The development of food based dietary guidelines (FBDGs) for 6 to 23 month old Rwandan children

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It all starts here ™

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ABSTRACT

Background

Stunting (low height for age), a measure of chronic malnutrition among young children, is a public health problem in Rwanda. Exclusive breastfeeding for the first six months is common and routinely practised. Complementary feeding practices, on the other hand, are inadequate, which could explain the high prevalence of stunting seen among Rwandan children aged between six and 23 months. Inadequate nutrition has significant short and long term consequences for both the physical and cognitive development of children. Nutrition education given to caregivers using appropriate tools, such as food-based dietary guidelines (FBDGs), can improve infant and young child feeding practices and nutritional status. FBDGs are nutrition education messages based on scientific evidence, intended to present nutrition information using language and symbols easily understandable to the general public, health providers and lay individuals.

Aim

The aim of this thesis was to develop FBDGs to improve the feeding practices and the nutritional status of children of six to 23 months old in Rwanda. This study investigated the complementary foods consumed, the dietary diversity and the energy and nutrient intake of children aged six to 23 months in Rwanda. In addition, the factors influencing caregivers' complementary feeding practices were studied.

Design

This was a cross-sectional study using interviewer-administered food frequency questionnaires and single 24-hour dietary recalls with the main caregivers of 765 children aged six to 23 months from eight of Rwanda's 30 districts. For mixed dishes, local recipes were collected and the average proportion of each individual ingredient calculated. A food composition database for the purposes of this study was compiled by adding data from, in order of preference, the Ugandan food composition table, food composition table for Rwanda, and South African food composition tables. Furthermore, a descriptive qualitative study was done in which ten focus group discussions were conducted with caregivers from five districts to investigate the knowledge and practices of complementary feeding.

Results

Dried beans and green leafy vegetables were consumed by more than half of the children, according to both the food frequency questionnaire and the 24-hour recall. Dried small fish

and cow milk were the only animal products consumed by more than 5% of the children. Breast milk was consumed by 79.9% of the children. The median daily energy intake was 650 (549-839) kcal/d, 765 (607-1051) kcal/d and 801 (592-1236) kcal/d for children aged six to eight months, nine to 11 months and 12 to 23 months respectively. Around half of the children in the age groups six to eight months (43.4%), nine to 11 months (53.1%) and 12 to 23 months (57.8%) had an energy intake below the recommendation. Over 80% of the children in the age groups six to eight months and nine to 11 months did not meet the recommended nutrient intake for calcium, iron, zinc and vitamin A. Apart from breast milk, the top five foods that contributed to energy were dried beans (11.36%), cassava pap (6.41%), cow milk (5.86%), maize (5.08%) and sweet potato (4.49%). Dried beans contributed most to iron (33.54%) and second most to zinc (21.35%). The complementary diet on average did not reach the desired nutrient density for iron and zinc, and a high proportion (>60%) of the children, in all age groups, had iron and zinc intakes below the recommendation.

Caregivers' knowledge and beliefs about the benefits of breastfeeding and timely introduction of complementary food seemed to be the primary factors promoting good practices. However, the common belief that infants should be given liquids (thin gruel, fruit juices and meat broth) as first foods instead of semi-solid foods might compromise child nutrition in the first months of complementary feeding. The community-based nutrition education and counselling programmes were facilitators of good complementary practices.

The knowledge and understanding acquired through the above-mentioned quantitative and qualitative studies and infant and young child feeding (IYCF) recommendations from the WHO were used to formulate the following food-based dietary guidelines : (1) Breastfeed exclusively for six months and start complementary feeding at six months, while continuing to breastfeed your baby until two years or beyond; (2) Feed your baby food of a thick consistency; (3) Feed your baby a variety of nutritious foods; (4) Feed your baby small dried fish, cow milk, eggs or meat every day or as often as you can; (5) Follow hygienic practices while preparing, storing and feeding the complementary food; (6) Create a clean environment for your baby.

Conclusion

Nutrient intakes are reported for the first time for this population in this thesis. This was made possible by adapting existing food composition tables to contain local foods and recipes. The findings generated contribute to scholarly knowledge about IYCF in Rwanda and probably also in other developing countries, especially in Africa. We propose that FBDGs, as a nutrition education tool, may complement other interventions to address sub-optimal complementary feeding practices in Rwanda.

Key terms: Food-based dietary guidelines, infants and young children, complementary feeding, nutrient intake, feeding practices

ABSTRAK

Agtergrond

Ingekorte groei (beperkte lengte vir ouderdom), 'n maatstaf van kroniese wanvoeding onder jong kinders, is 'n openbare gesondheidsprobleem in Rwanda. Eksklusiewe borsvoeding vir die eerste ses maande is algemeen en word gereeld beoefen. Aanvullende voedingspraktyke aan die ander kant is onvoldoende, wat die hoë voorkoms van ingekorte groei onder Rwandese kinders tussen die ouderdomme van ses en 23 maande kan verklaar. Onvoldoende voeding het beduidende kort- en langtermyn gevolge ten opsigte van beide die fisiese en kognitiewe ontwikkeling van kinders. Voedingsvoorligting aan versorgers deur middel van gepaste hulpmiddels soos Voedselgebaseerde Dieetriglyne (VGDRe) kan voedingspraktyke onder babas en jong kinders sowel as hul voedingstatus verbeter. VGDRe is voedingsvoorligting-boodskappe wat gebaseer is op wetenskaplike bewyse en bedoel is om inligting oor voeding met behulp van taal en simbole maklik verstaanbaar te maak vir die algemene publiek, gesondheidsvoorsieners en individue.

Doel

Die doel van hierdie tesis was om VGDRe te ontwikkel om die voedingspraktyke sowel as die voedingstatus van ses tot 23 maande oue kinders in Rwanda te verbeter. Hierdie studie het die aanvullende voedselverbruik, die diversiteit in dieet en die energie en nutriëntinname van kinders tussen die ouderdomme van ses en 23 maande in Rwanda ondersoek. Daarbenewens is die faktore wat die aanvullende voedingspraktyke van versorgers beïnvloed, bestudeer.

Ontwerp

Dit was 'n deursnee-studie wat gebruik gemaak het van voedsel frekwensie vraelyste wat deur ‘n onderhoudvoerder geadministreer is asook ‘n enkele 24-uur herroep van die dieet aan die hoofversorgers van 765 kinders tussen ses en 23 maande, afkomstig vanuit agt van Rwanda se 30 distrikte. Vir gemengde geregte, is plaaslike resepte verkry en die gemiddelde bydra van elke individuele bestanddeel bereken. ’n Voedselsamestellingstabel vir die doel van die studie is saamgestel, deur data vanaf die Uganda voedselsamestellingstabel, die voedselsamestellingstabel van Rwanda, en die Suid-Afrikaanse voedselsamestellingstabel, saam te voeg. Verder is 'n beskrywende kwalitatiewe studie gedoen waarin tien fokusgroep-besprekings gevoer is met die versorgers van vyf distrikte om die kennis en praktyke van aanvullende voeding te ondersoek.

Resultate

Gedroogde bone en groen blaargroentes is verbruik deur meer as die helfte van die kinders, volgens beide die voedsel frekwensie vraelys en die 24-uur herroep. Klein gedroogde vissies en koeimelk was die enigste diereprodukte wat verbruik is deur meer as 5% van die kinders. Borsmelk is verbruik deur 79,9% van die kinders. Die mediaan daaglikse energie-inname was 650 (549-839) kcal/d, 765 (607-1051) kcal/d en 801 (592-1236) kcal/d vir kinders tussen die ouderdom van ses tot agt maande, nege tot 11 maande en 12 tot 23 maande onderskeidelik. Ongeveer die helfte van die kinders in die ouderdomsgroepe ses tot agt maande (43,4%), nege tot 11 maande (53,1%) en 12 tot 23 maande (57,8%) het 'n energie-inname onder die aanbeveling gehad. Meer as 80% van die kinders in die ouderdomsgroepe ses tot agt maande en nege tot 11 maande het nie aan die aanbevole nutriëntinname (ANI) vir kalsium, yster, sink en vitamien A voldoen nie. Afgesien van borsmelk, is die top vyf voedselsoorte wat bygedra het tot energie droë bone (11,36%), ‘cassava’ pap (6,41%), koeimelk (5,86%), mielies (5,08%) en patats (4,49%). Gedroogde bone het die meeste bygedra tot yster (33,54%) en tweede meeste tot sink (21,35%). Die aanvullende dieet het oor die algemeen nie die gewenste nutriëntdigtheid bereik vir yster en sink nie en 'n groot deel (> 60%) van die kinders, in alle ouderdomsgroepe, het minder as die aanbevole yster- en sinkinname gehad.

Die kennis en oortuigings van versorgers oor die voordele van borsvoeding en tydige bekendstelling van aanvullende voeding blyk die primêre faktore te wees vir die bevordering van goeie praktyke. Die algemene oortuiging dat babas vloeistowwe (dun pap of meelpap (‘gruel’), vrugtesap en vleissous) gevoer moet word as eerste kos in plaas van semi-vaste kos kan moontlik die voeding van kinders in die eerste maande van aanvullende voeding in gedrang bring. Deur middel van gemeenskapsgebaseerde voedingsvoorligting en beradingsprogramme is goeie aanvullende praktyke gefasiliteer.

Die kennis en begrip wat verkry word deur middel van die bogenoemde kwantitatiewe en kwalitatiewe studies asook voedingsaanbevelings vir babas en jong kinders uit die WHO is gebruik om die volgende voedsel-gebaseerde dieetriglyne te formuleer: (1) Borsvoed uitsluitlik vir ses maande en begin aanvullende voeding op ses maande, terwyl borsvoeding voortgesit word tot op twee jaar of langer; (2) Voed jou baba kos met 'n dik samestelling; (3) Voed jou baba 'n verskeidenheid van voedsame kos; (4) Voed jou baba klein gedroogde vis, koeimelk, eiers of vleis elke dag of so dikwels as wat jy kan; (5) Volg higiëniese praktyke met voorbereiding, berging en aanbied van aanvullende voedsel; (6) Skep 'n skoon omgewing vir jou baba.

Afsluiting

Voedingstofinname vir hierdie populasiegroep is vir die eerste keer met hierdie tesis aangespreek. Dit is moontlik gemaak deur bestaande voedselsamestellingstabelle aan te pas om plaaslike kos en resepte te bevat. Die bevindinge wat gegenereer is dra by tot wetenskaplike kennis oor baba en jong kinder voeding in Rwanda en waarskynlik ook in ander ontwikkelende lande, veral in Afrika. Ons is van die opinie dat VGDRe, as 'n voeding voorligtingsinstrument ander intervensies om sub-optimale aanvullende voedingspraktyke in Rwanda aan te spreek kan aanvul.

Sleutelterme: Voedselgebaseerde dieetriglyne, babas en jong kinders, aanvullende voeding, voedingstowwe inname, voedingspraktyke

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LIST OF ABBREVIATIONS

AIDS	Acquired immunodeficiency syndrome
CHWs	Community health workers
DHS	Demographic and health survey
EE	Environmental enteropathy
EKN	Embassy of the Kingdom of the Netherlands
FAO	Food and Agriculture Organization
FBDGs	Food-based dietary guidelines
HAZ	Height-for-age z-score
HEI	Healthy eating index
HIV	Human immunodeficiency virus
IYCF	Infant and young child feeding
MoH	Ministry of Health
NISR	National Institute of Statistics of Rwanda
NWU	North West University
RDHS	Rwanda Demographic and Health Survey
UNICEF	United Nations Children's Fund
UHT	Ultra-high temperature
VAD	Vitamin A deficiency
WFP	World Food Programme
WHO	World Health Organization
WHZ	Weight-for-height z-score
WLZ	Weight-for-length z-score

CHAPTER 1 INTRODUCTION

1.1 Background and rationale

Stunting and micronutrient deficiencies in childhood are global undernutrition problems (Howson *et al.*, 1998; UNICEF, WHO, WBG, 2015) with short and long term consequences on both physical and cognitive development (Dewey & Begum, 2011; Bailey *et al.*, 2015). Undernutrition is one of the most important contributing factors to poor health among children in the world. In 2011, undernutrition was estimated to be an underlying cause in 45% of all deaths among children under five years, worldwide (Black *et al.*, 2003).

Globally, in 2014 stunting affected 159 million children under five years; that is one in four children. Looking at the trends from 1990 to 2014, while the prevalence of stunting reduced from 42.3% to 32% in children under five years living in Africa, the absolute number of stunted children under five years was on the rise, from 37 million to 58 million (UNICEF, WHO, WBG, 2015).

The United Nations Children's Fund's (UNICEF) conceptual framework for determinants of nutritional status, which was developed in the 1980s (UNICEF, 1990) and modified by Black *et al.* (2008), recognises the complexity of malnutrition due to the many contributing factors involved. This framework posits that inadequate dietary intake and disease constitute immediate causes of child undernutrition. It also acknowledges that household food insecurity, inadequate care, insufficient health services and an unhealthy environment are key underlying contributors to undernutrition (Black *et al.*, 2008). The period from conception through the first two years of life (the first 1000 days) is a critical period for a child, when stunting can develop as a consequence of malnutrition (Shrimpton *et al.*, 2001; Victora *et al.*, 2010; Prendergast & Humphrey, 2014). After the first 1000 days of a child's life, it becomes increasingly difficult to reverse stunting (Victora *et al.*, 2010). The period from six to 23 months of age is one of the most decisive periods for linear growth; it is also the time of peak stunting prevalence in developing countries (Dewey & Huffman, 2009; Victora *et al.*, 2010; Lartey, 2015). The high vulnerability to malnutrition of children aged six to 23 months is related to increased nutrient needs, hardly met by the poor complementary diets in developing countries (Gibson & Ferguson, 1998; Faber, 2005; Avallone *et al.*, 2007), and higher exposure to disease due to more mobility and independence of the infant.

In order to achieve optimal growth, development and health, infants should be exclusively breastfed for the first six months of life. Complementary foods should be introduced at six months while breastfeeding is continued up to two years or beyond (WHO & UNICEF, 2003).

From six to 23 months of age, the child is gradually introduced to foods and liquids provided along with breast milk, and progressively shifts from a milk-alone diet to consumption of family food (PAHO & WHO, 2003; WHO & UNICEF, 2003).

A considerable body of evidence suggests that interventions for reducing stunting should be undertaken during the 1000 days window of opportunity (Victora *et al.*, 2010; Black *et al.*, 2013). Interventions to improve breastfeeding and complementary feeding have been identified among the most effective for the survival and thriving of children less than two years (Jones *et al.*, 2003; Bhutta *et al.*, 2013; de Onis *et al.*, 2013).

Nutrition education given to caregivers can improve infant and young child feeding (IYCF) practices and nutritional status in developing countries (Dewey & Adu-Afarwuah, 2008; Shi & Zhang, 2011; Bhutta *et al.*, 2013). Food-based dietary guidelines (FBDGs) are nutrition education messages based on scientific evidence. FBDGs express the principles of nutrition education mainly in terms of foods, avoiding the technical terms of nutritional science, and are based on existing eating patterns of populations, with the aim to improve these patterns where necessary (WHO & FAO, 1998; Schneeman, 2001; Vorster *et al.*, 2001; Bourne *et al.*, 2007). FBDGs present information using language and symbols easily understandable to the general public, health providers and lay individuals (WHO & FAO, 1998). FBDGs as nutrition education tools have several advantages, including the fact that they are formulated to address specifically the diet-related health concerns of a population and take into account the cultural, economic and social context of the target population.

1.2 Situation in Rwanda

The most recent data on malnutrition among children, reported by the Rwanda Demographic and Health Survey (RDHS) of 2014/15 (NISR, 2015), showed a prevalence of 3.6% of wasting (weight-for-height measurement, indicative of acute undernutrition) among children aged six to 23 months. The prevalence of underweight (weight-for-age), which reflects both chronic and acute malnutrition, was 9.6%. The prevalence of chronic malnutrition or stunting (height-for-age) among children aged six to 23 months was 32.6%. Stunting affects 38% of children under five years in Rwanda, making it the most prevalent form of malnutrition in children (NISR, 2015).

In Rwanda, in the first six months of life, 10.5% of the children are affected by stunting. From about eight months of age, the prevalence of stunting increases dramatically and reaches 49% between 18 and 23 months. Among children aged 24 to 59 months, the prevalence of stunting remains high and stable, with a slight decrease (NISR, 2015).

Among infants below six months of age, 87% were exclusively breastfed in 2015; this prevalence was 85% in 2010 and 88% in 2005 (NISR, 2015). In 2015, overall breastfeeding (exclusive, predominant and partial breastfeeding) was 99% among infants below six months of age. Continued breastfeeding was also commonly practised, with 94% and 88% of children aged 12 to 17 months old and 18 to 23 months old being breastfed (NISR, 2015).

While breastfeeding indicators show good practices, optimal complementary feeding is poorly practised. The RDHS of 2014/15 found that only 57% of the infants six to eight months and 91% of children nine to 11 months of age had received solid, semisolid or soft foods the previous day. Only 18% of children aged six to 23 months met the criteria for a minimum acceptable diet (i.e. inclusion of at least four out of seven food groups in the diet and minimum meal frequency) in Rwanda (NISR, 2015). Another survey conducted in 2015 found that among Rwandan children of six to 23 months, nutrient-rich foods, including dairy products, flesh foods, fortified foods and eggs, were consumed by a low percentage (24%, 17%, 13% and 3%, respectively) the day before the survey (WFP, 2015).

Rwanda has no country-specific food-based dietary guidelines for adults or children, to address nutrition-related public health problems. Moreover, there is a paucity of detailed knowledge about complementary foods and nutrient intake of six-to-23-old children in Rwanda and the individual, contextual and societal level factors influencing feeding practices of primary caregivers of children of six to 23 months in Rwanda are poorly understood.

Information about food and nutrient intake and understanding of the factors influencing complementary feeding are crucial for developing effective interventions and nutrition education messages, which will improve feeding practices, and ultimately the nutritional status, of six-to-23-month-old children in Rwanda.

This thesis focuses on assembling the evidence base for the formulation of FBDGs to prevent and address malnutrition among six-to-23–month-old children in Rwanda.

1.3 Research aim and objectives

The primary aim of this study is to develop FBDGs for six-to-23-month-old Rwandan children. The FBDGs will be country-specific, affordable, culturally acceptable and based on available, traditional and indigenous foods.

To reach this primary aim, the following objectives were set:

- To determine the food, energy and nutrient intakes of six-to-23-month-old Rwandan children

- To identify and describe the factors that influence the caregivers regarding the feeding practices of six-to-23-month-old children
- To explore ways of reaching the target population in Rwanda to change feeding practices using the FBDGs as a nutrition education tool
- To formulate easily understandable FBDGs for the caregivers of six–to-23-month-old children
- To document the scientific evidence for each newly developed FBDG

1.4 Positioning of this study within a larger programme

This study is part of the UNICEF Rwanda programme: "Contributing to the reduction of stunting in children under two years in Rwanda". The programme was designed by a consortium of non-governmental organisations and the University of Rwanda, coordinated by UNICEF and funded by the embassy of the Kingdom of the Netherlands (EKN). Therefore, the programme will be referred to as the EKN programme hereafter. The research component of the EKN programme was coordinated by the University of Rwanda. The EKN programme was implemented in the most food insecure and with the highest prevalence of stunting districts in the country. Therefore, the present study was conducted in eight districts including those that were most food insecure and had the highest prevalence of stunting in Rwanda.

1.5 Ethics considerations

Ethics approval was granted by the Ethics Committee of the North West University, South Africa (NWU-00098-14-S1) and Rwanda National Ethics Committee (0251/RNEC/2015). Permission to conduct the study was granted by the Ministry of Local Governance. The researchers met administrative units (district, cell and village) leaders to explain the purpose of the study. The purpose of the study and the procedures were explained, and participants were given the opportunity to ask any question they had before signing the consent forms. Illiterate participants put a thumb print on the informed consent form.

Participation was voluntary. Participants could withdraw from the study at any time without any consequences for them.

1.6 Research team and contributions

The research team and their respective roles in the study are listed in Table 1-1.

Table 1-1 : Research team

Members of the research team	**Role**
Prof E Wentzel-Viljoen	Promoter of PhD thesis. Guidance regarding protocol and questionnaire development, data coding and analysis for dietary data. Guidance regarding writing of thesis and interpretation of results. Co-author of all manuscripts.
Prof HH Vorster	Co-promoter of PhD thesis. Guidance regarding protocol and questionnaire development. Guidance regarding writing of thesis and interpretation of results. Guidance regarding formulation of guidelines. Co-author of all manuscripts.
Prof L Havemann-Nel	Co-promoter of PhD thesis. Guidance regarding writing of thesis and interpretation of results. Co-author of all manuscripts.
Dr A Lyambabaje	Principal investigator of EKN programme baseline survey. Guidance regarding coordination and supervision of field data collection.
Ms R Laubscher	Assisted with the analysis of dietary data. Co-author of one manuscript.
Ms M Umugwaneza	PhD student. Responsible for protocol development, development of food and dietary intake questionnaires and focus group discussions. Responsible for food and dietary intake data collection, coding and analysis. Involved in fieldworker training, supervision of data collection and quality control of dietary data. Data analysis and interpretation of results. Leading author of all manuscripts.

1.7 Thesis outline

The structure of this thesis is in article format and it is divided into six chapters (including this one). The format and referencing style of the three articles (Chapters 3-5) are according to the respective journals' guidelines and these are indicated at the start of each chapter.

Chapter 1: Provides the background information, aim and objectives, outline of the thesis and information about the research team.

Chapter 2: This chapter reviews the problems of stunting and iron, zinc and vitamin A deficiencies in young children aged six to 23 months globally and in Rwanda. Current infant and young child complementary feeding recommendations and the relevance of FBDGs are reviewed.

Section 2.1: Describes the nutritional status of children and IYCF practices and their relevance in the context of Rwanda.

Section 2.2: This section focuses on IYCF practices recommended by the WHO and UNICEF to address malnutrition and reviews the situation of IYCF practices in Rwanda.

Section 2.3: This section reviews the relevance of nutrition education and FBDGs in African countries.

Chapter 3: The chapter presents the first article manuscript. The title of Manuscript 1 is "Complementary foods and nutrient intakes of children aged six to 23 months in Rwanda". This manuscript documents the complementary foods consumed and the energy and nutrients intakes from the complementary foods and breast milk in rural and semi-urban Rwanda. This manuscript will be submitted to the journal "Maternal and Child Nutrition". A content and style guideline for the journal "Maternal and Child Nutrition" is presented in Annexure 1.

Chapter 4: This chapter presents the second article manuscript. The title of manuscript 2 is "Factors influencing caregivers' complementary feeding practices in Rwanda: A qualitative study". In this manuscript, qualitative data, collected through focus group discussions, are analysed to explore the factors influencing feeding practices of primary caregivers of children of six to 23 months in Rwanda. Manuscript 2 will be submitted to the journal "Maternal and Child Nutrition". A content and style guideline for the journal "Maternal and Child Nutrition" is presented in Annexure 1.

Chapter 5: The chapter presents the third article manuscript. The title of manuscript 3 is "Proposed food-based dietary guidelines for six-to-23-month-old children in Rwanda". This

manuscript presents the proposed population-specific, food-based dietary guidelines for Rwandan children from six to 23 months old. Manuscript 3 will be submitted to the journal “Maternal and Child Nutrition”. A content and style guideline for the journal “Maternal and Child Nutrition” is presented in Annexure 1.

Chapter 6: This chapter comprises a conclusion that summarises the major findings of the study and makes recommendations.

The literature used in the thesis is contained in the list of references. References used in the manuscripts will be included as part of the manuscripts.

CHAPTER 2 LITERATURE REVIEW

2.1 Nutritional status

2.1.1 Stunting, wasting and undernutrition

Malnutrition is typically assessed by anthropometric measures that reflect stunting (height-for-age Z-score (HAZ)), wasting (weight-for-height Z-score (WHZ)) and/or underweight (weight-for-age Z-score (WAZ)). Malnutrition has significant negative consequences for many developing countries, particularly in terms of poor human health, lost human capital and decreased economic productivity (Alderman *et al.*, 2006; The World Bank, 2006; Dewey & Begum, 2011; Prendergast & Humphrey, 2014).

Stunting reflects failure to reach one's genetic potential for height. Stunting (low height-for-age) in childhood is the most prevalent form of undernutrition globally, affecting an estimated 165 million children under five years of age (Black *et al.*, 2013). Worldwide, 45% of mortality in children under five is attributable to various forms of malnutrition, of which stunting is a significant contributor (Black *et al.*, 2013). Stunting often begins in utero owing to poor maternal nutrition and continues during the first two years of life owing to inadequate hygiene and poor infant and young child feeding practices, among others (Frongillo, 1999). Children who are stunted are at increased risk of repeated infections, are more likely to die from diarrhoea, pneumonia or measles, and may be at increased risk in adulthood of chronic diseases such as cardiovascular disease (Black *et al.*, 2013; Olofin *et al.*, 2013; Prendergast & Humphrey, 2014).

Wasting is a condition characterised by a rapid reduction or loss of weight, caused by a combination of infection and a poor diet. In 2012, 51 million children under five years of age were wasted (WHO, 2012). Just over one-quarter of wasted children live in Africa (WHO, 2012). Underweight is influenced by both the weight-for-height and height-for-age ratio of a person, thus indicating wasting or stunting. In comparison with children with no anthropometric deficits, children with anthropometric deficits are at increased risk of death from diarrhoea, pneumonia, measles and other infectious diseases (Black *et al.*, 2013; McDonald *et al.*, 2013).

Figure 2-1 presents the prevalence of stunting, wasting and underweight among children under five years old in Rwanda.

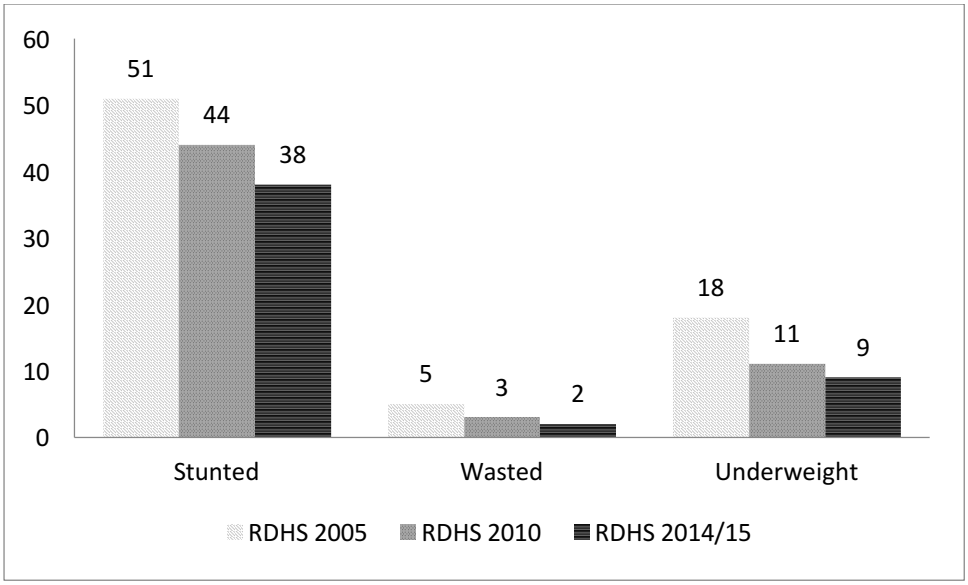

Figure 2-1: Percentage of malnourished children under five years of age (RDHS 2005, RDHS 2010, and RDHS 2014/15)

In Rwanda, the nutritional status of children under five years old has improved over the last decade. The prevalence of stunting decreased from 51% in 2005 to 38% in 2015. Over the same period, underweight decreased from 18% to 9% and wasting from 5% to 2%.

Surveys of the National Institute of Statistics of Rwanda and the World Food Programme show a marked rural-urban divide, with 40.6% of rural children being stunted, compared to 23.7% of urban children. Regions with the highest rates of food insecurity also have the highest rates of stunting: 44.9% and 40.5% in the western and southern provinces, while the lowest rates (22.7%) are in the city of Kigali (NISR, 2015; WFP, 2015).

