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Growth of children during the first two years of life in the Tanga-region, Tanzania

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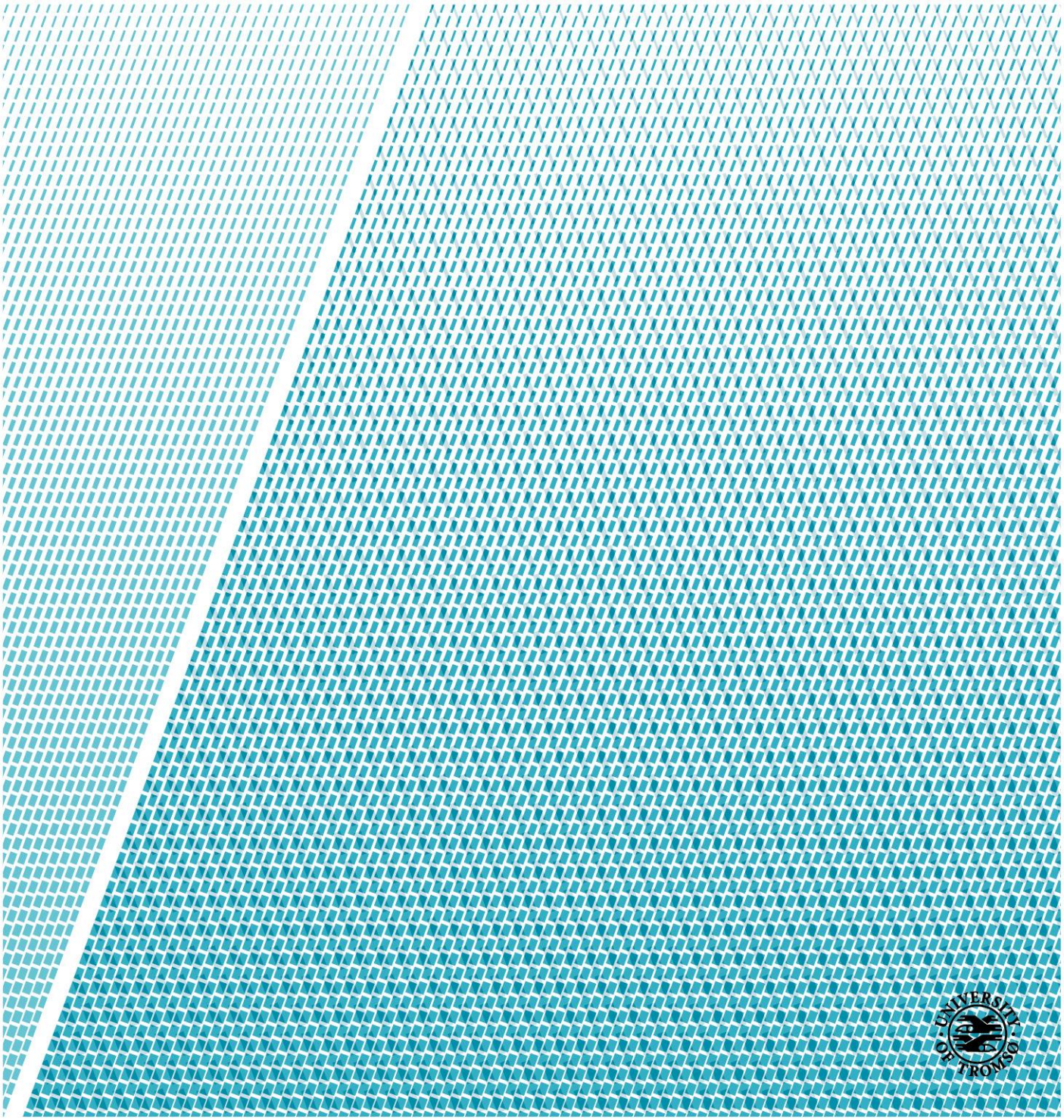
MED-3950 master thesis /class of 2012

Medical school

Faculty of Health Science

UiT – The Arctic University of Norway, 2017



Preface

This study is a collaboration between the University of Tromsø – The Arctic University of Norway (UiT), The National Institute for Medical Research (NIMR) and Tanga International Competence Centre (TICC). The aim of this study is to evaluate growth of children during their first two years of life in Tanga, Tanzania in order to understand how child health and breastfeeding is linked in this area. There were several reasons for conducting the study in Tanzania. Despite efforts from the Ministry of Health and other stakeholders in Tanzania on giving education to pregnant women and mothers on infant feeding practices, there has been considerable challenges on its implementation. All the associates of this study have a special connection to Tanzania, and want to contribute to health benefits for the future generation of this country.

This study is of importance because there is in fact a gap between breastfeeding practices and the World Health Organizations (WHO) recommendations in Tanzania. Interventions done in Tanzania as part of the Millennium Development Goal (MDG) 4 for child survival showed a substantial reduction in mortality by >2/3 for children aged 1-59 months (1). Improvements of breastfeeding practice led to 2400 more lives saved in 2012 in comparison to 2010 (1). This shows that changes in breastfeeding practises and nutrition is important. Also, the prevalence of stunted and underweight children is relatively high in Tanzania (2, 3). The purpose of this study is to examine the relationship between child growth and breastfeeding as well as vaccination coverage, mothers age, education, occupation, and reproductive health characteristics. The results of the study can be used to inform health care workers in Tanzania about growth status, breastfeeding practises and vaccination coverage in 1-2 years old children in the region. This information may be useful to find areas to improve in growth and general health of children attending the local health clinics.

Funding

There is no specific funding for this project. I received a scholarship from The University of Tromsø - The Arctic University of Norway to cover parts of the travel expenses (330 USD) and some administrative expenses (240 USD). The University of Tromsø has no role in design, execution, interpretation or writing of the thesis. The timeframe of the research required accommodations in Tanga for 6 weeks. The accommodation at TICC is 35 USD a day, a total of 1470 UDS for the entire period. The travel expenses with return ticket from Norway to Tanzania is approximately 900 USD, with an affordable flight company and bus from Dar es Salaam to Tanga, which takes about 5-8 hours.

Associates and co-workers

The assistance received from the supervisors involved in this study has been invaluable. I offer my sincere thanks to Claus Klingenberg, Ketil Størdal and Mercy Chiduo. They have been a great source of support and functioned as academic supervisors. Their involvement has made this study possible.

Claus Klingenberg is a professor in paediatrics and works at the Neonatal unit of the University Hospital of North Norway. Klingenberg is the supervisor from UiT. He has worked 6 months in Tanzania (Kilimanjaro Christian Medical Center, Moshi) during his training to become a paediatrician and has an interest in nutrition and infectious diseases. Klingenberg has been the lead supervisor for this study in Norway. He has been dedicated throughout the whole application period, and taken the time to assist with the writing process, preparations for the field work, statistics and finalising the thesis.

