTION

The quality of care provided to infants and young children is an important determinant of growth and development. To promote optimal growth, child care practices should be provided in a responsive manner, taking into account the child's characteristics, needs and developmental level [1–4]. Caregivers should not only be able to allocate adequate time and resources to child care, but also interpret and respond to a child's needs in an accurate timely manner [3, 5]. Responsive feeding behaviours

such as persistence, physical help and verbalization during feeding enhance the level of caregiver and child interaction and the feeding experience and are associated with adequate dietary intake [2–5].

Over the years, research on infant feeding has shifted from food security and dietary diversity to the effect of feeding behaviour and stimulation on nutrition status [6]. It is now evident that successful infant and young child feeding not only depends on what the child is fed, but also the quality of interaction between the caregiver and child. Responsive feeding styles have been linked to fewer food refusals and good nutrition status [7–11]. Although informative, most of these studies are carried out in Asian countries. Little is known about child care practices in African countries.

In Kenya, despite a decreasing trend of the prevalence of undernutrition nationwide [12, 13], stunting levels still remain high, especially in urban slum areas [14, 15]. The steady growth in urban women joining the paid labour force has led to an increase in the number of day-care centres, as women seek alternative child care services [16–18]. Little is known about the quality of care provided in these day-care centres in urban slums and its impact on nutrition status.

Aims

This pilot study aimed to assess the nutritional status of the children enrolled in day-care centres in urban slums in Nairobi, Kenya, and describes child feeding and hygiene practices in these centres.

METHODOLOGY

Setting and study design

This pilot study was an exploratory cross-sectional survey in five day-care centres located in two urban slums in Nairobi: Mukuru kwa Njenga and Mukuru kwa Reuben. These slums have a combined population of around 1.5 million and are characterized by crowded semi-permanent housing, open sewage systems and poor access to water and sanitation facilities. The study targeted children aged 6–24 months in day-care centres and was conducted over a 6 week period (mid-June to July 2014).

Research approval

Ethical approval was granted by the University of Glasgow college ethics committee, UK and University of Nairobi/Kenyatta National Hospital ethics review committee. The study was approved by the National Council for Science, Technology and Innovation as well as the Nairobi county health office. Written consent was obtained from the day-care centre management and from one parent or guardian of the selected children.

Research procedures

Initially, a survey of existing care centres both private and state owned was carried out in four slums, Mukuru kwa Reuben, Mukuru kwa Njenga, Mathare and Korogocho. From a list of 23 care centres that were identified, 10 of them with >10 enrolled children were selected for general surveying (Fig. 1). Information on centre characteristics such as ownership, construction, water supply, toilet facilities and child–caregiver ratio was collected in all 10 centres. Lunchtime meal and hygiene practices inclusive of hand-washing were observed in only five day-care centres in Mukuru kwa Njenga and Mukuru kwa Reuben, as these were conveniently located. Because the parents brought their children to the centres before dawn, information regarding consent was passed on to them through the caregivers. Signed consent forms were obtained from parents by caregivers and later handed to the researchers. This form also asked for each child's age. Where this was not completed, as was the case in five children, the care staff reported an approximate age. Children were categorized into three age groups, 6–11, 12–17 and 18–24 months, and we aimed to take anthropometric measurements of up to four children in each age group for easy comparison. Where there were less than four children with consent per age group, all children in that group were studied. If this number was more, four children were selected at random by drawing lots.

Anthropometry

Weight, height and mid upper arm circumference (MUAC) measurements were taken by two researchers. Supine length was measured using the Rollametre measure mat (Raven Equipment Ltd