Figure 2-2 shows that the prevalence of stunting in Rwanda increases dramatically between six and 22 months of age, which is the period of complementary feeding.

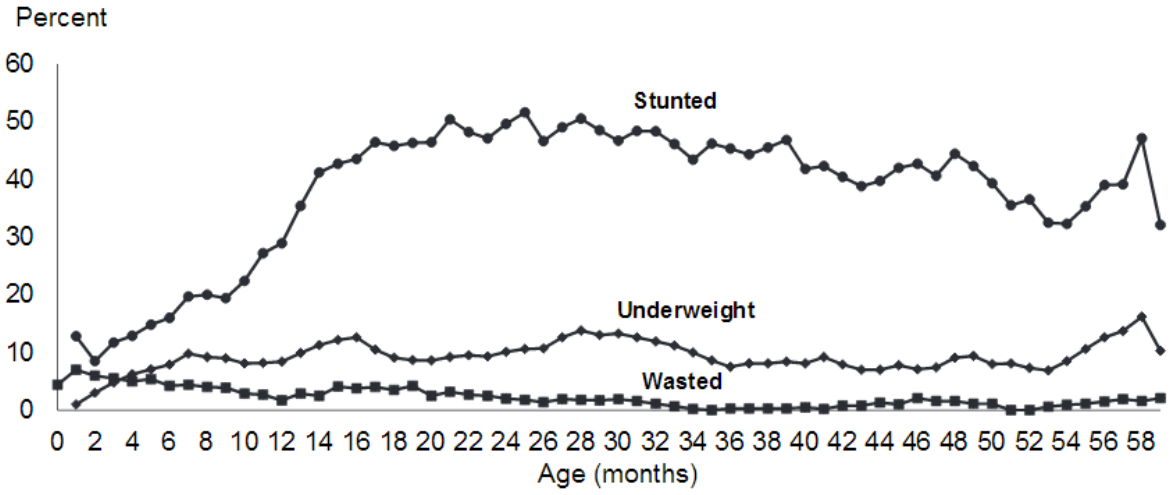

Figure 2-2 : Nutritional status of children by age (NISR, 2015)

The distribution of malnutrition by age shows a steep increase in the prevalence of stunting from birth to around 22 months. Thereafter there is a plateau and a slight decrease in the prevalence of stunting towards the age of five years. The prevalence of underweight and wasting remains relatively stable among children under five years. These data show that the prevalence of stunting increases during the complementary feeding period, a transitional period from breastfeeding to family food.

Thus, for children under five years in Rwanda, the prevalence of stunting, wasting, and underweight is very high, low and medium, respectively. This classification is according to the WHO classification for assessing the severity of malnutrition by prevalence ranges (de Onis & Blössner, 1997).

In comparison with other politically stable East African countries, the prevalence of stunting is higher in Rwanda. The prevalence of stunting is 34% and 26% in Tanzania and Kenya respectively. As in Rwanda, in Tanzania stunting increases with age from 14.4% among infants six to eight months old to 43.1% among children aged 18 to 23 months (MoHCDGEC, 2016). In Kenya, stunting increases with age from 12.3% among infants six to eight months old to 35.5% among children aged 18 to 23 months (National Bureau of Statistics of Kenya & ICF International, 2015)

This high prevalence of stunting in Rwanda should be addressed because stunted children are at higher risk of morbidity and mortality (Black et al., 2013; Olofin et al., 2013). Moreover, in comparison with a stunted child, a well-nourished child completes more years of schooling,

learns better and earns higher wages in adulthood (Dewey & Begum, 2011; Hoddinott *et al.*, 2013b).

Furthermore, it is estimated that young child malnutrition can cost countries from 4% to 11% of their GDP (Horton & Steckel, 2013).

The Sustainable Development Goals proposed by the United Nations (UN) member states set out a goal to "end hunger, achieve food security and improved nutrition, and promote sustainable agriculture" (Goal 2). That goal is accompanied by the aim to achieve by 2025 the internationally agreed targets on stunting and wasting in children under five years of age and put an end to all forms of malnutrition by 2030 (Target 2.2) (United Nations Division for Sustainable Development, 2015). Addressing child malnutrition, especially stunting, in the 1000 days opportunity window would help Rwanda to achieve that target.

2.1.2 Key micronutrients in the context of Rwanda

Micronutrient malnutrition affects an estimated two billion people worldwide, particularly pregnant women and young children (Howson *et al.*, 1998; Tulchinsky, 2010). In children, micronutrient deficiencies impair growth and lower resistance to infections (UNICEF & The Micronutrient Initiative, 2004).

Iron deficiency is considered to be the most common nutritional deficiency worldwide (Lopez *et al.*, 2016). Black *et al.* (2008) estimated that zinc and vitamin A deficiencies result in 6% and 4% of deaths of under-five children respectively, and concurrent multiple micronutrient deficiencies are estimated to be widespread in infants and young children in low- and middle-income countries (Lutter & Rivera, 2003; Muthayya *et al.*, 2013; Bailey *et al.*, 2015).

This overview will focus on iron, zinc and vitamin A. These nutrients are often not provided at an adequate level by complementary foods for children aged six to 23 months in developing countries (Gibson & Ferguson, 1998; Faber, 2005; WFP, 2015).

2.1.2.1 Iron

Iron is an essential component of haemoglobin in red blood cells and of myoglobin in muscles, which contain around 60% of total body iron. It is also essential for the functioning of various biochemical processes, including enzymatic processes, cell differentiation and growth, as well as mitochondrial energy generation (McDermid & Lönnerdal, 2012).

Iron deficiency is defined as a condition in which there are no mobilisable iron stores in the body and in which there is a compromised supply of iron to tissues, including the red blood

cells and their precursors in the bone marrow. The more severe stages of iron deficiency are associated with anaemia. Anaemia can be caused by iron deficiency but also other causes such as malaria and deficits in other nutrients, e.g. vitamins A, B12, C and folic acid (WHO, UNICEF, UNU, 2001). Deficiency in iron is thought to be the most common cause of anaemia (Lieu et al., 2001; Abbaspour et al., 2014).

Iron deficiency and anaemia in young children are associated with growth failure and anorexia, recurrent infections and impaired motor and cognitive delays (Lozoff et al., 2006; Kraemer & Zimmermann, 2007).

Iron deficiency is thought to be the most common nutritional deficiency globally. In most sub-Saharan African countries the prevalence of iron deficiency anaemia is estimated to affect from 40% to 60% of children under five years (UNICEF & The Micronutrient Initiative, 2004).

The 2014/15 RDHS found that younger children in Rwanda were most affected by anaemia (72% of children age six to 8 months), and the prevalence of anaemia decreased as the children grew up (21% of children aged 48 to 59 months). Overall, 37% of children aged six to 59 months in Rwanda had some level of anaemia (NISR, 2015). Iron deficiency is estimated to account for about one half of anaemia cases (WHO, 2001).

Iron deficiency can result from inadequate intake or absorption of dietary iron, increased need for iron in periods of growth or pregnancy, increased losses from menstruation, or infection with intestinal helminths such as schistosomiasis or hookworm infection, in areas where these infestations are endemic (Zimmermann & Hurrell, 2007; Camaschella, 2015). The most common causes of anaemia in Rwanda are inadequate dietary intake of iron, malaria and intestinal worm infection (NISR, 2015).

There are two types of dietary iron: haeme iron and nonhaeme iron. Haeme iron, which comes from haemoglobin and myoglobin in animal food sources, is more bioavailable. Its absorption is not affected by other constituents in the diet apart from calcium. Thus, haeme iron with an approximate absorption of 25% is efficiently absorbed from the diet (Zijp et al., 2000; McDermid & Lönnerdal, 2012). Good sources of haeme iron are meat, poultry, fish and eggs (WHO, 2005).

Nonhaeme iron, which is present in both plant and animal foods, is much less well absorbed than haeme iron. Inhibitors of nonhaeme iron absorption include phytates found in cereals and pulses (main inhibitor of iron absorption), polyphenols found in beverages such as tea and proteins such as milk proteins, eggs and soybeans. On the other hand, ascorbic acid present in fruits, juices, potatoes and some other tubers and other vegetables such as green leaves, cauliflower and cabbage is an enhancer of nonhaeme iron absorption (WHO, 2001; Hurrell &

Egli, 2010). Also, muscle tissue found in meat, fish, or poultry has been shown to have an enhancing effect on the absorption of iron from vegetarian meals (Hurrell & Egli, 2010).

Iron is required by infants to produce red blood cells in the first months after birth. Infants commonly use iron stored during the last months of gestation. A healthy term baby is born with sufficient iron stores for four months to balance the low iron concentration in human milk (Dorea, 2000). When the infant is four to six months of age, the stores can become low or depleted. This is exacerbated when there are inadequate iron stores due to low birth weight and prematurity (Long et al., 2012; Ferri et al., 2014); increased requirements from rapid growth and erythropoiesis; inadequate iron from the diet and blood loss due to intestinal parasitic infections (Zimmermann & Hurrell, 2007; Camaschella, 2015).

The highest probability of suffering iron deficiency is found in those parts of a population that have inadequate access to foods rich in absorbable iron during stages of high iron demand. These groups correspond to children, adolescents, and women of reproductive age, in particular during pregnancy (Lopez et al., 2016).

The main components of the infant and young child diet in low- and middle-income countries, including breast milk, plant-based complementary foods, and cow's milk, are all low in iron (Faber, 2005; Gibson et al., 2010; Victor et al., 2014). Moreover, phytate-rich whole flours often used in porridges in Sub-Saharan Africa, including in Rwanda, contain reduced bioavailable iron (Gibson & Ferguson, 1998; Gibson et al., 2010; Lung'aho et al., 2015).

In a survey conducted in Rwanda by Lung'aho et al. (2015), 81% of the mothers reported that they prepared cereal porridge for their children below two years of age. Another survey of 2015 found that among Rwandan children of six to 23 months flesh foods, fortified foods and eggs were consumed by 17%, 13% and 3% respectively (WFP, 2015). Therefore, the complementary diet of Rwandan children is probably low in bioavailable iron.

Strategies for preventing and correcting iron deficiencies in populations include nutrition education combined with dietary modification, to improve iron intake and bioavailability; iron supplementation, iron fortification of foods and biofortification (Lopez et al., 2016).

2.1.2.2 Zinc

Zinc is a dietary essential trace element with critical structural and functional roles in numerous enzyme systems that are involved in gene expression, cell division, immunologic functions and reproductive functions (Hess et al., 2009; Prasad, 2014). The human body has no specialized storage system for zinc, so consistent daily intake is required (Bailey et al., 2015).

Zinc deficiency is associated with impaired linear growth and increased morbidity and mortality due to infectious diseases (Black et al., 2003; Jones et al., 2003; Caulfield & Black, 2004; Prasad, 2014).

Because of the issues concerning the assessment of zinc status by biomarkers, little is known about the prevalence of zinc deficiency. Estimates of zinc inadequacy are largely based on the prevalence of child stunting, estimates of dietary intakes and the availability of zinc from the food supply. Globally, it is estimated that 17.3% of the population has inadequate zinc intakes, with the highest estimates in Africa (23.9%) and Asia (19.4%) (De Benoist et al., 2007; Bailey et al. 2015).

Suboptimal dietary zinc intake is increasingly recognised as an important public health issue (Brown et al., 2001; Prasad, 2003; Hess et al., 2009), affecting between one-third and one-half of the world population (Brown et al., 2001). No zinc deficiency prevalence data are available on Rwanda. Good food sources include organs and/or flesh meat, poultry, fish and shellfish, and to a lesser extent eggs and dairy products.

Three major factors are responsible for the development of zinc deficiency in developing countries: dietary inadequacies; disease states that induce excessive losses or impaired utilization of zinc; physiological states that increase zinc requirements (Gibson, 2006).

According to the International Zinc Nutrition Consultative Group (IZiNCG), zinc deficiency is largely due to insufficient dietary zinc intakes, caused by reliance on low zinc content foods or phytate-rich foods. Phytic acid is the main known inhibitor of zinc absorption (IZiNCG, 2004). Zinc bio-availability, in healthy individuals, it is determined by three factors: the individual's zinc status, the total zinc content of the diet, and the availability of soluble zinc from the diet's food components.

Zinc deficiency can also be caused by excess losses of zinc due to frequent diarrhoeal diseases (Caulfield & Black, 2004).

Plant sources are nuts, seeds, legumes and whole-grain cereals (IZiNCG, 2004). As in the case of iron, the complementary diet of Rwandan children is probably low in bioavailable zinc.

In many low-income countries, Rwanda included, cereal foods are commonly then used for complementary feeding. These foods have low content of total and absorbable zinc and thus, fail to meet the needs for zinc.

In low- and middle-income countries, infants and young children are at increased risk of zinc deficiency because of increased requirements for tissue growth, coupled with limited consumption of zinc-rich food (Gibson et al., 2010).

Pregnant women and their young children are the highest-risk groups for zinc deficiency (De Benoist et al., 2007; Bailey et al., 2015).

Compared to adults, infants, children, adolescents, pregnant and lactating women have increased requirements for zinc and thus, are at increased risk of zinc deficiency (IZiNCG, 2004).

Healthy exclusively breast-fed infants obtain sufficient zinc from breast milk for the first five to six months of their life. After this age, complementary foods containing absorbable zinc are required to satisfy their requirements (Krebs & Westcott, 2002). In many low-income countries, complementary feeding is delayed and cereal foods are then used for feeding. These foods have low content of total and absorbable zinc and thus, fail to meet the needs for zinc (IZiNCG, 2004).

Given that chronic inadequate dietary intake of zinc is the most likely cause of zinc deficiency, quantitative dietary intake surveys to evaluate zinc intake are useful to evaluate the risk of zinc deficiency in populations. Based on the type and bioavailability of the diets, the risk of zinc deficiency is estimated by comparing the intakes with the respective EAR values. The risk of zinc deficiency in populations is considered to be elevated when the prevalence of inadequate intake is >25% (Wessells & Brown, 2012; Roohani et al., 2013).

2.1.2.3 Vitamin A

Vitamin A consists of a group of lipid-soluble vitamins that are essential for the normal functioning of the visual system and maintenance of cell function for growth, epithelial integrity, red blood cell production, immunity and reproduction (Sommer & West, 1996; Semba & Bloem, 2002).

Infants and young children have increased vitamin A requirements to support rapid growth and combat infections. Vitamin A deficiency (VAD) affects especially young children, in whom it limits growth and causes anaemia and depressed immunity. VAD can cause xerophthalmia and lead to blindness. VAD is also associated with increased risk of mortality from measles and diarrhoea in children (Sommer & West, 1996). VAD results from a combination of low

dietary intake of preformed vitamin A from animal products and carotenoids from fruit and vegetables, malabsorption and high excretion rates due to illnesses (Rice *et al.*, 2004).

Worldwide, VAD affects an estimated 21% of children of preschool age (Rice *et al.*, 2004) and approximately 30% of preschool children in developing countries suffer from sub-clinical vitamin A deficiency (UNICEF & The Micronutrient Initiative, 2004).

There are no population survey data on VAD in Rwanda, but it is estimated that 42% of preschool children in Rwanda suffer from VAD (WHO, 2009).

Dietary vitamin A is obtained from two sources: preformed vitamin A and vitamin A precursors. Pre-formed vitamin A includes retinol, retinal, retinoic acid and retinyl esters, which are available from animal source foods. Conversely, vitamin A precursors, also known as carotenoids, are available in plant foods.

Plants synthesise hundreds of carotenoids, but only some act as vitamin A precursors. β-Carotene is the most important carotenoid owing to its vitamin A activity compared with other carotenoids, and its widespread availability in the diet (Haskell, 2012).

Food sources are eggs, milk, liver, deep orange fruits and dark green leafy vegetables (Rice *et al.*, 2004). The 2014/15 RDHS found that 74% of children aged six to 59 months had consumed food rich in vitamin A in the 24 hours before the survey (NISR, 2015).

The WHO recommends vitamin A supplementation for infants and young children living in settings where VAD is a public health problem. The recommended dose is 30 mg retinol equivalents (RE) for infants aged six to 11 months and 60 mg RE at least twice a year for young children aged 12 to 59 months (WHO, 2011). In 2015, the majority (86%) of children aged six to 59 months had received vitamin A supplements in the six months preceding the RDHS interview day (NISR, 2015).

2.2 Breastfeeding and complementary feeding practices

Recognising the importance of optimal IYCF practices for child survival, growth and development, the WHO in 2003 launched the Global Strategy for Infant and Young Child Feeding (WHO & UNICEF, 2003) and the Guiding Principles for Complementary Feeding of Breastfed and Non-Breastfed Children (PAHO & WHO, 2003; WHO, 2005). These two global frameworks describe key guidelines for optimal IYCF practices. In 2008, indicators for assessing IYCF practices were launched (WHO, 2008) for monitoring and evaluation purposes.

2.2.1 Guiding principles for optimal infant and young child feeding practices

2.2.1.1 The importance of continued breastfeeding after six months

The WHO recommends exclusive breastfeeding for the first six months of an infant's life (WHO & UNICEF, 2003). At about six months of age, the supply of energy and some nutrients from breast milk alone is no longer adequate to meet an infant's needs (Brown *et al.*, 1998). Therefore, safe and appropriate complementary foods should be introduced to children at six months, alongside continued breast feeding until they are two years of age or older (PAHO & WHO, 2003; WHO & UNICEF, 2003).

Breastfeeding, especially exclusive breastfeeding in the first six months of life, has a range of advantages including nutritional, immunological and cognitive benefits for the baby, making it the cornerstone of good infant nutrition, health and survival (Anderson *et al.*, 1999; WHO Collaborative Study Team on the Role of Breastfeeding on the Prevention of Infant Mortality, 2000; Kramer & Kakuma, 2002; Victora *et al.*, 2016).

For children aged six to 23 months, breast milk remains the most appropriate liquid part of a progressively diversified diet for the vast majority of children (PAHO & WHO, 2003; WHO & UNICEF, 2003).

The human milk nutrient composition appears to become relatively constant after four months of lactation; the mean macronutrient composition of mature milk is approximately 9 to 12 g/l for protein, 32 to 36 g/l for fat and 67 to 78 g/l for lactose. The energy density of breast milk is 0.67 kcal/g. In terms of micronutrients, mature breast milk contains 0.3 mg/l of iron and 1.7 µmol/l of vitamin A, but zinc decreases from 1 mg/l at six months to 0.5 mg/l at 12 months (Butte *et al.*, 2002; Ballard & Morrow, 2013).

Breast milk also contains a variety of bioactive components including growth factors, growth-regulating hormones and immunological factors for protection against infections and inflammation (Ballard & Morrow, 2013).

For non-breastfed children aged six to 23 months or children for whom breastfeeding will stop before the recommended duration of two years or beyond, the WHO (2005) recommends milk sources such as full cream milk, fermented milk or yoghurt or commercial infant formula.

2.2.1.2 Responsive feeding

Responsive feeding is the process of paying attention, recognising and guiding infant's cues for hunger and fullness and responding to them appropriately. This process is driven by active communication and interaction between the infant or child and the caregiver (Black & Aboud,

2011; Harbron *et al.*, 2013). Responsive feeding is essential for the child's learning to eat (Birch & Doub, 2014).

2.2.1.3 Good hygiene and proper food handling

In low- and middle-income countries, poor hygiene of complementary foods and inadequate hygienic conditions contribute to child malnutrition through episodes of diarrhoea and possibly a chronic subclinical disorder of the small intestine known as environmental enteropathy (Humphrey, 2009; Buchsbaum *et al.*, 2016; Mbuya & Humphrey, 2016).

The WHO recommends practising good hygiene and proper food handling by (a) Washing caregiver's and children's hands before food preparation and eating; (b) Storing foods safely and serving foods immediately after preparation; (c) Using clean utensils to prepare and serve food; (d) Using clean cups and bowls when feeding children; and (e) Avoiding the use of feeding bottles, which are difficult to keep clean (PAHO & WHO, 2003).

2.2.1.4 Energy and nutrient density (amount, frequency, consistency)

Energy density refers to the amount of calories in a gramme of food and nutrient density refers to the concentration of a nutrient in 100 kcal of food. Current recommendations of total energy intake (EI) for healthy infants and young children are 615 kcal/d, 686 kcal/d and 894 kcal/d, at six to eight months, nine to 11 months and 12 to 23 months of age respectively (Dewey & Brown, 2003; Lutter & Dewey, 2003).

Breast milk remains an important source of energy during the complementary feeding period. In developing countries, the estimated mean energy consumed from breast milk at six to eight months is 403 kcal/d for partially breastfed infants and 483 kcal/d for exclusively breastfed ones (413 kcal/d on average for both exclusively and partially breastfed children). Partially breastfed children get an estimated 379 kcal/d from breast milk at nine to11 months of age and 346 kcal/d at 12 to 23 months of age (Brown *et al.*, 1998).

Thus, for breastfed children, energy requirements from complementary foods are 202, 307 and 548 kcal/d for ages six to eight, nine to 11 and 12 to 23 months respectively.

The frequency of feeding required for breastfed children to meet the daily energy requirements from complementary foods depends on the energy density of the available local foods. Children in all age groups should be able to consume enough energy if they receive at least three meals per day, with a minimum energy density of 1.0 kcal/g. With a minimum energy density of 0.80 kcal/g, children from six to 11 months of age would be able to satisfy their energy needs from complementary foods if they received at least three meals per day,

whereas those from 12 to 23 months of age would need to receive at least four meals per day (Dewey & Brown, 2003).

For the average healthy breastfed infant, the WHO guideline recommends two to three meals per day at six to eight months of age and three to four times per day at nine to 11 and 12 to 23 months of age, with additional nutritious snacks offered once or twice per day, as desired (PAHO & WHO, 2003). For the average healthy non-breastfed infant, WHO guidance is to offer meals four to five times per day, with additional nutritious snacks offered once or twice per day, as desired (WHO, 2005). However, in practice, caregivers do not know the precise amount of breast milk consumed, nor are they able to measure the energy content of complementary foods. Therefore, the amount of food to be offered should also be based on the principles of responsive feeding (PAHO & WHO, 2003). As a general principle, when the energy density of complementary foods is higher, fewer meals can be provided daily; conversely, when more meals are offered daily, energy requirements can be met with complementary diets of lower energy density.

The complementary diet should also be nutrient dense, to support the rapid growth and development of children below two years of age. For infants of six to eight months in developing countries, when assuming that the average energy need from complementary food is 200 kcal/d, with an average intake of breast milk, the minimum target nutrient density for iron and zinc is 4.5 mg/100 kcal and 1.14 mg/100 kcal respectively. At nine to 11 months, because the expected intake from complementary foods increases, the desired nutrient densities fall to 1.0 and 0.46 mg/100 kcal, for iron and zinc respectively (Dewey, 2013).

Non-breastfed infants need a daily intake of approximately 200 to 400 ml of milk if adequate animal source foods are consumed, or 300 to 500 ml of milk if animal source foods are not consumed regularly. Milk sources include full-cream animal milk, ultra-high temperature (UHT) full-fat milk, reconstituted full-fat evaporated (not condensed) milk, fermented milk or yoghurt and expressed breast milk (breast milk should be heat-treated if the mother is HIV-positive) (WHO, 2005).

The recommended intake for infants and young children aged six to 23 months is 6.2 to 18.6 mg/d of iron (depending on iron bioavailability), 4.1 mg/d of zinc (assuming average bioavailability) and 400 µg RE/d of vitamin A (Joint FAO/WHO Expert Consultation on Human Vitamin and Mineral Requirements, 2004). Table 2-1 presents the recommended energy, nutrient intake and desired nutrient densities of complementary foods for children of six to 23 months.

The WHO recommends that children consume a variety of complementary foods to meet their energy and nutrients needs (PAHO & WHO, 2003).

The consistency of food should be semi-solid/pureed at first, then lumpy solid foods should be offered until the child is able to eat family foods of solid consistency by around 12 months (PAHO & WHO, 2003; WHO, 2005).

Table 2-1 : Recommended energy, nutrient intake and desired nutrient densities of complementary foods for children of six to 23 months

	6 to 8 months	9 to 11 months	12 to 23 months
Recommended daily energy intake[1]			
Energy (kcal)	615	686	894
RNI[1]			
Protein (g)	9.9	9.9	13
Calcium (mg)	400	400	500
Iron[2] (mg)	9.3	9.3	5.8
Zinc[3] (mg)	4.1	4.1	1.1
Vitamin C (mg)	30	30	30
Thiamin (mg)	0.3	0.3	0.5
Riboflavin (mg)	0.4	0.4	0.5
Niacin (mg)	1.5	4	6
Vitamin B6 (mg)	0.3	0.3	0.5
Folate (mcg)	80	80	160
Vitamin B12 (mcg)	0.5	0.5	0.9
Vitamin A RAE (mcg)	500	500	300
Vitamin A, RE	400	400	400
AMDR[1]			
Fat, % kcal			30-40
Protein, % kcal			5-20
Carbohydrate, % kcal			45-65
Average desired nutrient density[1]			
Protein	1	1	0.9
Calcium	105	74	63
Iron[2]	4.5	3	1
Zinc	1.6	1.1	0.6
Vitamin C	1.5	1.7	1.5
Thiamin	0.08	0.06	0.07
Riboflavin	0.08	0.06	0.06
Niacin	1.5	1	0.9
Vitamin B6	0.12	0.08	0.08
Folate	11	9	21
Vitamin A, RE	31	30	23

AMDR, acceptable macronutrient distribution range, RE, retinol equivalent; RNI, Recommended nutrient intake
[1]Energy and recommended nutrient intakes and densities used are those proposed by FAO/WHO (2002) and for protein and AMDR those proposed by Otten *et al.* (2006)
[2]Assuming medium bioavailability (10%)
[3]Assuming moderate bioavailability (30%)

2.2.1.5 Feeding during and after illness

Children are often fed less frequently and/or lower quantities of complementary foods during and after common illnesses (Brown *et al.*, 1990; Paintal & Aguayo, 2016). The WHO recommends increasing fluid intake during illness, and more frequent breastfeeding. Continued consumption of complementary foods is recommended to maintain nutrient intake and enhance recovery (PAHO & WHO, 2003; WHO, 2005).

Box 2-1 and **Box 2-2** present the lists of feeding guidelines of breastfed and non-breastfed children six to 23 months old.

Box 2-1: Guiding principles for complementary feeding of breastfed children six to 23 months of age (PAHO & WHO, 2003)

- Practise exclusive breastfeeding from birth to six months of age, and introduce complementary foods at six months of age (180 days) while continuing to breastfeed.
- Continue frequent, on-demand breastfeeding until two years of age or beyond.
- Practise responsive feeding, applying the principles of psychosocial care.
- Practise good hygiene and proper food handling.
- Start at six months of age with small amounts of food and increase the quantity as the child gets older, while maintaining frequent breastfeeding.
- Gradually increase food consistency and variety as the infant grows older, adapting to the infant's requirements and abilities.
- Increase the number of times that the child is fed complementary foods as the child gets older.
- Feed a variety of nutrient-rich foods to ensure that all nutrient needs are met.
- Use fortified complementary foods or vitamin-mineral supplements for the infant, as needed.
- Increase fluid intake during illness, including more frequent breastfeeding, and encourage the child to eat soft, favourite foods. After illness, give food more often than usual and encourage the child to eat more.

Box 2-2: Guiding principles for feeding non-breastfed children six to 23 months of age (WHO, 2005)

- Ensure that energy needs are met.
- Gradually increase food consistency and variety as the infant gets older, adapting to the infant's requirements and abilities.
- For the average healthy infant, meals should be provided four to five times per day, with additional nutritious snacks offered once or twice per day, as desired.
- Feed a variety of foods to ensure that nutrient needs are met.
- As needed, use fortified foods or vitamin-mineral supplements (preferably mixed with or fed with food) that contain iron.
- Non-breastfed infants and young children need at least 400–600 ml/day of extra fluids in a temperate climate, and 800–1200 ml/day in a hot climate.
- Practise good hygiene and proper food handling.
- Practise responsive feeding, applying the principles of psychosocial care.
- Increase fluid intake during illness and encourage the child to eat soft, varied, appetising, favourite foods. After an illness, give food more often than usual and encourage the child to eat more.

