

# **Feeding and growth of infants in Eastern Uganda**

*Methodological challenges and associated factors*

**Ingunn Marie Stadskleiv Engebretsen**



Dissertation for the degree philosophiae doctor (PhD)

at the University of Bergen

2009

ISBN 978-82-308-0862-7

Trykk: AIT AS e-dit, Oslo 2009

## Abstract

**Engebretsen, IMS. 2009: *Feeding and growth of infants in Eastern Uganda: Methodological challenges and associated factors*. ISBN 978-82-308-0862-7.**

### Introduction

Exclusive breastfeeding (EBF) is established as the safest feeding method in the first half of infancy. Mixing breast milk and other foods, including non-human milk and semi-solid foods (MF), before 6 months carries an increased risk of child mortality compared to EBF due to infectious diseases. Replacement feeding (RF) is only recommended for HIV-1 positive mothers when it is acceptable, feasible, affordable, sustainable and safe (AFASS). This thesis assesses infant feeding practices, growth and related factors in Mbale, Eastern Uganda, where infant mortality rate is ~80/1000 and adult HIV-1 prevalence is 5-6 %.

### Methods

The thesis comprises: 1) a cross-sectional survey of 727 mother-infant pairs (paper I and II); 2) a follow-up study of 30 mother-infant pairs seen weekly for 12 weeks after birth (paper III); and 3) 8 focus group discussions, 4 among men and 4 among women (paper IV). From the cross-sectional survey, infant feeding practices - according to dietary recall since birth and the 24-hour dietary recall - were assessed in addition to early infant feeding practices and associated factors. Infant anthropometric status, including determinants for undernutrition, is presented in relation to feeding practices and socio-demographic characteristics. From the follow-up study, feeding modalities yielded from weekly assessments were compared to those obtained from the dietary recall since birth, being conducted at weeks 6 and 12 post-partum using Kaplan-Meier analysis. Perceptions of both fathers and mothers regarding infant feeding practices have been addressed in the focus group discussions, and inductive content analysis was used. This thesis combines the quantitative and qualitative studies under the 'mixed methods approach.'

### Results

The main finding was that despite universal breastfeeding EBF was scarcely practiced. Dietary recall from the survey showed that 7% and 0% practiced EBF at 3 and 6 months, respectively. The feeding modalities obtained from the 24-hour recall versus recall since birth showed discrepancies. The EBF prevalence was much higher according to the 24-hour recall than the recall since birth. Pre-lacteal feeds were given to 57% of the infants in the survey, and it was widely accepted according to the qualitative findings. Breast milk was often perceived as 'not enough' from birth. In the survey half of the mothers had not initiated breastfeeding within two hours, and still after the first

day a quarter had not initiated it. Initiation of breastfeeding was delayed for a variety of reasons; the qualitative findings emphasized hygiene procedures and traditions. Insufficient supplementary feeding occurred in the second half of infancy.

Stunting increased with age: of the infants in the survey alone, 17% were stunted. Fewer girls than boys were stunted (41% versus 59%, OR 0.6 95% CI 0.4 – 0.97). Low wealth status was associated with decrease in linear growth as well as sub-optimal infant feeding practices.

The feeding modalities obtained from the prospective weekly follow-up showed a similar pattern as the results obtained from the recall since birth at 3 months, but estimates from the recall since birth were slightly longer (~1 week). At 12 weeks post-partum, the mean duration for ending EBF and starting predominant breastfeeding (PBF), by introducing water liquids and fruit juices, was 0.5 weeks (95% CI 0-1.1 weeks) according to the frequent short-time recalls, and 1.4 weeks (95% CI 0.1-2.7 weeks) for the recall since birth (Mantel-Cox-test,  $p=0.15$ ). The mean time for ending PBF and starting MF was 5.2 weeks (95% CI 3.9 – 6.5 weeks) according to the frequent short-time recalls, and 6.6 weeks (95% CI 5.4-7.8 weeks) for the recall since birth (Mantel-Cox-test,  $p=0.20$ ).

Even if the health system conveyed the concept of ‘exclusive breastfeeding’, mothers did not seem to have an ‘internalised knowledge’ of it and why it was promoted. An illustrative quote from the discussions among mothers was: *‘I want to know why they refuse us to give other feeds during the first six months.’* Men felt left out of the children’s health education, and said they had learnt *‘nothing.’* Not undertaking breastfeeding was seen as unacceptable in the qualitative study, except for maternal illness, and it was socially sanctioned. Verbal accusation, physical violence and even divorce could be the result of a non-breastfeeding decision according to the qualitative analysis.

## **Conclusion**

Sub-optimal feeding practices and high stunting rates were seen. Dietary recall since birth provides an informative tool for recording infant feeding modalities. Poverty was strongly associated with impaired growth and sub-optimal infant feeding practices, and parents expressed confusion and difficulties adhering to the recommended feeding practices. Hindrances experienced by the mothers to practice recommended infant feeding practices, including EBF, need to be taken into consideration, and the involvement of fathers is imperative.

## Résumé in Lumasaaba

### **Ukhwanjula:**

Khununisa bussa akhaali khuwa kho umwana ishindu ishindi akhali libelle khwatuyikhana nga ikhulikho ni shiyangafu shosi taa khubulamu bwe babana mushishisha shinyowa shee bulamu. Khutubasa libelle lye mushifubha ni bilyo ibindi nga kimyesi kisesabi kishili khwola khwongela igambi ye ba baana khufa lwe bulwaye bwa busheye nga bubila ukhwama khumundu mutwela bwastya mumundu uknundi, mumesi, ni bibindi, nga wabilengasile ni khununisa bussa. Khuwa abaana bilyo ebindi akhali libeli mu ba mayi baali ni khawukha khamuniafu-1 shikanibwa nga bifukilisibwa, binyalikhana, bifunikha mu mapesa ke bamayi imbukha yosi nalundi nga ibilikho ni shiyangafu shosi taa. Iripota yiino iyambakhana ni khumusomo ukhwakholebwa imbale mu mwakha kwa 2003 ni 2005 nga khu wenselessa khu ngeli tse njawaulo tse khu khulisamu abaana, ingeli esi batsowamu, ni bibindu ibindiu, biyambakhana khubyene byo.

### **Bibyamamo:**

Khununisa khwakholebwa woosi neenga khununisa buusa akhali khuwa babana shishidu shishindi si shabawo taa. Akhaba nga inengaregekha iye byebulamu yokesaninisa ingoola iyekhununisa buusa, bamayi si begyiisa khutegera khuno taawe nalundi sibamanya khulwashina kwakhupilisibya taawe. Basani bawulila nga balekhebwa ibulafu, mukhusomesa khwebyebulamu khu baana baawe. Mukhuweselesa khuno, bilyo nga bashili khununisa byaweebwa bisitsa karano na musavu khu shimya, nalundi byafukyilisibwa naabi. Khunanikha khununisa khwakyeluwa lwebitsililwa bikhaali bitweela taa. Bilyoo bekhukhogela khukhununisa nga kimyesi kisesaba kyawele byaba sibimala taa. Shino sharelela babaana likhumi na musavu khu shimya khutakhutsowa bulayi taa. Bassinde niibo babafurisa khuuta khusowa bulayi taa, khubitsisa karano na shenda khu shimya khufurisa bakhana khubistisa kaane na ndwera khu shimya. Byebuyidifu bye aasi nibyo byibyakyila khutsowa khwatsa nga khukhendela. Khutakhulisa babaana mubwyitsufu shakholebwa naabi, nasho shokesa ishukhashukha mukhutsowa. Khutakhununisa sikhafukyilisibwa musishitsa taa, khurusakho nga maayi walwalile .

### **Shikhakamayo:**

Khutakhulisa babaana mubyitsufu ni khutakhutsowa bulayi shanyolekhana. Butambi niibo bubwarela itsowa yatakhuba indayi taawe. Ingasikhana iyebamaayi khutakhununisa buusa taawe ili nikhukhwambasibyako nalundi nibasani khukhwitubilamo shikanibwa.

## **Résumé in Norwegian**

Barnedødelighet er et stort globalt problem og feilernæring er en viktig grunn til at nesten 10 millioner barn dør årlig. Fullamning er etablert som det tryggeste ernæringsalternativet til spedbarn under 6 måneder og anbefalt av verdens helseorganisasjon (World Health Organization, WHO). Tidlig introduksjon av vannholdige væske og kumelk utgjør en betydelig risiko for infeksjonssykdommer og død i mange lavinntektsland. Dersom barnet gis føde i tillegg til amming de første seks månedene øker også risikoen for smitte av HIV-1 via brystmelk fra mor til barn. Fullamning beskytter mot smitte. Derfor anbefales HIV-1 positive mødre enten å fullamme eller ikke amme barna sine, men morsmelkserstatning er kun anbefalt fra WHO til HIV-1 positive mødre dersom det er akseptabelt, praktisk og økonomisk gjennomførbart og et varig og trygt alternativ. I denne avhandlingen blir praksis hva gjelder barneernæring og vekst, samt relaterte faktorer diskutert med bakgrunn i feltstudier fra Mbale, Øst-Uganda. Der er barnedødeligheten (under 1 år) på ~80/1000 og ~6% av den voksne befolkning er smittet med HIV-1. Avhandlingen benytter kvantitative og kvalitative metoder og kombinerer disse: 1) en spørreundersøkelse blant 727 mødre med barn under 1 år, 2) en ukentlig oppfølgingsstudie i 3 måneder etter fødsel blant 30 mor-barn par, og 3) en kvalitativ studie med åtte fokus gruppe diskusjoner, fire blant fedre og fire blant mødre.

Studien fant at amming var svært utbredt, 99% av barna i spørreundersøkelsen ble ammet, men fullamning eksisterte nesten ikke. Selv om fullamning hadde blitt undervist som et ledd av svangerskapsomsorgen hadde mødre liten forståelse av hva det var og hvorfor det ble promotert. Fedrene følte seg helt utestengt fra helseundervisningen som angikk barna deres. Spørreundersøkelsen viste at 57% av barna ble gitt annen føde enn brystmelk de første dagene etter fødsel. De kvalitative analysene viste også at dette var lokalt akseptert og forventet. Mødrene ble forsinket med å legge barna til brystet etter fødsel av en rekke ulike grunner, blant annet ulike tradisjoner og hygienerutiner forsinket ammingen. I andre halvår ble det observert at barna ikke fikk tilstrekkelig ernæring i tillegg til brystmelk. Blant mer enn 700 babyer under 1 år hadde 17% for lav høyde-for-alder (eng. stunting; høyde-for-alder < -2 'z-scores'), og det forekom hyppigere blant gutter enn jenter (59 vs 41%). Fattigdom påvirket hvordan foreldrene matet barna sine. Dersom mor valgte ikke å amme kunne det få dramatiske sosiale konsekvenser for moren. Morsmelkserstatning alene var derfor ikke et reelt alternativ. Studien har belyst metodeaspekter for innsamling av data hva gjelder spedbarnsernæring. Det er et behov for økt fokus på spedbarnsernæring og vekst i denne settingen. Foreldres behov og hindringer for å følge anbefalingene må tas alvorlig.

*Lwekhuba khukana babaana beffe*

*Because we love our children*

*To Terje,*

*Synne Marie and Simon*

## **Papers included in this thesis**

### **I**

Engebretsen IMS, Wamani H, Karamagi CA, Semiyaga N, Tumwine JK, Tylleskar T: Low adherence to exclusive breastfeeding in Eastern Uganda: a community-based cross-sectional study comparing dietary recall since birth with 24-hour recall.

*BMC Pediatr* 2007, 7:10.

### **II**

Engebretsen IMS, Tylleskar T, Wamani H, Karamagi C, Tumwine JK: Determinants of infant growth in Eastern Uganda: a community-based cross-sectional study.

*BMC Public Health* 2008, 8(1):418.

### **III**

Engebretsen IMS, Shanmugam R, Tumwine JK, Tylleskär T.  
Infant feeding modalities addressed in two different ways in Eastern Uganda  
*Submitted*

### **IV**

Engebretsen IMS, Moland KM, Nankunda J, Karamagi CA, Tylleskär T, Tumwine J. 'No newborn feeds on breast milk only:' perceptions on infant feeding among fathers and mothers in Eastern Uganda

*Submitted*



## **Collaboration**

This study emerged from Centre for International Health, Faculty of Medicine and Dentistry, University of Bergen. The existing collaboration with Paediatrics and Child Health, Medical School, Makerere University, laid the foundations for the research environment in which this study was conducted. It was funded by The Norwegian Programme for Development, Research and Education (NUFU; grant no. 43/2002 'Essential nutrition and child health in Uganda'). The research presented herein was also part of formative research for the multi-centre cluster-randomised behavioural-intervention study across 4 African countries, Burkina Faso, Uganda, Zambia and South Africa: Safety and Efficacy of Exclusive Breastfeeding Promotion in the Era of HIV in Sub-Saharan Africa (<http://clinicaltrials.gov>, Id no.: NCT00397150). Mbale, Eastern Uganda, was the chosen Ugandan site, and the study area for this thesis. I was given the opportunity to work closely on 2 research projects - PROMISE EBF and PROMISE PEP ([www.clinicaltrials.gov](http://www.clinicaltrials.gov), Id no: NCT00640263) – during my training. This opportunity gave me contacts, travels and research experience for which I am deeply grateful.

## **Acknowledgements**

My thanks go to the University of Bergen, Faculty of Medicine and Dentistry, which has been my base throughout my medical and doctorate training. The Centre for International Health has provided an inspiring working environment since I began in 2003. Special thanks go to the leaders, Gunnar Kvåle, Bernt Lindtjørn and Rune Nilsen, who have been supportive and interested in my work. I would further like to thank the people in the administration, now headed by Ingvild Hope, for their positive attitude.

First and foremost, I thank my main supervisor, Professor Thorkild Tylleskär, for allowing me to start the planned research projects in 2003. I must thank for the trust, inspiration, scientific training and opportunities I have been given throughout these years, for which I am deeply grateful. Thanks also to his family for their hospitality!

Special and warm thanks go to the Ugandan team from which I was privileged to get supervision and with whom I worked. Professor James Tumwine was my co-supervisor; I will always appreciate his input and reflections. Thanks also go to Charles Karamagi for walking those extra miles in 2003 while implementing the first study, and for his wise and patient way of guiding me while we were walking. Thanks also to Henry Wamani for collaboration on questionnaires and their analysis, and for the travels and discussions throughout the years. To Nulu Semiyaga, I must say that without her efforts, the fieldwork would not have been conducted when and how it was done. I am grateful for the friendly collaboration.

There would have been no fieldwork without fieldworkers. Thanks go to Madina Seera, Patricia Namwanda, Evalyn Nandudu, Lawrence Wamukota, Deborah Siango, Grace Hiire, Jane Nabumati, Herbert Mugooda, Grace Kanagwa, Moses Mandu, Racheal Namboozo, Moses Mukhwana, Kathrine Kamedde, Vicent Gizamba, Zalika Ngati, Miriam Faith Mbasalaki, Doreen Nambuya and Fredrick Nangosya Wetaya, who all did a splendid job, showed endurance and patience in the field, warmth and humour during travels and in the office. Samuel Kisembo and Wilson Ssendegeya were driving safely, thanks.

A vote of thanks needs to be given for the kind collaboration of all the employees at Mbale District Referral Hospital and the health Units in Mbale Municipality and Bongokho.

I wish to thank Karen Marie Moland for leading me through another methodological pathway. Elisabeth Sommerfelt was enthusiastic about infant

feeding methodology and I thank her for her collaboration. Thanks to William P Howlett for his generosity. There are many other professors and research fellows at CIH and UiB who, indirectly or directly, contributed to my progress and this thesis. I would like to give special thanks to Halvor Sommerfelt, Birgitta Aasjø, Maurice Mittelmark, Tor Strand and Astrid Blystad.

I feel privileged to have many fantastic friends and colleagues: my thanks must also go to Hanifa Bachou, Grace Ndeezi, Jolly Nankunda, Victoria Nankabirwa, Margareth Wandera, Josephine Kayondo and Robert Byamugisha from Uganda. There are many other people from the 'PROMISE-family' I would like to thank, but I must mention the close collaboration and friendship of Tanya Doherty, Debra Jackson and Rebecca Shanmugam.

To my CIH friends and colleagues, Marte Jurgensen, Maria Mathisen, Mari Skar Manger, Nils Gunnar Songstad, Hans Steinsland, Mary Tuba (MT), Sebalda Leshabari, Khadija I. Yahya-Malima, Bjørg E. Olsen and the rest of the team, I wish to express my gratitude for the environment you were all creating. I was so happy to be working with Eli Fjeld and Lars Thore Fadnes, and special thank-you to Jørn Klungsøyr, with whom I have shared long periods of field work, and Ingvild F. Sandøy, who spent a long period of 'rooming in' with me.

Thanks go to my family and friends outside CIH for your support over this 6-year period, which has meant a lot to me. Thanks also to Hedda Hoel, Birgitte Aarbu, Beate Jelstad, Einar and Mariann Aares, Bjørg and Thore Schjøt for your calling and caring. Mum and dad, Kristine and Øystein, I thank you for the support and love you have given us and our Ugandan friends.

Thanks also go to Harriet, Winter, Bright, June and Rachel Nkoobe for being close friends for 12 years now. I want to thank Rebecca, Wilson, Marion and Vivian Kaabala for all you have done for us, and for making the 2005 fieldwork possible. To my dear Igangan friends, I want to thank you for inviting me into your families and clan, and for calling me 'auntie' and a Nangobi.

And last, to Terje, without whose love, patience, humour and extra efforts this thesis would not have been possible. Thanks also to Synne Marie and Simon for being yourselves.

Knowing we all are *fearfully and wonderfully made* (Psalm 139), I would like to say that working for global safer infant feeding has been and remains a privilege. This thesis, but especially the years lived during this process, is a result of how life's fascinating spindle is embedded in God's merciful plan.

## Table of content

<i>Abstract</i> .....	3
<i>Résumé in Lumasaaba</i> .....	5
<i>Résumé in Norwegian</i> .....	6
<i>Papers included in this thesis</i> .....	8
<i>Collaboration</i> .....	9
<i>Acknowledgements</i> .....	10
<i>Table of content</i> .....	12
<i>List of tables, figures and pictures</i> .....	14
<i>List of abbreviations</i> .....	15
<i>Definitions</i> .....	17
Feeding modalities .....	17
Anthropometric definitions .....	20
<i>Introduction</i> .....	21
Perspectives on infant feeding trends and programmes.....	21
Infant feeding research .....	27
Rationale for an infant feeding study in Mbale.....	32
<i>Aim and objectives</i> .....	33
<i>Subjects and methods</i> .....	34
Theoretical framework of mixed methods.....	34
Methods applied.....	39
Mixed methods analysis .....	50
Ethics .....	54
<i>Results</i> .....	55
Background characteristics .....	55

<b>Breastfeeding as the primary infant feeding practice.....</b>	<b>56</b>
<b>Early infant feeding practices .....</b>	<b>57</b>
<b>Assessment of infant feeding modes .....</b>	<b>58</b>
<b>Anthropometric characteristics .....</b>	<b>62</b>
<b>Wealth and feeding perspectives.....</b>	<b>63</b>
<i>Discussion .....</i>	<i>65</i>
<b>Quantitative assessments .....</b>	<b>65</b>
<b>Qualitative assessment .....</b>	<b>71</b>
<b>Mixed methods assessment .....</b>	<b>71</b>
<b>Anthropometric assessment.....</b>	<b>73</b>
<b>Poverty related issues.....</b>	<b>79</b>
<b>Programme and research implications .....</b>	<b>80</b>
<i>Conclusion .....</i>	<i>84</i>
<i>References.....</i>	<i>85</i>

***Paper I, II, III and IV***

***Appendices***

Appendix 1: Cross-sectional survey: informed consent form and questionnaire

Appendix 2: 12 week follow-up study: the 3 week interview given

Appendix 3: Thematic Focus Group Discussion Guide

***Errata***

## List of tables, figures and pictures

<i>Table 1:</i>	<i>p. 19</i>
Criteria for infant feeding practices	
<i>Table 2:</i>	<i>p. 24</i>
Twelve steps to successful breastfeeding	
<i>Table 3:</i>	<i>p. 38</i>
Criteria for assessing the trustworthiness of research	
<i>Table 4:</i>	<i>p. 41</i>
Data method, fieldwork, topic and main analysis conducted for the respective papers	
<i>Table 5:</i>	<i>p. 51</i>
Mixed methods matrix for this thesis	
<i>Figure 1:</i>	<i>p. 26</i>
PMTCT Programme, Ministry of Health-Uganda and UNICEF; 2000	
<i>Figure 2:</i>	<i>p. 36</i>
Mixed-methods design matrix	
<i>Figure 3</i>	<i>p. 37</i>
A classical mono-strand model	
<i>Figure 4:</i>	<i>p. 53</i>
Conceptual framework of mixing relevant for this thesis	
<i>Figure 5:</i>	
Time of growth faltering in length-for-age in preschool children by geographic region	<i>p. 75</i>
<i>Figure 6:</i>	
Conceptual framework of the causes of maternal and child undernutrition	<i>p. 78</i>
<i>Picture 1:</i>	<i>p. 24</i>
A typical health education session at the maternity ward, Mbale hospital	
<i>Picture 2:</i>	<i>p. 42</i>
Map of Uganda and Mbale with surroundings	
<i>Picture 3 and 4:</i>	<i>p. 73</i>
Fieldwork	

## List of abbreviations

AFASS	Acceptable, Feasible, Affordable, Sustainable and Safe (WHO's criteria for formula feeding/replacement feeding)
AIDS	Acquired immunodeficiency syndrome
BF	Breastfed / Breastfeeding
BFHI	The baby-friendly hospital initiative (launched by UNICEF/WHO 1991)
CF	Complementary feeding
CI	Confidence interval
DHS	Demographic and Health Surveys
EBF	Exclusive breastfeeding
FGD	Focus group discussion(s)
GOBI-FFF	Growth, oral rehydration salts, breastfeeding, immunisation-Food, Family planning and Female education (UNICEF 1980s)
HIV	Human immunodeficiency virus
IATT	Interagency Task Team on Prevention of HIV Transmission in Pregnant Women, Mothers and their Children
IMCI	Integrated Management of Childhood Illness (launched by UNICEF/WHO and partners 1995/96)
IMR	Infant mortality rate
KII	Key informant interviews
LAZ	Length-for-age z-score(s)
LC	Local chairman
LL	Lower Limit
MDG(s)	Millennium Development Goals (UN: End poverty 2015)
MF	Mixed feeding
MGRS	Multi-centre growth reference study
MMR	Mixed methods research
MTCT	Mother-to-child transmission of HIV
NBF	Non-breast fed/non breast-feeding
NCHS	National center for health statistics (USA)
OR	Odds Ratio (a measure of effect size describing strength of association between two variables)
PBF	Predominant breastfeeding
PCA	Principal components analysis
PI	Peer Investigator
PMTCT	Prevention of mother-to-child transmission of HIV
RF	Replacement feeding
U5MR	Under-5 mortality rate
UL	Upper Limit

UN	United Nations
UNAIDS	Joint United Nations Programme on HIV/AIDS
UNICEF	United Nations Children's Fund (originally United Nations International Children's Emergency Fund, established 1946)
WAZ	Weight-for-age z-score(s)
WHO	World Health Organization
WLZ	Weight-for-length z-score(s)



## Definitions

### Feeding modalities

Throughout the study period, development of definitions and terminology has constantly occurred. Certain feeding modalities have had more than one term. A list of terms and their definitions relevant for this thesis is provided below. Most of the definitions are from 'Indicators for assessing breast-feeding practices' (WHO 1991) [1] and WHO documents which were published thereafter.