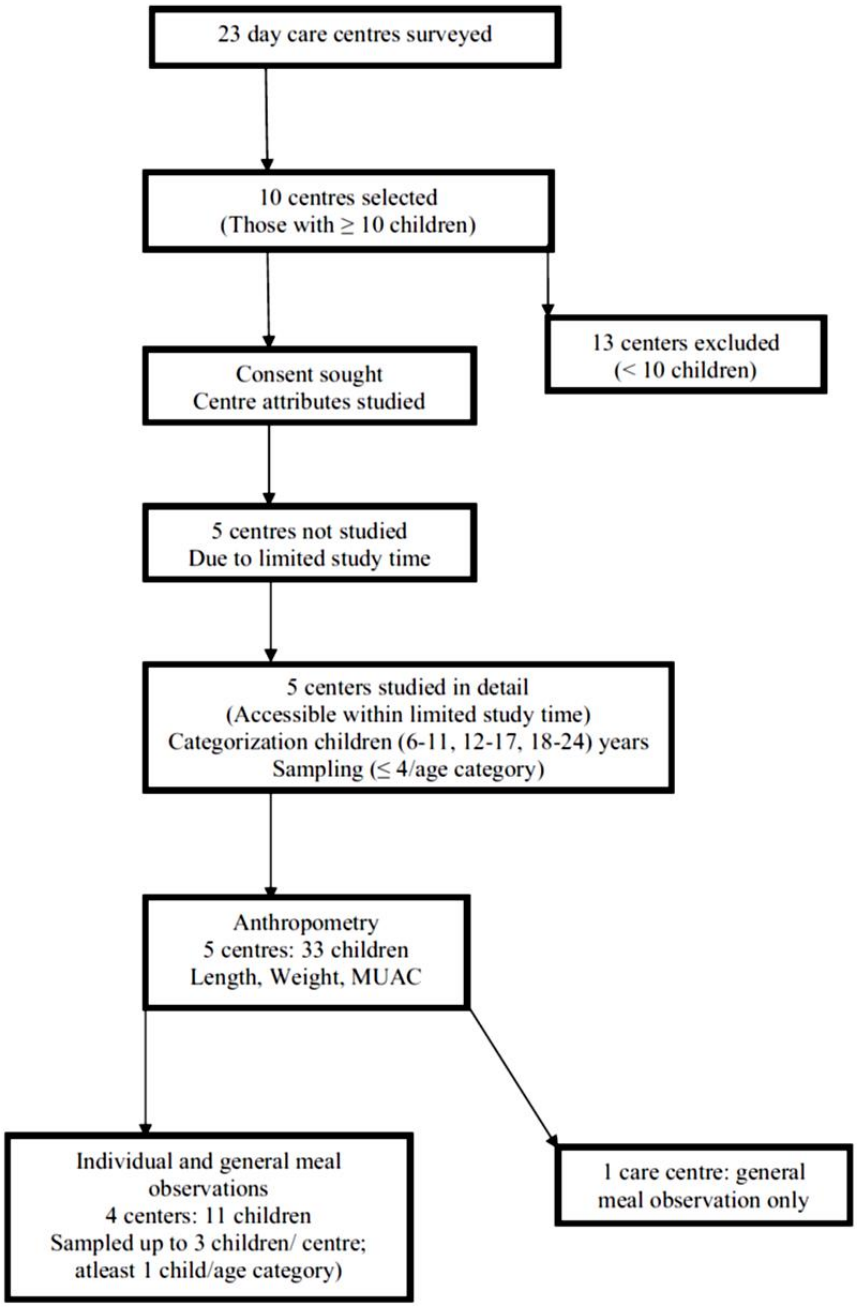

Fig. 1. Study flow chart.

Dunmow, U.K). The subject had to lie on this mat placed on a flat firm surface with all bulk clothes removed, head moved to Frankfort plane position and legs held down with gentle pressure. Three measurements were taken, and the mean of the closest two was then recorded. Weight was measured

using an electronic balance (SECA 385 digital weighing scale III) with the child either nude or in a clean dry diaper. MUAC was measured using MUAC tapes (The United Nations Children's Fund). The tape was placed on the left arm at the midpoint between elbow and shoulder, and the circumference was measured to nearest 0.1 cm [19, 20]. A caregiver had to be present during the process of taking each child's measurements.

Meal observations

Lunchtime meal observations were made for up to three children per centre, one from each age category, using a structured observation guide. This tool was designed using information from similar instruments [6, 21, 22] for a related pilot study that aimed at assessing child care practices in homes within urban Kenyan slums and peri-urban Lahore, Pakistan. The three children per centre were randomly selected by drawing lots. In the fifth centre, a general meal observation was made but not of individual children.

The two researchers (I.M. and A.M.) positioned themselves in a non-intrusive location, made observations and filled out the observation guide during the meal. Data on care centre structure, attendance, caregiver to child ratio, hygiene practices such as hand-washing, meal duration, food served and its consistency and mode of feeding were collected. Some of the data not included herein—care centre structure, sanitation and food consistency—will be reported in the results following the main study. We also observed the child actions such as interest in food, mood and distraction level, as well as the caregiver actions such as encouragement to eat, level of distraction and the presence of neutral actions, e.g. silence during meals, or flat verbalizations, e.g. 'eat your food'. These actions were observed at the start, 5 min into and at the end of the meal.