2.2.2 Current situation of infant and young child feeding practices in Rwanda

Using the 2008 WHO IYCF indicators of complementary feeding practices (WHO, 2008) defined in Annexure 2, the RDHS of 2014/15 found that 81% of children are breastfed within one hour of birth, and almost all the children (99%) born in the two years preceding the survey were breastfed at some point in time. Among the infants under six months who were not exclusively breastfed, 6% were given non-milk liquids and juice, 3% were given other milk, 2% were given complementary foods and 1% were given plain water only (NISR, 2015).

Practically all mothers (99%) reported they were breastfeeding their children of nine to 11 months. This proportion subsequently declined to 94% and 88% among children aged 12 to 17 months and 18 to 23 months respectively (NISR, 2015). The complementary feeding indicators, based on 24-hour recall of the child's dietary intake, were in general at a lower level compared to the breastfeeding indicators. For example, the indicator "Introduction of solid, semi-solid or soft food" shows that only 57% of the infants six to eight months of age had received complementary food the previous day. This is a point of concern because meeting the complementary feeding guidance to introduce solid foods at six to eight months of age was highly associated with lowered risk of stunting and underweight in an analysis of associations between WHO IYCF indicators and growth measures in 14 low-income countries (Marriott *et al.*, 2012). Table 2-2 shows the proportions of children aged six to 23 months meeting the eight core WHO IYCF indicators.

Table 2-2 : Proportion of children achieving WHO IYCF indicators in Rwanda, as reported by the RDHS 2014/15 (NISR, 2015)

Breastfeeding indicators	**Proportion meeting the criteria**
1. Early initiation of breastfeeding	81%
2. Exclusive breastfeeding under six months	87%
3. Continued breastfeeding at 12 to 17 months	94%
Complementary feeding indicators	**Proportion meeting the criteria**
4. Introduction of solid, semi-solid or soft foods (the proportion of infants six to eight months of age who received solid, semi-solid or soft food in the previous 24 hours)	57%
5. Minimum dietary diversity (the proportion of children six to 23 months of age who received foods from four or more food groups. The seven food groups used for tabulation of this indicator are in Annexure 2.)	30%
6. Minimum meal frequency	47%
7. Minimum acceptable diet (six to 23 months)	18%
8. Consumption of iron-rich or iron-fortified foods	20%

Minimum dietary diversity (proportion of children six to 23 months of age who received foods from four or more food groups during the previous day) was positively associated with HAZ (indicating stunting) in several studies on IYCF indicators and anthropometry (Jones *et al.*, 2014).

The minimum acceptable diet indicator is a composite indicator calculated from the following two fractions: breastfed children six to 23 months of age who had at least the minimum dietary diversity and the minimum meal frequency in the previous 24 hours, and non-breastfed children six to 23 months of age who received at least two milk feedings and had at least the minimum dietary diversity not including milk feeds and the minimum meal frequency in the previous 24 hours.

Less than a quarter of children had the minimum acceptable diet the day before the survey, as shown in Figure 2-3. Only 18% of children aged six to 23 months met the criteria for a minimum acceptable diet in Rwanda (NISR, 2015).

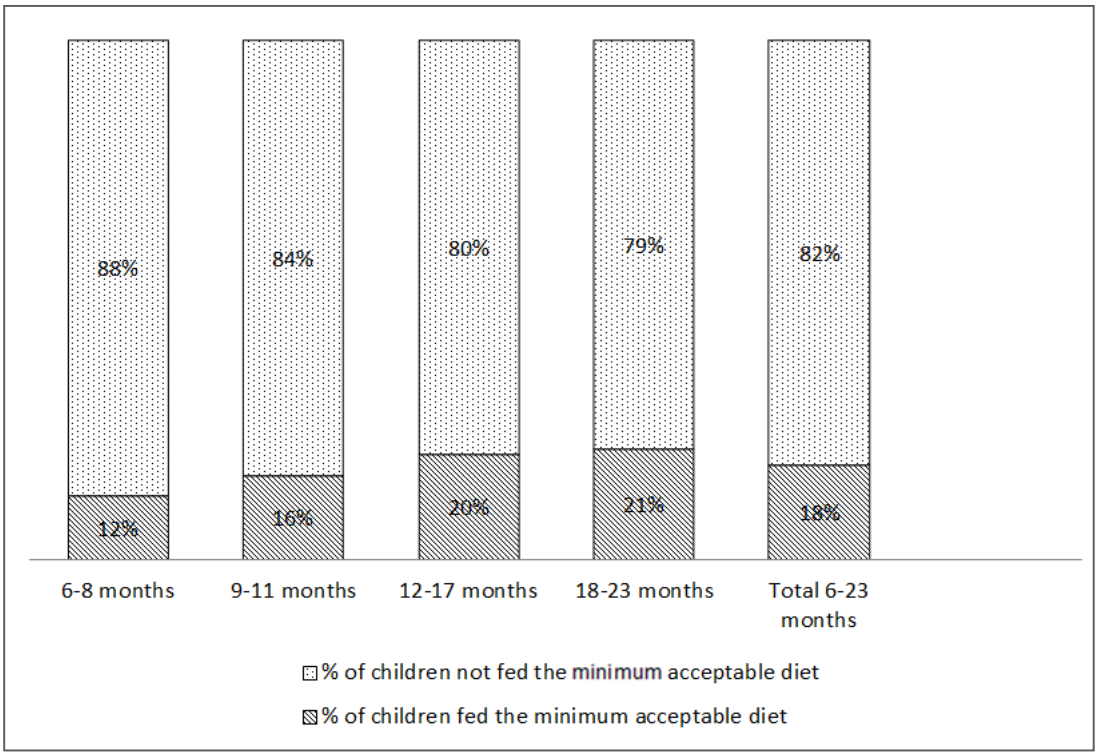

Figure 2-3 : Minimum acceptable diet by age (NISR, 2015)

The composite indicator of minimum adequate diet appears to be driven by lower rates of minimum dietary diversity rather than minimum meal frequency (Marriott *et al.*, 2012; Senarath *et al.*, 2012; Heidkamp *et al.*, 2015).

Cereal-based gruels (thin porridges) are very common in the complementary diet in Rwanda. In a survey conducted in 2014, the majority (81%) of the mothers reported that they prepared porridge for their children (Lung'aho *et al.*, 2015). As those porridges are very viscous, the caregivers tend to dilute them excessively, thus reducing their energy and nutrient density (Kikafunda & Walker, 1997; Amagloh *et al.*, 2013).

Another survey done in 2015 found that among Rwandan children of six to 23 months, nutrient-rich foods were consumed by a low percentage of the children the day before the survey. Dairy products, flesh foods, fortified foods (fortified porridge) and eggs were consumed, respectively, by 24%, 17%, 13% and 3% of the children (WFP, 2015).

In 2015, 80% of all households were food secure, 74% of households in Rwanda practised agriculture (including 88% of rural households) and the vast majority of agricultural households grew beans (88%), followed by maize (49%) and sweet potatoes (45%) (WFP, 2015). In Rwanda beans (mainly varieties such as red kidney beans and pinto beans) are left to mature and dry on the vine before harvest. Maize grains are also dried and milled.

2.3 Nutrition education and food-based dietary guidelines

Nutrition education is any combination of educational strategies to increase awareness or knowledge, provide skills and a supportive environment. It is designated to facilitate behaviour change or voluntary modification of dietary practices as the intended outcome (Contento, 2008; Hawkes, 2013; McNulty, 2013).

Nutrition education has been shown to improve the nutritional status in various populations (Contento *et al.*, 1995; Dewey & Adu-Afarwuah, 2008; Abizari *et al.*, 2014). In their review of 15 interventions, Shi and Zhang concluded that nutrition education interventions that are culturally sensitive, accessible and integrated with local resources improve complementary feeding behaviour and child growth (Shi & Zhang, 2011). Imdad *et al.* (2011) also demonstrated that maternal nutritional counselling leads to a significant increase in weight and height in children aged six to less than 24 months.

The above literature shows that educational interventions improve feeding practices, which then lead to improved growth outcomes.

2.3.1 Current nutrition education tools for infant and young child feeding in Rwanda

The most common IYCF education materials in use in Rwanda are those formulated by UNICEF, known as the Maternal Infant and Young Child Feeding (MIYCF) counselling package. The MIYCF counselling package is a set of materials on feeding recommendations

initially developed by UNICEF for community IYCF counselling by community health workers. The technical content of the package includes the guidelines for infant feeding in the context of HIV (WHO *et al.*, 2010).

The MIYCF education materials in Rwanda address the nutrition of children aged six to 23 months. Four food groups are shown in the counselling cards:

1 Vegetables and fruit
2 Meat, fish, eggs and milk products
3 Cereals and tubers
4 Legumes and nuts

Caregivers are advised to continue to breastfeed their infants on demand day and night. They are advised to introduce a variety of foods starting with staple foods. The cards also indicate the frequency of feeds (e.g. twice a day at six months, three times a day from six to nine months) and the amount recommended for each age group (e.g. two to three tablespoons per feeding at six months, half a 250 ml cup from six to nine months).

In addition, behavioural recommendations on hygiene and the consistency of the foods are given. A detailed description of the content of the UNICEF IYCF counselling package used in East African countries is given in Annexure 3. The focus is only on the recommendation related to the six-to-23-months age group.

In Rwanda, however, there is a mismatch between the food grouping in the UNICEF counselling cards and the community nutrition education messages that are still based on the three food groups classification.

The three food groups classification is based on body functions. The first group consists of energy-giving foods. Energy-giving foods are those that contain carbohydrates and fats. The second group consists of body-building foods. These are foods that contain animal source proteins (meat, chicken and milk) and vegetable proteins (Pulses). The third group consists of disease fighting/protective foods. These are foods that contain minerals and vitamins. Examples include vegetables and fruits. However, this food grouping has many shortcomings. For example, many foods belong to more than one group. Milk is usually in the body building group, but it is also rich in fat, and it contains calcium and vitamins. Moreover, people need to eat both carbohydrates and fat (essential fatty acids), and because both are classified in the energy giving group it is not clearly emphasized that both are needed by the body (King et al., 2015).

2.3.2 Food-based dietary guidelines

FBDGs are nutrition education tools based on scientific evidence. FBDGs express the principles of nutrition education mainly as foods; they avoid the technical terms of nutritional science and should be based on existing eating patterns of populations, with the aim to improve these patterns where necessary (WHO/FAO, 1998:). FBDGs are intended to be understandable for the general public and are often integrated with other health-promoting messages, concerning for example physical activity and hygiene. In general, FBDGs aim to guide the entire apparently healthy population in following nutrition and nutrition-related health recommendations. They aim at informing the population on how to get sufficient nutrients from their diet, avoiding deficiencies and excess (WHO/FAO, 1998).

Developing FBDGs is a comprehensive process, requiring a number of steps and skills. The development of FBDGs should follow a process to ensure that the guidelines are owned by both the nutrition education implementing partners and the population (Albert *et al*., 2007). In the process of developing FBDGs for Rwandan children of six to 23 months, the WHO/FAO (WHO/FAO, 1998) steps for developing FBDGs in **Box 2-3** have been adopted where relevant. The later steps of testing, implementing and evaluating FBDGs are beyond the scope of this thesis.

Box 2-3 : WHO/FAO process for development of FBDGs (WHO/FAO, 1998)

- Form a working group.
- Set nutritional objectives based on nutrition-related diseases, availability of food and the food intake patterns of the country.
- Formulate a preliminary set of FBDGs.
- Pilot-test understanding of FBDGs with consumer groups, and revise as needed.
- Compile technical support documents for each FBDG (scientific evidence).
- Finalise technical support documents, submit to national and international interest groups for comment, and consider inputs.
- Conclude, adopt, publish and disseminate final set of FBDGs.
- Implement FBDGs.
- Monitor impact of FBDGs on eating patterns.

Because “people eat food, not nutrients”, as pointed out by the late Doris Calloway during an international congress in 1970, nutrition education messages should be food-centred rather than nutrient-centred (King, 2003). Therefore, public nutrition education messages have shifted from a nutrient-based focus to a food-based focus since the 1980s (Anderson *et al*.,

2003). However, quantitative recommendations such as the dietary recommended intakes are still needed to validate the adequacy of food intake of the target population (Schneeman, 2003:5).

In general, FBDGs comprise a series of easily understandable messages and a visual representation to facilitate the interpretation of the messages. FBDGs recommend the consumption of food on the basis of country-specific epidemiological data, food consumption patterns and the most recent scientific evidence on the diet-health relationship (WHO & FAO, 1998; Vorster *et al.*, 2001; Albert *et al.*, 2007). The purpose of FBDGs is to give scientific, evidence-based nutrition advice to the general public by using a common language understood by the intended users. FBDGs for children target the caregivers of children.

FBDGs are formulated to address the needs of specific age ranges. One set of FBDGs cannot address all ages within a population because different age groups have different nutritional needs and dietary patterns. Usually, FBDGs for the different ages within the total range not only give advice on what should be eaten, but also behavioural and lifestyle recommendations (Montagnese *et al.*, 2015).

Because of the many factors to be taken into account for the development of FBDGs, such as nutrients needs of the population, problem nutrients for the vulnerable groups within the population, accessibility of food, and dietary patterns, complex mathematical models have been developed and used in the formulation of FBDGs and food-based recommendations (Darmon *et al.*, 2002; Ferguson *et al.*, 2004; Santika *et al.*, 2009).

In general, the promotion of FBDG has not always been accompanied by evaluation measures (Keller & Lang, 2008; Sirichakwal *et al.*, 2011; Fuster, 2015). A few studies attempted to assess the effect of adherence to FBDGs on health outcomes, but none was about children aged six to 23 months. McCullough *et al.* (2000) observed a moderately inverse association between adherence to the dietary guidelines for Americans and cardio-vascular disease, but there was no association with cancer risk in a cohort of female adults in the USA. As noted by the authors, the healthy eating index used to measure adherence was not optimal in defining a healthy diet (McCullough *et al.*, 2000). Besides, it would be difficult to establish a direct relationship between the population's diet and the promotion of FBDGs, because dietary patterns are influenced by several factors. Therefore, the question of whether FBDGs translate into improved nutritional status cannot be answered yet.

By asking consumers about the influence of FBDGs on their dietary behaviour and their subjective understanding and use of FBDGs, researchers took a step closer to the implementation of FBDGs.

In a review of 28 studies from developed and developing countries, consumers were found to have a certain level of awareness and understanding of FBDGs, but the reported use of FBDGs was generally limited (Brown *et al.*, 2011).

The limited use could be explained in several ways; firstly, awareness does not directly translate into improved dietary intake because the consumer takes into account many other factors such as preference, availability and convenience. Schönfeldt et al. (2013) showed that FBDGs alone have little relevance in such circumstances where financial means limit food choice. Secondly, the consumer may encounter difficulty in understanding abstract concepts such as portion sizes or sedentary life (Nicklas *et al.*, 2013). Another challenge in the adoption of FBDGs by the population is the influence of marketing and advertisement on individual food choices. As noted by Smitasiri and Uauy (2007), the resources dedicated to the marketing of unhealthy diets are between 100- and 1000-fold greater than the funds dedicated to supporting the dietary patterns based on FBDGs.

To date, there has not been much systematic assessment of impact, information on how FBDGs are actually implemented by countries, or detailed guidance on how implementation should be done (UNSCN, 2017).

2.3.2.1 An overview of food-based dietary guidelines in Africa

While nutritional deficiencies continue to be highly prevalent in low- and middle-income countries, there is an increasing prevalence of cardiovascular diseases, obesity, diabetes, and cancer; presumably due to changing lifestyles, food habits and environmental factors (Steyn & Mchiza, 2014; International Food Policy Research Institute, 2016). In general, FBDG in African countries aim to assist the healthy population of two years and above in following nutrition and related health recommendations. The guidelines focus on food groups and lifestyle behaviours, especially hygiene and physical activity.

On the African continent only five countries, namely South Africa, Seychelles, Namibia, Nigeria and Benin, have so far made their FBDGs available on the FAO website and these will be discussed below. This overview focuses therefore on FBDGs from the five countries mentioned above. The identified FBDGs were published between 2000 and 2015 by nutrition and health authorities in the respective countries. Table 2-3 contains more details on the

FBDGs in African countries. Although some of the FBDGs of African countries have were launched as early as the year 2000, their impact has not yet been evaluated.

Recommendations and supporting materials

In general, the FBDGs of African countries consist of food-related as well as lifestyle- or behaviour-related recommendations. FBDGs of African countries target mainly the general population over two or five years of age. Only the FBDGs of Nigeria and Benin address the specific needs of children under two years and pregnant women.

Visual aids

In all countries, FBDGs are accompanied by food guides (also called visual aids or pictorial representations) of different shapes. The use of food groups, as in food pyramids and circles, ensures the inclusion of all basic foods in the food guide.

As in other food guides used in European countries and Asia (Montagnese *et al.*, 2015), in the food guides of African countries the foods are grouped into food groups and the proportion of the area occupied by the food group on the food guide is usually an indication of its recommended proportion in the diet. Starchy foods are recommended as the largest proportion in all food guides; vegetables and fruits are recommended in the same proportions or come second, except for Benin where animal and plant sources of proteins come second. Images of food guides used in African countries are given in Annexure 4.

In most food guides fats and oils, salt and sugar are the smallest proportions in the food guides. Sugar and products that contain added sugar are not shown in the South African food guide.

All four food guides have some text, either the names of the foods in the food groups or the names of the food groups. None has an indication of the number of servings, except for water in the Seychelles food guide.

Foods are represented in either raw form or manufactured form, reflecting how they are found on the market. All food guides represented food with drawings, except the Seychelles food guide that used camera pictures.

The analysed food guides are qualitative, as they all show in what relative proportions the food groups should be consumed. For Benin, quantitative recommendations are given in the guidelines (not in the food guide) with reference to portion sizes and a suggested number of servings per day.

Food grouping

Food grouping shows the emphasis given to food nutritional properties or to local preferences in food consumption.

Food groups range from seven for South Africa to four for Namibia. Nigeria, Seychelles and Benin both have five food groups. While the Namibian food guide regroups eggs, meat, milk and legumes under the same food group, other food guides display those foods in two (meat, eggs, legumes together and milk products in a separate group) or three different groups. The Seychelles food guide is the only one to group legumes and vegetables together.

With the exception of Nigeria that has a group of confectionery represented on the food guide and Seychelles that has a bottle of soft drink represented on the food guide, the three other food guides show only foods that are necessary for healthy eating.

Table 2-3 : Overview of FBDGs in Africa

Country, year of publication	**South Africa, 2013**	**South Africa, 2013**	**Seychelles, 2006**
Official name	Food-based dietary guidelines for South Africa (revised in 2013)	Proposed paediatric FBDGs for South Africa	The Seychelles dietary guidelines
The format of the FBDGs	The FBDGs target individuals aged five years and older. They recommend foods that should be eaten at most meals, daily and regularly. The FBDGs contain indications of portions, apart from the proportions of circles in the food guide. Language: English	The guidelines address four age groups: birth to six months, six to 12 months, 12 to 36 months and three to five years. The recommendations are different for the four age groups Language: English	The Seychelles has 16 guidelines, targeting people aged two years and older. The first guideline is to eat a variety of foods and it refers to the food guide for the recommended proportions. The Seychelles FBDGs contain recommendations about the consumption frequency for every food group. Languages: The FBDGs are in English, but the food groups are in both English and a local language.
Other specific integrative recommendations on beverages, salt, sugar, fat	The FBDGs for South Africa contain recommendations to use fat, sugar and salt, and food or drinks high in sugar and salt, sparingly. The recommendation about the use of fat also advises using vegetable oils instead of hard fats.		
Healthy behaviour, lifestyle and physical activity	“Be active” is the second recommendation.	There is a recommendation to breastfeed exclusively for the first six months. Complementary feeding is advised to be introduced at six months,	A recommendation on exercise, one recommendation to exclusively breastfeed infants

Country, year of publication	South Africa, 2013	South Africa, 2013	Seychelles, 2006
	The recommendation about water, stresses the use of safe water.	in addition to breast milk. Physical activity is encouraged for children aged 12 to 36 months and three to five years. The guidelines contain advice on responsive feeding (e.g. feed slowly and patiently and encourage your baby to eat, but do not force him or her) and hand washing.	from birth to six months and one recommendation on hygienic handling of food.
Visual aids, foods pictured and food grouping composition	The food guide shows seven food groups, the six listed below plus water, in circles of different sizes. The starchy foods group is in the centre, surrounded by the six other groups. The vegetables and fruit group circle and starchy foods group circle are the biggest and have the same size. The next circle in terms of size is the one on top showing water and a cup of tea or coffee. The dry beans, split peas, lentils and soya group and the milk, maas and yoghurt group are of the same size as the fish, chicken, lean meat and eggs group. The smallest circle display margarine, oil and peanut butter.	The paediatric FBDGs are not accompanied by a food guide, but, through the guidelines seven food groups are illustrated: 1 Meat, chicken, fish or egg 2 Dark-green leafy vegetables and orange coloured vegetables and fruit, vegetables and fruit 3 Tea, coffee and sugary drinks 4 High-sugar, high-fat salty snacks 5 Starchy foods 6 Milk, maas or yoghurt 7 Dry beans, split peas, lentils and soya.	The Seychelles food guide has a circular shape (plate shape) divided into five triangular shapes, each triangle displaying a food group. The fruit and vegetables group shows bananas, pineapple, carrots, cabbage, fruit juice, peas and beans. The rice, bread, cereals, pasta and tubers group has the same size as the fruit and vegetables group; these two groups occupy about 2/3 of the plate. The milk and milk products group and fish, meat and their alternatives group are equal in size. The smallest group is the one called foods containing fat and foods containing sugar group. The food guide also displays a glass of water.

Overview of FBDGs in Africa (table 2-3 continued)

Country, year of publication	**Namibia, 2000**	**Nigeria, 2001**	**Benin 2015**
Official name	Food and nutrition guidelines for Namibia	Food based dietary guidelines for Nigeria	Guide alimentaire du Bénin (Author's translation to English : Benin's dietary guidelines)
The format of the FBDGs	The food and nutrition guidelines for Namibia consist of 10 recommendations for healthy individuals aged two years and over. The guidelines are expressed in terms of foods. There are no indications on food group consumption frequency except for vegetables and fruit that are recommended every day. There is also a guideline on daily meal frequency (at least three meals a day). The FBDGs for Namibia booklet also contains explanatory text to support each guideline, accompanied by an image. Languages : English	There are FBDGs for different age groups from birth to six months, six to 12 months, 12 to 24 months, 25 to 60 months, six to 11 years, 12 to 18 years, especially girls, adults, pregnant women, breastfeeding mothers and the elderly. Then there are more recommendations addressing specifically protein-energy malnutrition, micronutrient deficiencies and diet-related non-communicable diseases for the different groups. There is no clear grouping of foods in these FBDGs. Language :English	The Benin FBGDs target people of two years and above, living in urban and semi-urban settings. The guidelines are further subdivided into the following age groups: two to three years, four to eight years, nine to 13 years, 14 to 18 years and older than 19 years. Language : French
Other specific recommendations on beverages, salt, sugar, fat			There is a side recommendation on oil consumption emphasising the portion size and indicating that palm oil is a rich source of vitamin A. Water is recommended to be consumed daily, but there is no indication of quantity.

Country, year of publication	**Namibia, 2000**	**Nigeria, 2001**	**Benin 2015**
Healthy behaviour, lifestyle and physical activity			The ninth recommendation is to teach children to cook traditional dishes to promote health and preserve culture
Visual aids, foods pictured and food grouping composition	The food guide for Namibia is a rectangular shape divided into four smaller rectangles, each displaying a food group. The top left rectangle, which is the biggest, shows images of bread, rice, maize and other starchy foods. The top right rectangle is the second biggest and shows images of pumpkin, cabbage, carrots, grapes, avocado, a red coloured drink in a glass that could be juice and other vegetables and fruit. The bottom left rectangle shows images of fish, eggs, meat and a white liquid that could be milk. The bottom right rectangle is the smallest and shows butter, oil and salt.	The Nigerian food guide is a pyramid divided into five food groups. At the bottom are grains, bread and tubers. The following level is vegetables and fruit. Those two groups are recommended at every meal. The third group is eggs, meat, fish and dairy. Foods in this group are recommended to be eaten in moderation. Oils and fats are to be eaten sparingly and confectionery should be limited to rare occasions. A glass of water is displayed outside the pyramid with the recommendation always to drink plenty of water.	The Benin food guide is a traditional hut with five food groups. A bottle and glass of water are displayed in the entrance. Cereals and tubers are the base of the hut, followed by meat, fish, beans and other rich sources of protein. The next level displays vegetables and fruit. Milk products are at the top of the hut. The guide is accompanied by recommendations on portion sizes. Units used are a bowl that is commonly used in restaurants in Benin, or a cup or the food itself (e.g. medium-size oranges). Recommended portions vary by age and sex.

2.4 Other nutrition interventions and policies aimed at improving children's nutrition in Rwanda

FBDGs should be integrated within national relevant policies (WHO & FAO, 1998). The substantial social and economic costs associated with malnutrition and micronutrient deficiencies, such as increased mortality and morbidity, reduced physical and intellectual development and reduced capacity for learning and work (Hoddinott *et al.*, 2008; Horton *et al.*, 2009; Hoddinott *et al.*, 2013a), have prompted calls for increased political action on nutrition worldwide.

In Rwanda, a call was made on the President in April 2009 to assign the matter greater priority and for more effective action to be taken to eliminate malnutrition among children. The President's public commitment and request for more effective action by government sectors emphasised the urgency of the issue and a higher level of commitment to fighting malnutrition in children at each administrative level. Therefore, a supportive policy framework is in place. Annexure 5 contains details on the policy framework and nutrition interventions for the improvement of child nutrition in Rwanda.

2.5 Conclusion

In Rwanda, the prevalence of stunting and micronutrient deficiencies is very high among children six to 23 months (Lung'aho *et al.*, 2015; NISR, 2015). Moreover, the WHO infant feeding recommendations are poorly practised for children six to 23 months old. Feeding practices have an impact on child survival, health and development (Black *et al.*, 2013). The literature suggests that educational interventions improve feeding practices, which then lead to improved growth outcomes.

More consistent and evidence-based information should be used to equip or empower all those involved in implementing guidelines for optimal infant feeding. Currently, Rwanda does not have specific dietary guidelines for children of six to 23 months old. FBDGs would contribute to improving the current nutrition education tools. The aim of this thesis is to develop FBDGs for six-to-23-month-old Rwandan children.

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CHAPTER 3

This manuscript is formatted according to author guidelines of Maternal and Child Nutrition (see Annexure 1), with exception of the line numbers, which will be inserted, the line spacing, which will be changed to double spacing and the citation style, which will be changed to APA 6th before submission.

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Complementary foods and nutrient intakes of children aged six to 23 months in Rwanda

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MU designed the study, collected and analysed the data and wrote the preliminary manuscript. RL analysed the nutrient intake. LHN, HHV and EWV supervised the study. All authors actively contributed to the interpretation of the results and critically reviewed the manuscript.