Ketil Størdal is a consultant in paediatrics and a senior researcher at the Norwegian Public Health Institute. Størdal has been head of the neonatal unit at Princess Marina Hospital, Gaborone, Botswana's main teaching hospital for two years and is involved in other research projects in both Botswana and Tanzania. Størdal is also teaching at London School of Tropical medicine and is currently supervising PhD candidates at Haydom Lutheran Hospital in Tanzania, involved in the SAFER Births project. Størdal immediately accepted to assist in the process of planning this master thesis. He was familiar with TICC and the local clinics and health care workers as he is teaching a course in tropical medicine in Tanga. Also, he was the one getting us in contact with the local research team. Størdal is always readily available for answering questions and has given his guidance regarding appropriate literature, field work, statistical analysis and with finalising the thesis.

Dr Mercy Chiduo is a Senior Research Scientist and the local investigator in Tanga. Dr Chiduo was in contact with the authorities in Tanzania and did a great job finalizing the study proposal which led to the Medical Research Coordinating Committee (MRCC) authorizing the ethical clearance for conducting this study. Dr Chiduo has been the one in contact with NIMR throughout the application period, and organized permission for the fieldwork.

Medical student Ingvild Skålnes Elverud has been responsible for the preparations of this study and was the one collecting data in Tanga. Elverud spent two years of her childhood in Dar es Salaam, Tanzania. The student has been responsible for completing this study as her master thesis. The supervisors have given advice concerning hypothesis and methods, assisted

the candidate by providing relevant research literature and academic guidance and discussed results and the interpretation of these. The supervisors have also assisted in ethical issues related to the research project and guided the student through data analysis.

Special thanks to Ruth Nesje at TICC for her interest in the project and making the data collection in Tanga possible. Thanks to Husna Rajabu and Mariam Mhina for identifying study candidates at the health clinics and helping with interpretation from Kiswahili to English.

Date: 07.06.17 Signature 

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Summary

Introduction: Child health is an important indicator of a country's level of development. Tanzania is on United Nations list of least developed countries, and has a high prevalence of underweight and stunted children. Optimal infant and child feeding practises improves survival, promotes normal growth, reduces the burden of infectious diseases and improves cognitive development.

Aims: The purpose of this study is to analyse the association between duration of exclusive and total breastfeeding and child growth. Data on vaccination, maternal education, occupation and reproductive health characteristics is also analysed.

Material & methods: This is a cross-sectional study of 327 mother-child pairs conducted in Tanga, Tanzania in 2017. The child's weight and height was measured, and the mothers were interviewed after collection of written consent. Z-scores (standard deviation scores) from WHO child growth standards was used to describe growth parameters. Descriptive and nonparametric statistics was used for analysis. Permission to conduct research in Tanzania was granted by the official authorities.

Results: Length-for-age (LFA) Z-scores of children exclusively breastfed for 0-5 months (median -0,12 (-1.43–0.70)) did not differ from children exclusively breastfed for 6 months (median -0.60 (-1.72–0.52)), p 0.16, with similar findings for weight-for-age (WFA) Z-scores of children exclusively breastfed for 0-5 months (median -0.19 (-1.17–0.34)) compared to 6 months (median -0.37 (-1.18–0.43)), p 0.72. LFA Z-scores of children with mothers of secondary or higher education (median -0.17 (-1.33–0.86) were significantly higher than those for children of mothers with none or primary education (median -0.68 (-1.90–0.61), with similar findings for WFA and higher (median -0.15 (-0.81–0.72) or none or primary (median -0.43 (-1.42–0.27) education.

Conclusion: The weight and height of children in this study population is below the WHO standard. There was no significant difference in weight or height between children exclusively breastfed for 0-5 months compared to 6 months. The prevalence of exclusive breastfed children at 6 months was 56 %. Children whose mothers had secondary or higher education had significantly higher weight and length for their respective ages.

Abbreviations and definitions

HFA – height-for-age

LFA – length-for-age

MRCC – Medical Research Coordinating Committee

NIMR – National Institute for Medical Research

SD – standard deviation

Stunted – HFA Z-score below 2 standard deviations of the population median, meaning low stature compared to the population.

TICC – Tanga International Competence Centre

UN – United Nations

Wasted – WFH Z-score below 2 standard deviations of the population median, meaning low weight compared to the population.

WFA – weight-for-age

WFH – weight-for-height

WHO – World Health Organization

Z-score – standard deviation scores

Introduction

The Millennium Development Goals (MDG) Report of 2015 (4) states that lacking sufficient nutrition in early life and being underweight is associated with increased risk of getting common infectious diseases, late recovery and dying from them, as well as impaired cognitive function and reduced school and work performance. Tanzania is on UNs list of the least developed countries, and has a relatively high prevalence of underweight (13.6 %), stunted (34.8 %) and wasted (6.6 %) children under five years of age (2, 3, 5). A recent study from Tanzania suggests that malnutrition is associated with suboptimal cognitive, communication and motor development (6). Breastfeeding promotes health and the health benefits gained from breastfeeding is inversely proportional to the populations socioeconomic level, which is lower in developing countries compared to developed countries (7). Developing countries benefits especially from breastfeeding because of the lower socioeconomic levels and poorer hygiene conditions. Between 800.000 – 1,4 million lives could be saved each year if every child between the age of 0-23 months was optimally breastfed globally, in addition 10 % of the disease burden in children under five years of age could be reduced (7, 8). According to WHO (8) 43 % of children between 0-6 months are exclusively breastfed globally, and it is estimated that 13 % of the deaths among infants worldwide is due to suboptimal feeding practices (8, 9). However, there is an improved awareness about the positive effects of breastfeeding and the number of children being exclusively breastfed is increasing, including in Sub-Saharan Africa where there has been an increase in exclusive breastfeeding at 6 months from 22 % in 1996 to 30 % in 2006 (8, 10).

The first 1000 days

The 1000 days from the beginning of a pregnancy to a child's second birthday offer a unique opportunity to build healthier and more prosperous futures (10). Nutrition is important in pregnancy, infancy and early childhood as the child brain and other organs is developing and the body is growing, and consequently the right nutrition is essential for normal development (10). The 1000-day window has a profound impact on children's ability to grow and thrive (10). Malnutrition early in life can cause irreversible damage to the body and malnourished children are more susceptible to infections and diseases and reduced physical growth due to lack of nutritious foods (10). This can lead to children being underweight, overweight, stunted and wasted, the brain development can be disrupted and these outcomes cannot be reversed later in life, and can increase the morbidity and mortality of the population (10). The learning

ability and school performance can also be affected and consequently a lifetime of earning potential can be lost (10). A solid nutritional foundation in the 1000 first days of life can contribute to make more prosperous futures (10).