Data analysis

For analysis of the anthropometric data, WHO Anthro 2011 (v 3.2.2) software [23] was used to convert the measures into Z scores and identify children with underweight, stunting and wasting using the World Health Organization (WHO) cut-off points. Stunting was defined as a HAZ (height for age Z score) of <-2. Wasting was defined as a WHZ (weight for height Z score) of <-2. Underweight was defined a WAZ (weight for age Z score) of <-2. Qualitative data from child meal observations were coded before respective frequencies were determined. The complete data set was analysed using SPSS software (v 16.0).

RESULTS

Five privately owned day-care centres each consisting of a single room were studied. The care centres were semi-permanent structures with iron sheet walls and cemented floors and were poorly ventilated. Each of the five centres had a pit latrine, which was shared by other households. Water was purchased from a public tap and was stored in jerry cans. Attendance in these centres ranged from 10 to 30 children. On average, one caregiver attended 10 children.

Child characteristics and nutrition status

The study included 33 children with a mean age of 15.9 ± 4.9 months of which 14 (42%) were female. Nine children were in the 6–11 months age category, 11 in the 12–17 months and 13 in the 18–24 months category. An average of six children per centre were selected for anthropometry.

Undernutrition (acute and chronic malnutrition) was relatively common, as 13 of 33 (39%) children had at least one Z score <-2 or oedema. A third of the children (11 of 33) were stunted, a third (11 of 33) underweight and 4 of 33 (12%) wasted (Table 1). Bilateral pitting oedema was observed in two children aged between 18 and 24 months. This age group also had the highest overall prevalence of malnutrition, with 9 of the 13 children having one or more Z scores <-2.

General meal observations

Lunch was served between noon and 2 pm, with meals lasting between 20 and 40 min. Apart from one care centre that had two caregivers, all centres had one caregiver attending to all the children during the meal. In one day-care centre, three mothers came to the centre during the lunchtime meal and fed their own children.

Table 1. Prevalence of undernutrition within the day-care centres (n = 33 children)

Variable	Total (*N*)	Height for age SDS	Body mass index for age SDS	Weight for height	Weight for age SDS	MUAC for age SDS	Malnourished[a]
Total mean Z score	33	−1.65 ± 1.58	−0.39 ± 1.06	−0.61 ± 1.02	−1.19 ± 1.15	−0.04 ± 1.1	
Portion (%) with Z score <−2		(11/33) 33%	(4/12) 12%	(4/12) 12%	(11/33) 33%	(2/33) 6%	(13/33) 39%
Mean Z score (malnourished)	13	−3.16 ± 1.14	−0.75 ± 1.17	−1.21 ± 0.94	−2.39 ± 0.43	−0.95 ± 0.88	
Undernutrition per category							
6–11 months	9	(1) 11%	(1) 11%	(1) 11%	(3) 33%	(1) 11%	(3) 33%
12–17 months	11	(1) 9%	(1) 9%	(1) 9%	(1) 9%	0	(1) 9%
18–24 months	13	(9) 69%[b]	(2) 15%	(2) 15%	(7) 54%	(1) 8%	(9) 69%

SDS, Standard deviation score (Z-score).
[a]Children were classified as undernourished if they had any Z score <−2 according to the 2006 WHO growth standards.
[b]Two of these children also had severe acute malnutrition with oedema.

Meals were provided from home for over two-thirds (26 of 33) of the children. The rest either had their meals prepared by the caregiver (5 of 33), as was the case in one centre, or purchased (2 of 33) from street vendors. The meal often cost about £0.50 and composed of rice and bean soup, without visible beans. Although adequate for the children, the quality of food as well as the hygienic conditions around these kiosks was lacking. Majority of the children received their meals all at the same time, though younger children were served first in most centres. Most of the children were provided with their own plate of food and a spoon. Several were left to self-feed, with minimal supervision and assistance from the caregivers. Hence, younger children (6–17 months) consumed less than half of food offered, with some crying, playing with their food, looking at others or dozing off.

The use of flat verbalizations like 'Eat your food' or threats such as 'I will beat you if you do not eat' were common during meals. Children who were fed by a caregiver had a shorter mealtime than those who self-fed, as caregivers were rushing to attend to other children. Infants who shared food/plates seemed to be left yearning and crying for more, but the caregiver rarely served another food portion.

On the other hand, the three children who were fed by their mothers had their own plates, received encouragement and undistracted assistance to eat. Hence, they consumed more than half of the food offered without any observed flat verbalizations.

Poor hygiene practices were observed in all the centres. Caregivers washed neither their hands nor those of the children before feeding. Meals were served on plates placed on the dusty cemented floors. Although children were provided with spoons, the majority struggled using them and instead used their unwashed hands to eat. Others rubbed their spoons on the untidy floor and then resumed feeding using these dirty spoons.