Abstract

Poor complementary feeding diets are associated with poor nutrition status in early childhood. This cross-sectional study aimed to provide previously unavailable information on the complementary food consumption, dietary diversity and energy and nutrient intake of Rwandan infants and young children aged six to 23 months. A total of 765 children aged six to 23 months and their mothers/caretakers were included in the study. An interviewer-administered structured questionnaire, food frequency questionnaires and single 24-hour dietary recalls with the main caregiver were used to collect data. Standardized anthropometric body measurements were employed to assess the height of the children. Dried beans and green leafy vegetables were consumed by more than half of the children, according to both the food frequency questionnaire and the 24-hour recall. Dried small fish and cow milk were the most commonly consumed animal source foods. Compliance with the minimum dietary diversity indicator was low in all age groups. At group level, the complementary diet consumed by infants and young children in Rwanda is adequate in energy but inadequate in micronutrients. The complementary diet on average did not reach the desired nutrient density for iron and zinc, and a high proportion (>60%) of the children, in all age groups, had iron and zinc intakes below the recommendation. Breast milk remained an important source of energy and nutrients for children below two years in Rwanda. Beans were found to be the main food source of energy, iron and zinc. Dark green leafy vegetables were the main contributors to vitamin A and vitamin C. Calcium was provided mainly by cow milk and vitamin B12 by small dried fish. The present study didn't show a statistically significant correlation (r) between HAZ score and energy, iron, zinc or vitamin A independently.

Keywords: Rwanda, infants and young children, complementary foods, nutrients

Introduction

The World Health Organisation (WHO) recommends introducing complementary foods at six months while continuing breastfeeding until the child is two years or older (PAHO/WHO, 2003). During the complementary feeding period, ranging from six to 23 months of age, the child is progressively introduced to different foods and shifts from a milk-alone diet to consumption of family food.

Because of complementary food of low quality in developing countries (Gibson & Ferguson, 1998; Faber, 2005), considerable malnutrition develops during the complementary feeding period (Brown, 1991; Gibson & Ferguson, 1998; Dewey & Huffman, 2009). Nutritional deficiencies, resulting in chronic or recurrent malnutrition in early childhood, are global problems with short and long term consequences for both the physical and cognitive development of children (Dewey & Begum, 2011; Bailey *et al.*, 2015).

Worldwide, 45% of mortality in children under five is attributed to different forms of malnutrition (Black et al., 2013). Besides its mortality burden, malnutrition has many negative consequences, including poor health, reduced human capital and limited economic productivity (The World Bank, 2006; Dewey & Begum, 2011; Prendergast & Humphrey, 2014).

The Rwanda Demographic and Health Survey (DHS) of 2014/15 found that the prevalence of stunting (an indicator of chronic malnutrition) increased rapidly from 18.2% among children aged six to eight months to 49.4% among children aged 18 to 23 months. Thereafter the prevalence of stunting declined slowly and reached 37.4% among children 48 to 59 months old (NISR, 2015). This suggests that Rwandan children aged six to 23 months are the group that is most vulnerable to stunting.

In Rwanda breastfeeding of children below two years is common and routinely practised. The Rwanda DHS of 2014/15 found that 87% of infants below six months of age were exclusively breastfed, and practically all mothers (99%) were breastfeeding their six-to-11-month-old children. This proportion subsequently declined to 94% and 88% of children aged 12 to 17 months and 18 to 23 months respectively (NISR, 2015). On the other hand, only 57% of the infants aged six to eight months and 91% of the infants aged nine to 11 months had received complementary foods (measured by the percentage of children who received solid, semi-solid or soft foods the previous day). Only 30% of the six-to-23-month-olds achieved the minimum dietary diversity (NISR, 2015), as per the WHO definition of the minimum dietary diversity indicator (WHO, 2008).

After six months of age, infants and young children need a diet that is energy and nutrient dense, because they have a small gastric capacity yet high energy and nutrient needs that cannot be met with continued breastfeeding alone. However, the complementary diets based on cereals and vegetables commonly served in sub-Saharan Africa, including in Rwanda, are generally not adequate in nutrients (Gibson & Ferguson, 1998; Faber, 2005; WFP, 2015). In a survey conducted in 2014 in Rwanda, 81% of the mothers reported that they prepared porridge for their children below two years of age (Lung'aho et al., 2015). As those porridges are very viscous, the caregivers tend to dilute them excessively, thus reducing their energy and nutrient density (Kikafunda & Walker, 1997; Amagloh *et al.*, 2013). Another survey conducted by the World Food Programme (WFP) in 2015 found that among Rwandan children of six to 23 months, nutrient rich foods had been consumed by a low percentage of children the day before the survey. Dairy products, flesh foods, fortified foods (fortified porridge) and eggs were consumed by 24%, 17%, 13% and 3% of the children, respectively (WFP, 2015).

The types of foods commonly consumed by infants and young children in Rwanda have been studied previously (Lung'aho et al., 2015; NISR, 2015). However, to date very little is known about the energy and nutrient intake of infants and young children in Rwanda and which foods are important sources of nutrients in their complementary diets. This limited scientific literature about food and nutrient intake is a substantial obstacle to the design, implementation, and evaluation of effective food-based infant and young child feeding (IYCF) recommendations in Rwanda.

The aim of the present study is therefore to determine and evaluate the complementary food consumed, the dietary diversity and the energy and nutrient intake of children aged six to 23 in Rwanda.

Methods

Design and setting

A community-based, cross-sectional study of children aged six to 23 months old was conducted between September 2014, at the height of the hungry season, and January 2015, at the height of the harvest season. The study was conducted in eight districts including those that were most food insecure and had the highest prevalence of stunting in Rwanda. The sample used for this study was drawn from the baseline survey of the “Contributing to the reduction of stunting in children under two years old in Rwanda” programme. Primary units for the study were administrative cells from the eight districts. From each district, 28 to 30 cells were selected using a systematic sampling approach with probability proportionate to size, where the size

was measured in terms of the number of children under two years according to the 2014 national nutrition screening data. From each selected administrative cell one or more villages were selected and exhaustive lists of all eligible households in the selected villages were compiled by community health workers. A household was eligible to participate in this study if it had a child aged six to 23 months without any congenital condition that would affect the child's food intake. Statistical units were selected using a systematic sampling method from exhaustive lists of all eligible children. The number of children recruited from each cell was proportional to the population of six-to-23-month-old children in the cell.

Participant sampling

The minimum sample size calculation estimated that 665 children would be representative of the population group under study (children of six to 23 months in the eight selected districts) based on a prevalence of 50% for all outcomes, a relative precision of 5% and a confidence level of 95%. The presumed prevalence of 50% was chosen because this proportion maximises the size of the sample despite a lack of estimates of the variables to be investigated. The minimum sample was further increased by 5% to account for contingencies such as recording error. Birth dates were recorded from child vaccination cards and children were recruited only if they had reached six months of age and had not yet reached their second birthday.

Socio-demographic data

The adult caregiver of the child or the head of the household were interviewed face to face in Kinyarwanda (the language spoken by all Rwandans) by trained field workers using a structured questionnaire. We used a questionnaire adapted from the household survey questionnaires usually used in Rwanda for the DHS and Comprehensive Food Survey and Vulnerability Analysis and Nutrition Survey (WFP, 2012).

Dietary data collection

Adult caregivers were interviewed in the Kinyarwanda language to obtain data about the food intake of the child. The field workers worked from Monday to Saturday; the dietary data collected therefore covered one weekend day and five weekdays (Sunday to Friday). Food intake was assessed using a seven-day food frequency questionnaire (FFQ) and a single 24-hour dietary recall.

Seven-day food frequency questionnaire

The FFQ used by the WFP (2012) was used for this study to determine whether or not the child had consumed each of the 22 listed foods and beverages items in the last seven days, and if the food was consumed (i.e. answer was 'yes'), how many times in the last seven days.

24-hour recall

We used a single 24-hour recall to collect dietary data with the purpose of assessing group intake (Gibson, 2005; Trumbo *et al.*, 2013). Information about the number of feedings, types, and quantity of food items and beverages consumed by the child the previous day was collected using the multi-pass interactive 24-hour dietary recall method (Gibson & Ferguson, 2008). If a child had not received any food/drinks apart from breast milk the previous day, we entered the value zero. During the interview with the caregiver, a food recall kit comprising three-dimensional sponge models and household kitchen utensil units was used to estimate quantities consumed. Sorghum grains were used to indicate the quantity of food served, eaten and left over. The volume of sorghum grains was then measured using a 1000 ml graduated cylinder, then recorded and converted to grammes after data collection. A quantities manual was developed for the study, in addition to the South African Medical Research Council quantities manual (Langenhoven *et al.*, 1991) and the Food and Agriculture Organisation food density database (Charrondiere *et al.*, 2012).

A Rwandan nutrient composition database containing 106 food and beverage items consumed by the children was compiled for the purposes of this study by nutrient composition data from, in order of preference, the Ugandan food composition table (Hotz *et al.*, 2012), food composition table for Rwanda developed by Harvestplus and previously used by Lung'aho *et al.* (2015), and South African food composition tables (Wolmarans *et al.*, 2010).

Collection of recipes

For mixed dishes, preparation methods and ingredients used in communities similar to the surveyed communities (same districts but different villages) were collected. In each district, three women with a child aged six to 23 months were organized to come together and cook the most common mixed dishes served to children. All the ingredients and charcoal needed were provided to them. The methodology proposed by Gibson and Ferguson (2008) was followed for determining the weight equivalent for each ingredient in the mixed dishes when nutrient data are expressed as cooked food.

Anthropometry

The standard anthropometric measurement techniques were followed (Cogill, 2003). All participants were asked to remove shoes and heavy clothing. Children were measured during home visits by trained field workers. Supine length, for children younger than two years, was determined to the nearest 0.1 cm by means of a portable measuring board (Seca, Eilbek, Germany). For children two years of age and older, standing height was taken to the nearest 0.1 cm using a stadiometer (Seca, Eilbek, Germany). All measurements were repeated twice to ensure accuracy. When duplicate measures differed by more than 0.2 cm, children were re-measured. Mothers reported the child's age in months as well as the child's birth date. The birth date was confirmed with the vaccination card. WHO Anthro software version 3.2.2 was used to calculate children's exact age in months. Gender of the child was also recorded at the time of measurement, so that height-for-age z-scores (HAZ) could be calculated.

Training of field workers

The field workers were 40 fourth-year nutrition students from the University of Rwanda. During training, the study protocol and the research questionnaires were presented and explained to the field workers in a classroom setting by the principal investigator of the baseline survey and the first author (MU). In order for the field workers to familiarise themselves with the research questionnaires and food recall kit, each field worker completed a questionnaire (self-administration). To ensure they were competent in administering the questionnaires and using the food recall kit, they practised administering the questionnaire to each other in pairs.

Pre-test and pilot testing of questionnaires

The 24-hour recall method and the recall kit were subjected to a pre-test and a pilot test. The pre-test of the 24-hour recall questionnaire and recall kit was conducted in five different households to investigate the most convenient way of measuring what infants and young children eat in Rwanda. Informed by the results of the pre-test, it was decided to use 1000 ml graduated cylinders to measure food quantities, instead of using measuring cups and spoons. The chosen graduated cylinders can measure small and large quantities accurately and were easier to carry in the field. Expanded polystyrene was bought and hand-shaped to create food models, representing food commonly served uncut (e.g. bananas, sweet potatoes, bread rolls etc.). A recall kit containing all the necessary recall aids was assembled.

The pilot test of all questionnaires was performed after the training of field workers. Four administrative cells (namely Shyembe, Gasata, Kinyonzwe and Burunga cells) in Karongi district were purposively selected for the pilot test. During the pilot test, every field worker administered the household socio-demographic and the 24-hour recall questionnaires to at least two caregivers in a community comparable to that of the actual study. All completed questionnaires were reviewed and feedback was given to the field worker. This allowed a discussion to improve both the use of the 24-hour method and recall kit. Based on the pilot study, it was decided to use sorghum grains instead of rice for quantifying food intake and to add an additional recall aid to the 24-hour recall kit.

Data and statistical analysis

Seven-day food frequency questionnaire

All data were imported and analysed into IBM SPSS Statistics for Windows, Version 23.0, and descriptive statistics of food consumption and food frequency were calculated.

24-hour recall

Food intake data were coded and captured into Microsoft Excel 2010.ink. STATA Version 14 was used to convert food intake to macro- and micronutrients using the above-mentioned food composition database compiled for this study, and further analysis. For breastfeeding children, daily intake of breast milk of 674 g/d at six to eight months, 616 g/d at nine to 11 months and 549 g/d at 12 to 23 months was assumed (Brown et.al., 1998). We used the breast milk composition of the South African food composition database (Wolmarans *et al.*, 2010). Nutrients obtained from nutritional supplements, medication and seasonings added to prepared foods at the table were not included in nutrients analysis.

Food and nutrient data were imported into IBM SPSS Statistics for Windows, Version 23.0. Data were checked for normality using a Kolmogorov–Smirnov test. Descriptive statistics were reported using means and standard deviation for normally distributed data, and median and 25^{th}-75^{th} percentiles for non-normally distributed data. The most frequently consumed foods on the previous day, dietary diversity, energy and nutrient intakes were determined.

Infant and young child feeding indicators

The 24-hour recall was used to assess the feeding frequency and dietary diversity indicators as proposed by the WHO (2008). For the calculation of the dietary diversity indicator we grouped the food items reported in the 24-hour recall under seven food groups (grains, roots and tubers; legumes and nuts; dairy; flesh foods; eggs; vitamin A-rich fruits and vegetables;

other fruits and vegetables), and calculated the proportion of children six to 23 months of age who had received food from four or more food groups. To achieve their daily energy needs, the WHO recommends that breastfed infants aged six to eight months and nine to 23 months must receive solid, semi-solid or soft foods at least twice and three times respectively. Non-breastfed children aged six to 23 months must receive solid, semi-solid or soft foods or milk feeds at least four times a day. We calculated the number of meals and snacks and reported the proportion of children meeting the recommended feeding frequency according to their age and breastfeeding status (WHO, 2008).

Energy and nutrient intake

Energy and nutrient intakes were compared to the recommended nutrient intake (RNI) (FAO/WHO, 2002; Otten *et al.*, 2006). The percentage of participants reporting intakes below the RNIs was calculated for specific nutrients and was stratified by age. In addition, the energy density (kcal/g) and nutrient density (g/100kcal) of the complementary foods were calculated and compared to the recommended energy and nutrient density (FAO/WHO, 2002). The mean energy density of the complementary diets was calculated by dividing the daily energy intake by the quantity consumed, not including non-caloric beverages. Male and female children were reported together.

Anthropometry

Height-for-age Z scores were calculated using the WHO Anthro software version 3.2.2 software. An average of measurements for height was used to calculate HAZ. Anthropometrics statuses were defined under World Health Organisation classification: Overall stunting prevalence was classified as (HAZ <-2).

Analysis of associations

Associations between continuous data namely energy, protein, iron, zinc intakes and HAZ were assessed by Pearson correlation analysis.

Ethics

This study was conducted as part of the protocol entitled “The development of food-based dietary guidelines for Rwandan children of six to 23 months”. Ethics approval for the protocol was granted by the Ethics Committee of the NWU (NWU-00098-14-S1) and Rwanda National Ethics Committee (0251/RNEC/2015). Permission to conduct the study was granted by the Ministry of Local Governance. The researchers met with local government leaders to explain the purpose of the study. The purpose of the study and the procedures were also explained to

the research participants who were given the opportunity to ask any questions they had, before signing the consent forms. Illiterate participants put a thumb print on the informed consent form. All respondents provided written informed consent before enrolment and their data were treated confidentially.

Results

Background characteristics

The background characteristics of the study sample are summarised Table 1. The food and nutrient intake of 765 children were collected and analysed. In our study sample, 385 children were male and 380 were female, and they were grouped into the age groups six to eight months (n=189), nine to 11 months (n=135), and 11 to 23 months (n=441). The mean (SD) age of the 765 children was 12.9 (±4.9) months. Nearly a quarter (23.5%) of mothers in the study had no education. Most children (78.3%) came from families classified as extremely poor to poor by the national Ubudehe classification system, and farming was the main activity of the majority (85.3%) of mothers.

Table 1 : Socio-demographic characteristics of the 765 children and their parents in eight districts in Rwanda

Characteristic	N	(%)
Gender of household head		
Male	712	(93.1)
Female	53	(6.9)
Wealth status of the household [a]		
Extremely poor	47	(6.1)
Very poor	158	(20.7)
Poor	394	(51.5)
Middle	57	(7.5)
Richer	2	(0.3)
Don't know	107	(14.0)
Age of the mother (years)		
16-20	29	(3.8)
21-30	400	(52.3)
31-40	270	(35.3)
40-45	66	(8.6)
Education level of the mother		
No education	180	(23.5)
Primary uncompleted	314	(41.0)
Primary completed	209	(27.3)
Secondary uncompleted	42	(5.5)
Secondary completed or higher	20	(2.6)
Mother main occupation[b]		
Agriculture	646	(85.3)
Livestock	5	(0.7)
Trade	8	(1.0)
Artisan	3	(0.4)
Casual labour	67	(8.8)
Salaried/pension	10	(1.3)
Other	18	(2.4)
Child age (months)		
6-< 9	189	(24.7)
9-<12	135	(17.6)
12-<24	441	(57.6)
Child gender		
Female	378	(49.4)
Male	387	(50.9)

[a] Wealth status classification system used is the old Ubudehe system

[b] A few missing data

Breastfeeding practices

Breast milk was received by 96.8%, 91.1%, 69.2% of the children in the age groups six to eight months, nine to 11 months and 12 to 23 months respectively. For breastfeeding children, daily intake of breast milk of 674 g/d at six to eight months, 616 g/d at nine to 11 months and 549 g/d at 12 to 23 months was assumed (Brown *et al.*, 1998).

Complementary food consumption

Type and frequency of consumption during previous seven days

Table 2 shows that in the seven days prior to the survey, the complementary foods consumed most commonly by the surveyed children were dark green leafy vegetables, beans, thin porridge and tubers (potatoes, cassava etc.). Fish and cow milk were the most commonly consumed animal source foods. Among the children who had consumed beans, the mean consumption frequency was about five times in the previous week. For children who had consumed fish or cow milk, the mean consumption frequency was about three times for fish and four times for cow milk in the previous seven days. In general, the frequency of consumption was not statistically different between age groups for the different complementary foods. Apart from sugary foods and fruits and vegetables that were consumed less frequently in older children. On the contrary, frequency of consumption of condiments and oils/fats increased among older children (data not shown).

Table 2: Complementary food consumed in the previous seven days

Food	Number of consumers	%	Frequency mean±SD Times/week
Dark green leafy vegetables	525	68.6	4.1±2.1
Beans, peas, lentils, nuts or seeds	517	67.6	5.1±2.1
Porridge	498	65.1	4.3±2.2
White potatoes, white yams, cassava or any other food made from tubers	349	45.6	3.6±2.0
Plain water	324	42.4	4.0±2.2
Condiments (chilies, spices or herbs)	320	41.8	6.2±1.5
Bread, rice, noodles or other foods made from grains	260	34.0	3.0±1.9
Other fruits or vegetables	216	28.2	2.7±1.8
Oil, fats or butter	199	26.0	4.7±1.9
Fresh or dried fish	176	23.0	2.9±1.7
Cow milk	166	21.7	4.2±2.1
Sugary foods (chocolates, sweets, cakes or biscuits)	151	19.7	2.6±1.9
Red palm oil	139	18.2	4.1±2.1
Mangoes or papayas	127	16.6	2.6±1.8
Pumpkin, carrots, squash or sweet potatoes that are yellow or orange inside'	85	11.1	3.2±1.9
Fruit juice	66	8.6	2.6±1.7
Eggs	49	6.4	1.9±1.3
Meat(beef, pork, lamb, goat, chicken or duck)	46	6.0	1.5±0.8
Clear broth	25	3.3	1.6±1.0
Infant formula	11	1.4	3.9±2.5
Liver, kidney, heart, or other organ meats	9	1.2	1.9±0.9
Yogurt	2	0.3	2.0±0.0

Type and quantity of consumption during the previous 24 hours

Based on the 24-hour recalls, 747 children out of 765 had received some form of complementary food, while 14 infants aged six to eight months, two aged nine to 11 months and two aged 12 to 23 months had not received any complementary food the day before the survey. Only a minority of children in the respective age groups six to eight months (28.1%), nine to 11 months (16.9%) and 12 to 23 months (18.1%) had their food cooked in a pot, separate from the family pot.

The milk and food consumed by at least 5% of the infants and young children on the previous day are shown in Table 3. Breast milk was consumed by 79.9% of the children. Dried beans and amaranth leaves were consumed by more than half of the children. Sorghum flour, maize flour, soybean flour and sugar were consumed by respectively 44.7%, 39.6%, 21% and 22.9% of the children. These legume and cereal flours, although reported separately here, were consumed as ingredients of a thin porridge. Biscuits (usually unfortified plain, filled, or coated sweet biscuits made of wheat flour, sugar and vegetable oil) were consumed by 9.5% of the children. Vegetable oil, tomatoes and onions were common ingredients of home-made amaranth and/or bean sauces. Vegetable oil and sweet potato were consumed by 33.1% and 18.3% of the children. Dried small fish and cow milk were the only animal products consumed by more than 5% of the children. Formula milk consumption was not reported for any child in our sample, in the 24-hour recalls.

Table 3: Milk and food consumed by more than 5% of the children on the previous day

Food	Number of consumers	%
Human milk	611	79.9
Dried beans	535	69.9
Amaranth leaves	431	56.3
Sorghum	342	44.7
Maize flour	303	39.6
Vegetable oil	258	33.7
Irish potato	261	34.1
Sugar	175	22.9
Soybean	161	21
Sweet potato	205	26.8
Cooking banana	150	19.6
Cassava flour	138	18
Fish	139	18.2
Cow milk	120	15.7
Rice	102	13.3
Groundnut powder	93	12.2
Tomato	145	19
Biscuits	73	9.5
Cassava tuber	100	13.1
Palm oil	62	8.1
Bread	52	6.8
Banana fruit	83	10.8
Onion	49	6.4
Mango	39	5.1

Dietary diversity and meal frequency

Table 4 shows the prevalence of compliance with the WHO IYCF practices indicators minimum dietary diversity and minimum meal frequency (WHO, 2008) based on the 24-hour recalls. About three-quarters of the children had the minimum number of recommended meals per day in all age groups. The recommended dietary diversity was reached by a low percentage of children, especially in the six-to-eight-months age group, where only 22.2% had the minimum dietary diversity.

Table 4: % of children meeting the WHO indicators of meal frequency and dietary diversity

Age	Minimum Dietary Diversity (MDD) [a]	Minimum Meal Frequency (MMF)[1]
6 to 8 months	22.2	75.7
9 to 11 months	37.8	77.0
12 to 23 months	41.7	72.8

[a] IYCF indicators as defined by the WHO (2008)

Energy and nutrient intake

Energy, macro- and micro-nutrient intakes from complementary foods and assumed breast milk intake were determined (Table 5). The median daily energy intake was 650 (549-839) kcal/d, 765 (607-1051) kcal/d and 801 (592-1236) kcal/d for children aged six to eight months, nine to 11 months and 12 to 23 months respectively (Table 5). The median energy intake of the boys was 765 (587-1084) kcal/d and that of the girls 715 (559-1017) kcal/d (data not shown in table). Median nutrient intakes that met or exceeded the WHO estimated needs for all age groups were protein and vitamin C. The median iron intakes increased with age, from 1.2 (0.6-2.9) mg at six to eight months, to 2.9 (1.6-5.7) mg and 4.4 (2.5-7.4) mg at nine to 11 months and 12 to 23 months.

The contribution of fat to energy intake was below the recommended range for about half (48.8%) of the children aged 12 to 23 months.

Table 5: Total daily energy and nutrient intakes from the complementary foods and breast milk, median (IQR) and percent children below AMDR

	6 to 8 months (n=175)		**9 to 11 months (n=133)**		**12 to 23 months (n=439)**		
	Median (IQR)	*Estimated need*	*Median (IQR)*	*Estimated need*	*Median (IQR)*	*Estimated need*	
Energy (kcal)	650 (549-839)	615	765 (607-1051)	686	801 (592-1236)	894	
	Median (IQR)	*RNI[a]*	*Median (IQR)*	*RNI[a]*	*Median (IQR)*	*RNI[a]*	
Protein (g)	12.0 (9.0-19.2)	9.9	17.9 (11.6-27.9)	9.9	20 (13-32)	13	
Lipid total (g)	31.7 (30.1-36.8)		31.7 (28.5-36.5)		27.4 (24.3-35.6)		
Carbohydrate (g)	76.5 (60.4-101.8)		102.6 (75.5-153.1)		122.4 (81.1-202.6)		
Calcium (mg)	252 (224-339)	400	267 (234-368)	400	283 (203-428)	500	
Iron (mg) b	1.2 (0.6-2.9)	9.3	2.9 (1.6-5.7)	9.3	4.4 (2.5-7.4)	5.8	
Zinc (mg) c	1.8 (1.4-2.8)	4.1	2.7 (1.9-4.1)	4.1	3.0 (2-4.7)	1.1	
Vitamin C (mg)	40 (34-48)	30	42 (35-63)	30	44 (30-85)	30	
Thiamine (mg)	0.1 (0.1-0.3)	0.3	0.3 (0.1-0.4)	0.3	0.3 (0.2-0.6)	0.5	
Riboflavin (mg)	0.4 (0.3-0.5)	0.4	0.4 (0.3-0.6)	0.4	0.4 (0.3-0.7)	0.5	
Niacin (mg)	2.1 (1.7-3.0)	1.5	3 (2-5)	4	4 (2-6)	6	
Vitamin B6 (mg)	0.2 (0.1-0.4)	0.3	0.5 (0.2-0.7)	0.3	0.6 (0.3-1.1)	0.5	
Folate total (mcg)	71 (47-119)	80	124 (75-200)	80	168 (92-253)	160	
Vitamin B12 (mcg)	0.7 (0.7-0.8)	0.5	0.6 (0.6-0.9)	0.5	0.5 (0.5-0.8)	0.9	
Vitamin A (mcg RE)	54 (1-193)	400	169 (44-375)	400	191 (44-483)	400	
	% kcal		% kcal		% kcal		% below *AMDR*
Fat, % kcal	43		34		28	30-40	48.8
Protein, % kcal	9		10		10	5-20	1.1
Carbohydrate, % kcal	48		56		62	45-65	10

IQR, Interquartile range with1st quartile-3rd quartile; RE, retinol equivalent; AMDR, acceptable macronutrient distribution range
[a]Energy and recommended nutrient Intakes used are those proposed by FAO/WHO (2002) for vitamins and minerals and Otten *et al.*(2006) for protein and AMDR
[b]Assuming medium bioavailability (10%)
[c]Assuming moderate bioavailability (30%)

Energy and nutrient density of the complementary diet

The energy density of the complementary diet and the proportion of breastfed children whose complementary diet was below the recommended energy density (Dewey & Brown, 2003) are summarised in Table 6. Among the children receiving breast milk and complementary food, in the nine-to-11-months age group, more than a quarter (28.1%) consumed a complementary diet below the recommended energy density. The average energy intake per meal (breast milk intake excluded) was 205.8 (± 73.4) kcal.

Table 6 : Energy density (kcal/g) of the complementary diet and percentage of children below the recommended energy density

Age group	Energy density (kcal/g)	Desired energy density [a]	% below recommended energy density
6 to 8 months	0.88±0.14	0.71	1.8(n=169)
9 to 11 months	0.97±0.19	0.84	28.1(n=121)
12 to 23 months	1.02±0.21	1.12	3.6(n=303)

[a] assuming two meals per day and average breast milk intake

The median and interquartile ranges for the nutrient density of the complementary diet per age group are given in Table 7. The protein, vitamin C, folate and vitamin A densities were above the desired density, while for calcium, iron, zinc, thiamine, riboflavin and niacin the complementary foods did not reach the desired density.

Iron and zinc densities were below the recommended nutrient densities of the complementary diet for all (100%) children aged six to eight months and nine to 11 months. Protein density was below the recommended density for complementary foods for only a few children in all age groups (0% to 1.5% of the children across the three age groups).