Access to healthy food and breastfeeding

It is essential that mothers have access to healthy nutrient food during pregnancy and lactation. This also requires time and having the ability to breastfeed, continuous follow-ups and breastfeeding guidance to help facilitate and encourage women to breastfeed (8). Having maternity leave and maternity benefits, access to safe, nutrient-rich breastmilk substitutes when breastfeeding is not possible, the opportunity to spend 24 hours with the infant and having access to supportive health services for both the mother and the child, is important factors of successful infant and young child feeding (8). Children require safe and right nutrition, and this includes breastfeeding during infancy and childhood. The WHO and United Nations Children's Fund (UNICEF) advises to exclusively breastfeed the first 6 months of life, this means no other food or drink supplement, no animal milk or water, however, oral rehydration solutions, vitamin or mineral supplements and medicines may be necessary (8, 11). In the Nordic countries, the department of health recommends that the child should be given supplement of vitamin D in the form of fish oil or vitamin D droplets because of the mothers reduced exposure to sunshine, less intake of foods and drinks containing vitamin D and because of ethnic traditions of wearing clothes that covers the body (7, 12, 13). There have been discussions about the duration of exclusive breastfeeding, and prior to 2001 the WHO recommended exclusive breastfeeding for 4-6 months, but after reviewing the literature available around year 2000 they changed the recommendations of exclusive breastfeeding to include the first 6 months of age (7). However, in Europe, there is no reason why healthy children should not be introduced to complimentary foods at the age of 4-6 months, although the official recommendations in Norway still suggest 6 months exclusive breastfeeding (14). In developing countries, however, it's still advised that complimentary feeding should not begin before 6 months because of poorer hygiene and food safety in developing countries leading to extra benefits of breastfeeding (11). Complementary feeding means introduction to safe, nutrient solid, semisolid and soft foods and liquids at a time when the child's needs exceed the one of breastmilk alone, and should start at 6 months for healthy children in developing countries and at 4-6 months for healthy children in developed countries. Introduction to complimentary foods for European children at 4-6 months is also recognized

as standard by The European Society for Paediatric Gastroenterology Hepatology and Nutrition (ESPGHAN) and European Food Safety Authority (EFSA) (7). Breastfeeding should continue up to two years or beyond if both the mother and child is satisfied with this (11, 13). The American Academy of Paediatrics recommends continued breastfeeding for 1 year, whilst the WHO recommends continued breastfeeding for 2 years (7). In industrialised countries mothers with higher education and socioeconomic levels tend to breastfeed their children, whilst women with lower educational and socioeconomic levels more often formula-feed their children. In contrast, this situation is reversed in developing countries (7).

Breastmilk

A systematic review and meta-analysis on nutrient content of breastmilk (15) describes the composition of breastmilk per 100 millilitres at 1 week and 10-12 weeks (Table 1). The composition is complex and varies with prematurity, postnatal age and between women (15). Methods for analysing breastmilk is also a factor in determining the nutritional contents, in addition, different laboratory techniques make it complicated to predict the exact composition of the milk (16). However, during the first weeks after birth the human milk gradually changes. The first milk is high in protein, but contains lower amounts of fat and carbohydrates but after a couple of weeks it develops into mature milk and the nutritional composition alters from high protein and low fat to gradually containing more fat and less protein, and thus more energy (15).

Table 1 The composition of breastmilk per 100 ml at 1 and 10-12 weeks (15).

	Kcal	Protein	Fat	Calcium	Phosphorous
1 week	60	1,8 g	2,2 g	26 g	12 g
10-12 weeks	68	0,9 g	3,4 g	26 g	16 g

The breastmilk will remain relatively stable in content from about two weeks of age (16). In addition to providing energy, breastmilk also contain other essential components for the child that helps with digestion, absorption of nutrients and the immune system (11). Breastmilk contains immune related substances such as secretory immunoglobulin A (sIgA), leucocytes, antimicrobial proteins such as lysozymes and nucleotides, lactoferrin, interferon-ɣ, nucleotides, cytokines, chemokines and human milk oligosaccharides which are important for the colonization of the intestines (7, 17). These substances also contribute to a healthy immune system by reducing the adherence of pathogens to the mucosa wall of the

gastrointestinal tract and to some extent the upper respiratory tract, in addition they contribute in the degrading of bacteria (17). Furthermore, breastmilk contains vitamins, minerals, essential fatty acids, hormones, enzymes, growth factors such as epidermal growth factor and polyamines that contributes to a healthy growth development (17). The amount of vitamin K in breastmilk is low, and it is recommended that the child should receive a supplement of vitamin K, preferably short after birth, as vitamin K is essential for the function of the coagulation system (18).

Effects of breastfeeding

Breastfeeding contributes to lower the incidence of infections, with greatest effect on gastrointestinal infections and acute otitis media, but may also have a preventive effect on severe lower respiratory tract infections reducing the incidence of children needing hospital treatment (7). Also, infants being breastfed appear to have lower blood pressure later in life which may arise from the low content of sodium in breastmilk or the high content of long-chained polyunsaturated fatty acids, which contributes to lowering the blood pressure in hypertensive subjects by being integrated in the vascular endothelium (7). There is no direct link between breastfeeding and the reduced risk of cardiovascular morbidity and mortality (7). The risk of becoming overweight and obese was thought to be reduced in those breastfed in infancy compared to non-breastfed (7), however a newly published large randomised trial from Belarus (19) concludes that there were no reduction in body mass index or obesity in those breastfed. Also, an intervention study from Kramer et al (20) revealed no reduction in obesity when children were breastfed for a longer period of time. There is also no clear evidence of breastfeeding reducing the risk of diabetes mellitus type 2 later in life (7, 21). The risk of childhood diabetes mellitus type 1 might be reduced in breastfed children, the introduction of cow's milk is thought to be a contributing factor of diabetes mellitus type 1, in addition, breastfed infants may have a decreased risk of diabetes mellitus type 1 later in life (7). There might also be a reduced risk of childhood leukaemia, as studies has shown reduced risk of acute lymphocytic leukaemia and acute myelogenous leukaemia in children breastfed beyond 6 months (7). Breastmilk contains docosahexaenoic acid (DHA), an omega-3 fatty acid, an important component in brain and retina development (22). This is thought to be a reason why breastfeeding contributes to better neurodevelopment and cognitive function (22). Insufficient levels of DHA is associated with foetal alcohol syndrome, attention deficit

hyperactive disorder, unipolar depression, cystic fibrosis and phenylketonuria amongst others (7, 22).

Still, studies of breastfeeding are largely observational studies with risk of confounding from other healthy choices made by breastfeeding mothers. Interventional studies are few, and in general are less convincing in term of breastfeeding benefits.

There are also potential health benefits for the mothers who breastfeed, including reduced risk of breast cancer, ovarian cancer and diabetes mellitus type 2 (7). In addition to the mentioned health benefits, breastfeeding seems to protect children from kwashiorkor (23). This condition often occurs after two-three years of age, when the breastfeeding declines and eventually stops (23).

In some cases, the mother is advised against breastfeeding to prevent transmission of diseases to the child. The major concern is transmission of human immunodeficiency virus (HIV) from HIV-positive mothers to their children because HIV is transmittable through breastmilk. In high income countries HIV-positive women are advised against breastfeeding their children. In low income countries, the recommendations are that every child should be breastfed, also children of HIV positive mothers (24). The value of breastfeeding is greater than the risk of getting infected with HIV. The risk of being malnourished and getting serious infections like diarrheal disease and pneumonia is greater than getting sick of HIV (24). This risk is mainly caused by unsafe drinking water containing infectious pathogens and the disadvantage of not receiving protective antibodies from the breastmilk (24). Today, antiretroviral treatment (ART) should be administrated to the mother and child and this will also greatly reduce the risk of mother to child transmission of HIV during breastfeeding (24). ARTs are now widespread available and breastfeeding is consequently safer, also for HIV positive women.