#### **Exclusive breastfeeding (EBF)**

The infant has received only breast milk from his/her mother or a wet-nurse, or expressed breast milk and no other liquids, or solids with the exception of drops or syrups consisting of vitamins, mineral supplements, or medicines [1, 2].

#### **Predominant breastfeeding (PBF)**

The infant's predominant source of nourishment has been breast milk. However the infant may also have received water or water-based drinks (sweetened or flavoured water, teas, infusions, etc.); fruit juice; Oral Rehydration Salts (ORS); drop and syrup forms of vitamins, minerals, and medicines and folk/ritual fluids (in limited quantities). With the exception of fruit juice and sugar-water, no food based fluid is allowed under this definition [1, 2].

#### **Complementary feeding (CF)**

Any food, whether manufactured or locally prepared, suitable as a complement to breast milk or to infant formula, when either become insufficient to satisfy the nutritional requirements of the infant. Such food is commonly called 'weaning food' or 'breast-milk supplement' [2, 3]. For this thesis, it is important to record that the *quality* of CF has not been addressed.

#### **Mixed feeding (MF)**

Feeding both breast milk and other foods or liquids [4]. This term acknowledges that CF had an element of *quality* in its definition highlighting 'nutritional requirements for the infant.' Being breastfed, but not being EBF or

PBF, qualified for MF. This term has been particularly useful in MTCT research.

Clarification: MF can comprise items given under the PBF- and CF modalities. CF was used instead of MF in paper I, without addressing the quality aspect. For paper II infants were grouped in EBF and MF according to the 24-hour recall. Even if MF can comprise items given under the PBF- and CF modalities, PBF does not comprise all items allowed in the MF modality. For paper III EBF, PBF and MF were used. Each paper defined inclusion criteria of food items and analysis technique separately. For the purpose of simplicity for this thesis I am referring to the practice of having introduced other feeds than breast milk, such as non-human milk and semi-solid feeds, as CF/MF.

### **Non-breastfeeding (NBF)**

This category includes all children no longer breastfed or never breastfed, irrespective of the quality of the diet. WHO recommends non-breastfed infants to receive replacement feeding according to the definition below:

### **Replacement feeding (RF)**

Feeding infants who are not receiving breast milk with a diet that provides the nutrients infants need until the age at which they can be fully fed on family foods. During the first 6 months of life, replacement feeding should be with a suitable breast-milk substitute. After 6 months, the suitable breast-milk substitute should be complemented with other foods [4]. The quality of RF was not assessed in this study.

Clarification: WHO are combining definitions and recommendations. It is therefore important to specify what each term means. For example, MF and NBF are descriptive terms, and CF and RF have elements of recommendations connected with them. In this thesis, CF and RF have been used in the first paper because the terms were customarily used by definition at that time, not by recommendation.

A recent WHO document ‘Indicators for assessing infant and young child feeding practices, Part 1, Definitions’ re-summarises the definitions in table format, as given below [5]:

Table 1: Criteria for infant feeding definitions: This table is a copy from 'Indicators for assessing infant and young child feeding practices, Part 1: Definitions.' World Health Organization; 2008

TABLE 1. CRITERIA THAT DEFINE SELECTED INFANT FEEDING PRACTICES

Feeding practice	Requires that the infant receive	Allows the infant to receive	Does not allow the infant to receive
Exclusive breastfeeding	Breast milk (including milk expressed or from a wet nurse)	ORS, drops, syrups (vitamins, minerals, medicines)	Anything else
Predominant breastfeeding	Breast milk (including milk expressed or from a wet nurse) as the predominant source of nourishment	Certain liquids (water and water-based drinks, fruit juice), ritual fluids and ORS, drops or syrups (vitamins, minerals, medicines)	Anything else (in particular, non-human milk, food-based fluids)
Complementary feeding <sup>a</sup>	Breast milk (including milk expressed or from a wet nurse) and solid or semi-solid foods	Anything else: any food or liquid including non-human milk and formula	NA
Breastfeeding	Breast milk (including milk expressed or from a wet nurse)	Anything else: any food or liquid including non-human milk and formula	NA
Bottle-feeding	Any liquid (including breast milk) or semi-solid food from a bottle with nipple/teat	Anything else: any food or liquid including non-human milk and formula	NA

<sup>a</sup> Refers to the following in the source document: 'The term complementary feeding, reserved to describe appropriate feeding in breastfed children 6 months of age or beyond, is no longer used in the indicators to assess infant and young child feeding practices. The previously used indicator 'Timely complementary feeding rate,' which combined continued breastfeeding with consumption of solid, semi-solid and soft foods, was difficult to interpret. This indicator has therefore been replaced by the indicator '**Introduction of solid, semi-solid or soft foods**' which is a measure of a single feeding practice. Nevertheless, the term complementary feeding is still very useful to describe appropriate feeding practices in breastfed children 6–23 months of age and will continue to be used in programmatic efforts,' etc.

NA: Not applicable

## Anthropometric definitions

### **Z-scores:**

*'The z-score system expresses anthropometric values as several standard deviations (SDs) below or above the reference mean or median value. Because the z-score scale is linear, summary statistics (e.g. means, SDs and standard errors) can be computed from z-score values. Z-score summary statistics are also helpful for grouping growth data by age and sex'*

(from Z Mei and LM Grummer-Strawn: Bull World Health Organ 2007) [6]

**Wasting:** weight-for-length z-scores (WLZ) <-2

**Stunting:** length-for-age z-scores (LAZ) <-2

**Underweight:** weight-for-age z-scores (WAZ) <-2 [7]

**Undernutrition:** having WLZ, LAZ and/or WAZ <-2

## **Introduction**

Hunger and extreme poverty remain the world's biggest public health problems, with ~1 billion suffering from hunger: unfortunately the trend is continuing to increase in some parts of the world [8]. Children and also childbearing women are most vulnerable to adverse health outcomes when nutritionally depleted [9], as internationally recognised by the United Nations' Millennium Development Goals (MDGs). MDG 4 and 5 in particular address child and maternal health, respectively [10]. This thesis presents issues regarding infant feeding and growth in Mbale, Eastern Uganda. A brief introduction to trends and programmes relevant for Uganda is first given.

## **Perspectives on infant feeding trends and programmes**

Some of the first medical research literature published in the English language in the early 20th century regarding child feeding in Africa focused on 'malnutrition'. Ciceley Williams was the first to describe Kwashiorkor associated with maize diet and 'defective feeding' in Ghana (formerly 'The Gold Coast') in 1933 [11]. She described the disease as being most frequent in children aged 6 months to 4 years, but also younger children were observed with the disease due to 'an unsuitable foster-mother when the mother may have died.' The danger of insufficient early infant feeding, in other words 'insufficient breastfeeding,' was highly acknowledged.

In Europe and North America, a 'bottle-feeding trend' began in the 1920s [12]. This trend was possible because the industry managed to mass produce a bottle which was cheap and had a rubber nipple. Bottle-feeding became an attractive infant feeding alternative as more mothers sought employment away from their homes. The industry established a fortified breast milk replacement product late in the 19<sup>th</sup> century.

From a marketing viewpoint, the social changes, the low-cost bottles and the support from the paediatric and nutritional environments [12] lay the ground globally for a commercial success-story. Unfortunately, the same story contributed to undernutrition and deaths among infants and children on a large scale in the decades to come [13]. Certain factions in the medical field went on blindly praising replacement feeding and unnatural lactation practices based on scientific dogmas that took decades to reject [14]. In some situations, especially in the United States, breastfeeding was seen only as an alternative to formula feeding, which increasingly became the norm. Both in industrialised

and non-industrialised settings, mothers were discouraged from breastfeeding for trivial reasons, not encouraged to breastfeed on demand, given formula samples, and so on, from the 1950s to late into the 1970s [15].

The bottle-feeding trend in American and European societies, together with a marketing trend from milk powder producers, resulted in a vast uptake of non-lactating infant feeding practices in low-resource settings in Africa. R Cook employed at the Department of Paediatrics and Child Health, Makerere, Kampala, published a review in 1966 in which he described the trend as follows: *'There is not only wrong knowledge of traditional origin, but also wrong knowledge of recent implantation. One form of this gives rise to much concern amongst paediatricians all over the tropics. This is the spread of the idea that artificial feeding is somehow better, more sophisticated, and more prestigious than breastfeeding. This idea is fostered by the advertisers of proprietary brands of powdered milk for babies; and also by the example of European and Asian women, and to some extent, of women of African professional classes'* [16]. It was obvious that sub-optimal breastfeeding practices carried high risk for children and unwanted effects for mothers, such as reduced periods of amenorrhea. Marketing was highly criticized by academics [17]. Political and organisational activism also played an important role in raising advocacy against commercial interests advertising for formula [18].

The US government convened a national task-force in 1978 where they aimed at having 75% of infants breastfed when they left the hospital post-partum, and 35% still being breastfed at 6 months [12]. The aims were not reached and they were subsequently rescheduled. Similar initiatives were seen in other parts of the world. Most initiatives were partly seen in the Scandinavian countries, where breastfeeding improvements and facilitation were on the political and medical agenda in the 1970s and 1980s [19]. Breastfeeding was also widely supported by the medical field in Uganda, and a separate lactation clinic was established in the capital, Kampala [20].

Finally, the International code of Marketing Breast-milk Substitutes was released from the World Health Organization (WHO) in 1981. Thereafter it has been referred to as 'The code' [3]. This was a result of intensive work in the 1970s, and was highlighted at the World Health Assemblies in 1978 and 1980. The code comprised 11 articles which aimed to *'contribute to safe and adequate nutrition for infants, by the protection and promotion of breastfeeding, and by ensuring the proper use of breast-milk substitutes, when these are necessary, on the basis of adequate information and through appropriate marketing and distribution'* (art. 1). No changes have been made in 'the code' until today, but certain elements on national formula policies for HIV-positive

women were added in a revision published in 2008 due to the HIV-pandemic [21]. A recent WHO summary that dealt with situations where breastfeeding should not be recommended was also published [22]. According to UNICEF reports, Uganda had an incomplete uptake of ‘The code’ in 1997 [23], and it continues to be violated in many African countries [24].

UNICEF has a tradition for active support and promotion of breastfeeding based on existing research. The former director, J Grant, launched an ‘attack on infant and child mortality’ when implementing ‘the child survival revolution’ in 1982 [25]. The so-called ‘GOBI-program,’ abbreviated from Growth, Oral rehydration therapy against diarrhoea, Breastfeeding and Immunisation and later GOBI-FFF, adding Feeding programmes, Family planning and Female education services as components were released in the 1980s [26, 27]. This vast program benefitted from the global increase in mass-media and mass-education, and consequently expanded rapidly. In 1991 the Baby-Friendly-Hospital Initiative (BFHI) was established by UNICEF [28]. This was based on updated knowledge of the superiority of breastfeeding as the safest infant feeding mode, and acknowledgement of lactation physiology, emphasizing early breastfeeding and breastfeeding on demand as fundamental in successful establishment of breastfeeding [29]. As part of the BFHI ‘10 steps to achieve successful breastfeeding’ was promoted from health institutions worldwide. The ‘10 steps’ (with additional 2 steps in the Ugandan setting and other places) are given in table 2. A baby-friendly maternity ward should not accept free or low-cost breast milk substitutes, feeding bottles or teats. Furthermore, the baby-friendly maternity wards need to promote the 10 steps to successful breastfeeding [28]. According to a UNICEF 2002-evaluation, 11 hospitals in Uganda, including Mbale referral hospital, were considered so-called ‘baby-friendly’ [30], but limited resources had compromised some of the components required for maintaining the ‘baby-friendly’ status.

The primary health and preventive work that began with the GOBI-FFF and BFHI initiatives were followed by a new huge programme released in 1995/96 by WHO, known as the ‘Integrated management of childhood illness (IMCI).’ IMCI was launched as a comprehensive package to address the most common diseases responsible for child mortality [31]. Uganda was one of the first countries to adapt this package with 3 test-districts in 1995, and 55 out of 56 districts had implemented IMCI by 2000 [32].

Table 2: Twelve steps to successful breastfeeding, as promoted at Mbale District referral hospital 2003/05. Copied from 'Nutrition section – Ministry of Health – Uganda'.

- 1) Have a written breastfeeding policy that is routinely communicated to all health care staff.
- 2) Train all health care staff in skills necessary to implement this policy.
- 3) Inform all pregnant women about the benefits and management of breastfeeding.
- 4) Help mothers initiate breastfeeding within one half-hour of birth.
- 5) Show mothers how to breastfeed and maintain lactation even if they should be separated from their infants.
- 6) Give newborn infants no food or drink other than breast milk, unless medically indicated.
- 7) Practice rooming in - that is, allow mothers and infants to remain together 24 hours a day.
- 8) Encourage breastfeeding on demand.
- 9) Give no artificial teats or pacifiers (also called dummies or soothers) to breastfeeding infants.
- 10) Foster the establishment of breastfeeding support groups and refer mothers to them on discharge from the hospital or clinic.

Uganda added another 2 steps:

- 11) Ensure that all newborns delivered in hospitals receive BCG and Polio 0 vaccine before discharge.
- 12) Issue a properly filled Child Health card for each newborn to the mother before discharge from the maternity ward.



"Ten/Twelve steps" UNICEF/WHO



Picture 1: Typical health education session at the maternity ward, Mbale hospital



Acknowledging the risk of the vertical transmission of HIV during pregnancy, birth and breastfeeding, national policies promoting breastfeeding influenced by WHO/UNICEF initiatives were strongly affected in areas suffering worst from the pandemic [33, 34]. The benefits of breast milk as the best infant food was highly acknowledged in the 1990s, but the benefits had still to be balanced against the risk of HIV acquisition. A paper published in *The Lancet* in 1998 stated that '*This risk (of mother-to-child transmission of HIV-1, MTCT) should be balanced against the effect of early weaning on infant mortality and morbidity and maternal fertility*' [35]. Policies from UNAIDS trying to prevent vertical HIV transmission, and from UNICEF trying to promote breastfeeding, were difficult to combine [36]. IATT was established in 1998 (renamed to Interagency Task Team on Prevention of HIV Transmission in Pregnant Women, Mothers and their Children in 2001) [36]. The main goals set by the IATT were: 1) primary prevention of HIV infection among women of childbearing age; 2) prevention of unintended pregnancies among women living with HIV; 3) prevention of HIV transmission from a woman living with HIV to her infant; and 4) provision of appropriate treatment, care and support to mothers living with HIV, and their children and families.

A prevention of mother-to-child transmission of HIV-1 (PMTCT)-programme was launched in Mbale, Uganda in 2000 [37]. A schematic illustration of the recommendations from the Ministry of Health- Uganda and UNICEF following the introduction of the programme is given in figure 1. Huge efforts were taken to reduce MTCT in an affordable way for the mothers. Whether cheaper alternatives to formula are safe and feasible have been discussed [38]. After the PMTCT feeding recommendations were introduced, they have been criticised as confusing [39]. Now, the feeding recommendations have been revised in line with new international guidelines [40], which has given exclusive breastfeeding (EBF) a stronger position. Nevertheless, the dilemma of conveying a message of risk versus protection is inherent.

The UN declared the Development Millennium Goals (MDG) in September 2000 at the Millenium Summit [10]. The goals embrace 1) End poverty and hunger; 2) Establish universal education; 3) Establish gender equality; 4) Reduce child mortality; 5) Secure maternal health and 6-8 on combating HIV/AIDS, ensure the environment and global partnerships, all within 2015. The MDGs catalysed huge initiatives on international and national level and focused research on strategies to reach the goals and monitoring of progress [41]. In order to reach MDG 4 of reducing child mortality by 2/3 from 1990 to 2015, an annual reduction in death rates of 4.3 % is needed [42]. Huge country and regional variations exist in achieving mortality reduction.

# GUIDELINES FOR COUNSELLING MOTHERS ON INFANT FEEDING

Information is partly layout copied from PMTCT Programme, Ministry of Health-Uganda and UNICEF; 2000

## Is the mother HIV POSITIVE

**NO**  
DON'T KNOW  
Counsel the mother to use:  
Exclusive breastfeeding for 6 months PLUS complementary foods from 6 to 24 months

**YES**

Is the mother willing to breastfeed?

**NO**

Is the mother able and willing to use formula?

**YES**

Counsel the mother to use:  
Commercial infant formula for the first 6 months; Followed by commercial infant formula PLUS complementary foods from 6 to 24 months

**NO**

Counsel the mother to use:  
Cow's milk for the first 6 months Followed by cow's milk PLUS complementary foods from 6 to 24 months

**YES**

Is the mother also able and willing to use cow's milk?

**YES**

Counsel the mother to use:  
Exclusive breastfeeding for 3 months Followed by cow's milk PLUS complementary foods from 6 to 24 months

**NO**

Counsel the mother to use:  
Exclusive breastfeeding for 6 months Followed by complementary foods from 6 to 24 months

Figure 1: Guidelines for counselling mothers on infant feeding as taught 2003/2005 in Mbale, Eastern Uganda. Information and layout copied from PMTCT Programme, Ministry of Health-Uganda and UNICEF; 2000

## Infant feeding research

Ruth Lawrence, editor and author of the book 'Breastfeeding, a guide for the medical profession' has frequently cited the pioneer work by Edith B Jackson and colleagues, who provided the necessary evidence for 'rooming in' as the preferred post-partum behaviour [43]. A large amount of research is provided on lactation physiology, breast milk components, breastfeeding practices and support. 'Infant feeding' research is currently a vast field embracing nutritional, bio-medical, societal, juridical, psychological and anthropological elements [44]. A brief description of some of the 'milestones' of research leading up to current public health recommendations from WHO follows.

### **Breastfeeding duration, morbidity and mortality studies**

Much discussion in the literature has focused on the optimal *duration* of EBF, as defined in the 'Indicators for assessing breast-feeding practices' from 1991 [1]. A Cochrane review by MS Kramer and R Kakuma was published in 2002, which concluded that 6 months of EBF was better than 3 months with regard to associated gastro-intestinal diarrhoea and lactational amenorrhoea. No negative effects were seen on linear growth [45]. Their results were partially based on the biggest cluster-randomised breastfeeding intervention trial to date, promoting breastfeeding in Belarus (PROBIT) [46]. The work had implications for WHO's recommendations. From 2002, 'EBF for 6 months' was repeated in all recommendations [45, 47]. Previously, 4 to 6 months had been discussed. The relationship between growth and total duration of breastfeeding was also studied in the 1990s, and a prospective study from Senegal published in 2001 found that women with stunted children chose to breastfeed longer and that longer duration of breastfeeding did not cause reduced linear growth [48]. From the reviews by MS Kramer et al., it was evident that 'non-uniform definitions of infant feeding' during studies was an increasing problem. In some studies, the EBF definition allowed water, while in others a strict EBF definition was used. Some studies were prospective with different recall intervals while others were cross-sectional. Some of the prospective studies used recall since last visit or birth, while others used short-time recalls, such as the previous 24 hours.

Parallel studies, especially from Asia, looked into the relationship between exclusive breastfeeding and diarrhoea, pneumonia, morbidity and hospitalisation. In an Indian trial promoting exclusive breastfeeding, published in 2003, diarrhoea and growth were assessed [49]. Reduction of diarrhoea was

observed at 3 months in the intervention clusters. They used the 24-hour recall method to assess feeding practices. In another study from the slums in Dhaka, Bangladesh, EBF proved highly protective against overall mortality and mortality from acute respiratory infections and diarrhoea [50]. This study used 7-day recalls and the infants were visited 3-monthly. A pooled analysis of the effect of breastfeeding on infant and child mortality due to infectious diseases in less developed countries was conducted by a study team established by WHO. In the results published in 2000, they found replacement feeding (RF) especially unsafe in low-income families with regard to mortality [51]. One of the most comprehensive non-HIV breastfeeding studies conducted in Africa was carried out in Ghana investigating the effect of early breastfeeding practices on mortality as part of an ongoing vitamin A study [52]. They assessed early infant feeding practices some weeks after birth and used 24-hour recall in their follow-up interviews, and found delayed initiation of breastfeeding associated with increased risk of neonatal mortality. Data from India, Ghana and Peru were pooled for analysis with regard to mortality and hospitalisation [53]. It was found that high risk of infant mortality was associated with non-breastfeeding (NBF), but there was only a small difference in mortality between EBF and predominantly breastfed children (PBF).

Today, there is wide a consensus that EBF has the potential to save children's lives. As part of *The Lancet* series in 2003, it was reported that EBF could potentially reduce U5MR (under-5 mortality rate) by 15% had it not been for MTCT; but even with HIV-1 transmission it could still reduce U5MR by 13% [13]. Breastfeeding promotion and EBF support, in particular, are therefore important in targeting the Millenium Development Goals 4 (MDG4): Reducing Child Mortality [10].