Table 7 : Nutrient density (amount of nutrient/100kcal) of complementary diet and percentage of children below recommended density

	6 to 8 months (N=175)			9 to 11 months (N=133)			12 to 23 months(N=439)		
	Median(IQR)	Recommended nutrient density[a]	% below recommended density	Median(IQR)	Recommended nutrient density[a]	% below recommended density	Median(IQR)	Recommended nutrient density[a]	% below recommended density
Protein(g/100kcal)	3 (2.3-4.4)	1	0.0	3 (2-4)	1	1.5	3.1 (2.5-4.0)	0.9	0.2
Calcium(mg/100kcal)	23 (12.7-42.7)	105	84.0	23 (15-39)	74	86.5	25 (17-46)	63	83.4
Iron(mg/100kcal)	0.8 (0.6-1.1)	4.5	100	1 (1-1)	3	100	1 (1-1)	1	70.4
Zinc(mg/100kcal)	0.5 (0.4-0.6)	1.6	100	0.5 (0.4-0.5)	1.1	100	0.5 (0.4-0.5)	0.6	87.9
Vitamin C(mg/100kcal)	2.9 (1.2-5.2)	1.5	31.4	3.5 (2.0-8.1)	1.7	17.3	4.6 (2.2-8.9)	1.5	15.5
Thiamin(mg/100kcal)	0.04 (0.03-0.11)	0.08	92.6	0.05 (0.04-0.06)	0.06	67.7	0.05 (0.04-0.06)	0.07	82.7
Riboflavin(mg/100kcal)	0.1 (0.0-0.1)	0.08	62.3	0.04 (0.02-0.06)	0.06	66.9	0.04 (0.03-0.08)	0.06	62.9
Niacin(mg/100kcal)	0.5 (0.3-0.7)	1.5	98.3	0 (0-1)	1	94.7	0.5 (0.4-0.7)	0.9	89.1
Vitamin B6(mg/100kcal)	0.08 (0.04-0.11)	0.12	76.6	0.1 (0.07-0.14)	0.08	31.6	0.1 (0.07-0.14)	0.08	28.5
Folate(μg /100kcal)	21 (11-33)	11	24.6	26 (18-37)	9	3.0	27 (18-38)	21	32.4
Vit A, RE(μg RE/100kcal)	37 (2-76)	31	44.0	42 (15-99)	30	36.8	35 (12-76)	23	38.3

IQR, Interquartile range with1st quartile-3rd quartile; RE, retinol equivalent
[a]Recommended nutrient densities used are those proposed by FAO/WHO (2002)

Contribution of breast milk, foods and food groups to energy and micronutrient intakes

The contribution of breast milk and food groups to energy, calcium, iron, zinc, vitamin A, vitamin B12, and vitamin C intakes in this population is presented in Figure 1. Breast milk contributed greatly to energy and micronutrients intakes, especially vitamin A intake (76%). Dark green leaves (amaranth leaves, cassava leaves and bean leaves) were the second highest contributor to vitamin A (9.93%).

Apart from breast milk, the top five foods that contributed to energy were dried beans (11.36%), cassava pap (6.41%), cow milk (5.86%), maize (5.08%) and sweet potato (4.49%). Dried beans contributed most to iron (33.54%) and second most to zinc (21.35%). Small dried fish and breast milk each contributed about 44% to vitamin B12. Breast milk contributed 40.49% of calcium intake, followed by cow milk (26.77%) and dark green leaves (10.26%). Breast milk, cassava flour and dark green leaves contributed most to vitamin C (39.57%, 17.24% and 16.71% respectively).

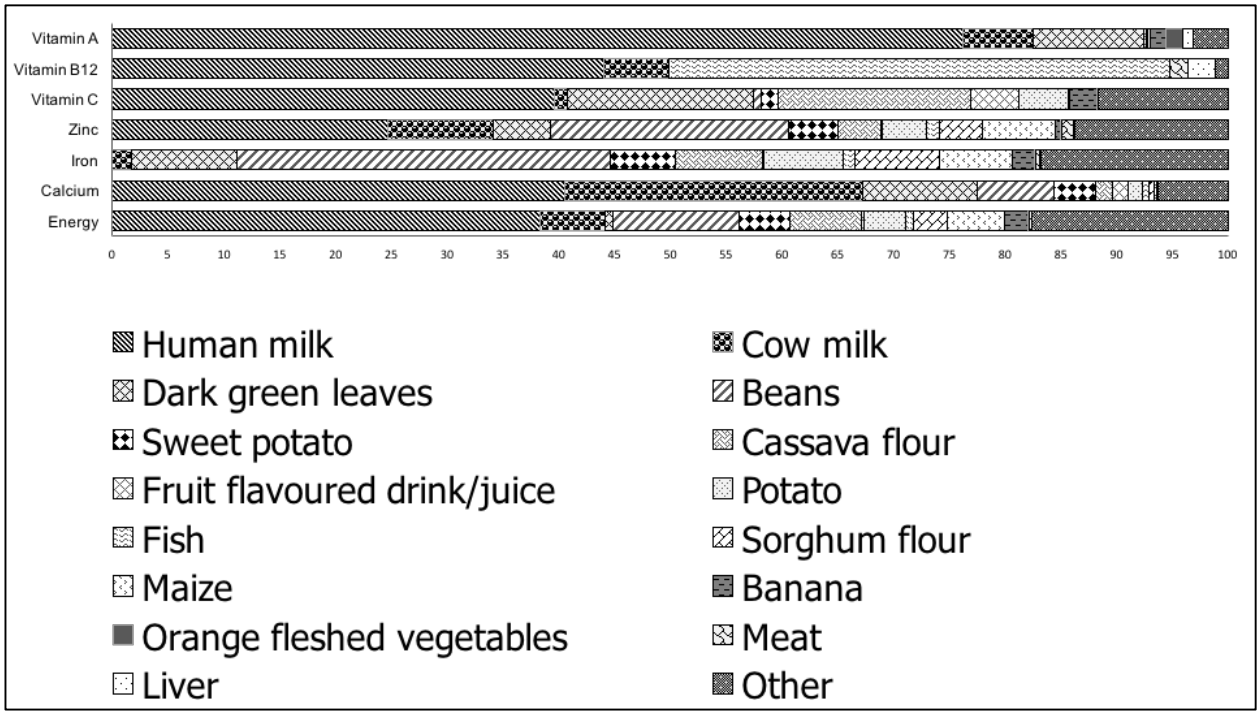

Figure 1 : The contribution of breast milk and complementary foods to total energy and micronutrient intakes

Dietary intake and anthropometry

Mean and standard deviation values for the anthropometric indicator HAZ z-score were −1.37 ± 2.06. The prevalence of stunting was 35.7%. According to age, stunting was more prevalent among children in the age group nine to 11 months old (43.2%) than infants aged six to eight months (34.3%) and children aged 12 to 23 months (34.8%). Stunting was more common among males compared with females (42.8 vs 29.3%). No significant associations were identified between any measures of dietary intake (energy, protein, iron, vitamin A) or nutritional indicators (DDS, MMF) with HAZ (all $p > 0.05$).

Discussion

The present study has shown that that the complementary diet is mainly made of beans, green leafy vegetables, cereals prepared as thin porridges and tubers. Animal source foods and fruits were consumed by a small number of children, only a few times per week and in small amounts. Approximately a quarter of the children in all age groups were not eating enough times per day to cover their energy needs. Half to three quarters were eating a diverse enough complementary diet. Our results show that children aged six to 23 months were, in general, eating food from the family pot. Our results show that breast milk remains an important source of energy and nutrients for Rwandan children of six to 23 months old. The complementary diet of Rwandan infants and young children is similar in many respects to the complementary diets of other developing countries, comprising cereal-based porridges, tubers and legumes as staples, while animal source foods are less commonly consumed (Gibson & Ferguson, 1998; Hotz & Gibson, 2001; Faber *et al.*, 2014; Katepa-Bwalya *et al.*, 2015). Sorghum and maize flours were consumed by more than one-third of the children, but they were not found to be important contributors to energy or micronutrients, which is a reflection of the watery consistency of cereal porridges consumed by children. Looking at the complementary diet alone (breast milk excluded), beans were found to be the main food source of energy, iron and zinc. Dark green leafy vegetables were the main source of vitamin A and vitamin C. Calcium was provided mainly by cow milk and vitamin B12 by small dried fish.

We used a single 24-hour recall to collect dietary data. Therefore, the energy and nutrient intakes we report here do not represent individual usual intakes. However, for the purpose of assessing group intake, a single 24-hour recall is sufficient (Gibson, 2005; Trumbo *et* al., 2013).

To calculate energy and nutrient intakes, we assumed breast milk energy and nutrient density values reported by Wolmarans et al. (2010) for South African women and breast milk intake

values reported by Brown et al. (1998). Because of these assumptions our results about energy and nutrient intakes should be interpreted with caution.

The median energy intake in our sample was slightly above the energy requirements for children aged six to eight months and nine to 11 months but slightly below the requirements for 12 to 23 months, suggesting a low prevalence of inadequate energy intake only for children aged six to 12 months. Also, the vast majority (89.1%) of children aged 12 to 23 months fell below the recommended macronutrient range for fat. One explanation of this low energy intake for that group may be that mothers cease breastfeeding but do not adjust the diet of the children to close the gap left by the high contribution of breast milk to energy intake. Low fat intake affects energy and essential fatty acids adequacy, thereby limiting growth and brain development (Uauy et al., 2000). Low energy intake was also found in 12-to-23-month-old Ethiopian and Cambodian children (Anderson *et al.*, 2008; Baye *et al.*, 2012).

The median carbohydrate and protein intakes for all age groups were in the range of being adequate. However, the quality of protein may be inadequate considering that very few animal source foods were consumed. The quality of protein can positively and significantly affect the nutritional status of children (Ghosh, 2016; Semba et al., 2016; Uauy et al., 2016).

The nutrient recommendations used in this study were based on the recommended nutrient intake (RNI) (FAO/WHO, 2002; Otten et al., 2006). RNI for all vitamin and mineral intake recommendations are Adequate Intakes (AI), except for iron and zinc for which Estimated Average Requirement (EAR) are available. Because, the AI is greater than the EAR, the proportion of a population with intakes below the AI is likely to be an overestimate of the prevalence of nutrient inadequacy (Otten et al., 2006). Therefore, in this study it is not possible to draw with certainty a conclusion about the proportion of infants with inadequate micronutrient intakes.

Low iron and zinc densities of complementary foods were also reported in other developing countries such as Ecuador, Ethiopia and Cambodia (Anderson et al., 2008; Baye et al., 2012; Roche et al., 2016). The daily median intakes of the three age groups were all below the RNI for vitamin A despite the fact that the median vitamin A density in the complementary foods was above the desired density. One explanation for this could be that many children did not reach the minimum meal frequency to cover their daily vitamin A needs.

The energy density of the complementary diet was adequate for age groups six to eight months and nine to 11 months and the majority of children in all age groups were meeting the minimum meal frequency.

The theoretical gastric capacity of 30 g/kg of body weight/meal was used to establish recommendations for complementary feeding. An intake below the assumed functional gastric capacity would lead to a low energy intake even when the energy density and the meal frequency are both adequate. Food intake below the theoretical gastric capacity has previously been reported in some developing countries in relation to suboptimal responsive feeding (Islam *et al.*, 2008; Hoan *et al.*, 2009).

The complementary diet did not reach the desired density for calcium, iron, zinc, thiamine, riboflavin and niacin. This is in accordance with a study by Faber (2005) who found that energy and protein intakes from complementary foods in a rural area of South Africa were adequate but the nutrient density of the complementary diet was inadequate for calcium, iron and zinc. In their analysis of energy and nutrient density of complementary foods used in developing countries several authors found that median protein density was generally adequate, but median calcium, iron and zinc densities were below the desired levels (Gibson & Ferguson, 1998; Faber, 2005; Roche et al., 2016).

Conclusion and programmatic implications

Children aged six to 23 months in Rwanda consume a complementary diet with low micronutrient density. Children aged six to 23 months have a low dietary diversity and low intake of animal source foods.

Studies have shown an association between low dietary diversity and micronutrient deficiencies, both suggested by our results, with stunting (Rosado, 1999; Rivera *et al.*, 2003; Arimond & Ruel, 2004; Rah *et al.*, 2010; Mallard *et al.*, 2014). This suggests there is a need for targeted nutritional intervention in this age group. The private and public organisations that deal directly or indirectly with child health should aim to increase animal source food intake and dietary diversity. Specific programmes such as micronutrient supplementation could greatly contribute to closing the gap in micronutrient intakes.

Breast milk was an important source of energy and micronutrients in the children's diet, which emphasises the need for continued breastfeeding until two years of age. Moreover, there is a need to consider improving the maternal diet, because the maternal diet influences breast milk composition, especially in respect of micronutrients and essential fatty acids (Ballard & Morrow, 2013). Because small dried fish are relatively easily accessible and culturally acceptable as part of the complementary diet in Rwanda, and they are a good source of micronutrients, small fish should be considered in nutrition interventions to improve the nutritional status of infants.

The present study had some limitations: First, the 24-hour recall method relies on respondent recall of food consumed and estimation of portion sizes. Second, we did not apply a minimum intake level to complementary foods to be counted in the DDS. This might have led to overestimation of absolute dietary diversity. However, it has previously been concluded that using a minimum intake level of 10 g does not improve the ability of a DDS in indicating diet quality compared to using a level of 1 g (Dewey et al., 2006).

Third, the FFQ was not validated, but the food list used was based on the FFQ previously used in mother and child nutrition module of 2012 of comprehensive food security and vulnerability analysis and nutrition survey in Rwanda (WFP, 2012) and adapted to IYCF with a thorough knowledge of the eating habits in Rwanda.

Finally, we surveyed the eight most food insecure districts with a high prevalence of stunting, therefore differences in socio-demographic characteristics between our study population and the population of better off districts also limit the extent to which the results can be generalised to other districts, especially the more urban districts.

Key messages

At group level, the complementary diet consumed by infants and young children in Rwanda is adequate in energy but inadequate in micronutrients.

Breast milk remained an important source of energy and nutrients for children below two years in Rwanda.

Children aged six to 23 months in Rwanda consume a complementary diet with low micronutrient density.

•The private and public organisations that deal directly or indirectly with child health in Rwanda should aim to increase animal source food intake and dietary diversity.

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CHAPTER 4

This manuscript is formatted according to author guidelines of Maternal and Child Nutrition (see Annexure 1), with the exception of the line numbers, which will be inserted, the line spacing, which will be changed to double spacing and the citation style, which will be changed to APA 6th before submission.

Title Page

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Factors influencing caregivers' complementary feeding practices in Rwanda: A qualitative study

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Conflict of interest statement

Contribution statement

MU designed the study, collected and analysed the data and wrote the preliminary manuscript. LHN, HHV and EWV supervised the study, actively contributed to the interpretation of the results and critically reviewed the paper.

Abstract

The complementary feeding of infants and young children in Rwanda is not optimal. Improving complementary feeding practices is crucial to preventing and reducing malnutrition among infants and young children. Knowledge and understanding of the factors influencing caregivers' complementary feeding practices would help to design interventions that address the barriers and reinforce the facilitators. However, in Rwanda there are limited data on the specific factors that may influence complementary feeding practices. In this article we report the results of a qualitative study of the factors influencing primary caregivers' feeding practices of children aged six to 23 months in Rwanda. In September 2015 we conducted 10 focus group discussions with caregivers and community health workers from five different districts in Rwanda. Caregivers' knowledge and beliefs about the benefits of breastfeeding and timely introduction of complementary food seemed to be the primary factors promoting good practices. However, the common belief that infants should be given liquids (thin gruel, fruit juices and meat broth) as first foods instead of semi-solid foods might compromise children's nutrition in the first months of complementary feeding. The community-based nutrition education and counselling programmes were facilitators of good complementary practices. At the societal level, poverty in rural agrarian households was a barrier to optimal feeding practices. The study provides insight into factors influencing complementary feeding at the individual, group and societal levels. The study shows that there is a need to empower caregivers with more specific guidelines on complementary feeding.

Keywords: Rwanda, infants, children, complementary feeding, qualitative

Introduction

Complementary feeding practices are essential determinants of growth, health and development among infants and young children (Black *et al.*, 2003; Jones *et al.*, 2003). The World Health Organisation (WHO) and the United Nations' Children's Fund (UNICEF) recommend that infants be breastfed exclusively for the first six months of life (Kramer & Kakuma, 2002; WHO & UNICEF, 2003). At six months breast milk is no longer enough to cover the energy and nutrient requirements of the infant (Butte *et al.*, 2002), therefore the WHO recommends the gradual introduction of adequate and safe complementary foods from six months with continued breastfeeding until the child is 24 months or older (PAHO & WHO, 2003). Complementary foods are "any food or liquids, whether manufactured or locally prepared, suitable as a complement to breast milk or to a breast milk substitute, fed to infants during the complementary feeding period" (WHO, 1981; UNICEF & WHO, 2008).

In Rwanda, the prevalence of stunting, measured by the height-for-age Z score, is high (32.6%) among children aged six to 23 months. The period of complementary feeding corresponds to a period of dramatic increase in the prevalence of stunting, from about 10.5% among children below six months of age to 49% of stunted children aged 18 to 23 months (NISR, 2015).

In rural Rwanda, mothers are usually the primary caregivers of infants and young children. Other family members (older siblings, fathers and grandmothers) may also play an important role in caregiving and supporting mothers. A number of factors have been identified that influence complementary feeding practices in different developing countries: the socioeconomic status of caregivers, mother's beliefs, knowledge of complementary feeding, the burden of other responsibilities, the influence of postnatal care and the social network, lack of decision-making power in the household and poverty (Dessalew *et al.*, 2014; Blaney *et al.*, 2015; Hawley *et al.*, 2015; Burns *et al.*, 2016). However, there are limited data on the specific factors that may influence complementary feeding practices of caregivers in Rwanda.

Therefore, the aim of this study was to identify and describe the factors influencing primary caregivers' feeding practices of children aged six to 23 months in Rwanda. Better knowledge and understanding of the factors influencing caregivers' complementary feeding practices is crucial for developing caregiver-friendly and effective interventions, which will improve feeding practices for children from 6 to 23 months in Rwanda and contribute to addressing the high prevalence of stunting.

Methods

This study is a descriptive qualitative study that employs the methodology of focus group discussions (FGDs) to gather opinions, beliefs and experiences about complementary feeding practices of primary caregivers in Rwanda. Focus groups provide an environment for participants of similar backgrounds and life situations to speak freely and openly about their experiences (Wilkinson, 1998; Silverman, 2004). Although qualitative data cannot be generalised because of its sampling strategy and often small number of participants (Silverman 2004; Flick 2009), it provides in-depth rich data, which can inform the debate about approaches to complementary feeding messages or interventions and stimulate further research. This section presents the methodology used to collect and analyse information from mothers, fathers, grandmothers and community health workers (CHWs).

Participants' recruitment

The study participants were recruited in five of Rwanda's 30 districts. Data collection was done in four rural (Nyaruguru, Gatsibo, Kamonyi, Gicumbi) and one semi-urban (Nyamasheke) purposefully selected study sites. The study sites were selected to represent views from different geographical locations suffering from a high prevalence of stunting and food insecurity in the country. The recruitment was done by a focal person (e.g. local field worker of a non-governmental organisation, health centre social worker or CHW), about 10 days before the day of the focus group meeting. The mothers, fathers and grandmothers were eligible if they were Kinyarwanda speaking, were aged 18 years or above and had a child/grandchild aged six to 23 months. They were given an appointment at a place that was convenient and central for them, such as a community hall or usual place of village meetings. For the recruitment of CHWs who participated in two FGDs, purposive sampling was used to involve both male and female CHWs and to have CHWs from different villages. All participants were refunded an amount of RWF 1500 (about USD 2.3 at the time of the study) to compensate them for the cost of transport from and back to their respective villages. Each FGD consisted of five to seven participants of a specific category, namely mothers, fathers, grandmother or CHWs, from the same sector but not necessarily the same village.

Data collection instruments

The FGDs were conducted in September and October 2015 by a researcher trained in conducting FGDs and took place in the community where the participants lived. The discussions were conducted in Kinyarwanda, the language of all Rwandan people. In all

FGDs, the same discussion guide (Box 1) was used to explore breastfeeding, complementary feeding, perceptions about animal source foods in the complementary diet, information networks about infant and young child feeding (IYCF) and decision-making about IYCF. The relevant portion of the FGDs was approximately 40 minutes in length. Half (five) of the FGDs were held in local government community halls (sector hall, usually used for meetings), two were held in the health centre's training hall (the two group discussions with CHWs), two in an open field usually used for village meetings, and one in a participant's house where mothers met for a community-based activity called "the Village Kitchen". Before discussions started the researchers prepared the venues and arranged the chairs in a circular pattern to allow easy communication between participants (Silverman, 2013). All 10 FGDs were audio-recorded with participants' consent and field notes were taken by a research assistant during the discussions (Silverman, 2013).

The first FGDs with different categories of participants (mothers, fathers and grandmothers) were fully transcribed and analysed while the data collection was still going on. The emerging themes were explored in more depth in subsequent FGDs. By the eighth and ninth FGDs, no new themes emerged from discussions (data saturation was reached). To confirm the themes that had emerged, one more FGD was conducted beyond data saturation, resulting in a total of 10 FGDs to be analysed.

Box 1: FGD Guide

1. What do you think about giving breast milk to babies?
   Prompt: If the participants answer that it is good for the baby, ask why they think it is good for the baby.
2. Do you think children need other liquids in addition to breast milk before six months?
3. Why do you think it is at six months that complementary feeding should start?
4. Why do you think children below two years need complementary foods?
5. Do you feel it is important to give food from animals to children below two years? Why?
6. Do you think that there is enough information on feeding babies available to mothers in your community? From where do you get the information on feeding babies?
7. Who has the biggest influence on mothers' decisions and actions when feeding the baby by giving information and advices?
   Prompt: If fathers and grandmothers are not mentioned, ask what role the father/grandmother of the baby plays in this decision.
8. Tell us a bit more about your experience (/experiences of mothers in your community) in starting to include solid foods and other liquids.
   Prompt: What you started with and why? Are there some foods that are not suitable for babies?
   Why?
9. Is there anything else that you would like to share about your complementary feeding experience?
   Prompt: Challenges mothers encounter in breastfeeding or complementary feeding for children under two.

Data analysis

FGDs were transcribed verbatim fully, in Kinyarwanda, into Microsoft Word 2010.ink. by a research assistant. The analyst (first author) checked the transcripts for quality against the original recordings and against the field notes for accuracy. The computer program Atlas.Ti Version1.0.50 was used for the storage of themes and subthemes. The analyst read and re-read the entire dataset to familiarise herself with the data and identify themes and patterns (Saldaña, 2013). An inductive thematic analysis (Braun & Clarke, 2006) was used for coding the transcripts. Descriptive codes (Saldaña, 2013) were applied to the data, then organised into themes and refined to represent the whole dataset. An inductive approach means the themes identified are strongly linked to the data themselves. Inductive analysis is therefore a process of coding the data without trying to fit it into a pre-existing coding frame, or the

researcher's analytic preconceptions. Thematic analysis is a search for themes that emerge as being important to the description of the phenomenon. In this study, the meaning unit of analysis was an entire phrase taken from the interviews/ FGD (Graneheim & Lundman, 2004). The meaning units were labeled with codes that were sorted and collated into themes. A theme is a group of codes that captures something important about the data in relation to the research question (Braun & Clarke, 2006). The analyst, who is bilingual, applied codes and themes in English to the transcripts in Kinyarwanda. To illustrate themes, typical quotations from participants were translated into English.

The conceptual framework from Hector *et al.* (2005), was used to classify the codes and themes as individual, environmental and societal factors influencing feeding practices of primary caregivers (Figure 1). This framework was originally developed to assess determinants of breastfeeding practices, but has been used previously by Blaney *et al.* (2015) to provide insight on underlying factors of complementary feeding in Indonesia.

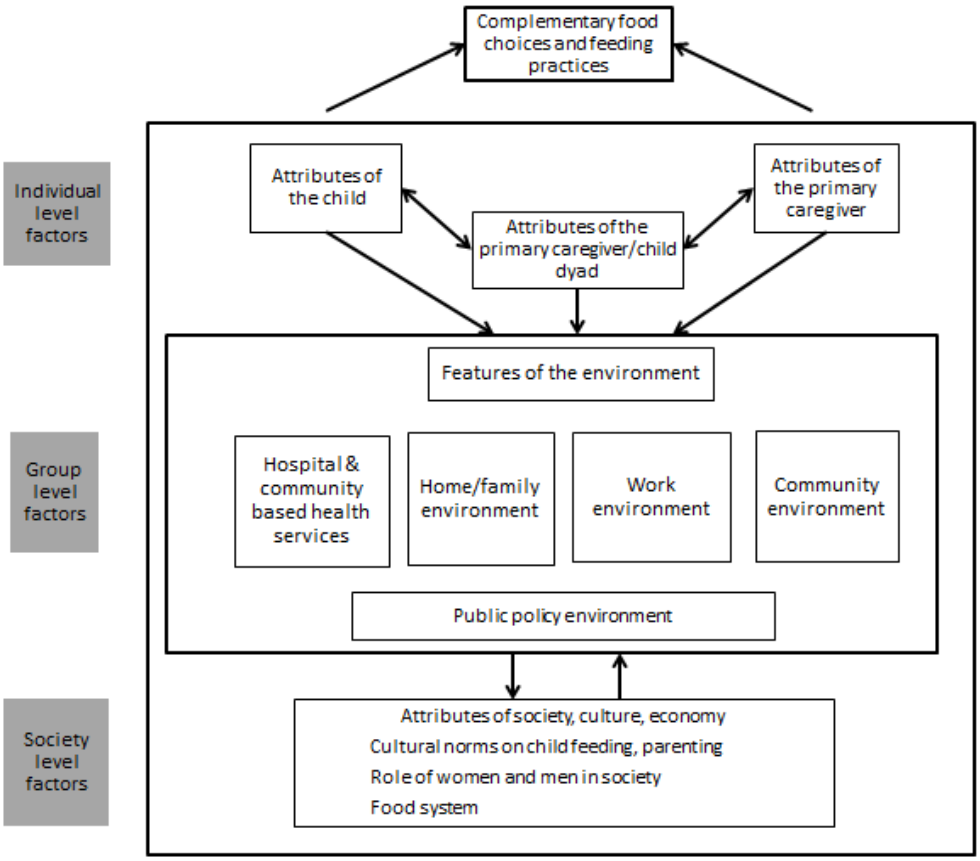

Figure 1: Conceptual framework of determinants of feeding practices among children above six months of age (adapted from Blaney et al. (2015)).

Ethics considerations

This study was conducted as part of the protocol entitled “The development of food-based dietary guidelines for Rwandan children of six to 23 months” Ethics approval for the protocol was granted by the Ethics Committee of the NWU (NWU-00098-14-S1) and Rwanda National Ethics Committee (0251/RNEC/2015). Permission to conduct the study was granted by the Ministry of Local Governance.

The researchers met with local government leaders to explain the purpose of the study. The purpose of the study and the procedures were also explained to the research participants, who were given the opportunity to ask any questions they had before signing the consent forms. Illiterate participants put a thumb print on the informed consent form. Participation was voluntary. The participants could withdraw from the study at any time without any consequences for them.

Results

Socio-demographic characteristics of the participants

The total number of participants in the 10 FGDs was 65 participants comprising 34 mothers, 12 fathers, seven grandmothers and 12 CHWs. We conducted five FGDs with mothers, two FGDs with fathers, one FGD with grandmothers and two FGDs with CHWs. Table 1 shows the socio-demographic characteristics of the participants.

Table 1: Participants' characteristics (n=65)

	Number	Percentage
Age range (years)		
< 30	12	18%
30-49	40	62%
>50	13	20%
Education level attained		
Never attended school	6	9%
Primary school 1-3	6	9%
Primary school 4-6	28	43%
Secondary school	20	31%
Tertiary and professional education	5	8%
Occupation		
None	6	9%
Farmer	50	77%
Informal trading	2	3%
Employed	7	11%

Individual level factors

Knowledge of timely introduction of complementary foods and benefits of breastfeeding

In all FGDs participants knew the recommendations of exclusive breastfeeding for the first six months of life. One participant noted that when the mother had to go back to work within six months after the birth, she could not follow that recommendation.