Knowledge in the population and current practice

Malnutrition and poor growth of children can be prevented by increasing the knowledge about breastfeeding and introduction to safe, nutrient food in infancy. In a study from Uganda (25), 59 % and 17 % of caretakers had proper knowledge of breastfeeding and complimentary feeding respectively. Lack of knowledge was associated with both stunting and wasting (25).

According to official statistics from Tanzania, 50 % of the children are exclusively breastfed under the age of 6 months (26). In comparison, the percentage of women breastfeeding at 3 months in Norway has increased from below 30 % in 1968 to above 80 % in 1991 and then

decreased to 65 % in 2013 (27). A study done in rural Tanzania in 2010, revealed that child-feeding practices was not in line with that of WHO's and the prevalence of underweight children (25 %) were found to be the same as in 1987/1988 (28).

Underweight is classified as the child's WFA Z-score below 2 standard deviations of the population median. Stunting is defined as a HFA Z-score below 2 standard deviations of the population median, and wasting as a weight-for-height (WFH) Z-score below 2 standard deviations of the population median (29). The Z-score classification system is used to assess anthropometric values as standard deviations below or above the reference median or mean value of the population (30).

WHO describes stunted growth as "a process of failure to reach linear growth potential as a result of suboptimal health and/or nutritional conditions" and wasting as "recent and severe process of weight loss, which is often associated with acute starvation and/or severe disease" (31). Being stunted or underweight is associated with increased risk of infections and death (32). Moreover, impaired growth in childhood may have severe long term consequences. Women of short stature has a greater risk of obstetric complications due to a smaller pelvis. Women of lower weight tend to give birth to low birth weight infants which again tend to be smaller as adults. (32) The mother's occupation may also have an impact on the child's ability to grow and thrive. When women work in farming there is a significant risk of their children being stunted (28). A study done in rural Rukwa of Tanzania (28) states that the time mothers spent in farming increases the risk of their children being underweight. Farming is not a sole predictor for being stunted and underweight and factors including food shortage, dry season cultivation and diseases also contributes to children of women in farming having an increased risk of being underweight or stunted (28). Factors such as sub-optimal feeding practices, food insecurity, caregivers limited opportunities to provide care as well as inadequate health services, lack of knowledge and poverty was also contributing to undernutrition (28). Stunting during the first two to three years of life increases the risk of death, contributes to poor physical and mental development and will contribute to lower societal development for the next generation (28).

Local conditions in Tanga and Tanzania

The prevalence of stunting, underweight and wasting at 0-59 months in Tanga and Tanzania and at 12-23 months in Tanzania is presented in Table 2 (33).

Table 2 The prevalence of stunting, underweight and wasting at 0-59 months in Tanga and Tanzania and at 12-23 months in Tanzania (33). SD; standard deviation.

	0-59 months		12-23 months
	Tanga	Tanzania	Tanzania
Stunting (HFA Z-scores < -2 SD)	24 %	35 %	39 %
Moderate stunting (HFA Z-scores < -2 and ≥ -3 SD)	19 %	22 %	25 %
Severe stunting (HFA Z-scores < - 3 SD)	5 %	12 %	14%
Underweight (WFA Z-scores < -2 STD)	10 %	13 %	16 %
Moderate underweight (WFA Z-scores < -2 and ≥ -3 SD)	9 %	11 %	12 %
Severe underweight (WFA Z-scores < -3 SD)	1 %	3 %	4 %
Wasting (WFH Z-scores < -2 SD and/or oedema)	5 %	4 %	5 %
Moderate wasting (WFH Z-scores < -2 and ≥ -3 SD)	5 %	3 %	4 %
Severe wasting (WFH Z-scores < -3 SD and/or oedema)	0 %	1 %	1 %

In Tanga, 24 % of children are stunted which is equivalent to 84 175 from a population of 2 045 205 in the Tanga-region (33). Tanga is not the area in Tanzania with the highest percentage of stunted children between 0-59 months, but in numbers it still includes a lot of children. The areas Kagera, Kigoma, Dodoma, Mbeya and Mwanza, situated in the inland and west of Tanga, has the highest prevalence of stunting (33). In total, more than 2 700 000 children in the age group 0-59 months are stunted in Tanzania (33). In 1999 the prevalence of stunting in Tanzania was 49 %, and in 2010 it was reduced to 43 % (1). Tanga has a slightly lower number of underweight children between 0-59 months compared to the national figures from Tanzania (33). Some children in Tanzania also suffer from malnutrition, but the prevalence of wasting is considerably lower than stunting (33). The Tanga-region has a higher prevalence of wasting and moderate wasting, but no severe wasting, compared to the national figures of Tanzania (33).

Save the Children published a report called "A life free from Hunger – Tackling child malnutrition" (34) in 2012, where they predicted that Tanzania will have 450.000 extra stunted children in 2020. They also stated that the global progress on stunting has been extremely low, only falling 0.6 percentage points a year on average from 1990 to 2010 (34). In 1990 the percentage of stunted children globally was 40 %, in 2010 it's only sunken to 24 % (34). They predict that if these trends continue, there will be 450 million children affected by stunting in the fifteen next years (34). "Malnutrition is an underlying cause of the death of 2.6 million children each year – one-third of the global total of children's deaths." (34). Numbers published in the Lancet in 2007 (35) states that "200 million children under 5 years of age in developing countries are not developing to their full potential". This has

consequences for the future generation, because malnourished children will have more than a twenty percent income deficit on average compared to those who were not malnourished (35).

Early initiation of breastfeeding, meaning breastfeeding initiated within the first hour of life, has a prevalence of 76 % in the Tanga-region (33). The national prevalence for Tanzania is 51 % (33). Early initiation of breastfeeding can prevent 22 % of neonatal deaths if started within the first hour of life, and 16 % of neonatal deaths if started the first day of life (36). The numbers from the Tanzanian National Survey of 2014 (33) investigated the prevalence of exclusive breastfeeding from the age 0-5 months. In the Tanga-region the prevalence of children being exclusively breastfed under the age of five months was only 12 %, which is a very low rate compared to the country rates, and not in line with WHO recommendations (8, 33). At 6-8 months 98 % of the infants received solid, semi-solid or soft foods, in addition to breastmilk (33). Number of children still being breastfed at one year is 90 % in Tanzania, and 92 % in the Tanga-region (33). At the age of 20-23 months 48 % of the Tanzanian children was breastfed, in Tanga the prevalence was 58 % (33). These numbers tell us that mothers in Tanga introduce foods or drinks other than breastmilk at an early age, but most continue to breastfeed up to one year of age and a majority even at two years of age (33). However, the study populations in this report was small with n=167 children from Tanga (33).