### **Infant feeding practices and the risk of HIV-transmission**

A field study on infant acquisition of HIV-1 through breast milk from infected mothers was first published in 1991 [54]. In 2000 it was estimated that without anti-retroviral intervention, mother-to-child transmission rates would be about 15-30% without breastfeeding, 25-35% with breastfeeding up to 6 months and 30-45% with breastfeeding up to 2 years [55]. Later studies showed that the different feeding modalities gave different risks of transmission. Pioneer work was done in South Africa by Coutsooudis et al. [56, 57] also as part of a vitamin A study. They described EBF and RF as equally protective with regard to HIV-transmission from mother-to-child, a finding that had immediate public health implications: EBF was thereafter recognised as a safe alternative to RF when RF was not AFASS (acceptable, feasible, affordable, sustainable and safe) [4]. The ZVITAMBO study group [58] presented infant feeding data from another

vitamin A study in 2005, with similar findings to the South African study, but with more participants. In this study in Zimbabwe, EBF versus MF reduced transmission by -3.1% and -5.0% at 6 and 12 months, respectively. The study collected feeding information at baseline, 6 weeks, 3 and 12 months, using a 22-item list that asked whether certain items had ever been given to the infants. Some lapses were allowed within the EBF definition. Another large non-randomised intervention study in South Africa [59] was published in 2007 which utilised the ‘assessment tool for research’ explained below. Mothers were seen on a weekly basis and 7-day recalls were conducted. They found that breastfed infants who received solids and formula had a much higher risk of acquiring HIV-1 than exclusively breastfed infants. Infants who were RF had a two-fold risk of dying compared to those who were exclusively breastfed at 3 months. The studies above, among others, contributed to the feeding recommendations from 2006 listed below. In December 2008, the WHO PMTCT expert consultation, while discussing the ‘*emerging evidence on the use of antiretroviral drugs for the prevention of mother-to-child transmission of HIV,*’ did not alter the feeding recommendations from 2006 [60].

#### *IATT 2006 infant feeding recommendations in the context of PMTCT*

The IATT released revised recommendations on HIV and infant feeding in 2006/2007 [40]. Among other recommendations, the IATT stated the following regarding breastfeeding versus formula feeding:

- *Exclusive breastfeeding is recommended for HIV-infected women for the first 6 months of life unless replacement feeding is acceptable, feasible, affordable, sustainable and safe for them and their infants before that time.*
- *When replacement feeding is acceptable, feasible, affordable, sustainable and safe, avoidance of all breastfeeding by HIV-infected women is recommended.*
- *At 6 months, if replacement feeding is still not acceptable, feasible, affordable, sustainable and safe, continuation of breastfeeding with additional complementary foods is recommended, while the mother and baby continue to be regularly assessed. All breastfeeding should stop once a nutritionally adequate and safe diet without breast milk can be provided.*

## Issues on the measurement of infant feeding practices

Many comprehensive infant feeding studies have addressed feeding practices in relation to different health outcomes and assessed infant feeding in a non-uniform way. An important validation study addressing maternal recall of infant feeding practices has been published in 2003 [61]. The study involved 130 mothers in South Africa who were visited weekly. An interview comprising a 48-hour and a 7-day dietary recall were done weekly. In addition 2 non-overlapping 48-hour recalls were done weekly for a sub-group. The results from the weekly 7-day assessment were compared to recalls since birth at 6 and 9 months. They concluded that 7-day recalls reflected feeding practices well compared to thrice weekly recalls in the same time period. They also concluded that long-term recalls were inaccurate. As mentioned, the study had relatively long periods of recalls (6 and 9 months). In addition, they asked 'how long the infant had received EBF' in the long-term recall. It is not clear from their publication that they asked 'item-by-item when other feeds were introduced for the first time.' This methodological study, among others, contributed to the WHO publication *'Breastfeeding and replacement feeding practices in the context of mother-to-child transmission of HIV. An assessment tool for research'* [2]. 'The tool' was developed in the context of MTCT. The weekly 7-day dietary recall was preferred in order to have 'continuous' assessment. This could provide information about how changes in feeding modes were related to MTCT. The authors of 'the tool' specified that not all infant feeding studies could or should do this.

For 1) non-HIV infant feeding studies; 2) HIV studies where infant feeding is just one out of many research components; and 3) program evaluation purposes the WHO tools from 2001 are too costly and thereby not feasible to use. WHO launched a recent résumé in which they summarised how infant feeding practices should be addressed according to existing definitions [5]. The recommended way to estimate feeding modalities, duration and age-appropriate breastfeeding were in general based on practices during the previous day divided by the number of infants in the respective age groups. This type of assessment fitted well into existing population-based surveys like Demographic and Health Surveys (DHS), etc., but the investigators might want to know more than current-status feeding practices. Researchers might therefore be in a dilemma over infant feeding assessment tools, which are either too labour-intensive and therefore too costly and tools that only provide current-status information. The result is that many choose modifications made specifically for their respective studies, and feeding practices are therefore not uniformly addressed.

## Reflections on infant feeding recommendations and research

Existing guidelines carry an element of *choice*. Coovadia and Coutsooudis [62] discussed how '*ethical*' it was to create situations that demanded an active choice from the mother. This is problematic when milk replacement is not acceptable, feasible, affordable, sustainable and safe at all, as the Ugandan formula feeding study has shown this year [63]. This study addressed a community-based service program, providing a formula for the infants among HIV-positive mothers and found formula feeding highly associated with increased infant mortality compared to breastfeeding. Furthermore, some studies indicated that existing guidelines might harm infant feeding practices. One study in Mbale, Eastern Uganda, found that HIV-1 positive mothers had less favourable infant feeding practices than mothers in the general population [39]. Existing infant feeding counselling within the framework of PMTCT has been criticised [64], and improvements are needed both among HIV-1 positive mothers and in the general population. One recent study showed that if HIV-1 positive mothers opted for breastfeeding, an information *vacuum* existed regarding best practices around breastfeeding cessation [65]. More evidence is becoming available regarding ante-, peri- and postnatal medical interventions to prevent MTCT in low resource settings [66], and more research will soon be done. EBF has the potential to reduce morbidity, hospitalization and deaths in the overall population and HIV-1 vertical transmission. Breastfeeding promotion and support is indeed important. However, wise monitoring and follow-up of potential infant feeding interventions needs to be conducted to address whether the initiatives are efficient and sustainable.

## Rationale for an infant feeding study in Mbale

The first studies in 2003 were done in Mbale, Eastern Uganda, 3 years after a PMTCT component was launched at Mbale District referral hospital. BFHI and IMCI breastfeeding information from WHO/UNICEF had been given to health workers nationally for a 5 to 10 year period at that time. Few community based infant feeding studies were done in Uganda, and none in Eastern Uganda, according to our knowledge. The studies could therefore serve as tools to describe how breastfeeding practices were maintained after the PMTCT program was introduced, and also how established the UNICEF/WHO recommendations were, especially whether the concept of 'exclusive breastfeeding' was understood and practised. Anthropometric assessment served additionally as a basis for public health advocacy. The perceptions and practices described by parents gave additional information to that provided by the quantitative instruments. This increased the overall understanding and interpretation of the data in the field. The fieldwork in 2005 gave the opportunity to evaluate the quantitative research instruments more thoroughly, and explore cultural dimensions further regarding infant feeding practices in this region.

The study was conducted during a time when there were ongoing methodological discussions regarding infant feeding research in the era of HIV, and an increased need for understanding infant feeding, breastfeeding and promotion of optimal infant feeding. The rationale for studying infant feeding practices, methodological changes and associated factors were to rethink infant feeding assessment, test potential models that might ease monitoring of feeding practices, create deeper understanding of the underlying factors associated with infant feeding choices, and most importantly to create awareness of existing feeding practices and anthropometric status among infants in Eastern Uganda.



## **Aim and objectives**

### **Aim**

- *To increase the understanding of actual feeding practices of infants in Eastern Uganda from both quantitative and qualitative methodological perspectives, and assess methodological challenges of the studies.*
- *To assess the anthropometric status of the same infant population.*

### **Primary objectives**

#### ***Infant feeding***

To explore infant feeding practices, categorised into different infant feeding modalities, according to the 24-hour dietary recall and the dietary recall since birth, and compare the two methods. (Paper I)

To compare feeding modalities obtained from frequent short-time dietary recalls (weekly 24-hour dietary recall and 7-day dietary recall) and dietary recall since birth. (Paper III)

To explore the reproducibility of infant feeding quantitative instruments capturing feeding modalities and early feeding practices by comparing answers from 2 different assessments in time. (Paper III)

To explore perceptions, practices and experiences of parents regarding infant feeding. (Paper IV)

#### ***Anthropometry***

To describe anthropometric status among community based infants in Eastern Uganda. (Paper II)

### **Secondary objectives**

To assess demographic, cultural and wealth related factors from quantitative and qualitative perspectives as potential determinants for feeding practices and infant anthropometric status. (Papers I, II and IV)

## **Subjects and methods**

I first provide the theoretical framework for mixed method research. Second, the actual fieldwork, data collection and process behind the papers will be presented. Third, the methods used will be presented with regard to how they relate to mixed methods research. I argue that mixing of methods has taken place at different stages: 1) in the design phase; 2) during data collection; 3) at interim analysis; and 4) at analysis, conclusion and dissemination of results for this thesis. I will also mention possible limitations to the mixed method approach.

### **Theoretical framework of mixed methods**

Cresswell et al. [67] elaborated on the term ‘mixed methods research’ and how it has been described since the 1950s. They suggested the following requirements for mixed methods research: 1) that it should involve both qualitative and quantitative data; and 2) that data should be integrated in more than one stage of the process. The authors recognized that these 2 requirements do not embrace how to define multiple studies within a project.

Mixed methods research or mixed research has been described as a paradigm shift, opposing the incompatibility thesis. The incompatibility thesis constituted a paradigm war where qualitative and quantitative research should not and could not be mixed [68]. The paradigm war was led by qualitative and quantitative researchers who proclaimed that their research tradition was superior. They have often been referred to as quantitative or qualitative ‘purists’ [69]. It has been argued that, even if the paradigm war is over, and there is an increased understanding among all researchers for both qualitative and quantitative approaches, remnants from the conflict can still be felt today [70]. A discussion of the research conflicts will not be discussed further.

Mixed methods goes beyond the old paradigm war and acknowledge that ‘both quantitative and qualitative research are important and useful’ [68]. Stakeholders have described mixed methods as the ‘third methodological movement’ in social and behavioural sciences [71]. This latter statement is also used when mixed methods are chosen purposely for political or ideological movements. Mixing methods was a particularly powerful tool for program development, especially within the WHO and partner organisations (go to e.g.: <http://www.who.int/hiv/pub/casestudies/evaluation/en/>). Further descriptions

of how mixed methods could be applicable for advocacy purposes will not be covered here.

Combining methods has been widely ongoing, but there has been limited conceptualisation of how, why and what is going on during the combining procedures [71]. Conceptualising ‘mixing’ is relatively new. In some research environments, and particularly in international health, public health and social sciences, mixing of methods has been done since the 1950s, but it has not necessarily been specified under the mixed methods umbrella. Typical of these research environments is that mixing has mostly taken place at the analytical level, rather than conceptualised throughout the whole research process. This analytical process has often been referred to as *triangulation*. The metaphor of triangulation was taken from mathematics and transferred to social science methodology. According to Erzberger and Kelle [72], the term ‘triangulation’ has now too broad semantic meaning as a research concept. Mixed methods research goes beyond triangulation, which has become only a smaller part of overall mixed method research. Sandelowski [73] summarises it in the following way ‘*when any kind of research combination is designated as triangulation, there is no inquiry that is not triangulated. Having too much meaning, the word triangulation has no meaning at all*’. When using terms like ‘mixing’ and ‘triangulation’, it is important to be specific about the meaning. Mixed method research is a paradigm shift embracing qualitative and quantitative components at all stages of research where conceptualisation of mixing is an important aspect. Mixing can also occur at some, and does not have to occur at all stages of the research process.

Jennifer Green [74] aimed at increased conceptualisation of mixed methods. In 1989, she identified 5 purposes of mixing based on 57 empirical studies: 1) triangulation; 2) complementarity; 3) initiation; 4) development; and 5) expansion. Further attempts to define and conceptualise mixed methods have been done and many viewpoints were gathered in 2003 [75]. One example is Teddlie and Onwuegbuzie 7-stage description of what was going on at the data analysis stage: a) reduction; b) display, c) transformation; d) correlation; e) consolidation; f) comparison, and g) integration. These 7 steps first took the researcher through data exploration, description and graph building. Transformation was the stage where quantitative data were illustrated and qualitative data were coded and analysed. The remaining 4 stages combined the quantitative and qualitative findings in an integrated presentation. An 8-step, ‘legitimizing’, considered the trustworthiness of the analysis and interpretation [76].

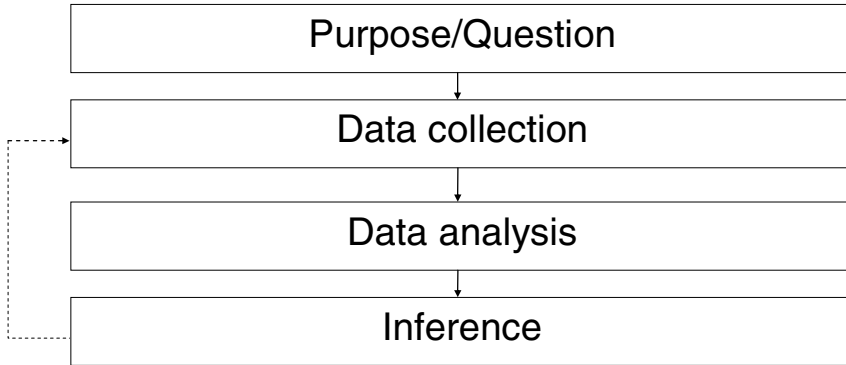
In the research process, mixing may occur concurrently or sequential. The qualitative and quantitative component can be given different emphasis; one of

them might have the dominant status. A copy of a mixed-method design matrix is given in figure 2. To describe concurrency, a plus (+) is given and to describe sequences an arrow (→) is used. The method having the dominant status is written with the 4 first capital letters (QUAN and QUAL) and the method having the least dominant status is written with the first four lowercase letters (quan and qual). These symbols can be useful in illustrating any mixed method research process.

		Time order Decision	
		Concurrent	Sequential
Paradigm emphasis decision	Equal status	QUAL+QUAN	QUAL→QUAN QUAN→QUAL
	Dominant status	QUAL+quan QUAN+qual	QUAL→quan qual →QUAN QUAN→qual quan→QUAL

Figure 2: Mixed-methods design matrix with mixed-method research designs shown in the four cells. Copied from: Johnson RB, Onwuegbuzie AJ: Mixed methods research: a research paradigm whose time has come. *Educational Researcher* 2004, 33(7):14-26.

Another way to illustrate mixed research is to put each phase of the study within a box or circle, and describe it, as in figure 3 showing a traditional mono-strand design for qualitative and quantitative studies. Two important issues arise: 1) the word ‘interference’ is introduced, which acknowledges the fact that analysis and interpretation goes back to the collected data and vice-versa; new collection is based on previous analysis. The word ‘inference’ will therefore be useful describing the connection between different methodologies at different phases of research. An example of interference is when qualitative research moderates the quantitative data collection. 2) The mono-strand model can be used as a basis for multi-strand methodologies where possible links and inferences are illustrated in more complex systems. In the last paragraph of the method chapter, I will apply these tools to the studies undertaken in this thesis.



*Figure 3: A classical mono-strand model copied from Tashakkori and Teddlie: The past and future of mixed methods research: from data triangulation to mixed model designs. In Handbook of mixed methods in social and behavioral research. Edited by Tashakkori A, Teddlie C: Sage Publications; 2003:671-701.*

In mixing of methods, a problem of nomenclature arises. One term can be used differently in the quantitative and qualitative tradition, or 2 terms might be used to describe the same concept: e.g. trustworthiness is described by ‘internal validity’ in quantitative designs, but as ‘credibility’ in qualitative designs [69]. Table 3 gives examples of differences in qualitative and quantitative nomenclature. The questions are: which terms should be kept for mixed methods research, or is new nomenclature needed? Tashakkori and Teddlie [71] emphasised that mixed methods research needs quality criteria description and discussion separately, just as in qualitative and quantitative research. The questions as to whether the mixed method study utilise single- or multi-strand design, to which degree and where there is inference, and whether there is consistency within and between methods also need to be addressed.

Table 3: Criteria for assessing the trustworthiness of research findings according to quantitative and qualitative research traditions copied from: Dahlgren L, Emmelin M, Winkivist A: *Qualitative Methodology for International Public Health*. Umeå: Print och Media, Umeå University; 2004: p 47.

<b>Question asked</b>	<b>Issue</b>	<b>Qualitative criteria</b>	<b>Quantitative criteria</b>
Have we measured what we set out to measure?	Truth value	Credibility	Internal validity
How applicable are our results to other subjects and other contexts?	Applicability	Transferability	External validity
Would our findings be repeated if our research were replicated in the same context with the same subjects?	Consistency	Dependability	Reliability
To what extent are our findings affected by personal interest and bias?	Neutrality	Conformability	Objectivity

One might ask why mixed method research is applied in this thesis. Certain arguments have been raised by others [76]: first, mixed methods can answer questions that other methods cannot; second, it can lead to stronger inferences; and, third, it provides the opportunity for presenting a greater diversity of divergent views. I found mixed methods applicable for this thesis for the following reasons:

- 1) The research topic for this thesis was planned and assessed by mixing qualitative and quantitative designs, given prior knowledge of the complexity of the topic.
- 2) Qualitative and quantitative materials were collected, and inference was identified on many levels throughout the research stages.
- 3) No data collection tools were developed in a ‘purist vacuum.’ The semi-structured questionnaires were based on focus group discussion (FGD) and the FGD guides, and key informant interview (KII) guides were developed thematically where the survey could not get in-depth information.
- 4) Integrating results potentially increased our understandings of the phenomena being addressed. A further elaboration on trustworthiness of the findings is given in the discussion. The quality of the mixing will also be addressed.

With these advantages taken into consideration, there are outstanding challenges in applying mixed methods research in a PhD thesis, e.g:

1) Time is limited: only 3 years for study purposes including planning and preparation for fieldwork, fieldwork, data cleaning and preparation, analysis, presentation and publications might not be sufficient when utilising 2 research strategies, and also attempting to combine them. For this thesis, I acknowledge that mixing could have been dealt with in greater detail for the papers to achieve more integrated presentations. In this summary, an integration of QUAN and QUAL aspects are given in the methods, results and discussion sections.

2) A tendency that the qualitative or quantitative approach is given priority at the expense of each other could be a result of the study question, but also in the capacity as far as human and time resources were concerned. This thesis consists of 3 quantitative and one qualitative paper. Mixing of methods could potentially have been improved if quan and qual aspects had more equal status.

A discussion of the applicability of the design chosen for some of the research issues will be addressed in the discussion.

## **Methods applied**

Data collection was done during 2 field studies in Mbale District, Eastern Uganda. The duration of the fieldwork was 3 months in 2003 and 6 months in 2005. The fieldwork comprised the following quantitative and qualitative methods:

### **Quantitative data**

#### *Cross-sectional study*

793 care-taker infant pairs were approached for a community-based cross-sectional survey October-November 2003, whereby 727 (723) were analysed.

#### *12-week follow-up*

31 mother-infant pairs were approached in first week after birth, and 30 mother-infant pairs consented to be followed up weekly for 12 weeks after birth between June and September 2005.

## **Qualitative data**

### *Focus group discussions*

Four focus group discussions by men among men and 4 focus group discussions by women among women were conducted in 2003.

### *Additional data*

Four preparatory focus groups were completed prior to quantitative data collection in 2003 in order to design and moderate the quantitative instruments. Three of these were done among mothers both in rural and urban areas, and one focus group discussion was conducted among grandmothers living in a rural area. Thirteen key informant interviews were also done among health personnel. Four were done in 2003 and 9 in 2005. In addition, one health education session was formally observed and numerous informal visits were done. Reflexive notes were written in 2003 and 2005. The additional data has not yet served as data for publications, but influenced pre-analysis, implementation of studies and interpretation of the summarised data.

A table displaying the different field studies and methods in relation to papers is given below (table 4).



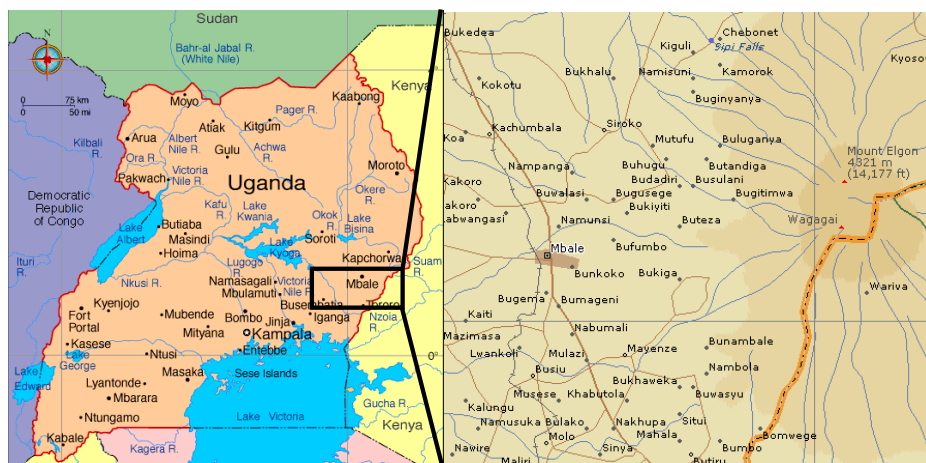
Table 4: Data method, fieldwork, topic and main analysis conducted for the respective papers.

Paper	Method	Fieldwork	Topic	Main Analysis
I	QUAN	Cross-sectional survey among mother-infant pairs n=727	Infant feeding practices and categories	1) Life-table (survival) analysis, 2) Cox regression 3) Principal components analysis
II	QUAN	Cross-sectional survey among mother-infant pairs  n=723 (from same population as in paper I)	Determinants for infant growth: association with infant feeding addressed	1) WHO growth standards 2) Linear and logistic regression 3) Hierarchical conceptual regression analysis 4) Design effect 5) Principal components analysis
III	QUAN	Prospective study: 12 week follow up of mother-infant pairs post partum (n=30)	Comparison of different infant feeding recall assessments	1) Kaplan-Meier analysis 2) Reproducibility: Kappa and one-sample test of proportion 3) Sensitivity and specificity
IV	QUAL	Focus group discussions among men and women (n=81)	Exploration of maternal and paternal perceptions regarding infant feeding	Inductive thematic content analysis

## Site

The fieldwork for this thesis was conducted in Mbale District, an area close to the equator (1°N) and situated in Eastern Uganda (~34.5°E). Mbale is also a busy trading area neighbouring Kenya in the east and at the foot of Mt Elgon (altitude ~1160 meter). The region is rainy (annual rainfall ~1000 mm), hilly, and some areas are occasionally flooded. The total population is ~720,000 in Mbale District, with a population density of 535 persons per square kilometre [77]. The Bagishu tribe speaking Lugishu/Lumasaaba (local name) - a bantu-language – predominate in the District. Their language differs from neighbouring languages, for instance Lusoga and Luganda, spoken in central Uganda. Due to unrest over the last decades, internal displacement of people from other areas, especially the Northern-Eastern areas of Uganda including the Karamajong area, has increased. Coffee and cotton have traditionally been important crops for trade. Tourism and trade with farming products have become important for the economy of the district. The population mainly consists of subsistence farmers. Matoke bananas, maize, sweet potatoes, cassava and millet are the principal food crops.