"The baby must be breastfed, without mixing anything else [with breast milk] until six months of age" Grandmother.

All the participants were aware of the recommendation to start complementary feeding when the infant is six months old, while continuing breastfeeding until two years or beyond.

“About breastfeeding after six months: the child grows well, gets intelligent, gets good stature, it’s also after those months that you start to give fruit, that helps the child because breast milk does not fill him anymore” Mother.

“In my understanding, the way they taught us is that it [continued breastfeeding] prevents stunted growth because children grow poorly from six months up to two years, so we think it prevents stunted growth and malnutrition” Mother.

Participants associated early introduction of complementary food with poor growth and frequent illnesses, as illustrated by the following quotes:

“When you give [solid] foods it causes poor health to the child, but when you start complementary feeding at six months the child grows well and does not lose health” Mother.
Participants, in general, reported better general health for the baby, better growth and cognitive development, and family planning, as advantages of breastfeeding. The following quotations illustrate participants’ knowledge:

“In my understanding, breastmilk contains all nutrients that a child’s life needs” Father

“It [breastfeeding] helps the child; it gives the vitamins to nourish his life” Grandmother.

Influences on the timing of introduction of complementary foods

The discussions indicated that in general the introduction of complementary foods was based on the baby reaching the recommended age of six months. The majority of the participants linked the age of six months to a physiological maturation of the infant's stomach. They believed that the reason why it is recommended to start complementary feeding at six months is that babies then have a “bigger” and/or “stronger” stomach.

”Complementary foods also helps because as the child grows, his stomach becomes bigger so they need complementary foods to feel full” Father.

Some participants, however, reported that early introduction of complementary foods at four or five months was sometimes practised. The reason for early introduction of complementary foods was perceived insufficient natural production of breast milk or when the mother was not getting sufficient food and the breasts did not produce milk. Some mothers said infant cues, such as the baby wanting to eat when others were eating or the baby being hungry, led to the introduction of complementary foods.

“At around four months, when you take a cup, the child reaches out to catch the cup because they want things, that is when I start taking gruel and mix it with milk [for them], until when they start crying to get food, and I give them food” Mother.

“When it is in such a case of a child who would not get full [with breast milk], usually at around four months when one can afford it, they start giving them gruel” Mother.

Food consistency and texture

The consistency/softness of the complementary food, especially at the beginning of complementary feeding, was very important for participants, and the most important characteristic of an acceptable complementary food. With respect to the consistency of foods, the participants’ concerns were about the physiological maturation of the stomach to a great extent and of the dentition to a lesser extent. Participants reported practices such as sieving flour or even straining cooked gruel to make it as fine as possible. Homemade fruit juices, fruit puree and thin gruel were mentioned by caregivers to have a consistency that is adequate as first foods. In general, most participants reported that liquids (gruel, milk, fruit juice, meat broth) are first introduced. Then solid foods (potatoes, banana, etc.) are mashed into a puree for children aged approximately eight months and beyond. However, gruel was said to remain the main “drink” for children.

“The way I see it, it’s because it [gruel] is something that is affordable, and they [parents] think the child has a soft stomach that would not handle other foods” CHW.

“When my child was six months old, I went to the market and bought fruit, I came home and took tree tomatoes, passion fruit and oranges, washed and used a tea strainer to make juice, that is the first thing I gave to my baby, because he couldn’t eat fruit, I first gave him fruit juice, after that I would buy fish and boil it and give the fine broth to the baby, that is what I gave as first complementary foods” Mother.

Many participants discussed how they add powered dried fish (injanga) to the child’s food; this was the only commonly reported animal source food. Most participants said meat is suitable when the child is nine months old or above, because they believed that is when the child’s teeth and stomach can handle the texture of meat. A few participants said that they used meat/fish broth in their infants’ and young children’s food. One mother, however, said that she gave her infant liver; she said liver can be mashed, so she found its texture suitable.

“When it comes to giving meat to go with vegetables, we use small dried fish instead; we

pound it so that children, who cannot chew, eat it with vegetables" Grandmother.

Filling the stomach

Several participants said the capacity of foods to fill the stomach was important to them. Some mothers mentioned that they introduced highly nutritious foods such as eggs and fish, but because those foods were not "filling" the child, the mothers would switch to bulkier feeds such as gruel.

"When you have gruel, you cook it, for example at noon you get home and cook it and give it to them, they play and in the evening when food is little, you cook gruel again and give them to drink, they go to sleep and if one of them cries during the night you give gruel" Mother.

Availability and affordability of complementary food as perceived by caregivers

Most of the participants said they give gruel because that is what they can afford, and many mentioned they would give cow milk instead if they could afford it. The first challenge to appropriate complementary feeding noted by participants in all FGDs is the difficulty of buying food from the markets. Small dried fish were the animal source food that the majority of participants considered most affordable, physically available in all areas and adequate for infants.

"Children are also given gruel, at around five months, most of the times milk is for those who have means, but some people in rural areas make gruel, they say that the mother does not have milk so they give gruel because that is what is within their means" Father.

"Usually when a child starts eating, when you don't have milk, you take raw soy beans, maize and sorghum grains to the mill, and you give gruel to your child" Mother.

Food produce grown by the household was more likely to be used as complementary food.
"The reason why we choose gruel is it is easier because we are farmers, when you don't have a cow, there is nothing else you can use apart from gruel and soy milk" Mother.

In one focus group mothers discussed the frequency of buying biscuits for their children and during the discussion one mother realised that they were spending a considerable amount of money on buying biscuits, sometimes every day.

"On our way back from the market, she says again and again, "Mum I want biscuits", so I buy her another one. So sometimes you end up buying biscuits every day, possibly we spend about 700 Rwandan francs every week".

An amount of 700 Rwandan francs was equivalent to about USD 1 at the time of the survey.

Balancing between meeting the child's nutritional needs and feeding food from the family pot

A few participants chose food based on the guidelines and foods' nutrition attributes. It is noteworthy that the caregivers and the CHWs use the three food groups classification (energy-giving foods, body-building foods and protective foods).

"The reason why I started with fruits is because they are among the foods that protect children from diseases; gruel is among the body-building foods so it allows the child to increase weight and grow well" Mother.

"It is true, when one starts giving complementary foods, preparing an adequate diet, and we show them how to do it, is to look for body-building, energy-giving and protective foods, often in the village where I live it would be banana and vegetables and when they are lucky they add a bit of soy flour and small dried fish when it's available" CHW.

Even though most participants said they give family foods, as soon as the child can handle it, they prepare a separate meal for the younger child when the family food is estimated to be too hard (e.g. beans and cassava), when they believe it cannot meet the child's nutritional needs, or when the child is ill.

"One knows what is needed, but sometimes you cannot get it. So like we said, the child eats the same as everyone else, not because we don't know cooking something aside would be more beneficial for them, but because even getting food to put into the family pot is difficult. You wouldn't bother cooking two pots when even getting food for the first pot is already difficult" Mother.

"Cooking a separate pot for the child alone, I am not going to lie, I cannot manage to do it. I take potatoes here, vegetables there, and boil it, when it's cooked, as I am about to put oil, I first put aside a little food for the child but we cook food at once simultaneously for everyone" Mother.

Food avoidance

Some participants said that beans are unsuitable for the young child. They believed beans cause diarrhoea to the child, yet beans are a staple family food in Rwanda. However, most participants said they give beans to their children, emphasizing the need to add vegetables to the beans and mash them.

"People say beans cause diarrhoea to children, one should not give beans to a child" Mother.

"They [caregivers] give beans to children usually after one year and above because before that age they would need to remove the beans' skins" CHW.

"I mix beans and vegetables, then I mash all of it to make it soft for the child" Mother.

When discussing how they prepare a separate meal for the child, some participants said that they avoided using oil in the food served to children.

"Because I wanted to avoid putting oil in the child's food, in the beginning of complementary feeding, I cooked a separate pot for her" Mother

Group-level factors

Community-based information and counselling system

In all discussions the primary caregivers (fathers, mothers and grandmothers) reported CHWs to be their first source of information. In Rwanda, CHWs are lay people trained to educate and counsel the community they live in on major public health issues. Community-based programmes; local leaders and churches were also cited as sources of IYCF information.
CHWs were perceived as the most important sources of information because they "lived" in the community; they were accessible and could give individualised counselling. The monthly community work session (umuganda) and community cooking sessions were also mentioned in all focus groups as a platform where they got information on IYCF from CHW. Parents and grandmothers, in general, expressed great confidence in the information provided by community health workers.

"Most of us parent listen to community health workers' teachings, mostly they teach us when with us in our households, and the teachings they give us are accompanied by images, they

show you, discuss with you how it works, and when you hear announcements on the radio, you find that it is the same as what community health workers were saying that they repeat" Mother.

The growth monitoring programme is community-based monthly weight monitoring of all children below five years of age. The CHWs use the child's weight gain or loss as the basis of counselling and education.

"When we are measuring children in the village, because parents are there, and we are going to look at the child nutrition as they gain or lose weight, so when we see that the child has lost we tell the parent that they are not preparing an adequate diet and they tell us that they can't find adequate food or that it was not well prepared; we measure children every month, that discussion takes place for parents to increasingly prepare adequate diets for their children's growth" CHW.

Village Kitchen (Igikoni cy'umudugudu) is a community programme where caregivers meet on a weekly or monthly basis to cook a meal for their children and to be educated by the CHWs. Most mothers perceived Village Kitchen as a source of knowledge and skills to prepare complementary foods. They feel more confident about giving children the food they have prepared before in the Village Kitchen sessions.

"We also have the child pot, the children's kitchen in villages. All of us women have to work together, and everyone goes there with food from their house, whatever we get we cook in the same pot, and they give us oil, maybe small fish, we put it in, the children eat it, and when there are leftovers we eat it" Grandmother.

"We also get information mostly because here we hold the Village Kitchen about every week where people with children go. Many of the people when they feel like it's not clear go there and they explain many things to you so you learn" Father.

"When we started cooking in our Village Kitchen we did not have any other aim but to feed our children an adequate diet, that is the pot we were talking about where we put bananas, we add sweet potatoes, vegetables so that our children can get an adequate diet" Mother.

Health facility-based information and counselling

Health centres' pre- and postnatal education sessions were also discussed as sources of information, mainly for mothers.

"Even before the community-based groups were put in place, there were health centres, as you know when a woman is pregnant they follow her until she gives birth, and they monitor the baby and immunise it. One gets information from there too, because of the education sessions before immunisation" Mother.

Mass media and brochures

Radio and take home brochures were also mentioned by participants as sources of information. The use of images on education materials was perceived as compelling by CHWs and mothers.

"The media are there, as we men sometimes don't go with women for the child vaccinations but even in the media you can hear it and learn things" Father.

"We have showed them the images we have in the books, we show them a child who eats before six months, and when you show them the image of a child who eats after six months you see her [the mother] more motivated" CHW.

Nutrition education by mothers

Some fathers said their wives were also an important source of information about IYCF, as the mothers get the information from antenatal consultations and education sessions during vaccination campaigns, where some fathers do not go.

"When they [wives] go to antenatal sessions, the doctors teach them, and they [wives] don't keep it [the information] to themselves, they tell us as fathers so that we help each other raise the child when it is born" Father.

Support network

In all discussions, participants said the primary role of fathers in IYCF was to provide money; however, some participants reported that a dialogue took place between the two parents about the child's food. Fathers reported that they were willing to contribute to the day-to-day caregiving of the child when the mother was ill or temporarily unavailable.

"The way I see it, usually us men, I can call it a fault we do not have to be able to prepare what children need, we often just leave it to women because they are the ones who are able

to do it and they do it. As men, I see our role in the nutrition of children to be the provider of means to buy what is needed" Father.

"The role of the father, usually all the food for the household, the father knows how to provide it. When it is provided, I must prepare the meal for the child with what was provided" Mother.
Grandmothers were not identified by parents as sources of information or as involved in the decision-making process on infant feeding. Physical distance and the fact that grandmothers do not have updated information were the main reasons why parents did not involve them. During the focus group discussion with the grandmothers, they described their involvement in cases when the mother was an adolescent or was living in the same household as the grandmother (the grandmother being the head of the household). Only in these circumstances, the grandmother had an influence. Some parents, however, noted that grandmothers usually followed the current feeding guidelines when left with the infants while parents were away, and the discussions with grandmothers showed that they were knowledgeable about breastfeeding and complementary feeding guidelines.

Societal level factors

Poverty

Financial constraints relating to buying food were an important barrier to complementary feeding.

"The barrier is mainly poverty, because if you have means, there would be no other reason not to give an adequate complementary diet. Because of limited means, complementary food is not given as it should, sometimes it is not enough, sometimes it does not meet the required quality" Mother.

Burden of other responsibilities

Some participants perceived continued breastfeeding, complementary feeding and caring as competing with agricultural and household chores. This was mentioned more often when referring to older infants that were no longer exclusively breastfed.

"For example, us farmers, we leave the child on the ground and he would eat things, so diarrhoea is a problem" Mother.

“Mothers have a lot of chores, so they leave the babies with their older siblings because of the work, and if the mother has prepared food for the baby the older ones might eat it” CHW.

“I would add that when they first start complementary feeding at six months, most mothers do their best, problems start when the child can be left at home, they still need breast milk and complementary foods, but because the mother sees that the child can now eat they somehow become less attentive” CHW.

Classification of identified factors

We can classify the factors influencing caregivers regarding complementary feeding practices at the individual, group and societal levels into two categories. Table 2 and Table 3 summarise the above-mentioned factors as facilitators or barriers to optimal IYCF.

Table 2 : Facilitators of optimal complementary feeding practices

Individual	Group level	Societal
Caregivers' knowledge about breastfeeding	Community networks and peer support groups	Continued breastfeeding after two years and beyond is the norm
Caregivers' knowledge about timely introduction of complementary foods	Media Community and Health facilities based nutrition education and counselling	
Caregivers want to prevent illnesses	Fathers' financial support to complementary feeding	
Caregivers want to see child weight increase		
Caregivers want to improve children's intelligence		
Caregivers believe children have different nutritional needs from adults.		

Table 3 : Barriers to optimal complementary feeding practices

Individual	Group level	Societal
Belief that gruel needs to be of watery consistency	Dependence of the mother on the father's financial support	Subsistence farming and need to top up own production with food from the market
Belief that fat/oil is harmful to children		Poverty and low access to animal source foods
Beans are thought to cause diarrhoea		Burden of other household chores and farming activities by the caregiver
Belief that a crying baby or a baby reaching out for food is hungry.		

Discussion

This study extends the qualitative literature on infant and young child feeding by exploring the factors influencing complementary feeding practices of a sample of rural and semi-urban caregivers in Rwanda.

Caregivers' knowledge of the benefits of optimal breastfeeding and complementary feeding on child health and growth facilitated optimal IYCF practices. Mother's perceived milk insufficiency and perceived child hunger/readiness for solid foods were barriers to exclusive breastfeeding for the first six months of life. Both barriers have been reported in the literature (Gatti, 2008; Siziba *et al.*, 2015; Burns *et al.*, 2016). Mothers in the present study were from food insecure districts, and maternal experience of hunger contributes to perceived milk insufficiency, anxiety about infant hunger (Webb-Girard et al., 2012).

Data from our study indicated that caregivers were aware that they can give semi-solid foods to their children at six months. However, from our discussions, we discovered that caregivers feed liquid gruels as a staple. They only incorporated solid foods into a child's diet only at eight to nine months old, and once solid foods were incorporated they rarely included micronutrient-rich animal source foods.

The belief that infants of six to eight months cannot eat semi-solid food was an important barrier to optimal complementary feeding. Thin gruels are very common first foods in sub-Saharan Africa (Hotz & Gibson, 2001; Katepa-Bwalya et al., 2015). Because of the high quantity of water and low quantity of flour used in their preparation, gruels are low in nutrients and energy (Isingoma et al., 2015). This study points out that the viscosity of complementary food, especially at the beginning of complementary feeding, is of great concern for caregivers, who perceive the need to first give feeds of liquid consistency. Despite the nutrition education messages about giving children thick semi-solid foods (PAHO & WHO, 2003), caregivers in Rwanda continue to give thin gruels as a staple in the complementary diet. This leads to a risk of insufficient energy intake.

Although, some caregivers reported that they were consciously avoiding feeding beans and oil to children, it was not a general practice. Moreover, caregivers reported that beans and oil were used in the Village Kitchen programmes. Because caregivers replicate at home what they do in the Village Kitchen programmes, the latter could be used as an opportunity for demonstrating ways to prepare complementary foods.

The question related to animal source food repeatedly drew responses from the caregivers indicating that cost of animal source foods was a barrier. In addition to its cost, meat was said

to be unsuitable for infants because they cannot masticate it. This leads to a risk of inadequate iron intake among infants and young children. It has been found that iron deficiency and anaemia in young children are associated with growth failure and anorexia, recurrent infections and impaired motor and cognitive delays (Lozoff et al., 2006; Kraemer & Zimmermann, 2007).

The results of these FGDs show that caregivers believe children have different nutritional needs and try to provide nutritious foods, but also give family foods as soon as the children are physically able to consume it. Thus, caregivers are continuously seeking a balance between meeting the child's nutritional needs and adapting the child's diet to the practical, social and financial situation of the family. An improvement in the nutritional value of the family food would probably benefit infants and young children as well.

Determining mothers' motivations for child feeding may provide information that would allow health professionals to reinforce mothers' feeding practices. Child weight gain was an important indicator of nutritional status for mothers in FGDs. As weight monitoring is done monthly by community health workers, seeing the weight increase was a motivation to feed their children optimally. At the time of the data collection for this study, routine growth monitoring was done only by mid-upper arm circumference and weight measurements. This suggests that height was not seen by caregivers as a nutritional outcome because it was not incorporated in routine growth monitoring.

In the present study, caregivers emphasized the role played by CHWs in nutrition education in Rwanda. The findings show that caregivers, in general, received information and counselling from the CHWs through community-based nutrition education platforms such as the Village Kitchen programme. This reinforces findings from other studies indicating that CHWs play an important role in interventions for child survival in community settings (Quinn *et al.*, 2005; Haines *et al.*, 2007; Bhutta *et al.*, 2013).

Rural agriculturalist mothers have a heavy burden of field work and household chores (preparing food for all household members, fetching water, etc.) to perform daily. Time allocation to different chores was identified as a barrier to adequate feeding and care in other countries as well (Hackett *et al.*, 2015; Nankumbi & Muliira, 2015).

In accordance with the review of Aubel (2012) of the wider household members' roles in child nutrition, our findings also show that in Rwanda, mothers performed the day-to-day nutrition

activities, while fathers were less involved. Contrary to the findings of Aubel (2012), we found that grandmothers did not play a major role in child nutrition. This can be explained by the family structures in Rwanda, where multigenerational family systems are not the norm, with the exception of teenage mothers. Grandmothers and fathers were, however, knowledgeable about good breastfeeding practices. This supports the need to continue educating all community members through community platforms such as 'umuganda' (monthly community work) and other mass media. Moreover, in a quasi-experimental study performed in Kenya, improved knowledge of fathers and grandmothers on health and nutrition of infants and young children resulted in improved social support reported by mothers in terms of physical action and material support (Mukuria et al., 2016).

Caregivers reported poverty as a barrier that affected their feeding practices. Even though most of them were agriculturalists, they explained that it was difficult for them to afford complementary foods. This may be explained by the fact that in Rwanda crop-growing households do not produce enough to cover their food needs; about 70 percent of household food is bought at the market, while only a quarter comes from households' own production (WFP, 2015). Household food insecurity in agriculturalist communities was found by Burns *et al.* (2016) in the Democratic Republic of Congo as well. Many participants perceived that their feeding choices prospects were determined by being poor versus rich, living in rural areas and being farmers. Future nutrition education interventions should aim to change this perception by teaching caregivers how to best utilize the resources available in rural farming environments.

For example, the mothers in one focus group estimated that they could spend up to RWF 700 every week to buy biscuits for children. The biscuits mentioned are usually plain, unfortified biscuits, lower in nutrient density compared to eggs or meat. The RWF 700 estimated by mothers is equivalent to about 1 USD (using the exchange rate of 2015). The same amount could, for example, buy at least seven eggs or about 250 g of meat (prices of 2015). It is possible that perceptions of biscuits being nutritious and convenient may be a motivating factor for caregivers to buy those foods. Contrary to this perception however, studies have shown that processed high sugar foods are may increase the risk of obesity and metabolic risk (Goran, 2013). Nutrition education may need to address this by reminding parents of the risk of high-sugar foods and suggest more nutrient dense alternatives.

This study shows that the factors influencing complementary feeding practices of a sample of rural and semi-urban caregivers in Rwanda are at individual, group and societal level.

Strengths and limitations

The study had a number of limitations, the first of which was the lack of methodological triangulation: the methodology did not foresee any in-depth interviews or observations. Secondly, the focal persons used to recruit participants for the study were linked to community nutrition education. This may have introduced a social desirability bias where participants would have answered what they assumed was the right thing to do rather than what they actually did.

However, the results fit well within the current scientific knowledge reported from other countries in sub-Saharan Africa, and we are confident that the above limitations did not greatly reduce the validity of our findings.

The strengths of the study are that the participants were recruited from a range of locations and varied in terms of age, wealth and socio-economic background; therefore, it seems likely that a broad range of views and experiences were elicited.

Implications for policy and recommendations

This study has contributed to understanding the factors influencing the feeding practices of primary caregivers of children in Rwanda who are six to 23 months old. The research highlights a number of key implications for policy and recommendations.

IYCF messages should address the issue of early introduction of complementary feeding. Since caregivers have a strong trust relationship with CHWs, the latter should be empowered to counsel mothers who believe that they are not producing enough breast milk. Infant growth monitoring can be used to reassure mothers about the normal growth of their infants. Besides, social behaviour such as reaching out for food seen in infants below six months of age should be explained to caregivers who read it as hunger signals.

In Rwanda, IYCF recommendations should aim to normalise thick foods as opposed to thin gruels. Animal source foods, especially those perceived as suitable for infants, such as milk, small dried fish and eggs should be promoted through nutrition-sensitive interventions (increased entitlement of mothers and children to animal foods).

This research also highlights the importance of community-based platforms in nutrition education. For successful nutrition education interventions in Rwanda, the community health workers should be trained and equipped properly.

Key messages

- In Rwanda, IYCF recommendations should aim to normalise thick foods as opposed to thin gruels.
- Animal source foods, especially those perceived as suitable for infants, should be promoted through nutrition-sensitive interventions.
- IYCF messages should address the issue of early introduction of complementary feeding. CHWs should be empowered to counsel mothers who believe that they are not producing enough breast milk. Infant growth monitoring can be used to reassure mothers about the normal growth of their infants.
- This research also highlights the importance of community-based platforms in nutrition education.

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CHAPTER 5

This manuscript is formatted according to the author guidelines of Maternal and Child Nutrition (see Annexure 1), with the exception of the line numbers, which will be inserted, the line spacing, which will be changed to double spacing, and the citation style, which will be changed to APA 6th before submission.

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Contribution statement

MU designed the study, collected and analysed the data and wrote the preliminary manuscript. EWV, LHN and HHV supervised the study, actively contributed to the interpretation of the results and critically reviewed the paper.

Abstract

Stunting (low height for age), a measure of chronic malnutrition among children, is a public health problem in Rwanda. Available data indicate that complementary feeding practices are not optimal in Rwanda and children are most vulnerable to stunting between six and 23 months of age. Currently, Rwanda does not have food-based dietary guidelines (FBDGs) for children of six to 23 months old. In this paper, we report FBDGs to improve the complementary feeding of this group of children in Rwanda. To formulate the guidelines, we conducted a dietary intake assessment to determine the food and nutrient intakes of children in Rwanda. In addition, we used focus group discussions with caregivers to understand the factors influencing caregivers' feeding practices. Also, we considered the complementary feeding recommendations from the World Health Organisation (WHO). We formulated six guidelines, namely (1) Breastfeed exclusively for six months and start complementary feeding at six months, while continuing to breastfeed the baby until two years or beyond; (2) Feed the baby food of a thick consistency; (3) Feed the baby a variety of nutritious foods; (4) Feed the baby small dried fish, cow milk, eggs or meat every day or as often as possible; (5) Follow hygienic practices while preparing, storing and feeding the complementary food; (6) Create a clean environment for the baby. We propose that FBDGs, as a nutrition education tool, may complement other interventions to address sub-optimal complementary feeding practices in Rwanda.

Keywords: Rwanda, dietary guidelines, complementary feeding, infants

Introduction: Setting the national context

Stunting, or chronic under-nutrition, is defined as failure to grow physically and cognitively as a result of long-lasting nutritional deficiencies or recurrent malnutrition (Frongillo, 1999; Black *et al.*, 2008; Prendergast & Humphrey, 2014). Children who are stunted are at increased risk of repeated infections and are more likely to die from diarrhoea, pneumonia or measles, and may be at increased risk of chronic diseases such as cardiovascular disease in adulthood (Black *et al.*, 2013). The United Nations Children's Fund (UNICEF) defines stunting as a height-for-age Z-score (HAZ) below -2 SD (i.e. more than two standard deviations below the population median) (UNICEF, 2012).

Stunting is the most common form of malnutrition in Rwanda, with an estimated 38% of children under five years of age classified as stunted in 2015 (NISR, 2015). Based on the WHO classification for assessing the severity of malnutrition by prevalence ranges (de Onis & Blössner, 1997), the prevalence of stunting in Rwanda is very high. Thus stunting is a public health problem that needs to be addressed. The prevalence of stunting increases during the period of complementary feeding, when children are transitioning from a diet of breast milk or other milk alone to the family food. The complementary feeding period ranges from six to 23 months of age. The prevalence of stunting was twice as high among Rwandan children aged 18 to 23 months as among children aged six to eight months, as Figure 1 shows (NISR, 2015).

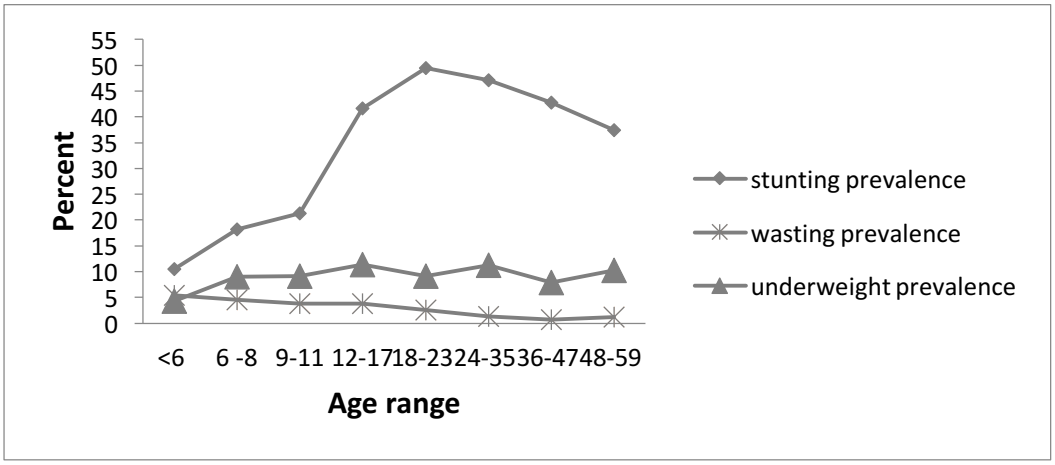

Figure 1: Nutritional status of children aged below five years in Rwanda (National Institute of Statistics of Rwanda (NISR), 2015).

In Rwanda, complementary feeding practices are not optimal (NISR, 2015; WFP, 2015) and complementary diets are commonly poor in energy, protein and micronutrients (Lung'aho *et al.*, 2015; Umugwaneza *et al.*, 2016b).

Interventions to reduce stunting should be undertaken during the first 1000 days of a child's life (also called the 1000 days window of opportunity), after which it becomes increasingly difficult to reverse stunting (Victora *et al.*, 2010). Interventions to improve child nutrition have been shown to increase the likelihood of educational success (Maluccio *et al.*, 2009) and economic productivity in adulthood (Hoddinott *et al.*, 2008) and to prevent chronic diseases (McEniry, 2013; Campbell *et al.*, 2014).