Immunization and supplementation

Vaccination protects against diseases like diphtheria, tetanus, pertussis (whooping cough), hepatitis B, pneumonia, measles, mumps, rubella and polio (37). It is estimated that the use of vaccines prevents about 2-3 million deaths worldwide each year, and with better immunization overage an additional 1.5 million deaths could be avoided (37). Immunization coverage is defined as the percentage of children who received the vaccine (37).

Data from Tanzania indicate a high vaccination coverage. The Bacillus Calmette-Guérin vaccine (BCG), the first dose of the diphtheria, tetanus and pertussis vaccine (DTP1), the third dose of the hepatitis B vaccine (HepB3), the third dose of the polio vaccine (POL3), the rubella vaccine (RCV1) and the first dose of the measles vaccine (MCV1) all had an immunization coverage of >95 %, whereas the booster dose of the measles vaccine (MCV2) only had an immunization coverage of 57 % (38). The third dose of Haemophilus influenzae B vaccine had an immunization coverage of 98 %, the third dose of the pneumococcal

conjugate vaccine (PCV3) had an immunization coverage of 95 % and the last dose of the rotavirus vaccine had an immunization coverage of 98 % (38).

Tanzania and Tanga

Tanzania is a republic in East Africa, and a part of the African Great Lakes region. The country has a large coastal line towards the Indian ocean and shares borders with Kenya, Uganda, Rwanda, Burundi, The Democratic Republic of Congo, Zambia, Malawi and Mozambique. Official languages are Swahili and English. In 1964, Tanganyika and Zanzibar were united to form The United Republic of Tanzania (39). Dar es Salaam, the largest city in Tanzania, was the capital until 1974 when it was replaced by Dodoma, which is situated in the inland (39). Tanga is Tanzania's second largest seaport, situated north of Dar es Salaam and close to the Kenyan boarder. Tanzania has experienced an increase in economic growth, but still the country is one of the world's poorest with a poverty rate of 66 % and a per capita income of 1.760 USD (39). 68 % of the population have less than 1.25 USD a day (1). A large amount of the population works in farming, mining, tourism and other service occupations (39). Life expectancy in Tanzania is approximately 65 years (39).

The past decades Tanzania's gross national income (GNI) has increased, and so has the population (1). In 1990, the population of Tanzania was 25 million, in 2012 there were 45 million people and currently more than 53 million people live in Tanzania (1, 39). The donor funding for child health and HIV/AIDS has tripled with the major funding from The Global Fund to Fight AIDS, Tuberculosis and Malaria, but the main health sector funding is still the Tanzanian government (1). Education now reaches 78 % of Tanzanian children, and 85 % of the children complete primary school, however, 20 % of the population is still illiterate (40). 57 % of the population has access to safe drinking water, but only 16 % has access to proper sanitation facilities (40). There are 5.5 doctors, nurses and midwifes per 10.000 inhabitants in Tanzania. The recommendations from WHO is 4,5 skilled health professionals per 1000 inhabitants (1). 70 % of the population of Tanzania lives in rural areas, but the percentage of health care workforce that are situated in these areas are only 55 % (41).

Interventions (immunization, insecticide-treated bed nets and prevention of maternal to child HIV-transmission) done in Tanzania as part of the Millennium Development Goal (MDG) 4 for child survival, led to a major reduction in mortality for children aged 1-59 months, between 2000 and 2010 (1). Tanzania achieved the MDG 4 of under-five mortality rate of 54

deaths per 1000 livebirths in 2013 after a period of substantial reduction since 2000 (1). “A promise renewed” (42) reveals that it is possible to reduce the under-five mortality rate of every country to below 20/1000 live births by 2035 (1). However, Tanzania’s progress in reducing maternal and neonatal mortality has been slow (1). Neonatal mortality is defined as deaths occurring during the first 28 days of life, per 1000 live births in a defined time period (43). In Tanzania, 40 % of the deaths among children under five is occurring the first 28 days of life and neonatal mortality had half the reduction rate compared to the overall mortality of children under five years (1). Globally, around 45 % of children under five years die during the first 28 days of life (44). In Sub-Saharan Africa, 1 in 12 children died before they turned five years in 2015 (44).

The major risks of mortality in children aged 1-59 months in Tanzania is the infectious diseases of pneumonia, malaria and diarrhoea as these childhood infections count for 55 % of deaths among children older than 28 days (1). The main causes of neonatal mortality in Tanzania is intrapartum-related events with birth asphyxia counting for 31 % of the deaths, preterm complications which counts for 25 % and sepsis which counts for 20 %. Maternal and child health care is free of charge in Tanzania and women in Tanzania can seek antenatal care, but only half of them visit the clinics the recommended four or more times during pregnancy (1). Almost all pregnant women in Tanzania has access to at least one visit at the antenatal clinic during pregnancy (1). Rural areas of Tanzania have the highest proportion of women that doesn’t use modern contraceptive methods.

Setting and aim of the current study

In this study, we analysed the growth of children aged one to two years visiting two of the Health Clinics in Tanga. Tanga International Competence Centre (TICC) has an agreement with the Tanga City Medical Officer and facilitated the contact to the health clinics. TICC also offers accommodation, restaurant facilities and houses exchange students from different universities in Norway as well as other institutions and companies from other countries (45). TICC is also the mother company of a local nongovernmental organization, HAMA (Hatua na Maendeleo – Steps for Development) that seek to contribute to development for communities of Tanga (45).

The purpose of the study was to analyse the association between duration of exclusive breastfeeding, total duration of breastfeeding and growth. Data on vaccination, mother’s age,

education, occupation and reproductive health characteristics were also collected to study whether this affect child growth. The study is important because data can be used to inform local health care workers in Tanga about breastfeeding patterns, nutritional status, growth and vaccination coverage in 12-24 months old children in the region.

Methods

This is an observational, cross-sectional study. The data collection was done in Tanga, Tanzania, in March and April of 2017. The study population was children aged approximately 12-24 months (we included 18 children from 9-11 months and 6 children from 25-26 months) and their mothers who attend the two health clinics in Tanga, and where the mothers consented to participate. We aimed to recruit at least 200 mother-child pairs. Exclusion criteria were children in other age groups and children attending with another caretaker than the mother. The child's weight from five previous visits was collected from existing health charts, and at the day of the interviews the weight and height was measured at the clinic. Length or height was not routinely measured. There was no length board available at the facilities, so the measurements are height values and not recumbent length. The children were measured standing with a measuring tape by me and Norwegian nursing students. To adjust for this in children aged below 24 months, 0.7 cm was added to the measured height to convert it to length (46). The dates from the five previous visits was not collected and as a consequence the time of the five previous measurements is estimates, but as monthly measurements are uniform, this represents the last five months.

The interview contained 14 questions (Attachment 1 "*Questionnaire in English"*) including duration of exclusive breastfeeding, mixed feeding, total duration of breastfeeding, age, education, occupation, number of pregnancies, parity and year of birth of each child.