Studies were carried out in 2 of the 7 counties: the urban Mbale Municipality, situated ~200 km from Kampala, and the rural Bungokho. Six sub-counties were chosen for the studies: Nakaloke, Namanyonyi and Bufumbo in Bungokho, and Wanale, Industrial- and Northern- divisions in Mbale Municipality. Mbale Municipality is the centre of the district with ~10% of the District's population. Bungokho surrounds Mbale Municipality. Mbale Regional Referral Hospital added a PMTCT-component to its remit in May 2000. The success rate was described as low in 2003, with <10% uptake of voluntary counselling and testing (VCT) services [37]. This situation has totally changed after the opt-out approach was launched, where pregnant women actively had to withdraw from the PMTCT services [78]. The change in policy was from June 2006 to May 2007 and both the routine antenatal care services and the testing for HIV increased tremendously [79]. The adult HIV-prevalence was 7.9 (LL 7.5 - UL 9.2) in 2001 and 5.4 (LL 5.0 - UL 6.1) in 2007 [80]. The reason for this decline in HIV-prevalence has been widely discussed [81]. All the 6 sub-counties had their own government clinics, except Namanyonyi. Smaller clinics and NGO-ran clinics were scattered in the study area. The maximum driving distance in our studies was 1 - 1.5 hours by mini-bus to Mbale District Hospital, depending on the weather. The roads had a tendency to become muddy when it rained.



Picture 2: Map of Uganda and Mbale with surroundings

## Survey (Paper I+II)

### *Participants in the survey*

A total of 793 caretaker-infant pairs were approached in their homes, of which 30 were non-respondants – 27 from Mbale Municipality and 3 from Bunguhoho, which left 763 for data cleaning. Due to incomplete data, 36 care-takers who were not the mothers of the infants were excluded. This resulted in 727 mother-infant pairs for the infant feeding study (paper I). Another 4 mother-infant pairs were excluded because of incomplete anthropometric data, which resulted in 723 mother-infant pairs being included in the anthropometry study (paper II). Data was collected from October 6 until November 4, 2003. Fourteen data collectors went out in pairs to do the interviews and the actual measurements. The pairs were gender-balanced in the majority of the interviews.

### *Sampling*

Administrative information was retrieved from the Uganda Bureau of Statistics, Entebbe, which gave us parish sizes and the number of villages per parish (<http://www.ubos.org>). The populations were sampled on the basis of probability being proportional to size. The following procedure was used: '350' was used as a round figure. The percentage of households each parish had of the total parishes in study area was calculated. This percentage was multiplied with 350 to get the total number of households we were supposed to sample from each parish. Dividing the number of households in each parish by 7 gave us the right amount of villages in each parish. Within each village, 7 households were randomly selected. We decided that we should cover at least the selected number of households in each parish; e.g. a parish with pre-selected 24 households should be visited in 4 villages/cells (LC1-level), making it 28 households instead of 24. Deciding which villages to go to within each parish was done randomly by giving each village a number and selecting numbers according to a random number list. The sample was not stratified on urban/rural status.

An average village has ~1000 inhabitants, with the administrative tasks being delegated to an elected local chairman (LC1). While the data collection team approached a village, collaboration from the local LC1 was assured and a guide knowing the borders of the village was hired. Most arrangements with the village leaders were made a day in advance. Arrangements with more senior leaders in the administrative hierarchy had been made prior to the study by the study-coordinator. Mothers of infants under one year were the primary

targets as respondents, but any household with infants was approached for data collection. Each data collection pair was supposed to complete 7 interviews per day and to visit one village/LC1 unit per day.

Entering the village, households were selected by going to the centre of the village, twisting a bottle and following the randomly selected direction. The guide would follow the pair to the eligible households, defined in the inclusion criteria of the questionnaire (appendix 1). All households on the way were assessed for eligibility. If the team had reached the edge of the village, they were asked to toss a coin to choose either to go clockwise or anti-clockwise. A common practical problem was that the LCI units often lay along a road where all the houses were lined up. Behind the houses there were only fields and swamps. The bottle in this situation was used to choose whether to go up or down the road. They then tossed a coin to decide whether to go on the right or left side of the road. In many places these methods were not thwarted by the very scattered population and hilly terrain (Bufumbo). Here the research assistants used the randomisation methods learned in the training as efficiently as possible to make sure that the households were randomly selected. In most cases the potential bias selecting informants most centrally on a central-periphery axis was not so relevant at the village level as the central-periphery axis was more evident at the parish-level. A central-periphery selection bias was probably overcome because villages within each parish were randomly selected. When there were >7 eligible households to visit within each village, households were chosen randomly by the data collectors.

### *Sample size*

The study was designed to be large enough to assess the prevalence of semi-exclusive breastfeeding at 3 months. Semi-exclusive breastfeeding was defined as exclusive breastfeeding disregarding pre-lacteal feeds. The assumption was that the prevalence rate of semi-exclusive breastfeeding at 3 months was the same as in a previous study at a rate of ~50%, based on a 24-hour recall [82]. The confidence interval (CI) was set at 95%. The minimum sample size of 645 children was thus obtained with Sample XS software using the following equations and assumptions [83]:

$$A=3.8416 PQW$$

$$n=A/(E*E+(A/N))$$

where n=the required sample size (645 children)

P=the assumed population prevalence of semi-exclusive breastfeeding in Mbale municipality and Bungokho county (50%)

$Q=100-P$

E=the maximum acceptable sampling error (5% at 95% level of confidence)

W=the likely design effect (2)

N=the population size (under one year 4% of the general population = 4000 children)

We decided to include a minimum of 700 infants to allow for non-responders.

### *The questionnaire, measurements and definitions*

A semi-structured site-specific questionnaire was developed, translated from English into Lumasaaba and pre-tested. The preparatory focus groups served as background information. The questionnaire was back-translated to check for a common understanding of the concepts. This procedure was itself a challenge because written Lumasaaba was not taught in school and existed more as an oral than a written language. The interviews were performed face-to-face with the care-takers by data collectors fluent in Lumasaaba. In a few settings (<5), the English version or another common Ugandan language was used.

Thirty-five liquid and food items were asked for in a 24-hour dietary recall. The same items were asked for in a dietary recall since birth immediately after the 24-hour recall. The 24-hour recall reflected the feeding practices from the previous morning to the morning of the interview. In the dietary recall since birth, the respondents were asked if any liquid and food item had been given to the infant and, if so, when that was done for the first time. The mothers were asked what they thought about colostrum on an ordinal scale ranging from good (1) to bad (5). Actual practices regarding colostrum were not covered in the questionnaire. The questionnaire also included questions on breastfeeding in general, pre-lacteal feeding, initiation of breastfeeding, socio-demographic characteristics, water and sanitation, education of mothers and fathers, having brothers and/or sisters, type of work, marital status, religion, immunisation status, primary healthcare usage for the infants, and recent sickness. The questionnaire is given in appendix 1.

Weight and recumbent length were taken according to WHO standardized techniques [84]. Undressed infants were weighed to the nearest 0.1 kg using a 25 kilogram (kg) portable Salter spring scales. Recumbent length was measured to the nearest 0.1 cm. Validation of instruments, measurements and random auditing were done on a daily basis.

Pre-lacteal feeds were defined as any food item given within the first 3 days. Answers about food items were grouped into 4 feeding categories, modified according to the WHO definition for the infant feeding study: 1) exclusive breastfeeding (EBF), those who had received nothing but breast milk from

their mothers; 2) predominant breastfeeding (PBF), those who had breast milk as their predominant source of nutrition, but with the possible addition of water and water-based drinks, fruit juice and locally made oral rehydration salts solution (ORS); 3) complementary feeding (CF/MF), including any supplementary milk, fresh diluted and undiluted cow's and goat's milk, any infant formula and milk powder or milk in tea, as well as any semi-solid and solid food with starch, fruits and vegetables, meat, fish and other protein rich products were probed for; and 4) replacement feeding (RF), including any foods or liquids except breast milk to the infant. These categories were simplified in the anthropometry study dividing the population into either 1) EBF or 2) MF and/or RF according to the 24-hour recall. Potentially associated determinants for feeding practices and anthropometric statuses were assessed in paper I and II and categorisation of the determinants varied slightly, as specified in the papers.

Certain assumptions were made when addressing socio-economic status/wealth in these low-income areas. First, socio-economic status or wealth are acknowledged determinants associated with health related behaviour and outcomes. Second, within seemingly socio-economic homogenous populations, different strata exist that should be detected and described. The discussion centres on how to describe differences in wealth as soundly as possible. DHS published a comparative report in 2004 where they carefully addressed different wealth assessments [85]. Wealth can be addressed looking at: 1) household income; 2) household expenditures; and 3) household wealth. There are obvious limitations, mostly associated with irregularity, under-reporting and comprehensiveness with the former 2 assessment categories that made them irrelevant for us at the chosen Ugandan site. The wealth assessment capturing durable assets was chosen, based on the assumption that it reflected long-term socio-economic status and provided the most reliable basis for delineating categories. Estimations and categorisation were done according to work reflected by previous research from the In-depth Network and a reference article by Filmer and Pritchett [86, 87]. In the infant feeding study, wealth assessment (called socio-economic status) was done according to principal components analysis (PCA). Reanalysis of wealth assessment was carried out for the anthropometry study. The wealth indices used in paper I and II were highly correlated ( $>0.7$ ).

### *Analysis*

The infant feeding study (paper I) assessed feeding practices using SPSS life-table analysis (survival analysis) for the different feeding categories for both the dietary recall since birth and the 24-hour dietary recall. To make it simpler for the respondents, the information about dietary recall since birth was

recorded in months, with <4 weeks counting as zero months, and completed full months being used for analysis. Termination of a case in the life-table analysis was the introduction of a food item discontinuing EBF and starting PBF, and discontinuing PBF and starting CF/MF. The cumulative percentages of infants being fed within the respective feeding categories at different times were obtained. Cox regression analysis was used to check for factors associated with the different feeding practices for the recall since birth and the 24-hour recall. The practice of giving pre-lacteal feeds was analysed by logistic regression. The food items given to >20% percent of the infants were presented separately.

Anthropometry is acknowledged as an important instrument to assess infant and child health [84]. This study (paper II) utilised newly developed growth standards from WHO, based on the Multicentre Growth Reference Study (MGRS) [88]. They not only provide a reference, but a standard on how children 'should' grow under ideal conditions, such as with non-smoking mothers, exclusive breastfeeding and favourable socio-economic conditions. A sub-study of the anthropometric data compared the estimations from the previously used NCHS/WHO-reference and the new WHO Child Growth Standards. This concluded that the old reference underestimated the proportion with z-scores below -2 SD (wasting, stunting and underweight) compared to the WHO Child Growth Standards in this population [89]. Yang and de Onis recently published an algorithm that could be used to convert the old NCHS/WHO estimates to the new WHO Standards when the original data could not be provided [90]. To conclude, anthropometric estimates from the WHO Standards cannot be compared to older studies using NCHS/WHO-reference directly without caution.

Wasting was defined as WLZ <-2, stunting as LAZ <- 2 and underweight as WAZ <-2 [91]. Potentially associated determinants for stunting and wasting were assessed by crude and adjusted analyses, the latter conducted according to a conceptual hierarchical framework. This framework was established in paediatric epidemiology by Mosley and Chen in 1984 for the study of infant mortality, and refined and elaborated upon by Victora et al. in 1997, with the example of diarrhoea. Similar models have been used for the study of anthropometry [92-95]. Structural frameworks has been used in different settings, and also for implementation and evaluation by UNICEF [96]. Adapting them for statistical analysis is debatable. The framework used is given in paper II, figure 1.

Anthropometric mean indices were assessed with respect to pre-lacteal feeding, mode of feeding and household wealth. The indices were adjusted according to selected factors to identify confounding between feeding practices

and anthropometric z-scores, and household wealth and anthropometric z-scores.

The data were entered using EpiData 3.0 and analysed using SPSS (version 14 and 15) and STATA (version 9.2 and 10.1.) Anthropometric indices were generated using the WHO Anthro 2005 software (<http://www.who.int/childgrowth/software/en/>).

### **Twelve-week follow-up of mother-infant pairs (Paper III)**

The 12-week follow-up study was part of formative research for the ongoing study: 'Promoting infant health and nutrition in Sub-Saharan Africa: Safety and efficacy of exclusive breastfeeding promotion in the era of HIV (PROMISE EBF)', which is a cluster-randomized multi-centre trial of the safety and efficacy of EBF promotion by peer-counsellors in Burkina Faso, Zambia, South Africa and Uganda [97]. The prospective study was conducted from June to September, 2005. Breastfeeding practices were assessed. Two infant feeding recall assessments were conducted and compared: one assessment was a weekly follow-up with 24-hour and 7-day recalls, the other was recall since birth at weeks 6 and 12 after birth among the same mother-infant pairs. The mother-infant pairs were recruited through appointed recruiters for the PROMISE EBF-study. There was no evidence of family relations or strong social bounding between any of the mothers. Thirty-one mothers were approached and 30 mother-infant pairs consented for recruitment to the follow-up study. Three were lost to follow-up at week 11; among these 3, 1 infant had died. Two did not complete the 12-week interview. Therefore, 25 mothers remained for the 12-week interview. Certain central elements of the questionnaires were asked twice to assess reproducibility, specified in the paper. In all, 427 interviews were conducted. The study overview is presented in paper III, table 1.

#### *Questionnaire*

Interviews were conducted in Lumasaaba by data collectors working in pairs, and fluent in the language. Pre-testing and back-translation were done. The survey in 2003 and the qualitative work partially served as the basis for questionnaire design. In addition to breastfeeding practices, 22 locally appropriate food and liquid items were included in the 24-hour, one-week and since-birth recalls. A copy of the questionnaire is given in appendix 2.



## **Analysis**

The feeding assessments made it possible to create variables from the following criteria: 1) EBF versus PBF+CF/MF (-RF); 2) EBF+PBF versus CF/MF (-RF); and 3) BF versus NBF (RF). All women breastfed, making the last variable redundant. These variables were created for prospectively gathered information and compared with the two retrospective assessments at weeks 6 and 12. Change in feeding category was defined as an 'event' in the Kaplan-Meier analysis. Time-to-event was calculated based on first positive answer qualifying for change in feeding category in the prospective assessments and reported first time of introduction of similar foods in the retrospective assessments. We compared first time of introduction of 'water-based feeds, Oral Rehydration Solution, and fruit-juices' which meant re-categorisation of a breastfed infant from exclusively breastfed to predominantly breastfed. Similarly, we compared the first time for introduction of 'milk-based feeds and semi-solid feeds', which re-categorised an exclusively or predominantly breastfed child into a mixed fed child. Reproducibility, specificity and sensitivity were calculated. Data were double-entered using EpiData 3.0 and analysed using SPSS 15 and Stata 10.1.

## **Qualitative assessment (Paper IV)**

Focus group discussions (FGD) were adopted as the method. Two men facilitated the discussions with the men and 2 women facilitated the discussions with the women. Among the 81 informants, 38 were men and 43 were women. Of these, 10 men and 11 women were urban dwellers. The men and women were not related as couples. The participants were recruited by the local vaccinator or local chairman in their respective villages. The venues chosen for the discussions were not linked to any health institution. The inclusion criteria were 'having children younger than 2 years' and 'giving informed consent for participation.' Confidentiality within each group discussion was agreed among the participants prior to the start.

The following themes were investigated in all 8 groups, using a focus group discussion guide with open-ended questions and numerous probing alternatives (framework given in appendix 3): (1) actual knowledge of breastfeeding, including positioning, problems, cultural norms and early breastfeeding practices; (2) reactions and feelings about non-breastfeeding; (3) support, family structure and feeding priorities within the family; (4) child nutrition and nutrition related morbidity; and, among men only, (5) satisfaction with the

local health units communication towards men regarding child nutritional aspects. Each discussion lasted ~2.5 hours.

### *Analysis*

Each FDG was conducted by one moderator and one recorder, both fluent in Lumasaaba. The recorder took notes, observing body language and the general atmosphere in the group. All interviews were tape-recorded after consent had been given. Paper transcripts were used as back-ups. Data were translated into English by those who conducted the discussions. Inductive content analysis was performed. Reading was done in consecutive sessions. The coding was done phrase by phrase, and manually cut and pasted in categories before broader themes emerged. The end-result was compared to pre-analysis. Based on the identified themes, 2 study questions were used as the basis for describing infant feeding practices and perceptions among men and women in Eastern Uganda. How are the different feeding options understood and accepted? And, what responsibilities do men and women have that are related to infant feeding?

### **Mixed methods analysis**

Issues from the quantitative material and the qualitative material were largely overlapping and are presented thematically in the result section where that applied, e.g. where the quantitative material provided frequencies and statistical associations, and the qualitative material provided perceptions and statements to the common themes. But, mixing has been ongoing throughout the study process, with both sequential and concurrent elements. The process of mixing is summarised in a quan/qual matrix below, which also gives the time outline:

Table 5: Mixed methods matrix for this thesis

	<b>Stage</b>	<b>Sequential</b>	<b>Concurrent</b>
<b>Year</b>			
<b>2003</b>	Data collection	qual → (QUAN → QUAL)	qual
<b>2004</b>	Preliminary data analysis	qual → quan	
<b>2005</b>	Data collection	(qual+quan) → QUAN+qual	QUAN+QUAL
	Preliminary data analysis	qual/quan	
<b>2006</b>	Data analysis	QUAN	
<b>2007</b>	Data analysis	(qual) → QUAN	
<b>2008</b>	Data analysis	QUAN → QUAL	
<b>2008</b> <b>2009</b>	Data analysis + thesis writing		QUAL+QUAN

*Data collection, Sept-Nov 2003*

Qualitative research including 4 FGDs with nearly 50 participants were done prior to the quantitative survey in 2003. This constituted a qual → QUAN relationship. At the end of the quantitative survey without analysis of the quantitative data, 8 new FGD were done with 81 participants. This constituted a QUAN → QUAL relationship because the time-frame for collecting the data did not overlap, and the qualitative interview guides were based on impressions and problems arising while performing the quantitative study. In parallel to the survey and the FGDs, 4 KII were performed. Time-wise the KII overlapped both the survey and the 8 explanatory FGDs. The KII had an

exploratory character and was meant as supportive information to the study, being described therefore with lower case letters. This constituted a (QUAN → QUAL) + qual-relationship. The data collected in 2003 had the following relation qual → (QUAN → QUAL) + qual.

#### *Preliminary data analysis, January and June-Oct 2004*

The initial data analysis was qualitative; this had a preliminary character where deductive results were presented among the fellow researchers, but not published. After the initial qualitative reports, quantitative analysis of the survey began. The preliminary data analysis in 2004 had the following relation qual → quan.

#### *Data collection, February – October 2005*

Qualitative and quantitative data collection took place from June to September 2005. Preparation was made from February 2005. First, new questionnaires for the comparative study were made. Background preliminary qualitative and quantitative analysis supported the design of the new quantitative instruments, which could be described as (qual+quan) → QUAN. Concurrent qualitative data collection was done by visiting health institutions and performing new KIIs. The relationship with the ongoing quantitative data collection was QUAN+qual. Meanwhile analysis of open-ended questions from the 2003 survey was done [98]. The overall process could be described as (qual+quan) analysis → QUAN+qual data collection + qual/quan data analysis.

#### *Data analysis February – June 2006*

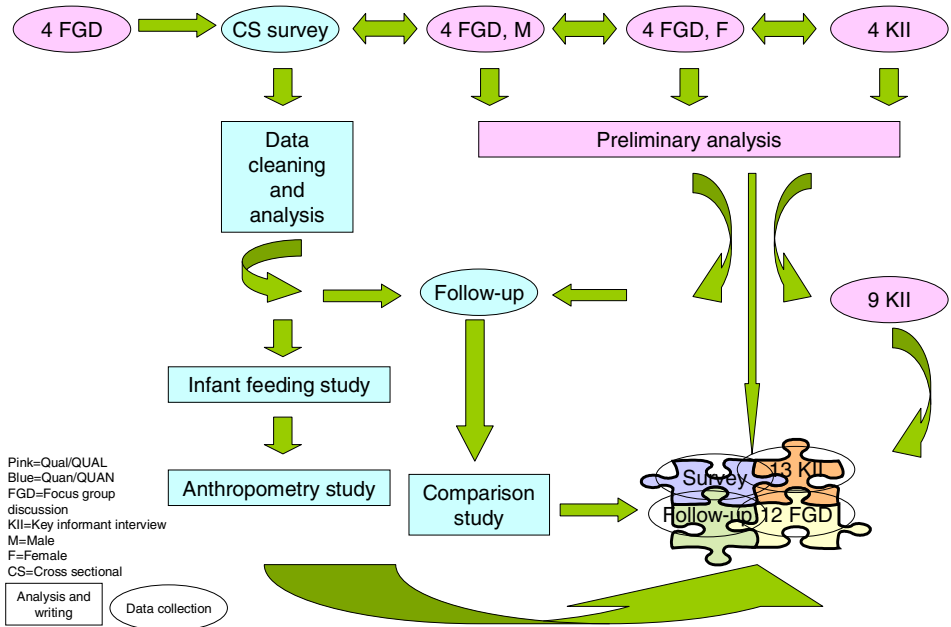
Priority was given to finishing analysis of the quantitative measurements of actual infant feeding practices from the survey in 2003, which led to a quantitative publication: QUAN (paper I).

#### *Data analysis August 2007 until thesis submission*

Priority was given to finishing analysis of the anthropometric measurements that led to paper II. In parallel, the KIIs were transcribed and influenced the focus of the analysis; e.g. by knowing that wealth and health services in the districts varied across sub-counties, more underlying determinants were thought about and added to the hierarchical analysis. Some qualitative aspects were taken into considerations in the introduction and discussion. The process could be described as qual (analysis) → QUAN (analysis).

Another focus of the period was finalising the comparative study. This was mostly QUAN work. Analysing the FGD was QUAL work. These 2 stages were sequential. When doing the last QUAL work, the majority of the QUAN work was done, and will have influenced the selection of data and interpretation.

This process has been illustrated in figure 4 in which the pink colour represent qualitative components, the blue colour quantitative components and the green arrows inference: a conceptual framework of ‘mixing methods’ relevant for this thesis.