Nutrition education interventions targeting caregivers have been shown to improve complementary feeding and growth of children (Contento *et al.*, 1995; Shi & Zhang, 2011). In Mozambique, mothers with better knowledge of nutrition and health, acquired primarily in informal education programmes, chose more nutritious food and a more diversified diet for their children than did mothers with less knowledge of nutrition and health (Burchi, 2010).

The Food and Agriculture Organisation (FAO) and the WHO defined food-based dietary guidelines (FBDGs) as the expression of the principles of nutrition education mostly as foods, formulated in a way that avoids the use of the technical terms of nutritional sciences (WHO & FAO, 1998). FBDGs are intended to be understandable to the general public and are often integrated with other health-promoting messages, concerning for example physical activity and hygiene (WHO/FAO, 1998).

More than 100 countries worldwide, including five on the African continent, have developed FBDGs for their populations (FAO, 2015). Rwanda does not have FBDGs, and given the high prevalence of stunting seen among children six to 23 months of age, caregivers need science-based dietary recommendations to guide their feeding practices.

We are presenting, in this paper, a set of proposed FBDGs for Rwandan children of six to 23 months old to promote optimal complementary feeding and a healthier nutritional status of children.

Methods

Under the auspices of UNICEF Rwanda's "Contributing to the reduction of stunting in children under two years of age in Rwanda" programme, we undertook the task of collecting the science-based data needed for the formulation of FBDGs for six-to-23-month-old Rwandan children.

First, we conducted a dietary intake assessment to determine the food and nutrient intakes of children. Then we conducted focus group discussions with caregivers to understand the factors influencing their feeding practices. Both the dietary intake assessment and the focus group discussions were reported elsewhere (Umugwaneza *et al.*, 2016a; Umugwaneza *et al.*, 2016b) [chapters 3 and 4 of this thesis, manuscripts in preparation]. The knowledge and understanding acquired through the above-mentioned studies and infant and young child feeding (IYCF) recommendations from the WHO formed the basis we used to formulate the guidelines presented in this paper.

Results and discussion: Proposed guidelines

The proposed guidelines are

1. Breastfeed exclusively for six months and start complementary feeding at six months, while continuing to breastfeed your baby until two years of age or beyond;
2. Feed your baby food of a thick consistency;
3. Feed your baby a variety of nutritious foods;
4. Feed your baby small dried fish, cow milk, eggs or meat every day or as often as you can;
5. Follow hygienic practices while preparing, storing and feeding the complementary food;
6. Create a clean environment for your baby

In this section, first, the scope and health benefits of each guideline are discussed. Thereafter the current situation and guidance for implementation are described for each guideline.

Breastfeed exclusively for six months and start complementary feeding at six months, while continuing to breastfeed your baby until two years of age or beyond

Scope of the guideline

The WHO recommends exclusive breastfeeding for infants from birth until the child is six months of age. Semi-solid and solid complementary foods should be introduced at six months of age and breastfeeding continued, alongside complementary feeding, until the child is two years old or beyond (PAHO & WHO, 2003).

The WHO recommends that human immunodeficiency virus (HIV)-infected mothers take antiretroviral (ARVs) drugs during pregnancy and throughout the breastfeeding period, and their babies are given ARVs during the first six weeks after birth. For all breastfeeding babies who test negative for HIV infection at six weeks the WHO recommends continued exclusive breastfeeding up to six months and thereafter the introduction of complementary foods while breastfeeding is continued (WHO, 2010). In Rwanda, the recommendation is then to stop

breastfeeding gradually, over a one-month period, beginning when the baby is 17 months old (Ministry of Health of Rwanda, 2012).

Health benefits of adherence to the guideline

Exclusive breastfeeding during the first six months of life protects infants from morbidity due to gastrointestinal infections without exposing them to growth deficits. Afterwards, breast milk alone is no longer enough to cover the energy and nutrients needs, thus it is recommended to start complementary feeding at six months (PAHO & WHO, 2003; Kramer & Kakuma, 2012).

To measure timely introduction of semi-solid and solid foods, the WHO defined the indicator "Introduction of solid, semi-solid foods or soft foods", which is the proportion of infants six to eight months of age who received solid, semi-solid or soft foods during the previous day (WHO, 2008). The indicator "Introduction of solid, semi-solid foods or soft foods" was positively associated with HAZ in Bangladesh and Zambia, and the odds of stunting were significantly lower for children six to eight months of age who achieved this indicator in Bangladesh (Jones *et al.*, 2014). In their assessment of the relationship of child feeding with growth in 14 poor countries, Marriott *et al.* (2012) found that the timely introduction of solids was associated with lower risk of stunting.

Continued breastfeeding up to the age of two years protects the child against mortality and morbidity from infectious diseases, as well as overweight and obesity (Victora *et al.*, 2016). Breastfeeding has been associated with improved cognitive function, and the cognitive developmental benefits of breastfeeding increased with the duration of breastfeeding (Anderson *et al.*, 1999).

Current situation that the guideline will address

The Rwandan Demographic and Health Survey (DHS) of 2014/15 found that 87% of the children from birth to six months were exclusively breastfed, but only 55.8% of the children six to eight months were consuming semi-solid and solid foods, while 23.2% of children six to eight months old were reported to be exclusively breastfed. The rest of the children aged six to eight months were breastfed, supplemented with other milk or non-milk liquids (NISR, 2015). Figure 2 shows that there is a certain level of early and late introduction of semi-solid and solid complementary foods.

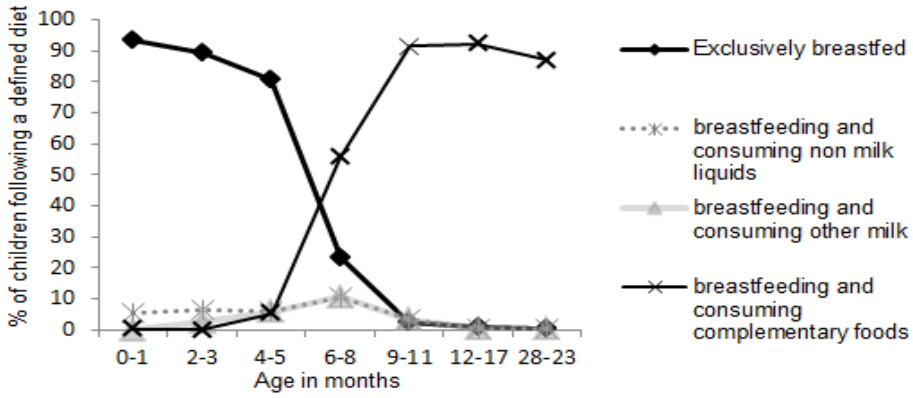

Figure 2 : Percentage of children following a defined diet by age group (NISR, 2015)

Among children aged six to 23 months in Rwanda, the rate of continued breastfeeding was 98.5%, 98.7%, 94.2% and 87.6% in the age groups six to eight months, nine to 11 months, 12 to 17 months and 18 to 23 months, respectively (NISR, 2015).

Breast milk was still an important source of energy and nutrients in the diets of Rwandan children of six to 23 months, contributing 38.32 %, 40.49%, 76.22% and 44.08% of total energy, calcium, vitamin A and vitamin B12, respectively (Umugwaneza *et al.*, 2016b) [chapter 3 of this thesis, manuscript in preparation].

Implementing the guideline

In Rwanda, the practice of breastfeeding must be encouraged to remain commonly practised and timely introduction of complementary foods has to be emphasised in nutrition education.

Regarding the introduction of semi-solid and solid foods, caregivers need specific guidance about the types of food that they should feed infants, especially when starting complementary feeding.

When starting solid foods, a small amount of the food (equivalent to a teaspoon serving size) is enough. Caregivers should expect infants to take only two to three bites at the first meals. The serving size is then increased gradually (Ministry of Health of Rwanda, 2012).

Feed your baby food of a thick consistency

Scope of the guideline

Even if the nutrition education messages in Rwanda refer to giving children thick semi-solid foods (Ministry of Health of Rwanda, 2012), caregivers continue to serve thin gruels to children

as a staple of the complementary diet (Umugwaneza *et al.*, 2016a) [chapter 4 of this thesis, manuscript in preparation]. Prepared by mixing cereal flour, water and other ingredients, the cereal-based gruels are low in energy and nutrient content (Mouquet-Rivier *et al.*, 2008; Mouquet-Rivier *et al.*, 2016). Foods that are watery and diluted may contain only about 0.3 to 0.45 kcal per gramme (Mouquet-Rivier *et al.*, 2016). Breast milk contains about 0.7 kcal per ml (Butte *et al.*, 2002). Complementary foods should have a greater energy density than breast milk, that is, a minimum of 0.8 kcal per gramme (Dewey & Brown, 2003; Codex Alimentarius, 2006). Because of the high quantity of water and low quantity of flour used to prepare gruels, the gruels have a low nutrient density (amount of nutrient per 100 kcal) (Isingoma *et al.*, 2015).

Health benefits of adherence to the guideline

When complementary food is introduced, a child tends to be breastfed less often and his or her intake of breast milk decreases (PAHO & WHO, 2003). For a complementary diet to have high energy density, the food must be quite thick and contain fat or oil, which are the most energy-rich foods. If the complementary food is more energy diluted than breast milk, the child's total energy intake may be less than it was with exclusive breastfeeding. Complementary foods of thicker consistency would provide more energy and nutrients, thus contributing to meeting the children's nutritional needs.

Current situation that the guideline will address

In Rwanda, caregivers believe that infants and young children, especially when starting complementary feeding, cannot eat food of thick consistency (Umugwaneza *et al.*, 2016a) [chapter 4 of this thesis, manuscript in preparation]. Cereal-based gruels (thin/watery porridge) are a common complementary food in Rwanda. In a survey conducted in 2014, 81% of the mothers reported that they prepared gruel for their children under 24 months (Lung'aho *et al.*, 2015). As those gruels are very viscous, the caregivers tend to dilute them excessively to reach the desired consistency, thus reducing their energy and nutrient density (Kikafunda & Walker, 1997; Michaelsen & Friis, 1998; Amagloh *et al*., 2013).

Implementing the guideline

To address the caregivers' concerns about the ability of infants to eat semi-solid foods of thick consistency, demonstrations can be given. The Village Kitchen (Igikoni cy'umudugudu) is a community-based programme where caregivers meet on a weekly or monthly basis to cook a meal for their children and to be educated by the community health workers (CHWs). The Village Kitchen platforms can be used for demonstration of the optimal consistency of cereal-based porridge. Cereal-based gruels should be prepared with less water. Other types of locally

available foods that are energy and nutrient dense are pumpkin, cooking bananas, sweet potato, egg, green leafy vegetables, dried bean relishes, mango, banana, avocado etc. All these foods can be finely mashed with a fork (without the need of a blender) and expressed breast milk or cow milk can be added to reach the desired consistency. The complementary foods must be made thick enough not to run off the spoon, but still soft enough for the infant to be able to suck at it (Ministry of Health of Rwanda, 2012).

Feed your baby a variety of nutritious foods

Scope of the guideline

Dietary variety is defined here as the number of different items consumed across food groups (Remick *et al.*, 2009). To measure dietary variety the FAO defined the indicator of minimum dietary diversity, which is the proportion of infants and young children who consumed, on the previous day, items from at least four of the following seven food groups: (1) grains, roots and tubers; (2) legumes and nuts; (3) dairy products; (4) flesh foods; (5) eggs; (6) vitamin A-rich fruit and vegetables; and (7) other fruit and vegetables (WHO, 2008).

Health benefits of adherence to the guideline

Dietary diversity has been shown to be positively associated with nutrient density and nutrient adequacy in breastfed and non-breastfed children (Kennedy *et al.*, 2007; Steyn *et al.*, 2007; Moursi *et al.*, 2008; Wondafrash *et al.*, 2016). Arsenault *et al.* (2013) found that dietary diversity was strongly correlated with overall micronutrient intake in Bangladeshi children. Several studies have shown that dietary diversity is positively associated with the nutritional status of children, including height for age (Arimond & Ruel, 2004; Rah *et al.*, 2010). In a longitudinal study in rural Zambia, Mallard *et al.* (2014) found that dietary diversity at six months of age was associated with a greater HAZ at 18 months independently of socio-economic factors.

Current situation that the guideline will address

The diet of infants and young children in Rwanda is not diverse. The complementary diets in Rwanda are generally monotonous, containing beans, green leafy vegetables, cereals prepared as thin gruels and tubers. Animal source foods (ASF) and fruit are less frequently consumed per week and served in lower amounts (Umugwaneza *et al.*, 2016b) [chapter 3 of this thesis, manuscript in preparation]. The minimum dietary diversity was reached by 22.2%, 37.8% and 41.7% of the children aged six to eight months, nine to 11 months and 12 to 23

months respectively (Umugwaneza *et al.*, 2016b) [chapter 3 of this thesis, manuscript in preparation].

In 2015, a national survey found that only 29% of the children six to 23 months had consumed foods items from at least four out of seven food groups (WFP, 2015). Another national study found that the day before the survey 81%, 70% and 56% of the children in Rwanda had consumed grains, roots and tubers; vitamin A rich fruits and vegetables; and legumes and nuts as part of their diets (WFP, 2015). In comparison, dairy products were consumed by 24%, flesh foods by 17% and eggs by 3% of the children (WFP, 2015).

While the nutrition education messages given in Rwanda use the three food groups classification (energy-giving foods, body-building foods and protective foods) as shown in Table 1, the counselling cards used by CHWs show four food groups (Ministry of Health of Rwanda, 2012). Figure 3 shows the four food groups displayed in the CHWs counselling cards.

Table 1 : Classification of foods based on function, major nutrients and examples of foods

Three food groups classification	Major nutrients and examples of foods
Energy giving foods	**Carbohydrates and fats** • Roots and starchy vegetables (cassava, cassava flour, sweet potato, potato, cooking banana) • Grains (maize, sorghum, rice) • Vegetable oil, ghee and sugar
Body building foods	**Proteins** • Pulses, nuts and seeds (dried common beans, soybeans, peanuts, sesame seeds) • Animal source foods (flesh meat, organ meat, eggs, fish) • Dairy products (fresh milk, fermented milk, milk powder, yoghurt)
Protective foods	**Vitamins and minerals** • Dark green vegetables (amaranth leaves, bean leaves, pumpkin leaves, cabbage) • Orange vegetables and fruits (carrot, pumpkin, mango, papaya) • Other fruit and vegetables (onion, banana, passion fruit, tree tomato)

Figure 3 : Food groups classification in CHWs counselling cards

In addition to the image of a mother breastfeeding her infant, the four food groups displayed on counselling cards are:

(1) Tubers, cereals and grains whose primary macronutrients are carbohydrate and protein.

(2) Legumes and nuts that supply protein, iron and zinc.

(3) Vegetables and fruit that provide an array of vitamin, fibre, potassium, folate and vitamin C. Some vegetables are especially good sources of certain nutrients: dark green vegetables are rich in folate and orange-fleshed vegetables provide carotene.

(4) ASFs including fresh and fermented milk, which are excellent sources of protein, calcium, phosphorus, and riboflavin; meat (beef, pork, lamb, fish, poultry) which is an excellent source of protein, iron, zinc and B vitamins.

Each of the food groups contributes key nutrients. Noteworthy, foods provide not only the key nutrients specific to the food group they belong to, but also small amounts of other nutrients.

We did not find a visual aid for the three food groups classification. This finding suggests there is a mismatch between the nutrition education messages and the visual aids currently in use.

So far, the three food groups classification is far better known to the population than any other type of food groups classification (Umugwaneza *et al.*, 2016a) [manuscript in preparation].

Apart from low dietary diversity, Rwandan children aged 12 to 23 months had a low energy intake and their median fat intake was below the acceptable macronutrient distribution range. Among children aged 12 to 23 months, 89.1% had a fat intake below the recommendation (Umugwaneza *et al*., 2016b) [chapter 3 of this thesis, manuscript in preparation].

Implementing the guideline

The visual aids must provide the caregivers with assistance in choosing the appropriate combination of foods, from among the food groups that will yield a diet adequate in micronutrients and balanced in macronutrients. The regular inclusion in the diet of a combination of foods from the food groups displayed on the visual aid would provide adequate macro- and micronutrients.

Fats and fatty acids are important in the diet of infants and young children as an energy source for growth and development (Prentice & Paul, 2000; Uauy *et al.*, 2000). The complementary foods should be cooked with a moderate quantity of vegetable oil. Thus, to guide the caregivers, the visual aids should show fat and oils.

Caregivers should aim to introduce a variety of foods so that by the end of the first year, the child is able to enjoy a variety of foods and consume family food (Gerrish & Mennella, 2001; Nicklaus, 2009).

The visual aid showed in Figure 3, currently used in counselling by CHW and endorsed by the Ministry of Health in Rwanda, could be used to accompany these FBDGs. However, it does not show fats and oils.

Feed your baby small dried fish, cow milk, eggs or meat every day or as often as you can

Scope of the guideline

The importance of including ASF in complementary feeding daily or as often as possible has been emphasised by the WHO (PAHO & WHO, 2003; WHO, 2005) and several investigators (Bwibo & Neumann, 2003; Yeudall *et al.*, 2005; Allen, 2013; Muslimatun & Wiradnyani, 2016). Nevertheless, the high cost of ASFs limits their consumption, especially in poor households. In addition, availability (defined here as the physical availability of food stocks in desired

quantities) is subject to seasonal fluctuations throughout the year in respect of fresh milk production and small fish species harvest.

In a four-country study by Krebs *et al.* (2011) the consumption of meat at least one to three times a week was associated with a reduced likelihood of stunting among children below two years of age. It has been reported that the regular intake of meat, even in small quantities, had a positive impact on children's iron intake (Yeudall *et al.*, 2005) and mental and motor function (Morgan *et al.*, 2004). However, Allen (2006) noted that the impact of a supplement of meat or milk on micronutrient adequacy of the diet of Kenyan school children was limited until intake was increased to 52 g/d from a usual amount of 17 g/d.

Health benefits of adherence to the guideline

ASFs such as fish, milk, eggs, flesh meat and organ meat are good food sources of micronutrients (Murphy & Allen, 2003; Allen, 2013) and the only food sources of vitamin B12 (Herbert, 1988; Watanabe, 2007). Breast milk supplies a certain amount of vitamin B12 in the diet of breastfed children, but breast milk's vitamin B12 concentration varies with the maternal diet and when the maternal diet is poor in ASF, breast milk does not supply adequate levels of vitamin B12 (Allen, 2012; Neumann *et al.*, 2013).

In comparison with non-haeme iron sources such as meat alternatives (e.g. legumes) and iron-fortified cereals, meat is an important source of highly bioavailable haeme iron (Bezwoda *et al.*, 1983; Hurrell & Egli, 2010). Milk is a good source of calcium (Bueno & Czepielewski, 2008). Eaten whole with head, viscera and bones, small fish species are a good source of animal protein, iron, zinc, vitamin A, polyunsaturated fatty acids and calcium (Kabahenda *et al.*, 2011; Thilsted, 2012; Abbey *et al.*, 2016). Eggs are a good source of protein, vitamin B12, riboflavin, phosphorus, selenium, vitamin A, vitamin D, and vitamin K (Applegate, 2000).

In Indonesian children, ASF consumption was significantly associated with adequate intake of protein and micronutrients, particularly zinc, calcium and vitamin A (Muslimatun & Wiradnyani, 2016). A randomised controlled school feeding study conducted in Kenya tested for a causal link between ASF intake and changes in micronutrient nutrition, growth, cognitive and behavioural outcomes. Children who received meat supplements showed improved cognitive performance, increased physical activity and leadership and initiative behaviours (Neumann *et al.*, 2007). Also, meat intake has been positively associated with gross motor development (Morgan *et al.*, 2004; Siegel *et al.*, 2005).

Current situation that the guideline will address

In Rwandan households, meat is consumed on average one day per week (WFP, 2015). Only a low percentage of children are given ASF in Rwanda. Besides, for those who are given ASF the frequency of consumption is low and portions served are small. Fish and cow milk were found to be the most commonly consumed animal source foods, consumed by 21.7% and 23% of the children respectively in the seven days before the survey. In comparison, only 6.4% had consumed eggs, 6% had consumed meat and 1.1% had consumed organ meat in the previous week. For children who had consumed fish or cow milk, the mean consumption frequency was about three times for fish and four times for cow milk in the previous seven days. The mean amount of cooked fish consumed was 18.2 g per day (Umugwaneza *et al.*, 2016b) [chapter 3 of this thesis, manuscript in preparation].

Lung'aho *et al.* (2015) found that Rwandan children of six to 23 months old from households with lower expenditure on foods such as meats, milk, eggs, and fresh fruits were more likely to be stunted (not adjusted for confounders).

Implementing the guideline

Iron and zinc rich foods should be given regularly, as these nutrients are critical for IYCF. The main barriers to providing ASF to children in Rwanda, as expressed by caregivers, are their high cost and the texture of flesh foods (Umugwaneza *et al.*, 2016a) [chapter 4 of this thesis, manuscript in preparation]. Regarding the cost, caregivers have to be educated about the most nutrient dense foods to be able to choose the best foods within their financial means. In a dietary intake survey of children of six to 23 months in Rwanda, sugary snacks, such as biscuits, and fruit-flavoured drinks were consumed by 19.7% and 8.6% of the children over a seven-day period and both were consumed about three times in that week (Umugwaneza *et al.*, 2016b) [chapter 3 of this thesis, manuscript in preparation]. By choosing to buy eggs instead of processed foods such as sugary snacks or milk instead of fruit-flavoured drinks, caregivers would greatly improve the ASF intake of infants and young children. In addition to educating the caregivers, marketing and promotion of processed foods commonly eaten by children should be tightly regulated because caregivers can be enticed to purchase nutrient-poor foods, resulting in less money being available for the purchase of more nutrient-rich food items.

Regarding the texture, the capacity of infants to cope with more complex textures develops as they are given the particular foods with textures requiring more oral motor skills (Mason *et al.*, 2005) and unnecessarily delaying the introduction of foods that require chewing causes

feeding difficulties later on (Northstone *et al.*, 2001; Le Révérend *et al.*, 2014). Thus, gradually offering food with more texture over time gives the child the opportunity to develop biting and chewing skills.

Powdered dried small fish can be added to soft foods for infants at six months of age. Besides the fact that they are widely available, relatively affordable and acceptable to caregivers as a soft food for infants and young children (Umugwaneza *et al.*, 2016a) [chapter 4 of this thesis, manuscript in preparation], in rural Rwanda, dried small fish have the additional advantage that they can be stored at room temperature in the many households that do not own a refrigerator. In addition, a hard-boiled egg can be mashed and softened to reach an acceptable texture for infants aged seven months. Tender finely shredded meat, chicken or fish mixed with mashed cooked vegetables can be served to eight-month-old infants (Butte *et al.*, 2004; New Zealand Ministry of Health, 2008).

Follow hygienic practices while preparing, storing and feeding complementary food

Scope of the guideline

Diarrhoeal disease in young children is thought to be mainly caused by a high level of microbial contamination of complementary food (Rowland *et al.*, 1978; Motarjemi *et al.*, 1993; Lanata, 2003; Kung'u *et al.*, 2009; Islam *et al.*, 2012). According to the 2015 DHS, 12% of Rwandan children under age five had experienced diarrhoea in the two weeks preceding the survey (NISR, 2015).

Islam *et al.* (2013) showed that complementary food contamination can be reduced by an intervention to improve the hygienic handling of complementary foods. The intervention consisted of counselling mothers (i) to wash their hands with safe water and soap before starting meal preparation or feeding a child, after cleaning a child's bottom and after using a latrine; (ii) to use safe water to wash utensils and prepare food; (iii) to cook and reheat foods until boiling; and (iv) to cover the food with a lid during storage. Safe handling of complementary foods, including reducing the time lapse between food preparation and consumption (two hours maximum at room temperature), thorough cooking (boiling temperature), storage of cooked food at a temperature below five degrees Celsius and avoidance of contamination from the household environment and the food-handler, could lead to fewer episodes of diarrhoea among young children (Motarjemi *et al.*, 1993; Fewtrell *et al.*, 2005; WHO, 2006).

Health benefits of adherence to the guideline

Frequent illness and inadequate food intake are immediate causes of child undernutrition (Black *et al.*, 2008). Worldwide, diarrhoeal disease is the second leading cause of death in children under five years of age (WHO, 2013). Episodes of diarrhoea contribute to stunted linear growth and development (Stewart *et al.*, 2013; Scharf *et al.*, 2014). It has been documented that episodes of diarrhoea are followed by catch-up growth; however, in regions where young children suffer from frequent episodes of diarrhoea the opportunity for catch-up growth may be missed (Richard *et al.*, 2014). In rural India, caregivers' self-reported practices of washing hands with soap before meals or after defecation were inversely associated with child stunting (Rah *et al.*, 2015).

Current situation that the guideline will address

In rural Rwanda, when the child starts complementary feeding, some mothers leave the child at home while attending to field work and leave food (at room temperature) for the child. Other mothers take the child with them and transport gruel/food (Umugwaneza *et al.*, 2016a) [chapter 4 of this thesis, manuscript in preparation]. Both these practices expose the food to bacterial growth and the child to diarrhoea.

Implementing the guideline

The practice of leaving infants and young children to the care of grandmothers or older siblings calls for hygiene education not only of mothers but also of school children and the elderly. Caregivers should wash their hands and the baby's hands with soap before handling food and wash all kitchen utensils in soapy water. They should discard any food left out at room temperature for more than two hours and reheat complementary food by bringing it to a rolling boil before serving it to the child. Caregivers should use a hot flask when transporting gruel for the child. They should pour the gruel into the hot flask when it is still boiling hot and serve it to the child in a cup.

Create a clean environment for your baby

Scope of the guideline

Over the first two years of life, children gain locomotion skills by rolling, crawling, cruising sideways along furniture etc. (McGraw, 1943; Adolph, 2008) and curiously explore their environment. As an imperative for their health, crawling and toddling children need clean environments in places where they live, explore, play, eat and sleep (Ngure *et al.*, 2014; Headey & Hirvonen, 2016; Williams *et al.*, 2016).

Health benefits of adherence to the guideline

Environmental contamination due to lack of sanitation (defined here as the safe disposal of human and domestic animal faeces) is associated, among other diseases, with diarrhoea in children (Esrey *et al.*, 1985). Even in the absence of overt diarrhoea, exposure to enteric pathogens in the child's environment leads to chronic inflammation of the small intestine, also known as environmental enteropathy (EE) (Ngure *et al.*, 2013; George *et al.*, 2015). EE is possibly an important contributor to stunting, through damage to the small intestine (Humphrey, 2009; Mbuya & Humphrey, 2016).

Unsafe child faeces disposal was significantly associated with EE and impaired growth in a paediatric population in rural Bangladesh (George *et al.*, 2016). Geophagy (putting soil, mud, clay, or sand directly into their mouths) in young children was significantly associated with EE and stunting in Bangladeshi children (George *et al.*, 2015). A 2013 study conducted in Zimbabwe directly observed 21 households with children six to 18 months old for six hours each and found that infants put their hands into their mouths 38 times on average during the observation period and that their hands were visibly dirty 75% of the time (Ngure *et al.*, 2013).

The possibly important contribution of the poor hygienic environment to the high prevalence of stunting can be reduced by improved hand washing and provision of toilets (Humphrey, 2009). Ngure *et al.* (2014) proposed the concept of "baby WASH", which consists of baby handwashing at key times and creation of a hygienic and protective play environment.

Current situation that the guideline will address

In rural agricultural Rwandan communities, child care was perceived as competing with agriculture and household chores (Umugwaneza *et al.*, 2016a) [chapter 4 of this thesis, manuscript in preparation], suggesting that children are sometimes left without supervision and may ingest soil in the household yard and in the fields while caregivers are working.