The data was processed and analysed in Norway in May 2017, and the final thesis was delivered June 7th. The total amount of time assigned to the thesis was 14 weeks. Six of them was spent doing data collection in Tanga and the remaining eight weeks was spent preparing for the field work, processing data and finalizing the thesis in Norway.

Detailed recruitment procedure

Mother-child pairs were recruited from two health clinics in Tanga called Ngamiani and Mikanjuni. Mikanjuni is situated in the periphery of the city center and is surrounded by local housings, and Ngamiani is located in the city center of Tanga. The population of the two clinics are supposedly somewhat different. According to local health care workers, the population visiting Mikanjuni health clinic is one of a lower socioeconomic level than Ngamiani health clinic, but we don't have any official information about the two populations. The mothers were asked to give their consent by signing their name or printing their

fingerprint on consent forms in Swahili and English. The English copy of the consent form was kept and the Swahili was given to the mothers along with an information sheet in Swahili. I was the one collecting data, accompanied of a local health care worker who identified the study population of interest and functioned as an interpreter. The interview was conducted in Swahili, and we (me and an interpreter) asked the questions and the interpreter translated the answers directly to English. I filled in all data in the questionnaires. Some days were extremely hectic and as a result, some measurements were lost as the mothers disappeared after weighing the child. Consequently, current weight was not always registered. Also, some earlier measurements were not registered because of misunderstandings and the lack of health cards at the time of the interview. The mothers also struggled with answering some of the questions, and for that reason not all the questions were answered for each of the participants. Apart from length measured, no other procedures or blood samples was necessary in order to collect the data. All data was stored anonymously, without name and date of birth.

WHO child growth standards

In order to convert the anthropometric measurements to Z-scores, the WHO child growth standard tables were used (47). The WHO defines Z-scores as "The deviation of an individual's value from the median value of a reference population, divided by the standard deviation of the reference population (or transformed to normal distribution)." (48). The tables are determined for gender, so different tables were used for boys and girls. To calculate the Z-scores, the median Z-scores, SDs and L-values for sex and age were punched in an Excel document, along with the collected anthropometric values. The numbers were converted into Z-scores by two different equations (49, 50).

Statistical analysis

IBM SPSS statistics 24 was used to analyse the data. Descriptive statistics was used to describe the demographic frequencies. The independent samples t-test was initially thought used for the analysis, but the variables was not normally distributed and therefore the nonparametric Mann-Whitney U test was used to conduct the analysis (51). The four assumptions of the Mann-Whitney U test were also checked prior to analysis (52). Descriptive results are expressed as median (interquartile range (IQR)). A p-value below 0,005 was considered significant. Z-scores for change in WFA was calculated by subtracting the current Z-score for WFA from the Z-score for WFA five months prior to the day at the interview. The change in Z-scores were split into three; $\leq$ -0.31, -0.30 – 0.30 and $\geq$0.31.

The Application Process

An approval from MRCC to conduct health research in Tanzania is required (53). We completed the necessary application forms and to help with the process, Ruth Nesje introduced us to Dr Mercy Chiduo, which has been the chief contact with the Tanzanian government and NIMR. Nesje and Dr Chiduo's work contributed to the study proposal being accepted by MRCC.

Results

A total of 327 mother-child pairs were recruited. 205 (63 %) from Ngamiani and 122 (37 %) from Mikanjuni health clinics in Tanga. Selected background information on the study participants is shown in Table 3-4 and Figure 1-2.

Table 3 Socio demographic and reproductive health characteristics of the mothers (N=327).

	Median (IQR)
Age (years) n=324	27 (23-32)
Number of pregnancies	2 (1-3)
Number of births (including stillbirths)	2 (1-3)
Number of children alive	2 (1-3)
Education	
None	7/327 (2 %)
Primary	196/327 (60 %)
Secondary	115/327 (35 %)
University/College	9/327 (3 %)
Occupation	
Peasant	1/327 (0 %)
Business	158/327 (48 %)
Employee	19/327 (6 %)
House wife	147/327 (45 %)
Student	2/327 (1 %)

Only 4 % of mothers had given birth to five children or more. No mother in this study was younger than 18 years, and only 1 % was younger than 20 years of age.

Primiparous mothers exclusively breastfed their children for median 5 (3-6) months, and at the time of the interview 70 % of these children were still being breastfed (median age 18 (15-22) months). I comparison, multiparous women exclusively breastfeed their children for median 6 (4-6) months and at the time of the interview 72 % of their children were still being breastfed (median age 16 (13-18) months).

The percentage of mothers with education from secondary school, university or college who exclusively breastfed their children for 6 months was 59 %. The percentage for mothers with none or primary education who exclusively breastfed their children for 6 months was 56 %. Also, the proportion of mothers from each educational group who exclusively breastfed their

children for 0-5 months is approximately the same in each group; 44 % for none or primary education and 41 % for secondary, university or college education

Figure 1 Age distribution of the mothers.

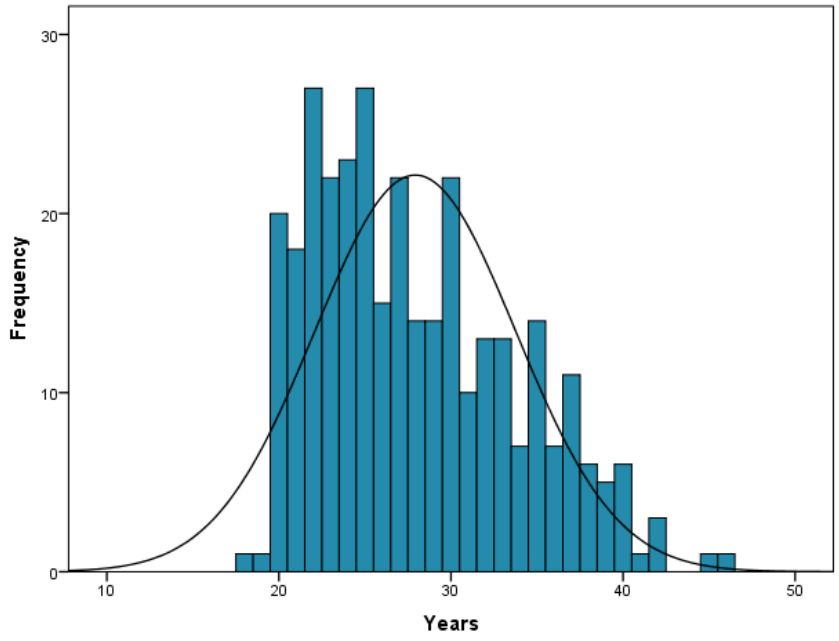
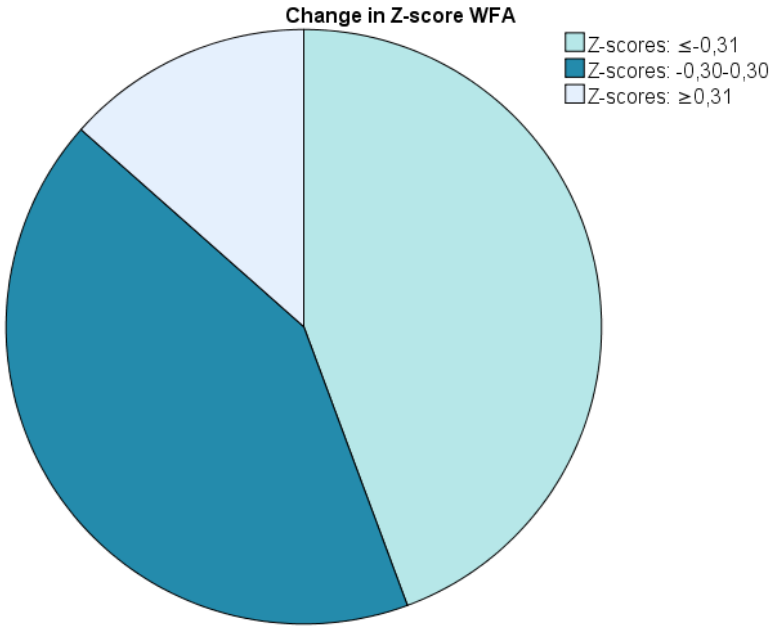