Engelbrechtsen, IMS 2009

Figure 4: Conceptual framework of mixing relevant for this thesis

## Ethics

Ethical clearance was obtained from Makerere University Faculty of Medicine Ethics and Research Committee, as specified in the papers.

Participants were informed about their rights as study participants: to withdraw anytime and that their participation would not affect other health services. They were also informed that there would be no immediate benefits for them, and that it could be time demanding, varying with the respective studies. There were no major risks related to participating in the study, but the participants were informed that the questions could cause discomfort. The data collectors were instructed on when to refer study participants or household members to health units. The consent form was verbally explained to the participants before it was signed/a thumbprint was given. The informed consent form used in the survey is given in appendix 1.

## **Results**

### **Background characteristics**

#### **Cross-sectional survey population 2003 (Paper I+II)**

In the cross-sectional survey, the mothers had a mean age of 25.4 years (range 14 to 43 years), and the infants had a mean age of 5.4 months (range 0.03 to 11.96 months). The mothers had an average of 6.4 years of formal education (range 0 to 16 years), and the fathers 7.7 years (range 0 to 20 years, response rate 85%). The mothers in the urban areas tended to be younger and also had higher formal education compared to those in rural areas. They had also immunised and weighed their infants to a higher degree. The mothers living in the rural areas tended to have more children than those in the urban areas. Characteristics are given in paper I, table 1.

#### **Twelve-week follow-up study 2005 (Paper III)**

Of the 30 mothers, 1/30 did not know her age. The remaining 29 were aged from 15 to 36 years, with a median of 24. Three mothers had never attended school and the rest had attended school for between 3 and 11 years, with a median school attendance of 7 years. Nearly half (13/30) reported that they were unable to read and write. Twenty-six had attended an ante-natal care unit (ANC). Seven mothers were having their first child. Background characteristics of the population are given in paper III, table 2.

#### **Qualitative study 2003 (Paper IV)**

The 81 participants were mainly subsistence farmers and petty traders. Both the men and the women were available during daytime. The participants were generally uncertain about their age, but the reported age ranged from 16 to 40 years.

## Breastfeeding as the primary infant feeding practice

All the 727 mothers in the cross-sectional survey (paper I), except 1, had breastfed the indexed infant. Of the 726 mothers having breastfed, 8 (1.1%) had stopped breastfeeding at the time of interview. All the mothers in the comparison study were breastfeeding (paper III).

This high prevalence of breastfeeding was also reflected in the focus group discussions (paper IV): the men described breastfeeding as *'the only way to feed'* an infant and as the mother's duty. The practice was rooted in traditions, but they also emphasized issues such as: *'physical growth,' 'intellectual'* and *'psychological development.'* A few mentioned that breast milk contained the *'necessary nutrients'* for the baby and was a *'source for energy'* for the babies who *'have no teeth for chewing'* and stomachs which *'are not ready.'* The preferred time to stop breastfeeding was between 1 and 2 years according to the men, or later if the child wanted, but depended mostly on when the mother conceived again.

The 8 mothers who had stopped breastfeeding in the cross-sectional survey (paper I) reported a feeling of not having enough milk, or that the child was no longer interested. All who had stopped breastfeeding did so before the infant was 5 months, the mean and median age of stopping breastfeeding being 3 months.

In the focus group discussion (paper IV), maternal or child illness, lack of milk, work and studies were the most frequent reasons for stopping or not starting breastfeeding. But, women's reasons were not necessarily taken seriously. Quotes such as *'some just pretend to be sick and they refuse to breastfeed'* and *'others want to remain young and want breasts to remain firm'* illustrated that whatever reasons the women might have had for not breastfeeding, these were unacceptable.

Unless the mother had a good reason for not breastfeeding, this was socially sanctioned. A statement among the women like *'she is not supposed to be among mothers'* indicated this attitude. Women used phrases such as *'difficult,' 'not serious,' 'irresponsible,' 'not ready for her baby,' 'abnormal,' 'mentally disturbed,' 'bad hearted'* and/or *'wants her baby to die'* about non-breastfeeding mothers.

The men perceived not breastfeeding as a potential threat to the health and life of their babies, and they were willing to use a wide range of tactics, such as verbal accusation, physical violence and administrative/judicial sanctions to



make the mother breastfeed. Some said a non-breastfeeding decision could result in divorce.

## Early infant feeding practices

Among the 727 mother-infant pairs in the cross-sectional survey (paper I), half of the women had initiated breastfeeding within 2 hours, and nearly 70% within the first day, and within the third day nearly all had tried breastfeeding (paper I, table 2).

In the female focus groups (paper IV), the women said breastfeeding could be delayed because of '*delayed milk*' or '*lack of milk*.' Other difficulties were also reported by men and women: the women had experienced stomach pain, loss of blood, delivery of placenta, exhaustion, stitching, and even collapse and unconsciousness as factors delaying initiation of breastfeeding. Furthermore, a sleeping or sick newborn baby was given as an obvious reason to delay breastfeeding, the baby being incapable of suckling. It was strongly felt that a clean body in general and clean breasts in particular were of importance before breastfeeding could be started. Bathing mother and baby and washing of breasts were mentioned in all female groups as important tasks to do before breastfeeding could be initiated. This practice was also confirmed as important in the male groups. Skilled attendance during delivery upheld the cleaning and washing practice. In exceptional situations where it was difficult to explain why breastfeeding was not established as expected, some of the women mentioned supernatural forces - spirits, curses and bewitching.

In the quantitative survey (paper II), 38% of the mothers perceived colostrum as good and 35 % as bad, with the remaining having less polarised views.

The focus group discussions explored further the views about colostrum (paper IV). Some of the men were aware of the value of colostrum, recognising it was good and nutritious for the newborn. Others held the view that it was necessary to discard the first milk. One reason mentioned for squeezing it out was to avoid 'blocking' of the breasts. More commonly reported was the belief that colostrum could '*cause diarrhoea*,' '*contained dirt*' and was '*bad*' for the baby.

In the quantitative survey (paper I and II), pre-lacteal feeding was given to 57.1% of the infants within the first 3 days, and water-based liquids were the most common. Paper I, table 3, shows that water-based liquids were given by 52%, and milk-based liquids or semi-solid foods by 5.1%. High education and

formal marriage remained significant as protective factors against pre-lacteal feeding in the adjusted analysis (adjusted OR 0.5, 95% CI 0.2 – 1.0 and 0.5, 95% CI 0.3 – 0.8, respectively).

In the focus group discussions (paper IV), pre-lacteal feeding was perceived as common and closely linked to a perceived lack of milk and delayed initiation of breastfeeding. The men mentioned *'warm water'* or *'diluted fresh cow's milk'* as pre-lacteals. Warm water should help with *'unblocking'* the baby's throat before other feeds could be given. The women mentioned *'plain water,'* *'glucose water,'* *'sugar and/or salt and water'* and *'Gripe water'* as pre-lacteals.

The main reason the mothers reported for giving pre-lacteal feeds was that they had to wait for their milk to start flowing. Other reasons had to do with the baby being hungry, cleaning of the baby's throat, the mother's own pain and exhaustion after delivery, traditions, and advice from health staff. One reported being influenced by her own relative: *'my mother stopped me from giving breast milk unless I first gave sugar water.'* Giving breast milk first was also believed to be bad among some women. *'Milk brings worms in the stomach, therefore I first give glucose water.'*

Questions regarding pre-lacteal feeding and initiation of breastfeeding were assessed in the comparative study (paper III). The women were asked at the week 1 visit and the same questions were repeated at the week 3 visit. Concordant answers were given in the week 1 and week 3 interviews for 6 items not given to the babies. A high proportion reported concordant answers for diluted cow's milk and oral rehydration salts (ORS). This was not the case for water, and water with sugar or glucose. Concordant answers were seen for handling of colostrum, but not for giving pre-lacteals and timing of putting the baby to the breast. The latter 2 practices yielded significantly reproducible answers according to the traditional kappa test.

## Assessment of infant feeding modes

The first paper from the cross-sectional survey among 727 mother-infant pairs included a 24-hour dietary recall, asking mothers about food item-by-item, and a dietary recall since birth asking the same item-by-item list. Life-table (survival) and Cox regression analysis were presented for the 2 recall assessments. In the third paper, 12-week follow-up post-partum among 30 mother-infant pairs was done. Weekly assessment, including a short-time recall

(24-hour dietary recall and 7-day recall merged), was compared to recall since birth at 6 and 12 weeks. The main findings are presented consecutively below:

### **Life-table analysis among 727-mother-infant pairs (Paper I)**

From the dietary recall since birth, the proportions still practising EBF at 3 and 6 months were 0.07 and 0 (nil), respectively. The proportions still practising PBF at the same times were 0.30 and 0.03, respectively.

The proportion who did not receive any liquids and food items in addition to breast milk, qualifying for EBF according to the 24-hour dietary recall, was 0.81 at 3 months and 0.52 at 6 months. This dropped steadily up to one year, but even at 9 months about a quarter did not get any water, or milk-based food items, or semi-solid and solid food items from the previous morning to the morning of the interview. The life-table analyses for recall since birth and 24-hour dietary recall are illustrated in paper I, figures 1 and 2.

According to the Cox regression analysis done for starting PBF and CF/MF for both recall since birth and 24-hour recall, no important factors were identified after adjustment, except that mothers aged 25–29 tended to give complementary food items slightly less according to the 24-hour recall (adjusted OR 0.8, 95% CI 0.6 – 0.9,  $p < 0.05$ ).

The differences between the 2 assessments, recall since birth and 24-hour recall, are given in paper I, table 5, ranging from 51 to 78% for EBF and from 30 to 59% for PBF.

### **Comparison of frequent short-time recalls (24-hour + 1 week recall) versus dietary recalls since birth at 6 and 12 weeks post-partum among 30 mother-infant pairs (Paper III)**

Comparing the mean duration of EBF and of PBF according to 1) frequent short-time recalls (based on 24-hour and 7-day recalls); versus 2) recall since birth showed the following pattern: no significant difference ( $p \geq 0.05$ ) in the mean duration of PBF at 6 weeks and EBF and PBF at 12 weeks were seen between the 2 assessments, but a significant difference ( $p < 0.05$ ) was observed for the mean duration of EBF at 6 weeks for the 2 assessments. The recall since birth showed generally a minor (~1 week) extended duration of EBF and PBF compared to the results from the weekly follow-up. The results are given below.

At 6 weeks, according to the frequent short-time recalls, the mean time for ending EBF and starting PBF was 0.50 weeks (95% CI 0-1.02 weeks). According to the recalls since birth, it was 1.51 weeks (95% CI 0.66-2.35 weeks) (Mantel-Cox test,  $p=0.049$ ).

The mean time for ending PBF and starting MF was 4.07 weeks (95% CI 3.38-4.77 weeks) according to the frequent short-time recalls, and 4.50 weeks (95% CI 3.93-5.07 weeks) for the recall since birth, (Mantel-Cox-test,  $p=0.82$ ).

At 12 weeks post-partum, the mean time for ending EBF and starting PBF was 0.53 weeks (95% CI 0-1.11 weeks) according to the frequent short-time recalls, and 1.40 weeks (95% CI 0.10-2.70 weeks) for the recall since birth (Mantel-Cox-test,  $p=0.147$ ).

The mean time for ending PBF and starting MF was 5.17 weeks (95% CI 3.86 – 6.49 weeks) according to the frequent short-time recalls, and 6.60 weeks (95% CI 5.40-7.80 weeks) for the recall since birth (Mantel-Cox-test,  $p=0.20$ ).

The Kaplan-Meier curves of these 4 comparisons are given in paper III, figures 1-4.

## **Change in feeding mode?**

The design of paper III gave the opportunity to assess what happened after the study participants had changed mode of feeding from EBF to PBF, or from PBF to CF/MF. A colour illustration was drawn where items qualifying for PBF are blue and those qualifying for CF/MF are red (paper III, figure 5). The illustrations show a tendency towards reduced usage of feeds qualifying for PBF when CF/MF was introduced. A tendency to continue CF/MF after its introduction was also observed.

Among the 727 mother-infant pairs participating in the cross-sectional survey (paper I), an item-specific assessment was made. Items which were given to >20% of the children were listed and median time for introduction given. A figure showing cumulative percentage of the introduction by monthly intervals was also given. It showed the tendency that water-based solids were introduced early in a high proportion, but it could also illustrate that common semi-solids, such as beans, were not usually introduced to infants after 6 months, except maize porridge.

## **Sensitivity, specificity, reproducibility of feeding recalls**

The comparison of the 30 mother-infant pairs (paper III) assessed sensitivity and specificity of certain feeding recalls. The probability of detecting EBF at 6 weeks by the since birth recall as compared to the frequent short-time recalls was 85.2%. The likelihood of detecting CF/MF was 90.0%. All estimations of non-EBF or non-CF/MF in the recalls since birth yielded the same patterns according to the frequent short-time recalls at both the 6 and 12 week assessments.

Reproducibility of the recall since birth and the one-week recall (including 24-hour and 7-day recall) were assessed by comparing interviews conducted twice at week 6 and 12. Reproducibility of the assessments was generally high, a conclusion reached by comparing variables created for PBF and MF. Reproducibility was only calculated at item-by-item level for the early infant feeding practices presented earlier in this result section.

## **Ideas about EBF versus other foods as soon as possible**

The focus group discussions among men (paper IV) showed that they were unfamiliar with the idea that an infant should be 'exclusively breastfed.' As with breastfeeding in general, a few described EBF as '*the only way*' and '*the easiest way*,' but the perception that breastfeeding was insufficient came out most strongly.

The women had been taught about EBF in antenatal clinics and were familiar with the recommendation to breastfeed exclusively for 6 months. They also thought that breastfeeding was insufficient, mostly because they felt that they did not have enough milk themselves. Confusion and uncertainty about the recommendation to give '*nothing, but breast milk*' for 6 months was observed among the women. The quote: '*I want to know why they refuse us to give other feeds during the first six months*' is illustrative of the concept being conveyed, but not adapted as internalised knowledge.

The men complained that they had learnt '*nothing*' about it. Through KII with health personnel (not published), we were told that attempts were made to include the men. This mostly involved asking the women to bring their husbands the next time. This was in contrast to the men's view, who expressed that they felt left out from health education. This leaves questions about whether 1) the message from the health education is not given to the men, and 2) the men do not feel invited to attend health education sessions which are useful or feasible for them.

Some women also believed EBF could be harmful and cause sickness of various kinds in the baby, such as '*wide stomachs*' and '*worms*'. In this context, breast milk supplements were described as beneficial and would make the baby '*more healthy,*' '*immune,*' and '*fatter*', and would help '*to avoid worms.*'

More important was the experience that EBF was very time-consuming and difficult to practice for a mother who had other commitments in the household or outside. The parents were also concerned that '*the baby should get used to other feeds.*' The babies were perceived as more vulnerable if they were entirely dependent on breast milk in case something should happen to the mothers.

## Anthropometric characteristics

Anthropometric characteristics of the children in the cross-sectional survey were assessed (paper II). The mean WLZ was 0.04 (95% CI -0.07 to +0.14), the mean LAZ was -0.76 (95% CI -0.88 to -0.65), and the mean WAZ was -0.49 (95% CI -0.59 to -0.39). Boys had significantly lower LAZ than girls, and the mean LAZ decreased with age. Among the infants who were stunted, 58.7% were boys and 41.3% girls. There was no significant difference between boys and girls in mean WLZ or WAZ. The proportions of wasted, stunted and underweight children were 4.2, 16.7 and 9.7%, respectively. The proportion of children with z-scores between -2 and 2 were 91.2% for WLZ, 82.3% for LAZ and 88.4% for WAZ.

No determinants were found to be significantly associated with wasting when all infants (n=723) were included. In a sub-group analysis of infants under 6 months (n=412), pre-lacteal feeding was significantly associated with wasting (OR 4.63, 95% CI 1.11-19.23).

Including all infants (n=723) it was seen that stunting was associated with many factors. According to the conceptual hierarchical framework, age and gender were present in the regression model throughout the 4 stages: gender was found to be associated with stunting at stages 2 and 3, and age throughout the model. In the first stage, underlying factors were included; being in the least wealthy sub-counties was associated with stunting (OR 1.64, 95% CI 1.00-2.71). At stage 2, distal factors were added; the lowest household wealth was significantly associated with stunting and remained in the model at stages 3 and 4, with a 3-fold increase in odds ratio (OR at entry of model: 3.50, 95% CI 1.57-7.78). Having brothers and/or sisters was also a protective factor in the

adjusted model. 'CF/MF and/or RF' was the only proximate factor significantly associated with stunting in the adjusted analysis (OR 2.71, 95% CI 1.02-7.13).

### *Anthropometric indices*

The adjusted mean anthropometric indices were investigated with respect to pre-lacteal feeding, mode of feeding, and household wealth. Pre-lacteal feeding was inversely associated with WLZ and WAZ (regression-coefficient - 0.20,  $p=0.023$  and -0.22,  $p=0.012$ , respectively). Mixed feeding or replacement feeding was inversely associated with LAZ (regression-coefficient -0.32,  $p=0.03$ ). Household wealth was associated with LAZ and WAZ; after adjusting for all inherent, intermediate and proximate factors, the adjusted regression-coefficient between the top and bottom wealth categories was - 0.58,  $p < 0.001$  for LAZ, and -0.49,  $p < 0.001$  for WAZ. A figure with the crude relationship between WHZ, LAZ and WAZ is given in paper II, figure 3.

### Wealth and feeding perspectives

The focus group discussions (paper IV) gave other perspectives that indicated whether infant feeding practises could be related to wealth-related issues.

From one perspective, EBF was associated with a wealthier status; first, by giving supplements to breast milk, the women could earn money allowing them to leave their babies for some time. For those who held this view, practicing EBF was something you could do only if you could afford not to work. Second, women in the focus groups described themselves as *'too poor to practice EBF.'* The women explicitly linked their perceived low breast milk production to poor food intake, saying that *'because mothers feed poorly, they don't get enough milk'*. Poverty and hunger were major concerns: *'poverty makes me fail to buy food and so I don't eat a balanced diet which limits the milk for the baby.'* Men were partially held responsible for the scarcity of food and hence for the women's poor milk production: *'husbands do not provide enough; most times they only provide millet bread, so there is no milk in the breast.'* Third, sickness and poverty were also related to not practising EBF. Women could simply be too sick to sustain only breastfeeding; *'sickness like HIV/AIDS stops some mothers from breastfeeding exclusively.'*

From another perspective, giving supplements to breast milk was associated with wealth: first, availability of cow's milk could *per se* be a reason for introducing supplements. *'I have a cow'* was mentioned by a few men and women as a reason to give cow's milk. While women said they were too poor to practice EBF because it demanded good food, men tended to associate EBF

with poverty and lack of ability to buy complementary food: *'exclusive breastfeeding exists because of financial constraints – one's income may be too low to attain other foods.'*

Money was not solely associated with breastfeeding difficulties. Both men and women stressed that neglect, lack of food and care during the important period of breastfeeding could cause emotional problems that again negatively affected breastfeeding. *'Emotions cause less milk, especially if the husband is not looking after the mother well.'*



## **Discussion**

This thesis has covered infant feeding practices and growth in Mbale Municipality and Bongokho, Eastern Uganda. Related factors to growth and feeding patterns and methodological aspects were described. Parents' perceptions were also addressed. The presented papers have shown that breastfeeding was generally practiced. The survey of 727 mother-infant pairs showed that all but 1 had breastfed, and at the time of the survey, all except 9 were practicing it. At the same time, the quantitative and qualitative findings show that mixing breastfeeding with giving other foods was the most common infant feeding practice. According to the dietary recall since birth in the survey, 93% of the mothers had given feeds other than breast milk at 3 months. Items qualifying for PBF were introduced prior to items qualifying for CF/MF in the majority of cases. Insufficient supplementary feeding was observed in the second half of infancy, as well as increasing stunting rates. A difference in linear growth between boys and girls was also observed. Associations were seen between growth and 1) early infant feeding practices, non-recommended infant feeding practices being inversely related to growth patterns; and 2) wealth, the lower wealth category being related to a reduction in linear growth. Giving pre-lacteal feeds was widely accepted, and initiation of breastfeeding was delayed for a variety of reasons. Not practising breastfeeding was considered highly unacceptable according to the qualitative findings.

The assessment and themes emerging from the results, plus potential strengths and limitations, will be discussed below.

## **Quantitative assessments**

The major contribution of the quantitative methodological studies were, first, they explored Ugandan infant feeding practices, providing additional information to the DHS-data and other statistical reports, using the 24-hour recall assessment only while disregarding pre-lacteal feeding from the estimates [41, 99]. Excluding pre-lacteal feeding from the analysis of the 727 mother-infant pairs in the cross-sectional survey yielded the same results in the life-table analysis from day 30 onwards. Second, analysis from the cross-sectional survey assessed potential factors associated with the different feeding practices. Third, the methodological comparisons asked whether duration of respective feeding modes could be addressed in a cheaper, but nevertheless reliable, way. Fourth, the studies have been population-based. Fifth, infant

anthropometric status has been related to infant feeding patterns among other factors.

The quantitative methodology had certain limitations. In the quantitative studies, the answers given by the mothers could only be interpreted as 'self-reported,' e.g. when a mother reported that she was breastfeeding, no further check of lactation ability was done. The cross-sectional survey and the follow-up study will be discussed separately below.

### **Cross-sectional survey**

Bias in measurement was addressed by conducting reproducibility checks for each interviewing pair. Random auditing of the interviewing pairs and random double assessment of anthropometry were done on a daily basis. Nevertheless, reproducibility or validation estimates were not calculated. Bland and Altman [100] have discussed the value of reproducibility/repeatability calculations for continuous data. They stressed that *'agreement is not present or absent, but should be quantified.'* In particular, the anthropometry assessment would have benefitted from quantified repeatability and validation calculations.

Bias in reporting comprises different elements. The degree to which socially desirable answers were given was assessed by collecting daily field-worker reports and visiting the areas. This provided some areas of 'caution' such as questioning 'under-reporting of wealth,' 'creation of fake village boundaries,' 'convenience choices of walking directions,' and so on [101]. However, taking this into consideration, problems were not identified during auditing, and therefore interviews were not disregarded during data-cleaning. Social-desirability may be addressed more efficiently from an external point of view, and this was not done in our studies [102]. To what degree historical recall bias occurs is unknown, and is really based on the design of the study. Rothman [103] went further by calling it *'maternal recall bias'*, in particular for research trying to capture what has happened immediately after birth. Asking the 24-hour recall before the recall since birth, and asking for foods item-by-item, hopefully yielded more valid results than, for example, grouping or clustering food items according to convenience for analysis. Technical terms such as 'semi-solid' and 'legumes,' etc. were also avoided. The item-by-item technique has been well tested and documented in previous studies, and is reflected in the WHO recommendations [2, 104]. The problem with phrasing the questionnaires in this way was that it extended the item lists: e.g. 'diary product' was replaced with 'milk,' 'milk with water,' 'milk in tea,' and so on. As a result, questionnaire fatigue might have been induced. The item selection was based on qualitative formative research, as previously mentioned. In retrospect, it is difficult to know how well the instruments captured what they

intended to (supplementary or replacement foods). The question ‘*other*’ was not frequently ticked. Further studies in this area would need to reassess the food item lists due to the nutritional transition which is ongoing, especially in the urban areas [105].