Individual meal observations

These were done in 11 of the 33 recruited children, with the meal lasting about 30 min. Meals served were mainly (7 of 11) dry solids that consisted of either boiled rice, boiled green bananas or boiled potatoes. In cases where meals were served with either bean or meat stew, only the soup and not the pieces of beans and meat were served. Apart from legumes (mainly beans/peas), none of the meals served had other types of vegetables, particularly leafy

vegetables. Six children between 12 and 17 months were fed by the caregiver, who simultaneously attended to other children, while five fed themselves. Two children (of 11) did not have their own plate, in which case the caregiver fed them out of a shared plate. Most children readily accepted the food and ate throughout the meal, but only four children ate more than half the food provided (more than half a fist), and only two were served more food when they had finished. All children were calm at the beginning of meal, but by the end of the meal, most were crying. The children became increasingly distracted and self-fed less as the meal progressed. The meal was terminated by the child in most (8 of 11) cases. Caregivers rarely encouraged children to eat throughout the meal and often shifted their attention to other children (Table 2).

DISCUSSION

The present study was designed to assess feeding, hygiene practices and child nutritional status in urban slum day-care centres in Nairobi. This pilot study also aided in testing the observation tools to be used for the main study assessing child care practices in urban slum Kenyan homes and a peri-urban area in Lahore, Pakistan. A high prevalence of undernutrition was found as well as poor hygiene and non-responsive feeding practices.

The 33% prevalence of stunting was similar to the 35–37% reported by other studies among children <5 years in Kenya [12, 24], while the prevalence of wasting of 12% was higher than the 7% reported at the national level [12]. The prevalence of underweight in this study (33%) was double the previously reported (16%) prevalence among children <5 years [12]. Nonetheless, it was similar to that reported in poor rural areas where hygiene conditions may reflect those in slums [25] and to the 33% that was observed among children <2 years in a peri-urban slum in Southern India [26]. Nine of 13 children in the 18–24 age category reported the highest number of malnourished cases as similarly reported in a study among children aged 5 years in western Kenya [25]. Although the high prevalence of underweight and stunting in this category could have resulted from overestimation of age in cases where records were missing, there was no overall difference in results when the five children with approximated ages were excluded. Undernutrition remained at 11 of 28 (39%), 7 of 11 (70%) malnourished in the 18–24 age category, with overall prevalence of stunting and underweight at 9 of 28 (32%) and 7 of 28 (25%), respectively.

Table 2. Children and observed actions during mealtime (n = 11)

Child's actions	Beginning	Five minutes into meal	End
Interest in food			
Interested	10 (91%)	8 (73%)	6 (54%)
Distracted	4 (37%)	8 (73%)	10 (91%)
Self-feeding			
Not at all	5 (46%)	5 (46%)	7 (63%)
Other child actions throughout meal			
Served dry solids	7 (63%)		
Shared same plate	2 (18%)		
Ate less than half of food	7 (63%)		
Served more food	2 (18%)		
Ended feeding episode	8 (73%)		
Caregivers actions			
Encourages child to eat most of the time	3 (27%)	3 (27%)	2 (18%)
Distracted	9 (82%)	10 (91%)	10 (91%)

This study also showed the prevalence of poor hygiene practices characterized by the absence of hand-washing before food handling in the day-care centres. Similar findings were reported among Kenyan households [27]. This increases the risk of transmission of diarrhoeal diseases associated with poor appetite, reduced food intake and low nutrition status [25, 28, 29]. Hand-washing with soap has been shown to significantly reduce the prevalence of diarrhoea in low-income communities [30]. It is likely that water for care centre use was limited by low income, resulting in a rationed quantity of water purchases. Nonetheless, there is a need to double efforts in promoting hand-washing, particularly before food handling and feeding.

In this study, because majority of the children carried food from home, parents played a key role in determining what the children consumed, as in the home [31, 32]. The foods offered to the children were carbohydrate based, lacked animal source protein and leafy vegetables as previously been reported in other studies carried out in developing countries [33, 34]. A study conducted among Kenyan households [32] showed that some parents considered certain food items expensive, while others claim that children are not able to consume them.