Table 4 Socio demographic and anthropometric characteristics of the children (N=327).

	Median (IQR)
Age (months)	16 (13-20)
Sex	
Male	146/327 (45 %)
Female	181/327 (55 %)
Current weight (kg)	9,9 (8,8-11,0)
Current length (cm)	78,7 (74,7-82,0)
Z-score current WFA*	-0,29 (-1,17-0,36)
Z-score current LFA**	-0,51 (-1,69-0,68)
Z-score change WFA***	-0,36 (-0,78-0,13)
Exclusive breastfeeding	6 (4-6)
0 months	14/327 (4 %)
1-5 months	123/327 (38 %)
6 months	183/327 (56 %)
> 6 months	7/327 (2 %)
Still breastfeeding at	
12 months	35/41 (85 %)
18 months	37/44 (84 %)
24 months	12/19 (63 %)
Still breastfeeding	233/327 (71 %)
Followed the vaccination schedule	312/324 (95 %)

The current WFA and HFA Z-scores are the measured value at the date of the interview. Z-score change WFA is the calculated difference in Z-score between the first (approximately five months prior to data collection) and the current value collected. The proportion of children still breastfeeding at the age of 12/18/24 months is calculated from the proportion of all children whose age was 12/18/24 months at the time of the interview. 44 % of the children in this sample has a lower current WFA Z-score than the WFA Z-score from approximately five months earlier. 42 % has a relatively stable WFA Z-score and 14 % increased their WFA Z-score (Figure 2).

Figure 2 Change in Z-scores for WFA; decreasing, stable or increasing (the first weight value is approximately 5 months prior to the current).



Several outcomes (comparisons of growth status and duration of exclusive and total breastfeeding, education and work) of this study are presented in Tables 5-8.

Table 5 WFA, LFA and change in WFA compared to exclusive breastfeeding for 0-5 months and 6 months. Median (IQR) and p-values are listed.

	BF 0-5 months N=137	BF 6 months N=182	p-value
WFA	-0.19 (-1,17 – 0,34)	-0.37 (-1.18 – 0.43)	0.72
LFA	-0.12 (-1,43 – 0,70)	-0.60 (-1.72 – 0.52)	0.16
WFA Change	-0.27 (-0,74 – 0,14)	-0.37 (-0.85 – 0.14)	0.55

BF; breastfeeding

Table 6 WFA, LFA and change in WFA, duration of exclusive breastfeeding and total breastfeeding is compared to low and high education. Median (IQR) and p-values are listed.

	Education – low N= 202	Education – high N= 124	p-value
WFA	-0.43 (-1.42 – 0.27)	-0,15 (-0.81 – 0.72)	0.001
LFA	-0.68 (-1.90 – 0.61)	-0.17 (-1.33 – 0.86)	0.012
WFA change	-0.38 (-0.83 – 1.18)	-0.33 (-0.68 – 0.05)	0.88
Duration of exclusive breastfeeding	6 (3-6)	6 (4-6)	0.49
Duration of total breastfeeding	15 (12-18)	15 (12-18)	0.54

Education – low; none or primary school.

Education – high; secondary school, college or university.

Table 7 WFA, LFA and change in WFA, duration of exclusive breastfeeding and total breastfeeding is compared in children of mothers working home and outside the home. Median (IQR) and p-values are listed.

	Working home N=147	Working-outside home N=179	p-value
WFA	-0.36 (-1.39 – 0.34)	-0.25 (-1.09 – 0.41)	0.16
LFA	-0.63 (-1.74 – 0.68)	-0.42 (-1.65 – 0.68)	0.35
WFA change	-0.37 (-0.81 – 0.15)	-0.34 (-0.72 – 0.10)	0.72
Duration of exclusive breastfeeding	6 (4-6)	6 (4-6)	0.49
Duration of total breastfeeding	16 (12-19)	14 (12-18)	0.016

Working home; house wife.

Working outside; peasant, business, employee, student.

There is no significant difference of Z-scores for LFA for the children who has followed their vaccination schedule up to the date of the interview

Table 8 The prevalence of stunting and wasting of the children in our study population. The study population (N), number of cases (%) and median (IQR) is listed.

	N	Number of cases	Median	IQR
Stunting (< -2 SD)	326	62 (19%)	-2,49	-3,18 – -2,35
Severe Stunting (< -3 SD)	326	17 (5 %)	-3,63	-4,23 – -3,37
Underweight (< -2 SD)	324	28 (9 %)	-2,47	-2,94 – -2,13
Severe underweight (< -3 SD)	324	6 (2%)	-3,18	-3,40 – -3,11

Discussion

Only a small proportion of children has increased their WFA Z-scores, meaning very few children (14 %) actually gained more weight than expected over the last five months. However, if it was less than five months between the observations, this could explain the outcome. As much as 44 % of the children in the study population had a decreasing WFA Z-score, which means that they are not gaining weight as they should, compared to the population mean for their age in the WHO child growth standards (47). This finding supports statements from local health care workers in Tanga expressing that child feeding practices and child growth might be a challenge.

The mothers attending the clinics was of a higher age than expected. The adolescent birth rate in Tanzania is 95 per 1000 adolescent women (15-19 years) giving birth, excluding stillbirths (54). In our study population, only two mothers were younger than 20 years and no mother was younger than 18 years at the time of the interview. The median age was 27 (23-32) years. However, some of the multiparous mothers were younger than 18 years at the time of previous childbirths. When selecting only the primipara women, the median age was 23 (21-26) years. Maybe the slightly older age is a result of more effective and free of charge contraceptives (1), or represents a regional difference of Tanzania as the population of Tanga is mainly Muslim. However, a study from Ethiopia found that Muslims are less likely to use or have the intention to use contraceptives compared to Orthodox women (55).