The life-table method is most commonly used for prospective/longitudinal assessment, but it was used for retrospective information in the cross-sectional survey. It follows that interpretation should be done cautiously. The life-table and Kaplan-Meier methods of analysis address time-to-event data, and capture individuals up to the point where they no longer contribute to the outcome of interest, at which point they are censored, e.g. loss-to-follow up or death [106]. ‘Change in feeding modality’ has been the ‘event of interest’ addressed in this survey. The time-to-event is calculated using the age of the infant in months when the event occurred. Thus, if an infant participating in the survey was, for example, 5 months, but changed feeding mode at 3 months, the infant contributed with 3 months before the event actually happened. If there was no change in feeding mode at the time of assessment, the respective individual contributed with their respective age from birth to the assessment, but not to event. In other words, they were censored, indicating that the event did not happen until the time of measurement [106]. The same applied for the 24-hour recall, but their actual age contributed to ‘time-to-potential-event.’

Cohorts have longer mean time-to-event if the event has happened only among a small proportion of the survey participants and the follow-up rate is good. In this survey, ‘change in feeding modality’ occurred for a substantial number of the participants. Therefore censoring did not pull the mean duration-until-event away from zero. The origin for time-to-event was the date of birth. Birth here is meant to be a similar marker to an enrolment date due to symptoms in a prospective study. Following a cohort for a certain amount of time, with or without intervention, qualifies for prospective/longitudinal assessment. Retrospective assessment would address the problem of what a population had been doing prior to enrolment [102]. There are very few prospective studies which can or should have a *continuous* overview of all the study participants. For example, if children are recruited at birth for the purpose of time-to-event analysis of feeding modes, as in this paper (or for any other outcomes), it is most likely that children could only be seen at given intervals. This interval carries with it an element of ‘retrospectiveness.’ It is partly for this reason that the WHO guidelines on Infant and Child feeding in the context of HIV suggested weekly one-week recalls [2].

The advantage of life-table analysis in a prospective compared to a cross-sectional retrospective survey is that it overcomes the ‘inbuilt selection-bias of cross-sectional studies.’ This term refers to selection which follows cross-

sectional design. In the survey area, information about diseased or dead children was not provided, which would have been captured by a longitudinal study on the premises of the same randomisation process and recruitment at birth. Those who would have contributed over time, with or without the event, before being lost to follow-up in a prospective/longitudinal design, did not do so with this cross-sectional design. Thus the argument is that 'the inbuilt selection bias' is the strongest limitation for using life-table methods or Kaplan-Meier analysis for retrospective data analysis. The infant mortality rate (IMR) is around 80/1000 (male IMR 98/1000 and female IMF 74/1000) in Uganda [99]. From a pragmatic point of view, it is unlikely that a theoretical loss of < 8% of the infant population would violate the results yielded from the analysis about feeding to any degree, but it is likely that diseased or dead children could have contributed more to the wasting and stunting prevalences.

### **Twelve-week follow-up study**

The strengths of the comparison study were the following. First, the recall since birth was compared with prospective data and an 'inbuilt selection-bias of cross-sectional studies' was thereby addressed. Second, the recall since birth was compared with core elements from the comprehensive 'gold standard' of population based infant feeding recalls. A site-moderated copy of the WHO recommended weekly one-week recall was used [2]. A huge undertaking by Coovadia et al. [59] was published in 2007, in which they had used the 'gold standard' (weekly infant feeding assessment) in an HIV and infant feeding study. Bland and Altman [100] mention that, in comparative studies, the standard method sometimes called the 'gold standard' is not measured without error, and that the measurement used does not always reflect the full biological truth, but nevertheless represents the best available tool for measurements. It is therefore important to acknowledge that a certain measurement is 'good enough' for a certain 'purpose.' The weekly one-week recall has therefore been referred to as 'the gold standard' for the infant feeding field study in this thesis. Other techniques, which might serve as better 'gold standards' for the questionnaires, were not used. High tech validation tools, like blood tests, doubly labelled water, urine samples, detailed weighing after meals or video cameras were not feasible within the scope and resources of the study. One could argue that more creative tools - diaries, illustrations or drawing, in depth interviews or observations to get hold of more information regarding what happened between each visit - ought to have been used. The possibility that greater presence of the study team could have interfered with the naturally chosen infant feeding patterns among the mothers might also be considered. Third, reproducibility of our questionnaire instruments was also assessed. Variable results were seen for reproducibility of answers regarding early

breastfeeding practices, but the reproducibility of created variables on feeding modalities was satisfactory.

We found no significant difference in the estimated mean duration of EBF and PBF at 12 weeks and PBF alone at 6 weeks when the frequent short-time recalls with the recall since birth were compared. A significant difference in the time reported for duration of EBF at 6 weeks was seen. This could be interpreted in different ways: one would be that the weekly follow-up assessment (the 'gold standard') included 11 unnecessary visits evaluating it at 12 weeks. At 12 weeks there were no statistical difference between the 2 assessments. Another interpretation would be to disregard the results on the basis that the study was too underpowered to detect potential significant differences between the 2 approaches and can only be interpreted with caution, if at all. An argument against this latter stand-point would be that the differences in absolute terms were of little clinical significance. If increased sample size had made the results significant, the actual difference would not have become any more interesting. The observed difference between the frequent short-time recalls and the recall since birth was around 1 week (time-to-event for PBF was approximately 0.5 versus 1.5 weeks, respectively, and 5.2 versus 6.6 weeks for MF, respectively). Based on these findings, it would be tempting to say that PBF started and EBF ended within the first to second week after birth, and MF started after the first month from birth. The answers might not be precise, but sufficiently accurate for certain purposes, such as program evaluation of the duration of the feeding modalities.

The study repeated certain instruments a number of times. This might create a problem that can be referred to as the 'repetitive recall bias.' This problem is acknowledged when reproducibility of questions is assessed. A certain time-frame is needed to test 'answers to the questions' and not only 'repetition of previous answers.' It is questionable whether morning and afternoon assessments provided a sufficient time-frame to address repeatability. A problem of repetition also arises when a mother on weekly basis said that she was giving water, for example. It is likely that she would answer positively when asked in the recall since birth about water. But one could assume it is less likely that, at 12 weeks, she would remember whether she said yes to water at week 3, 4 or 5 for the first time. Therefore, it was assumed that the frequent short-time recalls did not substantially influence the time-until-event variables for the Kaplan-Meier-curves.

Another limiting factor of the comparison study was the observed fatigue among the participants, who found the questionnaires boring and repetitive. This could have negatively impacted the reporting. It is possible that they simply answered 'no' or 'yes' to all items in the food-lists to complete them as

quickly as possible. Alternative data capturing methods - diaries, role plays, qualitative interviews or open-ended questions - could have reduced this fatigue. Information on fatigue should be taken into account in future study design. I have found few studies reflecting the participants' point of view to the tools WHO released in 2001 [2]. The WHO tools from 2001 require an extremely advanced study infrastructure, high costs (including lots of transport and field-workers), and highly motivated participants. From a pragmatic and programmatic point of view, frequent short-time assessment may not be feasible. It needs to be emphasised that the tools were designed in the context of infant feeding and HIV. More recent documents have circled around national and regional feeding practices, but concentrate mostly on 'current' infant feeding practices for the respective age groups. The last WHO document on 'Definitions' used the 24-hour recall strategy to assess EBF prevalences [5]. Another recent WHO publication '*Infant and young child feeding – Model chapter for textbooks for medical students and allied health professionals*' also re-emphasized the 24-hour recall [107].

To conclude this discussion on the quantitative feeding method, the following assumptions were made in favour of retrospective recall: 1) introduction of feeds to the baby could be perceived as 'a milestone' event by mothers; and 2) if giving foods to a baby is done from an early age and is not perceived as a milestone, this would also be reflected in the reporting; 3) it is likely that a mother will remember if her child have received a particular food at a young age. One might ask whether the answers regarding older children are less valid than those given for younger ones. This question was not assessed in our analysis, but Bland et al. [61] found unsatisfactory recall when comparing 6 and 9 months recall to prospective data having in mind that the phrasing of the questions was different from the phrasing in paper III (as mentioned in the Introduction). That mothers could recall events around birth was also anticipated. This made it valid to incorporate pre-lacteal feeding habits, but, as already mentioned, this has been criticised on the basis of *maternal recall bias* [103]. The comparison study also showed some lack of consistency between answers from week 1 and 3 about colostrum and pre-lacteal feeding. The since-birth infant feeding recall has provided useful information in different studies [104, 108]. DHS and WHO have not yet suggested it as an alternative. The conclusion in this thesis is that retrospective recall could contribute additional information for assessing the duration of infant feeding modality in low-resource settings compared to a prospective design which is too costly for most study purposes.

## Qualitative assessment

Our findings from the qualitative studies were based on 8 focus groups, 4 among men and 4 among women. The moderators and recorders were of the same gender as the participants making the groups female and male entities. This could be a potential strength and have created openness in the groups. However, the issues raised by the participants might have been less provocative.

Limitations to the qualitative study were that, even when key interviews, observations and field-notes had been carried out, the data were not merged for analysis. This decision was partly based on the nature of the data from the different sources. The topics which emerged from pre-analysis did not overlap enough, e.g. very limited information was given from the KII about male involvement. To overcome barriers to merged analysis of qualitative methods, deeper analysis of the material should have been conducted in the field, which was not adequately done. Another reason was that the focus group carried with it important elements which we, as authors, thought could be better presented if not mixed with other data, particularly the men's perceptions.

Lastly, a major disadvantage for the qualitative studies and interpretation was that I (the main investigator) do not speak Lumasaaba. Therefore the fieldworkers probing, interpretation of answers, and translational skills were of central importance. English-speaking interviews and observations with interpreters were conducted by myself. I tried to participate in preparatory focus group discussions, but found myself interfering more than supporting the groups. I also found that translation to me disturbed the natural flow of the discussion. I therefore decided to give the field-workers the central role in conducting the focus group discussions, but lost some of the 'immediate touch' with what had happened in the groups. As a colleague and anthropologist (MT) said, 'English dilutes.' For the Bagishu people as information providers and for me as a Norwegian information receiver and interpreter, sharing English as our common second language might have 'diluted' some of the original content.

## Mixed methods assessment

Mixing of results was done at the stage of thesis writing. Results from the quantitative analysis were to a large extent overlapping with themes that emerged from the qualitative analysis. An effort was therefore made to present the parallel issues clearly by first giving the quantitative results before any 'filling in of the gaps' was done [75]. Teddlie and Tashakkori, in discussing

‘issues and controversies’ in their *Handbook of Mixed Methods* say that ‘mixing methods can answer research questions other methodologies cannot’, and provide ‘stronger interference’ and ‘greater diversity.’ From a research perspective it could be argued that this thesis highlights the theme ‘infant feeding in Eastern Uganda’ in a more diverse way, while combining quantitative and qualitative material.

Mixing of results might also be potentially confusing, which means that ‘greater diversity’ would be problematic. The question is whether mixing, as done here, is trustworthy. For example, the ‘initiation of breastfeeding’ information might have been a problematic issue, where the quantitative data supported fair uptake of breastfeeding within the first day, but the qualitative data were focusing on ‘reasons to delay’. Maybe the reader would prefer to know why and how it was ‘started’, ‘who influenced it’ and ‘how much and what had they heard from health institutions about initiation’, and so on, but these matters were not addressed. Another issue was the diverging views on wealth and feeding modalities. While the quantitative survey provided information about the association between wealth and growth, the qualitative study showed a more differentiated pattern, discussing wealth and feeding choices. The preference for mixed feeding in the qualitative results and quantitative description of when foods were introduced supplemented each other.

Convenience sampling was done after certain criteria for the focus group discussions, while a randomised procedure was utilised for the cross-sectional survey. In other words, we did not obtain in-depth qualitative information from a representative sub-group of the quantitative sample. Looking at the background characteristics from the quantitative studies, a reasonable overlap was seen in baseline characteristics with the participants in the FGDs. Furthermore, the qualitative information first and foremost claims to be credible for the population it presents, not for the survey population. Mixing results from the participants in the same catchment area might therefore be justifiable. It also adds transferability (qual) or external validity (quan) that some of the findings from this thesis are supported in other studies from Uganda [109, 110].

In the method section, a quan/qual matrix and a figure illustrating methods used at which time and in which sequence for this thesis were presented. In retrospect, it is evident that quantitative and qualitative information supported each other, especially at the design phase. Knowledge of the quantitative material could have influenced the selection of topics for the qualitative analysis. Inference has been ongoing at different stages, but evidently most occurred during design and analysis. The inference has been on different



levels, supporting mostly the multi-strand model [71]. Mixing results for this thesis was based on in-depth knowledge of all 4 papers. One could argue that mixing should have been done more systematically from the design and analysis phase, which could also have benefitted the papers. Mixing was also done based on thematic overlapping of the material being analysed. One could argue that this reduced quality of mixing since not all themes studied and presented were overlapping. Mixing was done post hoc and not based on initial plan of analysis, as was the quantitative and qualitative analysis separately. If mixing of methods had been better planned from the start, improved development of tools might have been achieved; e.g. colostrum handling, male involvement, and reactions to non-breastfeeding could have been assessed from both quantitative and qualitative perspectives. Furthermore, in-depth research of initial feeding practices could have been conducted.

It is difficult to evaluate whether the quan or qual component should be written with capital letters, i.e. been given bigger emphasis [68]. From the outline of the papers, the quantitative component was definitely the largest, and took the most time and effort to conduct. On the other hand, the quantitative component is not necessarily more important. The quantitative papers providing infant modality curves did not explain why mixed feeding at the household level was chosen so often, which the qualitative assessment attempted to investigate.

## Anthropometric assessment

A few issues should be raised regarding anthropometric methodology and performance. Salter spring scales were used to measure weight because they are light to carry, easy to pack and robust, do not need batteries, and a flat surface for making measurements was not a requirement.



Picture 3 and 4: Fieldwork: weighing of baby using a Salter scale; and carrying a scale and length board over the bridge

The data collectors were instructed on double-checking that ‘only the baby was weighed.’ Satisfactory procedures were observed while auditing. There were some difficulties using the scales with pre-term and very small babies, in case they might fall out or be hurt. Some mothers were also hesitant to undress the infants. These barriers were to a large extent overcome by explaining the situation. For length measurement, we used solid wood boards from local carpenters with fixed measurement tapes on both sides of the board. The boards were heavy to carry, which resulted in some complaints from the fieldworkers, but they were very stable and robust. They might have been less accurate than metal industry produced infantometers, but that would have been even heavier to carry. Soft length meters were disregarded as an option because flat floors were not always easy to find. In Zambia during the PROMISE EBF study, the infantometers were often associated with coffins, but this was not the case in the study settings in Mbale district.

Oedema was not satisfactorily assessed. The information was therefore disregarded when calculating the z-scores. Only a few cases were questioned about oedema, so it could not have biased the calculations of WLZ and WAZ to extent or led to misclassification of wasting and underweight [102].

The anthropometric assessment found stunting rates of 17% among 723 infants in the cross-sectional survey, which is in line with other anthropometric studies where higher proportions of stunting occurred within the older age groups. Two studies from Western Uganda reported stunting rates of 25% in children below 2 years of age [95, 111]. Other reports have described stunting rates of 50% of children up to 5 years [99, 112]. The Lancet’s Series on *Maternal and Child Undernutrition* provided detailed appendices and statistics about stunting trends at country, continent and global levels [41]. According to those reports, Uganda had an under-5 year stunting prevalence of 44.8%, which reflects a total of 2.68 million stunted children in Uganda out of 178 million stunted children globally. Even if a validation and reproducibility exercise was not calculated, as mentioned earlier [100], the results seem plausible in this setting relative to parallel studies.

Stunting is a global public health problem. The WHO team working on the Child Growth Standards described faltering global stunting prevalences, but unfortunately there are increasing trends in some areas, including Sub-Saharan Africa [113]. They also presented a classic picture of when growth faltering is most prominent. From birth to the age of 2, children rapidly decline in length/height-for-age z-scores. This trend was also observed among the infants in our cross-sectional survey (paper II, figure 2).

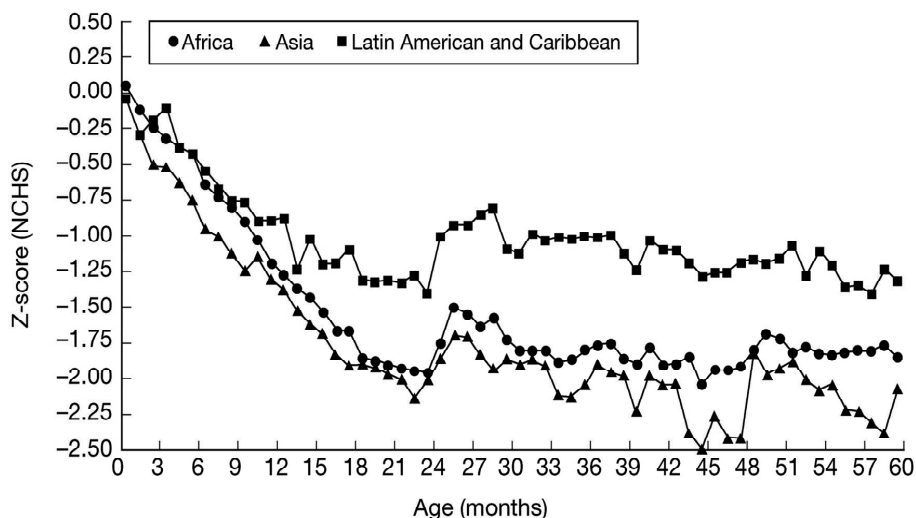


Figure 5: Time of growth faltering in length-for-age in preschool children by geographical region copied from de Onis and Blossner, *Int J Epidemiol* 2003, 32(4):518-526.

There were poorer growth outcomes among boys than girls. Stunting was more prevalent among boys than girls (58.7 versus 41.3%), and boys also had more rapid growth faltering. It is difficult to explain what caused this. The finding has been discussed in a meta-analysis of DHS data from Sub-Saharan Africa [114]. The authors suggested that ‘boys are more vulnerable to health inequalities than their female counterparts in the same age groups’ especially in lower socio-economic strata. As already reported, differences in infant mortality was also observed in the Ugandan DHS report from 2006. This aspect merits further assessment in future research.

There is evidence that environmental factors contribute on a large scale to stunting [115, 116]. The 2 most important factors relate to feeding and infections. Mata et al. [117] described the close relationship between growth and infection in the 1970s and published an illustrative curve from one child with recurrent infections up to the age of 3 years. Through comprehensive research, it was later accepted that breastfeeding, and most of all EBF, is the single safest feeding alternative for young infants and is important in avoiding recurrent infections, both respiratory and gastro-intestinal [49, 118].

Why is stunting such a large problem? Stunting is associated with long term disadvantages of educational, cognitive, economic and physical abilities later in life. It also carries a risk for pregnancies, births and offspring in the next

generation. Additionally, rapid weight gain and chronic diseases have been associated with stunting and nutritional depletion early in life [119, 120]. Recently, a Malawian study demonstrated a positive effect on stunting of ‘micronutrient-fortified lipid-based nutrient supplements (LNSs)’ given from 6 months [121]. More studies are needed before new effective stunting prevention strategies can be scaled-up, but promotion of EBF for 6 months, together with improved complementary feeding, vaccination and micro-nutrient supplementation, are already elements of the strategies [9].

Situations where stunting and obesity co-exist both at the community and individual level are becoming more frequently described [113]. The latter is sometimes referred to as ‘stunted obesity’ (personal attendance at the Wageningen Nutritional Sciences Forum 2009: ‘*Too much, too little*’ <http://www.humannutrition40.nl/conference.htm>). While undernutrition resulting in wasting and stunting is one component of the most severe public health problems worldwide, obesity is becoming a close competitor [122]. Where stunting and obesity co-exist, the individuals are most likely to have experienced both macro- and micro-nutrient deficiencies [123]. The so-called ‘Barker hypothesis’ of 1997 has now been established, suggesting altered genetic programming of foetuses that are susceptible to maternal malnutrition *in utero* [124]. It has been emphasized that stunting starts *in utero* and can be detected in infancy [125]. Genetic changes which can cause long term negative health effects are also associated with undernutrition during fetal and infant life [126]. The Dutch famine studies provide empiric evidence for genetic altering and metabolic disorders later in life [119]. Observational studies have found EBF protective against obesity in later life. Recent reviews discuss possible mechanisms, finding self-regulation of food-intake central among other factors [127]. It was also discussed in the 1990s whether EBF was associated with decreased linear growth [49, 128]. This discussion faded away because of the sound arguments for the protective effect of EBF on linear growth [47-49, 129]. Co-existence of stunting and obesity presents another argument for measuring both weight and length during the follow-up of children in settings where this is not yet implemented. Long-term effects of infant feeding was outside the scope of this thesis, but there is an increased demand for cohort-establishment with participants with known maternal, birth and feeding information from early childhood [130]. Infant feeding improvements early in life is more effective than improvements made at later stages with regard to the long-term benefits to the individual [9], but more information is needed for the generations to come.

In the survey, an inverse association between pre-lacteal feeding and weight-for-length among infants under 6 months was observed. Furthermore, an

inverse association was seen between non-exclusive breastfeeding and length-for-age among all infants of <12 months. The estimates were adjusted for a set of variables including age. It was noted in paper II that the EBF and linear growth association observed was a weak assessment because age-specific preferred feeding groups were not used [115]. Nevertheless, it is plausible that non-recommended feeding practices such as pre-lacteal feeding and non-EBF are involved in the inverse relation with WLZ and LAZ. The 24-h infant feeding recall is an example of a data collection technique which might erroneously give the impression of 'good habits.' According to the 24-hour recall a substantial number of infants were EBF under the age of 6 months. However, assessing complementary feeding practices in the second half of infancy gave the impression that a large number of infants were on marginal diets. The study leaves open the question of whether the 'good' EBF rates were due to 'under-reporting' of complementary feeds. The positive relation between EBF and linear growth is a counter argument. Better quality assessment would be needed in order to say more about quantity and quality of foods. Comprehensive studies on early feeding practices and neo-natal mortality in Ghana, where later initiation of breastfeeding was found associated with increased mortality, led to discussions of the potential mechanisms [52]. They discussed reduced establishment of successful lactation. This was also described in a Ugandan lactation clinic in the 1990s [20]. The study from Ghana did not find reduced lactation establishment as the probable primary cause of increased neo-natal mortality based on their adjusted analysis. But, factors like the limited supply of important breast milk properties, reduced protection of the gut, reduced immunisation, and reduced body warmth from the mother were held as potential risk factors which could partly explain the increased neo-natal deaths.