Apart from the few cases where the mothers came to feed their children during lunchtime, non-responsive feeding practices characterized by absence of encouragement during feeding were observed in the care centres. This resulted in 7 of the 11 observed children losing interest in food and consuming less than half of food offered. This could be partly because of the low caregiver–child ratio (1:10), which made it hard for the caregiver to adequately attend to all children. Still, it is possible that these children had poor appetite or lacked the skills and coordination necessary for self-feeding. Similar high rates of non-responsive feeding were also reported in Nicaragua as well as in a study done in Ethiopia, where caregivers were reported to encourage feeding in only 40% of eating events [35–36]. To effect a successful feeding event, the caregiver ought to closely supervise the child's self-feeding episode and where need be, assist a child to feed [37].

Apart from the poor care practices in the day-care centres, several other factors away from the care centre may also have contributed to the poor nutrition status. Factors related to poverty such as inadequate intake of nutritious food, inadequate breast feeding, low birth weight and presence of parasitic and infectious diseases are well-documented, predisposing children in slum settlements to undernutrition [38–40]. Data collected on all these factors may provide a deeper insight into the source of problem and guide future interventions.

This study is the first to assess feeding and care practices in day-care centres in Kenyan urban slums. It was particularly strengthened by direct observation with a systematic observation schedule. However, because of time limitation, only five centres were studied, which may not be representative. In addition to the small sample sizes used, the observation schedule had not been previously tested in this setting. Also, only one meal was observed and hence may not reflect the usual feeding practices. More data collection days could have reduced day-to-day variability and given a comprehensive view of dietary intake and patterns. The invasive nature of the observations might have resulted in change in subjects' behaviour and hence systematic bias in the data collected [41]. The approximation of child ages by the caregivers may also have biased the results of this study.

CONCLUSION

Although day-care centres provide alternative care to children on behalf of working parents, overcrowding, poor hygiene and low staff levels are a potential threat to child health, growth and development. There is therefore a need for interventions to improve hygiene, feeding practices and thus child nutritional status in these slum settings. Because such interventions require resources, these care centres would greatly benefit from funding and collaboration with government agencies and non-government organizations. In addition, close supervision of care centre activities should ensure efficient operation and adherence to set standards.

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Appendix 4

Day-care centre Interview and observation schedule

Baseline Information

Name of day-care center _____

Owner: □ Government owned □ Private □ Run by NGO □ Other (specify) _____

Number of care givers in facility _____

Number of children attending day-care center per day _____

How many children is one care giver assigned? _____

Centre construction (**1**=Permanent (stone built), **2**=Semi permanent (iron sheets, mud),**3**=

Temporary structures(tents, plastic paper),**4**=any other)..…… └──┘

Total number of rooms in the centre…..... └──┘

Type of water supply (**1**=Piped into house,**2**=Public Tap/ Hand pump,

3=Wells,**4**=Springs,**5**=other)…….... └──┘

Type of bathroom(**1**= Flush system,**2**=Latrine,**3**=Open place,**4**=Any other)…….. └──┘

Garbage disposal(**1**=in the dump,**2**=outside the house,**3**=inside the house)…

…….... └──┘

Sewage disposal

(**1**=Closed,**2**=Open,**3**=None)…..……..... └──┘

	Yes		Yes
Personal hygiene Care centre has soap and water within reach? Caregiver washes her hands before feeding child? Caregiver washes the child's hands before feeding? **Food hygiene** Use of clean feeding utensils? Dishes are clean and covered? Feeding area is clean? All food is covered?		**Household hygiene** Trash outside the care centre? Trash inside the care centre? Stagnant water around the centre? Presence of animals inside the care centre? Presence of animal waste inside the centre? Presence of animal waste outside the centre?	

For each sample child

Name _____**Date studied**_____

Childcare and feeding

Child's Sex: □Male □Female Date of birth: _____

Birth Order____Weight (kg):_____Length (cm):_____MUAC (cm) ____

How many meals does the child receive at the care centre per day?_____

Who supplies this? Care centre / child's family

How many snacks does the child receive at the care centre per in a day? _____

Who supplies this? Care centre / child's family

How is the food stored?

Observation Schedule

Time Meal Started:_____Who feeds the child:_____

_____

Location of the care giver/feeder: _____

What does the meal consist of? List in order of largest ingredients

1. _____
2. _____
3. _____
4. _____

Child has own plate: □Yes □ No Are other children having their meal at the same time?