Implementing the guideline

Caregivers must dispose of all faeces in a latrine, including children's faeces. To prevent them from putting contaminated soil and other unsafe objects into their mouths, children should be placed in clean protected spaces where they cannot access dirt/human and animal faeces when playing or eating, for instance by placing the child on a washable mat instead of the ground.

Conclusion and recommendations

We propose guidelines to deal primarily with improving the timely introduction and quality of complementary foods. In addition, we recommend improving hygiene and sanitation practices. Specifically, we address early and late introduction of complementary foods, provision of a varied and nutritious diet, provision of ASFs, and lastly we address hygienic and sanitisation practices that would prevent diarrhoea and EE. A summary of the proposed guidelines, their rationale and expected outcome are presented in Table 2.

Table 2 : Summary of FBDGs, the rationales and expected impact

Guideline	Rationale	Expected outcome
1. Breastfeed exclusively for six months and start complementary feeding at six months, while continuing to breastfeed your baby until two years and beyond	Early and late introduction of semi-solid and solid complementary foods	At six months of age, infants start complementary feeding with energy and nutrient dense semi-solid and solid foods
2. Feed your baby food of a thick consistency	Cereal-based gruels of low energy and nutrient density are common in the complementary diet	Infants and young children are fed thicker cereal-based porridges
3. Feed your baby a variety of nutritious foods	Low dietary diversity	Infants and young children aged six to 23 months are fed a variety of foods from across and within the food groups of the visual aid.
3. Feed your baby meat, eggs, fish, and cow milk every day or as often as you can	Low consumption of animals-source foods	Infants and young children aged six to 23 months are fed animal-source foods daily
4. Observe hygienic practices while preparing, storing and feeding the complementary food	Risky behaviours that expose infants and young children to foodborne diseases	Caregivers handle complementary foods hygienically
5. Create a clean environment for your baby	Infants and young children are exposed to environmental enteropathy	Caregivers provide children with a clean space for eating and playing

The proposed FBDGs are in line with the infant feeding recommendations currently used in Rwanda (Ministry of Health of Rwanda, 2012) and many other IYCF recommendations and

guidelines (PAHO & WHO, 2003; WHO, 2005; WHO, 2013; Fahmida & Santika, 2016). Compared with dietary guidelines currently used in Rwanda, the proposed FBDGs are unique in that they are formulated with practical examples of foods to be used when implementing the guidelines. Besides, to the best of our knowledge, this is the first time Rwandan caregivers are given a guideline on addressing EE.

We formulated a guideline on ASFs alone (not including legumes) in an attempt to stress the need for these foods in IYCF while acknowledging that some families cannot afford ASF daily. The same approach was used by Vorster *et al.* (2013) in the revised paediatric FBDGs for South Africa.

To ensure the sustainability of the process of formulation and revising dietary guidelines, a lead agency needs to be appointed.

The proposed guidelines should undergo further testing before implementation. First, these FBDGs should be tested for adequacy. Linear programming can be used to define portion sizes and test FBDGs two and three for meeting nutrient recommendations (Ferguson *et al.*, 2004). Second, an interdisciplinary experts' consultation should refine and validate the guidelines. This will also build ownership and commitment from the different professional sectors that will be involved in the FBDGs' implementation. Third, the FBDGs should undergo consumer research to test understanding of the meaning by caregivers of infants and young children. This should be done after the translation of messages in Kinyarwanda (the language of all Rwandan people). Dietary guidelines can be difficult for people to follow in their everyday practice (Jones *et al.*, 2012; Kirkpatrick *et al.*, 2012). Therefore, we recommend that these proposed dietary guidelines be tested for practicability (including availability and affordability of recommended foods) to unveil and address possible barriers to compliance. In an effort to harmonise the nutrition education messages given to the population, we propose to study the consumers' perceptions of food classification, align the messages with the visual aids and test the visual aids for comprehensibility.

Although FBDG visual aids were traditionally designed to represent foods, some additional lifestyle messages are often added (Montagnese *et al.*, 2015). In the context of the FBDGs presented in this paper, messages about complementary food thickness, hygienic practices and sanitisation can be added to accompany the visual aid.

Afterwards, the development of education materials and implementation will follow. Efficacy testing should be integrated into the implementation plan of FBDGs to evaluate their impact on the complementary feeding practices.

Key messages

This paper proposes FBDGs to improve feeding practices of children aged six to 23 months in Rwanda.

We propose FBDGs to improve complementary feeding practices in Rwanda, timely introduction of complementary foods, dietary variety, consumption of ASF, hygiene and sanitation. In view of its importance in the diet of infants and young children, breastfeeding is emphasised.

To be successfully implemented the proposed FBDGs need to be endorsed by authoritative bodies in Rwanda and gain multi-sectoral commitment.

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CHAPTER 6 GENERAL DISCUSSION AND CONCLUSIONS

6.1 General discussion

Rwandan children aged six to 23 months suffer from an alarmingly high prevalence of chronic malnutrition, and the prevalence of stunting increases during the complementary feeding period (Lung'aho et al., 2015; NISR, 2015; WFP, 2015). The aim of this thesis was to develop food-based dietary guidelines (FBDGs) to improve the feeding practices and the nutritional status of six-to-23 month-old children in Rwanda.

In chapter 1, we presented the background information, aim and objectives of this thesis. In chapter 2, we reviewed the current complementary feeding recommendations for infants and young children and the relevance of FBDGs. We also reviewed the nutritional status of infants and young children aged six to 23 months in Rwanda.

In chapter 3 (the first manuscript), we reported the food and nutrient intake of children aged six to 23 months of age in Rwanda. We used quantitative methods (a single 24-hour recall and food frequency questionnaire) to gather information on food and nutrient intake (N=765). The majority of children (78%) received complementary food and breast milk. We found that in general the children had adequate protein and energy intakes. However, micronutrient intakes were inadequate, probably owing to the observed low dietary diversity and low intake of animal source foods. In addition, the practice to prepare a very thin gruel contributed to the dilution of micronutrients. Breast milk was an important source of energy and vitamin A in the children's diet. Small dried fish was the main animal source food in the complementary diet and contributed most to the intake of iron and zinc.

In chapter 4 (the second manuscript), we reported a qualitative study to identify the factors influencing caregivers in the feeding of infants and young children. We conducted focus group discussions that revealed caregivers' knowledge of the benefits of optimal breastfeeding and complementary feeding for children's health and growth. This knowledge facilitated the implementation of optimal infant and young child feeding (IYCF) practices. Caregivers' misperceptions about infants' cues for hunger and the suitable consistency of complementary foods are individual level barriers to optimal IYCF practices. Caregivers prepared a very thin cereal-based gruel as part of the complementary diet. Caregivers were also facing group level and societal level barriers that would need other types of action beyond FBDGs to address. For instance, at societal level, poverty and mothers' food insecurity were perceived by mothers to cause low breastmilk production and caregivers' inability to provide adequate complementary foods. To identify the best way to reach the target population, we discussed their sources of

IYCF information with caregivers. Our findings show that community health workers (CHWs) are the most important source of information and counselling for caregivers. Community-based nutrition interventions, such as the growth monitoring and Village Kitchen programmes, are the best information platforms for reaching caregivers. Therefore, the conclusion reached was that FBDGs developed within this thesis should be communicated to caregivers through community-based programmes.

In chapter 5 (the third manuscript), with the insights on the local context given by the quantitative and qualitative studies, we formulated a set of six FBDGs to address early and late introduction of complementary foods, provision of a varied and nutritious diet, and provision of animal source foods. Also, we addressed hygienic and sanitisation practices that would prevent diarrhoea and environmental enteropathy (EE). These six guidelines (presented in Box 6-1) should be regarded as the major outcome of this thesis and part of the following discussion will focus on recommendations for the testing and implementation of these guidelines.

Box 6-1 : The proposed FBDGs for six-to-23-month-old Rwandan children

The proposed guidelines are

1. Breastfeed exclusively for six months and start complementary feeding at six months, while continuing to breastfeed your baby until two years of age or beyond;
2. Feed your baby food of a thick consistency;
3. Feed your baby a variety of nutritious foods;
4. Feed your baby small dried fish, cow milk, eggs or meat every day or as often as you can;
5. Follow hygienic practices while preparing, storing and feeding the complementary food;
6. Create a clean environment for your baby.

The proposed FBDGs are consistent with infant feeding recommendations currently used in Rwanda (Ministry of Health of Rwanda, 2012), many other IYCF recommendations (PAHO & WHO, 2003; WHO, 2005; Fahmida & Santika, 2016) and FBDGs (Vorster *et al.*, 2013). Compared with dietary guidelines currently used in Rwanda, the proposed FBDGs are unique in that they are formulated with practical examples of foods to be used when implementing the guidelines. Besides, to the best of our knowledge, this is the first time a guideline addressing EE has been given to Rwandan caregivers.

6.2 Limitations of the thesis

The development of FBDGs should follow a stepwise approach (WHO & FAO, 1998). Because of the context of formulation of these FBDGs within a PhD programme, the early involvement of multisector stakeholders was not possible and this could impede acceptance of the outcome. However, the research proposal of this PhD study was presented to the working group of the UNICEF Rwanda programme: "Contributing to the reduction of stunting in children under two years of age in Rwanda". The working group comprises nutritionists and agricultural professionals from the Ministry of Health, Ministry of Agriculture, University of Rwanda and local and international non-government organisations, and their inputs were considered.

Another limitation is that the participants in the studies presented in this thesis were all from rural and semi-urban areas of Rwanda. Therefore, when applying these findings to other groups, for example, the urban population in Rwanda, one should pay attention to relevant differences.

6.3 Policy implications

The findings generated contribute to scholarly knowledge about IYCF in Rwanda and probably also in other developing countries, especially in Africa. The barriers to optimal IYCF practices expressed by caregivers should be considered in the formulation of future IYCF interventions in Rwanda. Conversely, the facilitators should be used to promote the uptake of recommendations by caregivers in future interventions.

At the time of the data collection for this study, community-based monthly growth monitoring was done only by mid-upper arm circumference and weight measurements. For caregivers, seeing the weight increase was a motivation to feed their children. In line with the country's agenda to reduce stunting, these findings show infants and young children's height/length measurement should be incorporated into the monthly growth monitoring. That would make stunting visible to caregivers as a nutritional outcome, which may motivate them to change feeding practices.

Because the complementary diet of Rwandan children is based on the family diet, this diet should be studied and recommendations made for its improvement. That will benefit not only children in general but also pregnant and lactating women, thus addressing total nutrition in a lifecycle and more holistic manner.

Alignment of agriculture, food and nutrition policies to support the health of the population is necessary. For example, fishery policies can have a huge impact on the availability and

affordability of small fish species, which in turn would have an impact on the diet of infants and young children. This emphasises, once again, the need for multi-sector collaboration in reducing malnutrition. The original purpose of national FBDGs was to advise the public but there is a great potential for FBDGs to be further utilized for creating a supporting environment for nutrition (UNSCN, 2017).

6.4 The way forward and recommendations

Further research needs to be carried out to test the proposed guidelines before their implementation. We recommend that the guidelines be subjected to testing procedures (such as linear programming) to ensure that their implementation will always lead to balanced diets that will meet the nutrient recommendations for this age group (adequacy principle), without providing too much energy that could lead to obesity (prudence principle).

Thereafter, a validity test should be performed with nutritionists, community health representatives, community leaders and other stakeholders in Rwanda. This would lead to a first revision. The wording of the FBDGs should be evaluated in a study to test users' comprehension of the messages conveyed through the FBDGs. The eventual users are caregivers responsible for planning food and nutrient intakes of six-to-23-month-old children.

The implementation of FBDGs should include not only communication to consumers but also the integration of FBDGs into the country's relevant policies, such as the food and nutrition policy, and the community health policy.

Lastly, and most importantly, it is recommended that the implementation of the FBDGs should be evaluated in order to assess how implementation goals are reached, and to ensure that changes to implementation are made if necessary. Table 6-1: 6-1 shows the most important steps of this evaluation. The evaluation of nutrition programmes should include both process and impact evaluation (Wentzel-Viljoen, 2005). It is recommended that such evaluation plans should form part of the design of food and nutrition programmes in Rwanda, to ensure that the necessary budgets are available for conducting the evaluations.

It is only through a properly conducted evaluation that the contribution of FBDGs to IYCF practices and nutritional status can be determined. Nevertheless, the dietary guidelines are but a piece of the puzzle in achieving optimal diets and nutritional status.

Table 6-1: Proposed implementation evaluation of the FBDGs in programmes

Objectives of evaluation	Evaluation indicators	Data collection
	FBDGs implementation outputs	
To evaluate the implementation process	• Number of CHWs trained on the FBDGs • Number of items of education materials (leaflets, posters etc.) distributed • Number of national policy documents referring to FBDGs	• Desk study based on the review of terms of reference for training CHWs and training reports, and the review of education materials' procurement and delivery
	• Awareness and use of FBDGs in nutrition education	• Observation of nutrition education sessions, FGDs and in-depth interviews with CHWs
	Outcomes	
To assess the FBDGs acceptability and credibility to the caregivers	• Awareness • Knowledge change • Attitude change • Use of FBDGs in decision-making with regards to IYCF practices	• Knowledge, attitude and practice assessment
To evaluate the contribution of FBDGs to IYCF practices	• Changes in food purchases • IYCF practice changes • Changes in food/nutrient intake of six-to-23-month-old children	• 24-hour recall, food frequency questionnaires
	Impact	
To evaluate the effect of FBDGs on nutritional status	• Change in nutritional status	• Anthropometric measurements, including height-for-age

Because of ongoing progress in nutritional sciences, changes in nutrition-related public health and the food environment (such as the nutrition transition currently seen in some African countries), FBDGs ought to be adapted to those changes on a regular basis. To ensure the

sustainability of the process of formulation and revision of dietary guidelines for Rwanda, we recommend that a lead agency be appointed.

6.5 Conclusions

We have demonstrated that the complementary food intake of children aged six to 23 months is not optimal (low in micronutrients), that caregivers practise improper food preparation and that there are barriers at different levels that contribute to the poor IYCF practices. It is further concluded that the proposed FBDGs should complement IYCF interventions already in place and contribute to the prevention of the sharp increase in stunting after six months of age, thus improving the development of children in Rwanda.

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ANNEXURES

ANNEXURE 1: AUTHOR GUIDELINES FOR MATERNAL AND CHILD NUTRITION

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ANNEXURE 2: THE EIGHT WHO CORE INDICATORS OF IYCF

Core indicator	Definition
Early initiation of breastfeeding (EIB)	Historic recall by mothers of children born in the last 24 months who were put to the breast within one hour of birth.
Exclusive breastfeeding (EBF)	Recall of practices from the previous day among children from birth to five months of age.
Continued breastfeeding at one year (CBF)	Recall of practices from the previous day among children 12 to 15 months of age.
Introduction of solid, semi-solid or soft foods (ISF)	The proportion of infants six to eight months of age who received solid, semi-solid or soft foods the previous day.
The minimum dietary diversity (MDD)	Proportion of infants and young children who consumed at least four of the following seven food groups: 1. Infant formula, milk other than breast milk, and cheese or yogurt or other milk products 2. Foods made from grains, roots, and tubers, including porridge and fortified baby food from grains 3. Vitamin A-rich fruits and vegetables (and red palm oil) 4. Other fruits and vegetables 5. Eggs 6. Meat, poultry, fish and shellfish, and organ meats 7. Legumes and nuts.
The minimum meal frequency (MMF)	Breastfed infants aged six to eight and nine to 23 months must have received solid, semi-solid or soft foods at least twice and three times, respectively, in the previous day to achieve the MMF. Non-breastfed children aged six to 23 months must have received solid, semi-solid or soft foods or milk feeds at least four times in the previous day to achieve the MMF.
The minimum acceptable diet (MAD)	A composite of the MDD and MMF indicators. Breastfed children aged six to 23 months must have met the MDD and MMF the previous day, while non-breastfed children aged six to 23 months must have received at least two milk feedings and had met at least the MDD (not including milk feeds) and the MMF during the previous day.
The consumption of iron-rich or iron-fortified foods (IRF) indicator	Indicator is defined as children six to 23 months of age who received, during the previous day, an iron-rich food or a food that was specially designed for infants and young children and was fortified with iron.

ANNEXURE 3: REVIEW OF THE COUNSELLING CARDS USED IN EAST AFRICAN COUNTRIES

	Uganda	**Kenya**	**Rwanda**
Age groups*	Six months, seven to eight months, nine to11 months, 12 to 23 months	Six months, six to eight months, nine to 11 months, 12 to 23 months	Six months, six to nine months, nine to 12 months, 12 to 23 months
Food groups	The foods displayed at the bottom of the visual aid cards, are from left to right: oil, potato, sweet potato, green banana, maize on cob, milk, fish, meat, chicken, beans, eggs, cabbage, banana fruit, nuts, tomatoes, onion, mangoes, green leaves, pumpkin and avocado. There is no clear grouping of foods on the visual aids cards, but the groups are referred to in the text cards: 1 Millet flour, sorghum flour, maize flour, potatoes, matooke etc. 2 Fresh or dry beans, peas 3 Meat, chicken, fish or eggs 4 Vegetables like dark green vegetables (dodo, nakati, buga) and tomato, eggplant, carrot, cabbage etc. 5 Fruit like passion fruit, mango, pawpaw, orange, banana, watermelon, pineapple, avocado etc.	Images of foods are displayed at the bottom of the card. There is no clear pattern of food groups. From the left side to the right side : pap, legumes, oil, fish, okra (gombo), chicken, meat, eggs, nuts, green leaves, banana and mangoes, are mentioned.	There is an image showing four food groups, without naming them; the heading says: your baby needs a variety of food. The four groups are: 1 vegetables and fruits on the bottom left side 2 meat, fish, eggs and milk products on the bottom right side 3 cereals and tubers on the top left side 4 legumes and nuts on the top right side. The centre image displays a breastfeeding mother inside a circle; the four food groups are in boxes around the circle, groups 1 and 2 being bigger than 3 and 4.

	Uganda	Kenya	Rwanda
	6 Oil or ghee.		
Number of feeds and amount of food	For children aged six to eight months the portion size is half a cup and the meal frequency is three times a day (morning, noon and evening). For children aged nine to 11 months it is recommended to add an afternoon snack. At 12 to 23 months the recommendations about feed frequency is five feeds a day. At nine to 11 months the recommended amount of food at each feed is 1/3 of a cup (reference is made to a locally used 500 ml cup, named NICE)	The counselling card for six to eight months, by means of an image, recommends three meals: morning, noon and evening. At nine to 11 months the frequency of feeding is increased to four times a day: morning, noon, afternoon snack (the image shows a banana) and evening. The portion size remains half a cup. The 12-to-23-month card shows a portion increased to ¾ of a cup and increased frequency of feedings to five meals a day (an additional snack given in the midmorning).	At six months the recommended frequency of feeding is twice a day. From six to nine months the recommended meal frequency is three times a day. At six months: two to three tablespoons per feeding From six to nine months: half a 250 ml cup From nine to 12 months the frequency of feeding is increased to four times, and five times from 12 to 23 months. The recommended portion sizes are increased to ½ and ¾ of a cup, at nine to 12 months and 12 to 23 months.
Other advice	The counselling card for children aged six to eight months shows a mother who is feeding a baby with a spoon and a smaller image of a mother who is breastfeeding. There is an image showing the recommended consistency of the food (thick enough not to slip off a spoon).	The nine-to-11-month card shows the mother helping the child to eat on his/her own. At 12 to 23 months the counselling card shows a cup/glass with food given to the child.	The recommendation also emphasises that the food should be thick enough not to slip off a spoon. The mothers are advised always to give breast milk before other feeds. Mothers are also advised to start by offering staple foods and to use a separate plate for the child.

	Uganda	Kenya	Rwanda
	The text card gives more advice, for example to first breastfeed the baby before giving food. At eight to nine months it is recommended to start handing small pieces of food to the child to feed him/herself. The 12-to-23-month counselling card shows a baby feeding himself under supervision. Another recommendation is not to use bottles and teats.		

* Although all counselling cards focus on feeding children below 24 months of age, age grouping was not homogenous between counselling cards of different countries. Some counselling cards use, for example, 12 to 23 months, while others use 12 to 24 months. We chose to use the age group 12 to 23 months for all three countries.

ANNEXURE 4: VISUAL AIDS

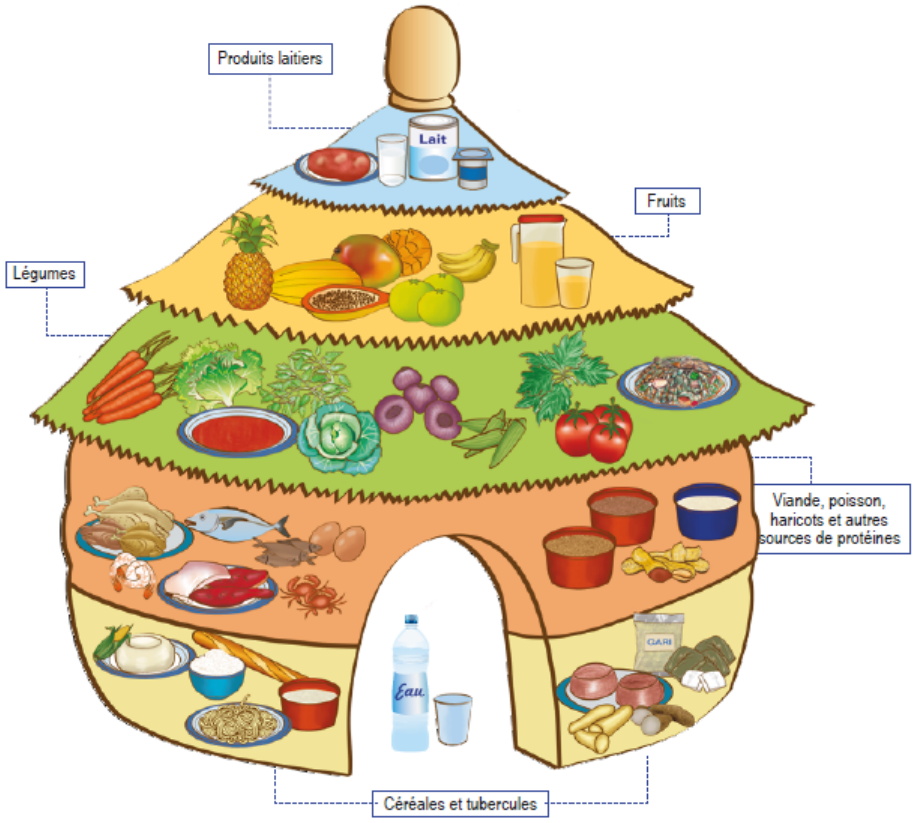
The South African food guide

Seychelles food guide

The Namibian food guide

The Nigerian food pyramid

Benin's food guide



ANNEXURE 5: POLICY FRAMEWORK AND NUTRITION INTERVENTIONS

The policy framework for addressing food and nutrition-related matters in Rwanda

Policy/ strategy	Implementation and coordination	Summary of sections that address food/nutrition-related matters
OVERARCHING POLICIES/PLANS		
Rwanda vision 2020 (revised in 2012)	The ministry in charge of finance and economic planning coordinates the implementation, monitoring and evaluation of Vision 2020.	Eradication of malnutrition among children will be emphasised and awareness of prevention and treatment of non-communicable diseases raised.
Government programme (2010-2017)		To fight malnutrition through various strategies, including the one cow per poor family programme, kitchen gardens, one cup of milk per child, school feeding and others
Economic development and poverty reduction strategy (EDPRS) II (2013–2018)	The ministry in charge of finance and economic planning coordinates the implementation and monitoring	The strategy recognises that in spite of a higher country food self-sufficiency ratio, malnutrition is still a problem. The strategy aims at reducing chronic malnutrition among children under two years of age, from 47%, as a prerequisite for Rwanda's continued economic and inclusive development. The EDPRS also emphasises the life cycle approach (1000 days), and cites growth monitoring, targeted school feeding programmes and food fortification. Workplace education targeting the prevention and control of NCDs is also treated.
Health sector policy 2015	Ministry of Health (MoH)	The policy emphasises that nutrition has to be mainstreamed in non-health sector programmes and multi-sectoral approaches to fight malnutrition need to be strengthened.

Policy/ strategy	Implementation and coordination	Summary of sections that address food/nutrition-related matters
Health sector strategic plan III (2012-2018)	Overall coordination rests with senior management of the MoH to ensure that all stakeholders align their priorities and interventions	The plan focuses on - Strengthening early identification and management of undernutrition and excess-related diseases - Identification and management of underlying causes of undernutrition. - Strengthening and scaling up of community-based nutrition programmes to prevent and manage malnutrition in children under five years, and pregnant and lactating mothers - Elimination of micronutrient deficiencies - Promotion of nutritional support and management of vulnerable groups - Promotion of food security at the household, community and national level - Promotion of nutrition in preschool education and school environments -Promotion of behaviour change communication on nutrition - Promotion of operational research and scaling-up of best practices; improving coordination with all nutrition partners and improving monitoring and evaluation for nutrition activities.

Policy/ strategy	Implementation and coordination	Summary of sections that address food/nutrition-related matters
FOOD AND NUTRITION-SPECIFIC POLICIES/STRATEGIES/PLANS		
Rwanda National Food and Nutrition Strategic Plan (2013-2018)	National food and nutrition technical working group	This plan aims at advocating better food and nutrition, and mobilising resources for reducing child stunting. Other aims are to enhance household food security, prevent and manage all forms malnutrition, improve food and nutrition in schools, assure healthy food and nutrition in emergencies.
National school health policy	MoH	This policy stresses that school feeding intervention should be continued and strengthened through community ownership and local food procurement.
Early Childhood Development (ECD) policy 2011	Ministry of Education	This policy focuses on overcoming child malnutrition, preventing and reversing developmental delays and improving child development outcomes for children with disabilities. In addition, it promotes core essential nutrition services from birth to three years for prevention and management of undernutrition.
Education Sector Strategic Plan (2013/14 – 2017/18)	Ministry of Education	Subjects treated in the plan are promotion and provision of disease prevention, nutrition, hygiene, sanitation services and physical activities in schools. The plan also focuses on the development of feeding and gardening programmes in schools.

Nutrition intervention targeting maternal and child health in Rwanda

Intervention	Target population	Lead institutions	Activities	Delivery platform
Optimum maternal nutrition during pregnancy				
Universal salt iodisation	Entire population is targeted through a market-based strategy	Ministry of Commerce, Rwanda Bureau of Standards	Salt iodisation standards, salt importation regulations	Markets
Infant and young child feeding				
Promotion of early and exclusive breastfeeding for six months and continued breastfeeding for up to 24 months	Pregnant/lactating women and general population. Refugee camps	Ministry of Health, Ministry of Disaster Management and Refugee Affairs (MIDIMAR)	1000 days in the land of a 1000 hills campaign on radio and TV World Cup in my Village (2014)	Health centres, community gatherings (umuganda), household visits by community health workers Behaviour change communication on radio and TV
Appropriate complementary feeding education in food secure populations and additional complementary food supplements in food insecure populations	Pregnant and lactating women General population	MoH		Health centres, community gatherings (umuganda), household visits by community health workers BCC on radio and TV
Micronutrient supplementation in children at risk	Children under two years	MoH	Micronutrient powders sachets given to parents	Household

Intervention	Target population	Lead institutions	Activities	Delivery platform
			of children under two years	
Vitamin A supplementation between ages of six and 59 months	Children six to 59 months of age	MoH	Once a year integrated vaccination campaign with other maternal and child health services like the provision of vitamin A supplements, deworming tablets, antenatal consultations and family planning counselling.	Health centres, schools, local government facilities
Management of acute malnutrition				
Management of moderately acute malnutrition	Children under five years	MoH	Screening of all children under five is done monthly by the community health workers. Malnourished children are referred to the health centre.	Household, health centre, district hospital
Management of severe acute malnutrition	Children under five years	MoH	Screening of all children under five is done monthly by the community health workers. Malnourished children are referred to the health centre.	Household, health centre, district hospital