Knowing that undernutrition is linked to detrimental health outcomes, and that it starts with reduced growth [131], it is tempting to explain reduced growth observed in this survey with non-recommended feeding patterns. The finding that non-recommended early infant feeding practices were related to poorer anthropometric outcomes could be interpreted as the supplements being given were of poor quality and possibly caused disease. Research questions regarding reverse causality were addressed in Senegalese studies from the mid 1990s. The dilemma was if prolonged breastfeeding caused reduced growth, because that relationship was seen in cross-sectional surveys. In a prospective design they found that mothers breastfed longer when their children had lower LAZ and WAZ, in other words: prolonged breastfeeding did not cause stunted or wasted children [129]. Being a cross-sectional survey, causal patterns cannot be assessed; reverse causality is always an option. Maybe the smallest children were receiving supplements early in life in order to boost their size?

Answering these questions requires further studies. The literature, however, supports an increased risk of adverse health outcomes among non-optimally fed infants, in this case lack of EBF during the first 6 months and sub-optimal early infant feeding practices. The traditional explanation was an introduction to the ‘vicious circle’ of undernutrition and frequent infection which follows from unsafe water and foods for the children. This ‘vicious circle’ has been frequently referred to, and was published in a WHO document in 1968 [132]. More complex models including society, local environment and child related factors have been used more recently. The illustration below is taken from the Maternal and Child Undernutrition series [131].

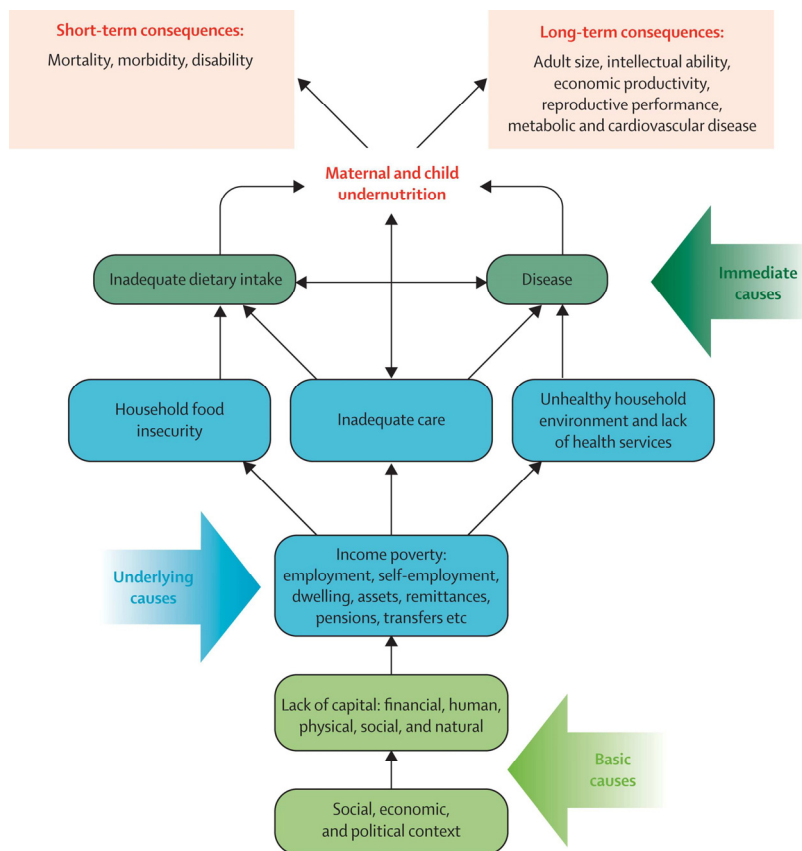


Figure 6: Conceptual framework of the causes of maternal and child undernutrition. Copied from: Black RE, Allen LH, Bhutta ZA, Caulfield LE, de Onis M, Ezzati M, Mathers C, Rivera J: Maternal and child undernutrition: global and regional exposures and health consequences. Lancet 2008, 371(9608):243-260.

## Poverty related issues

The qualitative findings reflected that poverty was highly associated with the infant feeding practices. Mothers described EBF as costly as it required precious working time, good nutrition of the mother herself, and a healthy maternal status. Many mothers said they could not afford to eat well enough to practice EBF. The view that poverty could also lead to EBF because the household could not get access to supplements to breastfeeding was also expressed, mostly by the male groups. It is likely that this also referred to sub-optimal complementary feeding in the second half of infancy.

Not having enough milk to practice EBF has been addressed. First, one could ask whether exclusive breastfeeding is not sufficient for the baby. Stina Almroth assessed the infants' needs during hot and humid and hot and arid conditions in Jamaica and India, respectively [133, 134]. These studies did not support the need for extra water or feeds under normal conditions until the age of 4-6 months. Second, one could also ask whether the mother needs extra feeds during lactation, or whether indeed a mother who is moderately nutritionally depleted can manage to practice EBF satisfactorily. Ruth and Robert Lawrence did not reach any conclusion on this theme [12]. Gambian studies gave divergent results. Heavy work load and low fat stores affected lactation negatively in one study [135]. Dietary supplements failed to enhance lactation abilities up to 3 months in another study [136]. The Lawrences stressed the psychological effects of hunger on breastfeeding. Fear of not getting enough food and not having enough milk could also have negative effects on breastfeeding. The mother's anthropometric status has also been addressed with regard to a positive HIV-status [137]. No anthropometric changes of clinical significance were observed among women in a South African study, but their BMIs were substantially higher than that expected in this Ugandan setting (unpublished data).

In the quantitative infant anthropometry survey, a relationship between wealth and growth was seen. This relationship might indicate that the chosen wealth assessment tool reflects actual wealth at the household level. The observed relationship between decreased wealth and growth faltering also re-emphasises the need to address specifically children of the poorest households who are most vulnerable to undernutrition. Efforts could also embrace nutrition during last trimester to 'at-risk' mothers, thereby preventing intrauterine growth retardation [138]. Efficient large-scale systems addressing these issues are scarce. Maternal body composition might in itself be one of the risk factors for low-birth-weight infants (<2500 grams) [139].

Relatively low mean education was seen in both the survey and the follow-up study. The mean length of education was 6-7 years, and a substantial proportion of participants had not attended school or done so for only a few years. No relation with maternal education and child growth were seen; but this was found in other Ugandan studies, and maternal education is known to be an important factor in child health [82].

A conceptual hierarchical model was used when assessing factors associated with anthropometric status. Similar models have been used before, first by UNICEF for monitoring and evaluation purposes [96]. Work by Mosley and Chen and Victora et al.[93, 94] and others have argued for the use of these causal models in statistical regression analysis. From a strict statistical point of view, one could argue that there are techniques, e.g. stepwise backward/forward analysis, where factor sorting is merely based on statistical values. Interfering with this process might introduce error. On the other hand there is no presented output without interpretation, or models without factor selection. Therefore, the benefit of the conceptual frameworks is that they force the analyst to be more critical about what is put in the respective models. The hierarchical conceptualisation also challenges the researcher to define ‘the most distal factors’ or ‘deeper factors’ [92]. ‘Neighbourhood’ is an example of a factor being increasingly taken into consideration [140].

Analysis of determinants for outcomes like feeding modes, anthropometric status or morbidity has traditionally been done for socio-demographic characteristics. Issues such as wealth, education, sanitation, parity, etc., have been described. It is questionable whether the traditional approach leaves out more important factors related to the outcomes. Such measures could include lack of health insurance or security, domestic violence, discrimination and stigmatisation, fear, fraud, decision power and self-esteem [141]. Including such factors might broaden the picture of the environments in which choices are made. Mixing of qualitative and quantitative assessments is part of the attempt to differentiate the picture.

## Programme and research implications

The target year for the MDGs has not yet been reached, and the debate and assessment of global performance in relation to the MDGs are ongoing [10]. Looking at MDG 4: reducing child mortality, much has been achieved, but it is obvious that huge tasks remain [10]. Comprehensive research [9] estimates that the promotion of EBF could save 8% of children’s lives annually if implemented worldwide. It is also urgent for child survival to target the



youngest children (<2 years). EBF enhances breast health, pregnancy spacing, reduces acquisition of HIV-1 among infants of HIV-positive women compared to MF, reduces the prevalence of infectious diseases in infancy, and provides long-term health benefits [131, 142]. It is key to identifying efficient sustainable strategies for scaling up EBF promotion. Promoting EBF and safer complementary feeding are just 2 of many tasks, but nevertheless important for improved child health and growth. Even though much is done from a scientific and organisational point of view regarding infant feeding recommendations, increased commitment at national and community level is needed to ensure sustainable programmes with efficient support for women and their children. A brief discussion of possible programme and research implications from this thesis follows.

## **Programme implications**

Do the findings of this thesis have any programme implications? Even with existing weaknesses that have been discussed, the thesis re-emphasizes the need for improved infant feeding practices, increased male involvement in child rearing, increased culture-sensitivity in infant feeding programmes, and improved child anthropometric status. The following issues were identified as important from a programmatic point of view:

Our studies demonstrate a need for improved quantity and quality of infant feeding promotion and support in Eastern Uganda. The mothers were well informed about relevant breastfeeding and infant feeding recommendations, from UNICEF/WHO through the BFHI and IMCI initiatives and separate PMTCT programmes in collaboration between UNICEF and Ministry of health-Uganda [143]. However, uncertainty and experience about the recommendations as being uncustomary was observed. Health workers have had a central role in acquiring existing knowledge. Their knowledge is imperative when meeting pregnant women [144]. One could ask if some of the uncertainty observed among the mothers is related to limited knowledge, communication skills and/or capacity among the health workers. This may have contributed to sub-optimal infant feeding practices in the studied communities.

In order to identify the most useful strategies to bridge the gap between recommended infant feeding practices and what is practiced on the ground formative research is needed. Bhandari mentions formative research as key to EBF enhancement, especially in PMTCT settings [145]. A study with peer education at woman-to-woman level has recently been conducted in 4 African countries and included Mbale, Eastern Uganda (PROMISE EBF) [97]. From

the preliminary analysis, peer-counselling in Mbale might be an effective strategy. Formative studies have also been done in the neighbouring districts Iganga, with promising results from peer-counselling [146]. Peer support is not necessarily the best or only strategy to improve EBF prevalence. Group counselling have also been discussed as promising [9, 145]. Experiences from lactating women and their spouses need to be heard in a non-judgemental forum in order to find the best strategies for EBF promotion in their settings. This thesis emphasised other factors as key - community involvement and improved feasibility of EBF, male participation, and strengthened rights for women.

A) Broader community involvement and increased feasibility: Mothers were often convinced to give, e.g., pre-lacteal feeds and practice MF based on experience and knowledge from older female relatives. They were often not given sufficient practical support for the first few months to maintain EBF.

B) Male participation: The men felt left out from health education and did not have sufficient knowledge to support their women practicing EBF. In some cases EBF was even perceived by a father as a threat to the health of his child, and a practice that left him stranded as a 'provider'. Strategies to improve male knowledge and support for his lactating partner are urgently needed. Formative research is needed in order to assess how this can be done in a wise and balanced way.

C) Strengthened rights for women: Unexpected infant feeding practices, like NBF/RF, were severely sanctioned in the society, and could even result in violence and divorce. In this setting, the choice women have regarding infant feeding, particularly with regard to PMTCT, is unrealistic since one of the options (RF) could have dramatic and unwanted consequences. There are issues still to be addressed for the improvement of conditions where the mother is expected to make her choice.

Length/height measurement: This is needed in addition to weight measurements in order to make the stunting problem apparent. This is particularly important in societies undergoing rapid food-transition [105, 147] and where undernutrition is prevalent in order to improve anthropometric assessment at individual and population levels [148, 149]. A stunting prevalence as high as 17% was observed among infants alone in the survey, and that is in itself alarming.

## Research implications

Bhandari et al [145] mentioned the following community factors as key for scaling-up of EBF promotion: ‘1) *evidence-based policy and science-driven technical guidelines*; and 2) *implementation strategy and plan for achieving high exclusive breastfeeding rates in all strata of society, on a sustainable basis*.’ Even with a strong consensus on the technical guidelines on infant feeding, there remains a need for research monitoring and evaluating programs and practices. For example, a reduction in median duration of EBF was observed in the DHS-data in Uganda (3.7 months in the 2000-2001 report to 3.1 months in the 2006 report) [99, 150]. The question is whether this is due to actual changes in feeding practices or to questionnaire and assessment changes in the DHS methodologies. Methodological assessment regarding infant feeding research therefore needs further consideration. Some methodological challenges with regard to infant feeding assessment were explored in this thesis. The findings have the following research implications:

A) Dietary recall since birth is an alternative strategy to monitoring the duration of feeding modes at survey level. Information provided by recall since birth would yield more comprehensive information than current status information alone. Another advantage is that the additional cost would be small. Alternative strategies for better feeding study assessment have been suggested and tested by Moursi et al. [115]. Age-dependent indices would probably be important tools in assessing complementary feeding practices in future.

B) Participant-friendly evaluation tools are needed. In the 12 week follow-up study with weekly infant feeding assessment, there was registered dissatisfaction among the participants. User-friendliness of the questionnaire instruments needs to be taken into account in order to achieve good and regular monitoring of interventions or programs.

C) Observed differences in stunting rates between genders should be assessed further. Differences in anthropometric status have been reported elsewhere [114, 151], but few explanations are given.

## **Conclusion**

This study assessed methodological challenges, associated factors and parents' perceptions of infant feeding and growth in Eastern Uganda. The study contributed with increased understanding for actual infant feeding practices and the environment in which infant feeding decisions were made. It further described the nutritional status of infants in this study area, and found infant stunting prevalence unacceptably high (17%). In this East African setting that was exposed to breastfeeding promotion and PMTCT programmes the majority of mothers did not feed their infants according to the recommendation. High levels of pre-lacteal feeding, delayed initiation of breastfeeding and non-exclusive breastfeeding for the first 6 months were the common feeding patterns along with sub-optimal complementary feeding in the second half of infancy. The mothers expressed uncertainty about the recommendations and the fathers expressed a feeling of being excluded from matters regarding child feeding. Most importantly, the mothers felt that neither of the recommended feeding options was feasible for them and that poverty related issues explained this difficulty. The parents' perspectives need consideration as well as the children's need for safe feeding in order to make progress regarding safer infant feeding.

## References

1. **Indicators for assessing breast-feeding practices.** Geneva: World Health Organization; 1991.
2. WHO: *Breastfeeding and replacement feeding practices in the context of mother-to-child transmission of HIV. An assessment tool for research.* WHO/RHR/01.12, WHO/CAH/01.21. Geneva, Switzerland: World Health Organization, Department of Reproductive Health and Research (RHR), Department of Child and Adolescent Health and Development (CAH); 2001.
3. WHO: **International Code of Marketing of Breast-milk Substitutes.** 1981.
4. **HIV and Infant Feeding Guidelines for decision makers.** WHO, UNICEF, UNAIDS, UNFPA; 2003.
5. **Indicators for assessing infant and young child feeding practices Part 1 Definitions.** World Health Organization; 2008.
6. Mei Z, Grummer-Strawn LM: **Standard deviation of anthropometric Z-scores as a data quality assessment tool using the 2006 WHO growth standards: a cross country analysis.** *Bull World Health Organ* 2007, **85**(6):441-448.
7. Onyango AW, de Onis M, Caroli M, Shah U, Sguassero Y, Redondo N, Carroli B: **Field-testing the WHO child growth standards in four countries.** *J Nutr* 2007, **137**(1):149-152.
8. **The State of Food Insecurity in the World 2008.** Food and Agriculture Organization of the United Nations; 2008.
9. Bhutta ZA, Ahmed T, Black RE, Cousens S, Dewey K, Giugliani E, Haider BA, Kirkwood B, Morris SS, Sachdev HP *et al*: **What works? Interventions for maternal and child undernutrition and survival.** *Lancet* 2008, **371**(9610):417-440.
10. **Millenium development goals**  
[<http://www.un.org/millenniumgoals/childhealth.shtml>]
11. Williams CD, Oxon BM, Lond H: **Kwashiorkor.** *The Lancet (reprinted in: Bull World Health Organ 2003, 81 (12))* 1935, **Nov. 16**:1151-1152.
12. Lawrence R, Lawrence R: *Breastfeeding A guide for the medical profession.* 5th edition. St. Louis, Missouri: Mosby; 1999.
13. Black RE, Morris SS, Bryce J: **Where and why are 10 million children dying every year?** *Lancet* 2003, **361**(9376):2226-2234.
14. Lawrence RA: **Standing on the shoulders of giants.** *Breastfeed Med* 2008, **3**(2):101-102.
15. Greiner T, Latham MC: **The influence of infant food advertising on infant feeding practices in St. Vincent.** *Int J Health Serv* 1982, **12**(1):53-75.
16. Cook R: **The General Nutritional Problems of Africa.** *African Affairs* 1966, **65**(261):329-340.
17. Steady FC: **Infant Feeding in Developing Countries: Combating the Multinationals Imperative.** *J Trop Pediatr* 1981, **27**:215-220.
18. Muller M: **The baby killer.** London: War on Want; 1974.
19. Helsing E: **Feeding practices in Europe: beliefs and motivations and possibilities for change.** *J Trop Pediatr* 1984, **30**(5):244-252.

20. Mukasa GK: **A 12-month lactation clinic experience in Uganda.** *J Trop Pediatr* 1992, **38**(2):78-82.
21. **The international Code of Marketing of Breast-Milk Substitutes: frequently asked questions. Updated version 2008.** WHO; 2008.
22. **Acceptable medical reasons for use of breast-milk substitutes.** Geneva: WHO UNICEF; 2009.
23. Barrington-Ward S: **The progress of Nations.** UNICEF; 1997:18.
24. Waterston T, Tumwine J: **Monitoring the marketing of infant formula feeds.** *BMJ* 2003, **326**(7381):113-114.
25. Ebrahim GJ: **Malnutrition and the child survival revolution.** *J Trop Pediatr* 1998, **44**(3):126-127.
26. Lindstrand A, Bergström S, Rosling H, Rubenson B, Stenson B, Tylleskar T: *Global health: an introductory textbook.* Studentlitteratur; 2006.
27. Schuftan C: **The Child Survival Revolution: a critique.** *Fam Pract* 1990, **7**(4):329-332.
28. **The Baby-Friendly Hospital Initiative**  
[<http://www.unicef.org/programme/breastfeeding/baby.htm>]
29. Cunningham AS, Jelliffe DB, Jelliffe EF: **Breast-feeding and health in the 1980s: a global epidemiologic review.** *J Pediatr* 1991, **118**(5):659-666.
30. **Nutrition: The progress of nations. Baby-friendly hospitals reach 3000.**  
[<http://www.unicef.org/pon95/nutr0012.html>]
31. **Multi-Country Evaluation: Integrated management of childhood illness**  
[<http://www.who.int/imci-mce/Sites/uganda.htm>]
32. Pariyo GW, Gouws E, Bryce J, Burnham G: **Improving facility-based care for sick children in Uganda: training is not enough.** *Health Policy Plan* 2005, **20** Suppl 1:i58-i68.
33. Coutsooudis A: **Breastfeeding and the HIV positive mother: the debate continues.** *Early Hum Dev* 2005, **81**(1):87-93.
34. Coutsooudis A, Goga AE, Rollins N, Coovadia HM: **Free formula milk for infants of HIV-infected women: blessing or curse?** *Health Policy Plan* 2002, **17**(2):154-160.
35. Leroy V, Newell ML, Dabis F, Peckham C, Van de Perre P, Bulterys M, Kind C, Simonds RJ, Wiktor S, Msellati P: **International multicentre pooled analysis of late postnatal mother-to-child transmission of HIV-1 infection. Ghent International Working Group on Mother-to-Child Transmission of HIV.** *Lancet* 1998, **352**(9128):597-600.
36. **UNAIDS: The first 10 years.** UNAIDS; 2008.
37. Karamagi CA, Tumwine JK, Tylleskar T, Heggenhougen K: **Antenatal HIV testing in rural eastern Uganda in 2003: incomplete rollout of the prevention of mother-to-child transmission of HIV programme?** *BMC Int Health Hum Rights* 2006, **6**:6.
38. **Discussion paper prepared for HIV and Infant feeding technical consultation 25-27 October 2006: Home-modified animal milk for replacement feeding: Is it feasible and safe?** Geneva: WHO; 2006.
39. Fadnes LT, Engebretsen IM, Wamani H, Wangisi J, Tumwine JK, Tylleskar T: **Need to optimise infant feeding counselling: A cross-sectional survey among HIV-positive mothers in Eastern Uganda.** *BMC Pediatr* 2009, **9**(1):2.