□Yes □ No

If yes then what foods and drinks served to the rest of the children but not to the child? _____

_____

Food consistency:

□ Liquid□ Thin spoon able □Thick spoon-able □Moist lumpy □Dry solid

Mode of feeding:

□Spoon □ Hand (caregivers hand) □Both hand and spoon □ Other_____

Action when child refuses food:

□Offers food again □Encourages child to eat □Shouts at child □Physically forces the child to eat (restrains child) □Stops feeding

Child eats all food served? □Does not eat □ Less than half □Half □ More than half □ All

Care giver serves more food? □Yes □No

Who ends the meal? □Child □ Caregiver

Time meal ends?_____

Is this what you usually feed the child? □Yes □No

Comments

Child Actions	**Beginning of meal**	**5 minutes into the meal**	**End of meal**
Interest in food (look at how readily the child accepts food)	□Very interested □Moderately interested □Neutral □Less interested □Not at all interested	□Very interested □Moderately interested □Neutral □Less interested □Not at all interested	□Very interested □Moderately interested □Neutral □Less interested □Not at all interested
Mood	□Excited □Very happy □Calm □Sad □Crying	□Excited □Very happy □Calm □Sad □Crying	□Excited □Very happy □Calm □Sad □Crying
Distracted during feeding (Playing with object, playing with someone else, looking at someone else)	□ Not at all □ Rarely □Sometimes □ Most of the time □ All the time	□ Not at all □ Rarely □Sometimes □ Most of the time □ All the time	□ Not at all □ Rarely □Sometimes □ Most of the time □ All the time
Self feeds	□ Not at all □ Rarely □Sometimes □ Most of the time □ All the time	□ Not at all □ Rarely □Sometimes □Most of the time □ All the time	□ Not at all □ Rarely □Sometimes □ Most of the time □ All the time

Care givers Action	**Beginning of meal**	**5 minutes into meal**	**End of meal**
Positively encourages child to eat: (smiles at child, praises child, demonstrates to child how to eat, touches the child)	□ Not at all □ Rarely □Sometimes □ Most of the time □ All the time	□ Not at all □ Rarely □Sometimes □ Most of the time □ All the time	□ Not at all □ Rarely □Sometimes □ Most of the time □ All the time
Neutral actions (Flat verbalization e.g. “eat your food”, does not talk to child)	□ Not at all □ Rarely □Sometimes □ Most of the time □ All the time	□ Not at all □ Rarely □Sometimes □ Most of the time □ All the time	□ Not at all □ Rarely □Sometimes □ Most of the time □ All the time
Distracted during feeding: (talking to another person, looking at another person, doing something else)	□ Not at all □ Rarely □Sometimes □ Most of the time □ All the time	□ Not at all □ Rarely □Sometimes □ Most of the time □ All the time	□ Not at all □ Rarely □Sometimes □ Most of the time □ All the time

Appendix 5

Data collection instruments used in the main study

Interview schedule

Identifying modifiable caring practice risk factors for undernutrition in infants attending health facilities in Nairobi

1. Child characteristics (circle appropriate answer)

Child's I D: _____ Age: _____ Date of Birth: _____

Gender: *Male / Female* Birth order:_____

What relation are you to the child? *Mother /Father / Other* _____

Anthropometry:

Weight (kg):_____ Height (cm):_____ MUAC (cm):_____ BMI _____

WAZ SDS_____ BMI (SDS) _____ WHF SDS_____ Height SDS_____ MUAC SDS _____

Who measured the child? Researcher/ Health staff/ Other (specify) _____

2. Child illness

a. Has your baby had any major health problems since birth? Yes / No If yes please describe them

b. In the past month has your child been admitted to hospital? Yes/ No

i) Reason for admission? _____

ii) Duration: _____

c. Seroreactive: *Reactive/ Non reactive/Exposed/Not tested*

3. Childcare and feeding

a. Breastfeeding Is your baby still breastfeeding? >3 feeds per day / 2-3 feeds per day/ 1 feed per day /<1 feed per day

What other drinks do you give your child? *Formula milk/ Cow's milk /Juice / porridge/Other* _____

b. Complementary feeding

At what age did you feed the child his/her first food? _____ Food given? _____

4. What sort of food do you usually give your child?

Record starchy / staple food _____

In the past 24 hours did you give your child?