40. WHO: **WHO HIV and Infant Feeding Technical Consultation Held on behalf of the Inter-agency Task Team (IATT) on Prevention of HIV Infections in Pregnant Women, Mothers and their Infants.** Geneva; 2006.
41. **Nutrition: Building a Healthy Foundation for the Future** [Web table 6 at: [http://www.globalnutritionseries.org/web\\_appendices](http://www.globalnutritionseries.org/web_appendices)]
42. **Reducing Child Mortality** [<http://www.gapminder.org/videos/gapcasts/gapcast-11-reducing-child-mortality/>]
43. Barnes GR, Lethin AN, Jackson ED: **Management of breastfeeding.** *JAMA* 1953, **151**(192).
44. Van Esterik P: **Contemporary Trends in Infant Feeding Research.** *Annual Review of Anthropology* 2002, **31**:257-278.
45. Kramer MS, Kakuma R: **Optimal duration of exclusive breastfeeding.** *Cochrane Database Syst Rev* 2002(1):CD003517.
46. Kramer MS, Chalmers B, Hodnett ED, Sevkovskaya Z, Dzikovich I, Shapiro S, Collet JP, Vanilovich I, Mezen I, Ducruet T *et al*: **Promotion of Breastfeeding Intervention Trial (PROBIT): a randomized trial in the Republic of Belarus.** *JAMA* 2001, **285**(4):413-420.
47. Kramer MS, Kakuma R: **The Optimal Duration of Exclusive Breastfeeding: a systematic review.** Geneva: WHO; 2002.
48. Simondon KB, Costes R, Delaunay V, Diallo A, Simondon F: **Children's height, health and appetite influence mothers' weaning decisions in rural Senegal.** *Int J Epidemiol* 2001, **30**(3):476-481.
49. Bhandari N, Bahl R, Mazumdar S, Martinez J, Black RE, Bhan MK: **Effect of community-based promotion of exclusive breastfeeding on diarrhoeal illness and growth: a cluster randomised controlled trial.** *Lancet* 2003, **361**(9367):1418-1423.
50. Arifeen S, Black RE, Antelman G, Baqui A, Caulfield L, Becker S: **Exclusive breastfeeding reduces acute respiratory infection and diarrhea deaths among infants in Dhaka slums.** *Pediatrics* 2001, **108**(4):E67.
51. **Effect of breastfeeding on infant and child mortality due to infectious diseases in less developed countries: a pooled analysis.** WHO Collaborative Study Team on the Role of Breastfeeding on the Prevention of Infant Mortality. *Lancet* 2000, **355**(9202):451-455.
52. Edmond KM, Zandoh C, Quigley MA, Amenga-Etego S, Owusu-Agyei S, Kirkwood BR: **Delayed breastfeeding initiation increases risk of neonatal mortality.** *Pediatrics* 2006, **117**(3):e380-386.
53. Bahl R, Frost C, Kirkwood BR, Edmond K, Martinez J, Bhandari N, Arthur P: **Infant feeding patterns and risks of death and hospitalization in the first half of infancy: multicentre cohort study.** *Bull World Health Organ* 2005, **83**(6):418-426.
54. Van de Perre P, Simonon A, Msellati P, Hitimana DG, Vaira D, Bazubagira A, Van Goethem C, Stevens AM, Karita E, Sondag-Thull D *et al*: **Postnatal transmission of human immunodeficiency virus type 1 from mother to infant. A prospective cohort study in Kigali, Rwanda.** *N Engl J Med* 1991, **325**(9):593-598.
55. De Cock KM, Fowler MG, Mercier E, de Vincenzi I, Saba J, Hoff E, Alnwick DJ, Rogers M, Shaffer N: **Prevention of mother-to-child HIV transmission**

- in resource-poor countries: translating research into policy and practice.** *JAMA* 2000, **283**(9):1175-1182.
56. Coutsooudis A, Pillay K, Kuhn L, Spooner E, Tsai WY, Coovadia HM: **Method of feeding and transmission of HIV-1 from mothers to children by 15 months of age: prospective cohort study from Durban, South Africa.** *AIDS* 2001, **15**(3):379-387.
57. Coutsooudis A, Pillay K, Spooner E, Kuhn L, Coovadia HM: **Influence of infant-feeding patterns on early mother-to-child transmission of HIV-1 in Durban, South Africa: a prospective cohort study. South African Vitamin A Study Group.** *Lancet* 1999, **354**(9177):471-476.
58. Iliff PJ, Piwoz EG, Tavengwa NV, Zunguza CD, Marinda ET, Nathoo KJ, Moulton LH, Ward BJ, Humphrey JH: **Early exclusive breastfeeding reduces the risk of postnatal HIV-1 transmission and increases HIV-free survival.** *AIDS* 2005, **19**(7):699-708.
59. Coovadia HM, Rollins NC, Bland RM, Little K, Coutsooudis A, Bennish ML, Newell ML: **Mother-to-child transmission of HIV-1 infection during exclusive breastfeeding in the first 6 months of life: an intervention cohort study.** *Lancet* 2007, **369**(9567):1107-1116.
60. **WHO expert consultation on new and emerging evidence on the use of antiretroviral drugs for the prevention of mother-to-child transmission of HIV, Geneva, 17-19 November 2008**  
[<http://www.who.int/hiv/mtct/meetings/arv4pmtct/en/index.html>]
61. Bland RM, Rollins NC, Solarsh G, Van den Broeck J, Coovadia HM: **Maternal recall of exclusive breast feeding duration.** *Arch Dis Child* 2003, **88**(9):778-783.
62. Coovadia HM, Coutsooudis A: **HIV, infant feeding, and survival: old wine in new bottles, but brimming with promise.** *AIDS* 2007, **21**(14):1837-1840.
63. Kagaayi J, Gray RH, Brahmbhatt H, Kigozi G, Nalugoda F, Wabwire-Mangen F, Serwadda D, Sewankambo N, Ddungu V, Ssebagala D *et al*: **Survival of infants born to HIV-positive mothers, by feeding modality, in Rakai, Uganda.** *PLoS ONE* 2008, **3**(12):e3877.
64. Doherty T, Chopra M, Nkonki L, Jackson D, Greiner T: **Effect of the HIV epidemic on infant feeding in South Africa: "When they see me coming with the tins they laugh at me".** *Bull World Health Organ* 2006, **84**(2):90-96.
65. de Paoli MM, Mkwanzazi NB, Richter LM, Rollins N: **Early cessation of breastfeeding to prevent postnatal transmission of HIV: a recommendation in need of guidance.** *Acta Paediatr* 2008, **97**(12):1663-1668.
66. Horvath T, Madi BC, Iuppa IM, Kennedy GE, Rutherford G, Read JS: **Interventions for preventing late postnatal mother-to-child transmission of HIV.** *Cochrane Database Syst Rev* 2009(1):CD006734.
67. Creswell JW, Clark VLP, Gutmann ML, Hanson WE: **Advanced mixed methods research designs.** In *Handbook of mixed methods in social and behavioral research*. Edited by Tashakkori A, Teddlie C. California: Sage Publications; 2003:209-240.
68. Johnson RB, Onwuegbuzie AJ: **Mixed methods research: a research paradigm whose time has come.** *Educational Researcher* 2004, **33**(7):14-26.



69. Dahlgren L, Emmelin M, Winkivist A: *Qualitative Methodology for International Public Health*. Umeå: Print och Media, Umeå University; 2004.
70. Roberts A: **A principled complementarity of method: in defence of methodological eclecticism and the qualitative-quantitative debate**. *The Qualitative Report* 2002, **7**(3).
71. Tashakkori A, Teddlie C: **The past and future of mixed methods research: from data triangulation to mixed model designs**. In *Handbook of mixed methods in social and behavioral research*. Edited by Tashakkori A, Teddlie C: Sage Publications; 2003:671-701.
72. Erzberger C, Kelle U: **Making Inferences in Mixed Methods: The rule of integration**. In *Handbook of mixed methods in social and behavioural research*. Edited by Tashakkori A, Teddlie C: SAGE Publications; 2003.
73. Sandelowski M: **Tables or Tableaux? The challenges of writing and reading mixed methods studies**. In *Handbook of mixed methods in social and behavioural research*. Edited by Tashakkori A, Teddlie C: SAGE Publications; 2003:321-350.
74. Greene JC, Caracelli VJ, Graham WF: **Toward a Conceptual Framework for Mixed-Method Evaluation Designs**. *Educational Evaluation and Policy Analysis* 1989, **11**(3):255-274.
75. Tashakkori A, Teddlie C: *Handbook of mixed methods in social and behavioral research*. California: Sage Publications; 2003.
76. Teddlie C, Tashakkori A: **Major issues and controversies in the use of mixed methods in the social and behavioural sciences**. In *Handbook of mixed methods in social and behavioral research*. Sage Publications; 2003:3-50.
77. **Uganda Bureau of Statistics: 2002 Population and Housing Census Report for Uganda**. Entebbe: Ministry of Finance, Planning and Economic Development 2003.
78. Chandisarewa W, Stranix-Chibanda L, Chirapa E, Miller A, Simoyi M, Mahomva A, Maldonado Y, Shetty AK: **Routine offer of antenatal HIV testing ("opt-out" approach) to prevent mother-to-child transmission of HIV in urban Zimbabwe**. *Bull World Health Organ* 2007, **85**(11):843-850.
79. Byamugisha R, Kagawa M, Tumwine JK, Karamagi CA, Onyango S, Tylleskar T: **Dramatic Increase of HIV-testing after Implementing Routine Antenatal HIV-testing in Eastern Uganda**. In *CROI: 2008; Boston*; 2008.
80. **2008 Report on the global AIDS epidemic**  
[[http://www.unaids.org/en/KnowledgeCentre/HIVData/GlobalReport/2008/2008\\_Global\\_report.asp](http://www.unaids.org/en/KnowledgeCentre/HIVData/GlobalReport/2008/2008_Global_report.asp)]
81. Parkhurst JO: **"What worked?": the evidence challenges in determining the causes of HIV prevalence decline**. *AIDS Educ Prev* 2008, **20**(3):275-283.
82. Wamani H, Tylleskär T, Astrøm AN, Tumwine JK, Peterson S: **Mothers' education but not fathers' education, household assets or land ownership is the best predictor of child health inequalities in rural Uganda**. *Int J Equity Health* 2004, **3**(1):9.
83. Cochran W: **Sampling Techniques**. New York: John Wiley & Sons; 1977.
84. *Physical status: The use and interpretation of anthropometry*. Geneva: WHO; 1995.

85. Rutstein SO, Johnson K: **The DHS Wealth Index**. ORC Macro, DHS Comparative Reports 6; 2004.
86. Filmer D, Pritchett LH: **Estimating wealth effects without expenditure data--or tears: an application to educational enrollments in states of India**. *Demography* 2001, **38**(1):115-132.
87. Indepth-Network: *Measuring health equity in small areas - Findings from demographic surveillance systems*. Aldershot, England: Ashgate; 2005.
88. de Onis M, Garza C, Victora CG, Onyango AW, Frongillo EA, Martinez J: **The WHO Multicentre Growth Reference Study: planning, study design, and methodology**. *Food Nutr Bull* 2004, **25**(1 Suppl):S15-26.
89. Engebretsen IMS, Tylleskar T, Klungsøyr JI, Wamani H, Tumwine JK: **The WHO Child Growth Standards compared to the old NCHS/WHO reference in a Ugandan infant population**. In *25th International Congress of Pediatrics 2007; Athens, Greece; 2007*.
90. Yang H, de Onis M: **Algorithms for converting estimates of child malnutrition based on the NCHS reference into estimates based on the WHO Child Growth Standards**. *BMC Pediatr* 2008, **8**:19.
91. de Onis M, Blossner M, Borghi E, Morris R, Frongillo EA: **Methodology for estimating regional and global trends of child malnutrition**. *Int J Epidemiol* 2004, **33**(6):1260-1270.
92. Chopra M: **Risk factors for undernutrition of young children in a rural area of South Africa**. *Public Health Nutr* 2003, **6**(7):645-652.
93. Mosley WH, Chen LC: **An analytical framework for the study of child survival in developing countries**. *Population and Development Review* 1984, **10**(Supplement: Child Survival):25-45.
94. Victora CG, Huttly SR, Fuchs SC, Olinto MT: **The role of conceptual frameworks in epidemiological analysis: a hierarchical approach**. *Int J Epidemiol* 1997, **26**(1):224-227.
95. Wamani H, Astrom AN, Peterson S, Tumwine JK, Tylleskar T: **Predictors of poor anthropometric status among children under 2 years of age in rural Uganda**. *Public Health Nutr* 2006, **9**(3):320-326.
96. **Conceptual frameworks and causal trees**  
[[http://www.ceecis.org/remf/Service3/unicef\\_eng/module4/index.html](http://www.ceecis.org/remf/Service3/unicef_eng/module4/index.html)]
97. **PROMISE EBF: Promoting infant health and nutrition in Sub-Saharan Africa: Safety and efficacy of exclusive breastfeeding promotion in the era of HIV** [Id: NCT00397150 at <http://clinicaltrials.gov>]
98. Engebretsen IMS, Wamani H, Semiyaga N, Karamagi CA, Tumwine JK, Tylleskar T: **Cultural obstacles to exclusive breastfeeding in Eastern Uganda: Experiences and Attitudes**. In *18th International Congress of Nutrition: 2005; Durban, South Africa; 2005*.
99. *Uganda Demographic and Health Survey 2006*. Calverton, Maryland, USA: Uganda Bureau of Statistics Entebbe (UBOS) and ORC Macro; 2006.
100. Bland JM, Altman DG: **Measuring agreement in method comparison studies**. *Statistical Methods in Medical Research* 1999, **8**:135-160.
101. Smith PG, Morrow RH: *Field Trials of Health Interventions in Developing Countries: A Toolbox*. Oxford: Oxford University Press; 1996.
102. Altman DG: *Practical Statistics for Medical Research*. Boca Raton: Chapman&Hall/CRC; 2000.

103. Rothman KJ: *Epidemiology, An introduction*. Oxford: Oxford University Press; 2002.
104. Shirima R, Greiner T, Kylberg E, Gebre-Medhin M: **Exclusive breast-feeding is rarely practised in rural and urban Morogoro, Tanzania**. *Public Health Nutr* 2001, **4**(2):147-154.
105. Raschke V, Cheema B: **Colonisation, the New World Order, and the eradication of traditional food habits in East Africa: historical perspective on the nutrition transition**. *Public Health Nutr* 2008, **11**(7):662-674.
106. Kirkwood BR, Sterne JAC: *Medical Statistics*. Cornwall: Blackwell Science; 2004.
107. **Infant and young child feeding - Model Chapter for textbooks for medical students and allied health professionals**. Geneva: WHO; 2009.
108. Almroth S, Latham MC: **Breast feeding practices in rural Jamaica**. *J Trop Pediatr* 1982, **28**(3):103-109.
109. Pool R, Nyanzi S, Whitworth JA: **Breastfeeding practices and attitudes relevant to the vertical transmission of HIV in rural south-west Uganda**. *Ann Trop Paediatr* 2001, **21**(2):119-125.
110. Wamani H, Astrøm AN, Peterson S, Tylleskär T, Tumwine JK: **Infant and young child feeding in western Uganda: knowledge, practices and socio-economic correlates**. *J Trop Pediatr* 2005, **51**(6):356-361.
111. Kikafunda JK, Walker AF, Collett D, Tumwine JK: **Risk factors for early childhood malnutrition in Uganda**. *Pediatrics* 1998, **102**(4):E45.
112. Bridge A, Kipp W, Jhangri GS, Laing L, Konde-Lule J: **Nutritional status of young children in AIDS-affected households and controls in Uganda**. *Am J Trop Med Hyg* 2006, **74**(5):926-931.
113. de Onis M, Blossner M: **The World Health Organization Global Database on Child Growth and Malnutrition: methodology and applications**. *Int J Epidemiol* 2003, **32**(4):518-526.
114. Wamani H, Astrøm AN, Peterson S, Tumwine JK, Tylleskär T: **Boys are more stunted than girls in sub-Saharan Africa: a meta-analysis of 16 demographic and health surveys**. *BMC Pediatr* 2007, **7**:17.
115. Moursi MM, Martin-Prevel Y, Eymard-Duvernay S, Capon G, Treche S, Maire B, Delpuech F: **Assessment of child feeding practices using a summary index: stability over time and association with child growth in urban Madagascar**. *Am J Clin Nutr* 2008, **87**(5):1472-1479.
116. Sawadogo PS, Martin-Prevel Y, Savy M, Kameli Y, Traissac P, Traore AS, Delpuech F: **An infant and child feeding index is associated with the nutritional status of 6- to 23-month-old children in rural Burkina Faso**. *J Nutr* 2006, **136**(3):656-663.
117. Mata LJ, Kromal RA, Urrutia JJ, Garcia B: **Effect of infection on food intake and the nutritional state: perspectives as viewed from the village**. *Am J Clin Nutr* 1977, **30**(8):1215-1227.
118. Roth DE, Caulfield LE, Ezzati M, Black RE: **Acute lower respiratory infections in childhood: opportunities for reducing the global burden through nutritional interventions**. *Bull World Health Organ* 2008, **86**(5):356-364.

119. Lussana F, Painter RC, Ocke MC, Buller HR, Bossuyt PM, Roseboom TJ: **Prenatal exposure to the Dutch famine is associated with a preference for fatty foods and a more atherogenic lipid profile.** *Am J Clin Nutr* 2008, **88**(6):1648-1652.
120. Victora CG, Adair L, Fall C, Hallal PC, Martorell R, Richter L, Sachdev HS: **Maternal and child undernutrition: consequences for adult health and human capital.** *Lancet* 2008, **371**(9609):340-357.
121. Phuka JC, Maleta K, Thakwalakwa C, Cheung YB, Briend A, Manary MJ, Ashorn P: **Postintervention growth of Malawian children who received 12-mo dietary complementation with a lipid-based nutrient supplement or maize-soy flour.** *Am J Clin Nutr* 2009, **89**(1):382-390.
122. **Obesity** [<http://www.who.int/topics/obesity/en/>]
123. Bachou H, Labadarios D: **The nutrition situation in Uganda.** *Nutrition* 2002, **18**(4):356-358.
124. Barker DJ: **Maternal nutrition, fetal nutrition, and disease in later life.** *Nutrition* 1997, **13**(9):807-813.
125. Maleta K, Virtanen SM, Espo M, Kulmala T, Ashorn P: **Childhood malnutrition and its predictors in rural Malawi.** *Paediatr Perinat Epidemiol* 2003, **17**(4):384-390.
126. Barker DJ, Clark PM: **Fetal undernutrition and disease in later life.** *Rev Reprod* 1997, **2**(2):105-112.
127. Bartok CJ, Ventura AK: **Mechanisms underlying the association between breastfeeding and obesity.** *Int J Pediatr Obes* 2009:1-9.
128. Kramer MS, Kakuma R: **The Optimal Duration of Exclusive Breastfeeding: a systematic review.** *Adv Exp Med Biol* 2004, **554**:63-77.
129. Simondon KB, Simondon F: **Mothers prolong breastfeeding of undernourished children in rural Senegal.** *Int J Epidemiol* 1998, **27**(3):490-494.
130. West KP, Jr., Christian P: **Antenatal micronutrients in undernourished people.** *Lancet* 2008, **371**(9611):452-454.
131. Black RE, Allen LH, Bhutta ZA, Caulfield LE, de Onis M, Ezzati M, Mathers C, Rivera J: **Maternal and child undernutrition: global and regional exposures and health consequences.** *Lancet* 2008, **371**(9608):243-260.
132. Scrimshaw NS, Taylor CE, Gordon J: **Interactions of nutrition and infection.** *WHO Monograph Series* 1968, **57**:60-144.
133. Almroth S, Bidinger PD: **No need for water supplementation for exclusively breast-fed infants under hot and arid conditions.** *Trans R Soc Trop Med Hyg* 1990, **84**(4):602-604.
134. Almroth SG: **Water requirements of breast-fed infants in a hot climate.** *Am J Clin Nutr* 1978, **31**(7):1154-1157.
135. Paul AA, Muller EM, Whitehead RG: **The quantitative effects of maternal dietary energy intake on pregnancy and lactation in rural Gambian women.** *Trans R Soc Trop Med Hyg* 1979, **73**(6):686-692.
136. Prentice AM, Whitehead RG, Roberts SB, Paul AA, Watkinson M, Prentice A, Watkinson AA: **Dietary supplementation of Gambian nursing mothers and lactational performance.** *Lancet* 1980, **2**(8200):886-888.
137. Papathakis PC, Van Loan MD, Rollins NC, Chantry CJ, Bennish ML, Brown KH: **Body composition changes during lactation in HIV-infected and**

- HIV-uninfected South African women. *J Acquir Immune Defic Syndr* 2006, **43**(4):467-474.**
138. Ceasey SM, Prentice AM, Cole TJ, Foord F, Weaver LT, Poskitt EM, Whitehead RG: **Effects on birth weight and perinatal mortality of maternal dietary supplements in rural Gambia: 5 year randomised controlled trial.** *BMJ* 1997, **315**(7111):786-790.
139. Edmond KM, Bahl R: **Optimal feeding of low-birth-weight infants: technical review.** Geneva: WHO; 2006.
140. Das J, Hammer J: **Location, location, location: residence, wealth, and the quality of medical care in Delhi, India.** *Health Aff (Millwood)* 2007, **26**(3):w338-351.
141. Alkire S: **Subjective Quantitative Studies of Human Agency** *Social Indicators Research* 2005, **74**(1):217-260.
142. Coovadia HM, Bland RM: **Preserving breastfeeding practice through the HIV pandemic.** *Trop Med Int Health* 2007, **12**(9):1116-1133.
143. Karamagi CA, Lubanga RG, Kiguli S, Ekwaru PJ, Heggenhougen K: **Health Providers' Counselling of Caregivers in the Integrated Management of Childhood Illness (IMCI) Programme in Uganda.** *Afr Health Sci* 2004, **4**(1):31-39.
144. Grossman X, Chaudhuri J, Feldman-Winter L, Abrams J, Newton KN, Philipp BL, Merewood A: **Hospital Education in Lactation Practices (Project HELP): does clinician education affect breastfeeding initiation and exclusivity in the hospital?** *Birth* 2009, **36**(1):54-59.
145. Bhandari N, Kabir AK, Salam MA: **Mainstreaming nutrition into maternal and child health programmes: scaling up of exclusive breastfeeding.** *Matern Child Nutr* 2008, **4 Suppl 1**:5-23.
146. Nankunda J, Tumwine JK, Soltvedt A, Semiyaga N, Ndeezi G, Tylleskar T: **Community based peer counsellors for support of exclusive breastfeeding: experiences from rural Uganda.** *Int Breastfeed J* 2006, **1**:19.
147. Piwoz EG, Bentley ME: **Women's voices, women's choices: the challenge of nutrition and HIV/AIDS.** *J Nutr* 2005, **135**(4):933-937.
148. Caulfield LE, de Onis M, Blossner M, Black RE: **Undernutrition as an underlying cause of child deaths associated with diarrhea, pneumonia, malaria, and measles.** *Am J Clin Nutr* 2004, **80**(1):193-198.
149. Jilcott SB, Masso KL, Ickes SB, Myhre SD, Myhre JA: **Surviving but not quite thriving: anthropometric survey of children aged 6 to 59 months in a rural Western Uganda district.** *J Am Diet Assoc* 2007, **107**(11):1983-1988.
150. *Uganda Demographic and Health Survey 2000-2001.* Calverton, Maryland, USA: Uganda Bureau of Statistics Entebbe (UBOS) and ORC Macro; 2001.
151. Pinchinat S, Enel C, Pison G, Duthe G, Lagarde E, Simondon F, Simondon KB: **No improvement in weight-for-age of young children in southern Senegal, 1969-1992, despite a drastic reduction in mortality. Evidence from a growth monitoring programme.** *Int J Epidemiol* 2004, **33**(6):1202-1208.