Number of Time of day	**Plated foods** requiring feeding by hand or spoon	**Finger foods** (fruit pieces, biscuits, crisps, mandazi, bread)	**Other drinks** (cow's milk, formula milk, juice, tea, yoghurt, porridge)
Morning	[ ]	[ ]	[ ]
Mid-morning	[ ]	[ ]	[ ]
Afternoon	[ ]	[ ]	[ ]
Evening	[ ]	[ ]	[ ]
Night	[ ]	[ ]	[ ]

Who usually feeds the child? *Mother /Father /Grandmother/ Sibling / Aunt / A neighbour/friend / House help / Other (specify)_____*

When the mother is away who usually feeds the child? *Father /Grandmother / Sibling / Aunt / A neighbour/friend /House help / Day-care /Mother always present / Other, specify _____*

Please tick one answer for each	**entirely self feeds**	**mostly self feeds**	**Half and half**	**Carer mostly feeds**	**Carer always feeds**	**Not given**
Who feeds the child meals (foods that are served on a plate and eaten with a spoon/hand)?	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
Who feeds the child snacks (finger foods pieces of fruit, biscuits)?	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]

Key message: Self- feed: let the child pick up food and eat

How often does the child eat (*please tick one answer for each*):		**Never/ rarely**	**At least once a month but not weekly**	**At least once a week but not daily**	**Once daily**	**More than once daily**
a.	**Meat/fish/poultry**	[ ]	[ ]	[ ]	[ ]	[ ]
b.	**Eggs**	[ ]	[ ]	[ ]	[ ]	[ ]
c.	**Dairy products** (milk, yoghurt, fermented milk)	[ ]	[ ]	[ ]	[ ]	[ ]
d.	**Legumes/nuts (**beans, peas, black eyed peas, chick peas, green grams**)**	[ ]	[ ]	[ ]	[ ]	[ ]
e.	**Fruits (**oranges, bananas, melons, pineapples**)**	[ ]	[ ]	[ ]	[ ]	[ ]
f.	**Leafy Vegetables** (Sukuma wiki, spinach, cabbage, terere, managu, pumpkin leaves,)	[ ]	[ ]	[ ]	[ ]	[ ]
g.	**Savoury snack foods** (crisps, chips, nuts, popcorn, biscuits)	[ ]	[ ]	[ ]	[ ]	[ ]
h.	**sweets snack foods** (chocolates, sweets, chewing gum)	[ ]	[ ]	[ ]	[ ]	[ ]
i.	**Food cooked in oil** (blueband, cooking fat, butter)?	[ ]	[ ]	[ ]	[ ]	[ ]

Key message: Offer a variety of food including fish, eggs, fruits and vegetables

Food preparation and supplementation

What type of flour do you use to make porridge for your baby? *Famila/ uji mix (millet, beans, omena, terere,groundnuts)/plain millet/plain maize flour/ plain sorghum/ millet +maize/ maize+ sorghum/ sorghum +millet/ other (specify)*_____

Are you giving any vitamin supplements?

Routine vitamin A Yes/no

Micro nutrient powders Yes/no

Other: specify_____

Mother child interaction during feeding

Child characteristics	All the time	Most of the time	Sometimes	Rarely	Not at all
My child :					
a) Is easy to feed	[ ]	[ ]	[ ]	[ ]	[ ]
b) Loves food	[ ]	[ ]	[ ]	[ ]	[ ]
c) Eats slowly	[ ]	[ ]	[ ]	[ ]	[ ]
d) Easily satisfied	[ ]	[ ]	[ ]	[ ]	[ ]

Key message: Be responsive: watch, listen and respond in words to your child's signals

<u>If receiving RTUF</u>, also complete section at end

Child characteristics	All the time	Most of the time	Sometimes	Rarely	Not at all
How often does your child do the following when offered food <u>other than RTUF</u>?					
a) Turns away when offered food	[ ]	[ ]	[ ]	[ ]	[ ]
b) Pushes food away	[ ]	[ ]	[ ]	[ ]	[ ]
c) Cries/ screams	[ ]	[ ]	[ ]	[ ]	[ ]
d) Holds food in mouth	[ ]	[ ]	[ ]	[ ]	[ ]
e) Spits out food	[ ]	[ ]	[ ]	[ ]	[ ]
What sort of things do you do if your child refuses to eat?					
a) Encourage him/her to eat	[ ]	[ ]	[ ]	[ ]	[ ]
b) Offer something else	[ ]	[ ]	[ ]	[ ]	[ ]
c) Restrain him by holding his/her hands	[ ]	[ ]	[ ]	[ ]	[ ]
d) Pour food in to his/her mouth	[ ]	[ ]	[ ]	[ ]	[ ]
e) Try to forcefully open his/her mouth	[ ]	[ ]	[ ]	[ ]	[ ]
f) Threaten/beat him/her (do not ask unless mother mentions)	[ ]	[ ]	[ ]	[ ]	[ ]
g) Leave him/her alone	[ ]	[ ]	[ ]	[ ]	[ ]
How do you feel when feeding your child?					
a) I find feeding my child stressful	[ ]	[ ]	[ ]	[ ]	[ ]
b) I worry that my child is not eating enough	[ ]	[ ]	[ ]	[ ]	[ ]

Key message: When your child refuses, pause and question why; do not force feed or threaten

	All the time	Most of the time	Some times	Rarely	Not at all
Do you wash your **Child's** hand with soap before feeding?	[ ]	[ ]	[ ]	[ ]	[ ]
Do you have soap and water within reach in food preparation area?	Yes	No			
When do you wash **your** hands with SOAP? (unprompted)	Mentions				
After using the toilet	[ ]				
After changing the baby's nappy	[ ]				
Before handling/preparing food	[ ]				
Before feeding the child	[ ]				
other	[ ]				

Key message: Wash your child's hands before he or she picks food

5. Housing characteristics

The house is: *Owned by family/Rented /Shared / Other*_____ Number of rooms in house_____

House construction *Permanent /semi-permanent / Temporary / Other specify*_____

Household possessions *Car/ Motorcycle / Bicycle /Refrigerator / Television / Radio / Mobile phone*

6. Water and sanitation facilities

	Piped into house	Public tap (purchase	Well/rain water	Vendor (truck	bottled water	Other
Main source of water for household use:						
Main source of drinking water						

Type of toilet: *Pit latrine (without flash system) /latrine (Flush system) /Flush toilet /bucket/pail open place / Other* ___

i) Is toilet shared by other households? *Yes / No*

ii) Do you pay to use the toilet? *Yes/No*

Garbage disposal: *Collected by "Private firm" /Disposal within compound/ Unauthorized heap outside the compound / Other (specify)* _____

Family characteristics

Mother's age: _____ Mother's weight: _____ Mother's height:_____

Education level: *None/ less than 5 years of primary /more than 5 years of primary education /Secondary education/ Tertiary/ Other* _____

Father's age: _____ *Resident / non resident and contributing to household / no contact*

Education level: *None/ less than 5 years of primary /more than 5 years of primary education /Secondary education/ Tertiary/ Other* _____

Number of children born to this mother (including this child) _____

Age of eldest child: _____ Age of youngest child:_____

How many children are under the age of 5 years_____

In your opinion what causes low weight in children?

Unprompted mention of: *Not enough food/wrong sort of food/ illness/ not breast feeding*

What do you think causes diarrhoea in children?

Unprompted mention of: *Eating contaminated food/ Lack of hand washing before feeding the child/ Lack of hand washing before handling the child's food/ Drinking contaminated water/ Lack of washing vegetables properly before cooking/ witch craft/ Teething/Other*

_____

Is there anything else you would like to say about feeding your baby?

Complete this section only if ready to use supplement is being given

Type of ready to use food given: _____ Prescribed Dose: _____

Energy provided: _____ Is the ready to use food shared with other siblings? [ ]Yes [ ] No

How is the child's appetite for home foods when eating RUF? _____

How do you feed your child the supplement ?

Child characteristics	All the time	Most of the time	Sometimes	Rarely	Not at all
My child					
a) Is easy to feed	[ ]	[ ]	[ ]	[ ]	[ ]
b) Loves the supplement	[ ]	[ ]	[ ]	[ ]	[ ]
c) Eats slowly	[ ]	[ ]	[ ]	[ ]	[ ]
d) Easily satisfied	[ ]	[ ]	[ ]	[ ]	[ ]
How often does your child do the following when offered supplement?					
a) Turns away when offered supplement	[ ]	[ ]	[ ]	[ ]	[ ]
b) Pushes food away	[ ]	[ ]	[ ]	[ ]	[ ]
c) Cries/ screams	[ ]	[ ]	[ ]	[ ]	[ ]
d) Holds food in mouth	[ ]	[ ]	[ ]	[ ]	[ ]
e) Spits out food	[ ]	[ ]	[ ]	[ ]	[ ]
When my child refuses to eat his/ her supplement					
a) I encourage him/her to eat	[ ]	[ ]	[ ]	[ ]	[ ]
b) Offer something else	[ ]	[ ]	[ ]	[ ]	[ ]
c) Restrain him by holding his/her hands	[ ]	[ ]	[ ]	[ ]	[ ]
d) Pour food in to his mouth	[ ]	[ ]	[ ]	[ ]	[ ]
e) Try to forcefully open his/her mouth	[ ]	[ ]	[ ]	[ ]	[ ]
f) I threaten/beat him/her					
g) Leave him alone	[ ]	[ ]	[ ]	[ ]	[ ]

Comments

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