Breastfeeding practices

In a previous study including mothers in Tanzania, being a primipara mother was a risk factor for partial breastfeeding (9). In our study primiparous mothers exclusively breastfed their children for median 5 (3-6) months and multiparous women exclusively breastfeed their children for median 6 (4-6) months, and thus the primiparous exclusively breastfed one month less in comparison. In our child population, 56 % of all children was exclusively breastfed for six months. This is actually a remarkable high number, because recent numbers from Tanga indicates that only 12 % of children are exclusively breastfed under the age of five months. 85 % of the study population was still breastfeeding at 12 months, similar to national numbers (33). This study also indicates a relatively high duration of total breastfeeding, with 85 % breastfeeding for 18 months and 63 % breastfeeding for 24 months. To compare with Norwegian numbers (56), 44 % of Norwegian children was exclusively breastfed at 4 months,

but 81 % was still breastfed at this time, only 17 % of Norwegian children was exclusively breastfed for 5.5 months, and by the 7th month 67 % practiced mixed feeding. At 12 months, only 35 % of Norwegian women breastfed their children (56). A reason for the high outcome regarding duration of exclusive breastfeeding may be that of the interview not being conducted anonymously.

Stunting and underweight

Compared to the current status in Tanga, the prevalence of stunted and underweight children identified in this study is quite similar to that presented in the Tanzania National Nutrition Survey of 2014 (33) (Table 9). Data collected in Tanga indicates a 5 % reduction of stunted children now, compared to WHO's numbers from 2006 and the percentage of severely stunted children appear to be the same (33).

Table 9 Prevalence of stunted and underweight children identified in this study compared to data from the Tanzania National Nutrition Survey with numbers from WHO (2006) (33).*

	Year	N	Number of cases	Median	IQR
Stunting (< -2 SD)	2017	326	62 (19%)	-2,49	-3,18 – -2,35
Stunting (< -2 SD) *	2006	571	136 (24 %)		
Severe stunting (< -3 SD)	2017	326	17 (5 %)	-3,63	-4,23 – -3,37
Severe stunting (< -3 SD) *	2006	571	30 (5 %)		
Underweight (< -2 SD)	2017	324	28 (9 %)	-2,47	-2,94 – -2,13
Underweight (< -2 SD) *	2006	590	60 (10 %)		
Severe underweight (< -3 SD)	2017	324	6 (2%)	-3,18	-3,40 – -3,11
Severe underweight (< -3 SD) *	2006	590	7 (1 %)		

Tanzania is a relatively stable country in comparison to some African countries affected by conflicts, war and famine. Recently, other east African countries such as South Sudan and Somalia are facing a humanitarian crisis as famine has driven millions of people to starvation (57). This could negatively influence child growth because of the acute lack of food. In Tanzania, however, we don't expect to see a dramatic negative change in weight or height, although it is predicted that the prevalence of stunted children in East Africa will increase until the year of 2050 (28). Data from this study does not indicate any higher levels of stunted or underweight children compared to data from the Tanzania National Nutrition Survey of 2014 (33).

Education and work

Children of mothers with secondary, university or college education had significantly higher length and weight measurements compared to children of mothers who had none or primary education (see Table 6). The reasons for this was not investigated, and there may be confounding factors influencing the outcome, which was not explored in the study. Perhaps mothers with higher education have greater knowledge about breastfeeding and infant feeding practises and government recommendations. Also, women of higher education may not only have a higher income and as a result afford more nutritious foods, but they may also have greater access to antenatal care and counselling on breastfeeding and other health benefits. A study from Tanzania (58) states that knowledge of optimal breastfeeding was higher among women receiving counselling on breastfeeding and infant feeding during antenatal care, compared to other women. However, the same study (58) found that higher education was not associated with knowledge on optimal infant feeding, and another study with participants from Tanzania reveals that the mother's education and age is not associated with risk of partial breastfeeding. (9). In our study, only 3 % of the women had university or college education.

There was no significant difference between Z-scores for LFA and WFA in children with mothers working outside the home or as a house wife. However, total duration of breastfeeding was significantly lower in children with mothers working outside the house (Table 7). Women working outside the house may spend less time with their children and consequently don't have the opportunity to breastfeed for the same amount of time as mothers working at home. The possibility of maternity leave and maternity allowance may also affect the mother's ability to stay at home from work the first period of the child's life, which is recommended for optimal feeding practices (8).

Vaccination

In Tanzania, there is a high immunization coverage (38). The data collected in Tanga shows that 95 % of the children has an up to date immunization coverage for their respective ages. There was no significant difference in LFA Z-scores for those who didn't have their vaccinations up to date, but because this proportion was only 5 % of the total child population, the study did not have power to find such associations.

Strength and weaknesses

The main strength of this study is the high level of participation (N=327) and low selection bias. However, only the ones that actually visit the health clinics was recruited. Some mothers

may not visit the clinics if their children are malnourished because it may lead to strict reprimands from health care workers and ultimately is too stigmatising. A main limitation to this study is that of a recall bias. Women were asked questions about breastfeeding practices for their children who are between one to two years, and some women might not remember exactly when they stopped breastfeeding. Also, the mothers where asked questions directly at the site, surrounded by other women, children, health care workers, and not in complete privacy. The mothers did not fill out the questionnaire themselves, but they were given a Swahili version to read. Some mothers struggled with reading and signing the consent forms, but only a small portion had to give their fingerprint instead of signing their name on the forms. A weakness is also that we included all children, even them below 24 months, when assessing total duration of breastfeeding. Consequently, numbers in this study might reveal a shorter duration of total breastfeeding, as some of these children might keep on breastfeeding for some time.

In addition, there are some weaknesses related to the collection of weight measurements. The date of the first weight measurement was not collected during the interview, but only estimated from the collected values measured five visits prior to the current. This should be equivalent to five months earlier than the current visit because the children are supposed to visit the clinics every month. Still, it is an uncertainty because some mothers attend the clinics at different dates than scheduled. Therefore, the time difference may vary and consequently affect the results. Also, some children wore clothes and diapers while being weighed, all though the health care workers instructed most of the mothers to undress the children properly. Additionally, the scale at the one facility measured 0.4 kg too much, and this inaccuracy was not always accounted for when registering the current weight.

Subjective impressions

When the children attend the monthly weight control most of them come with the mother. They arrive early in the morning and at one facility they immediately hand over the child's health card to the health care worker's desk (Picture 1) and wait for them to register their attendance. After about 1-2 hours, when they are all registered, they line up to get the children weighed. The mothers bring home tailored trousers with a loop to hang the child to the weight, that hangs from the roof of the facility (Picture 2). They tell me that they have to bring their own trousers because of the risk of infections transmitting through the fabric. After weighing, if the child is unhealthy, has poor growth or is scheduled for vaccination, the mother and child continues to the next building of interest. At the most, I have counted over 90 mothers at one health clinic at the same time, and they all have at least one child present. One day a week, there are only HIV positive mothers attending, and the number of women is considerable decreased compared to other weekdays. At the health care workers desk they keep a bucket of snacks, chips and popcorn for the mothers to buy for the children. I asked a 1st year medical student attending the health clinic why they sold snacks, and he informed me it was to increase the child's appetite. Some days, health care workers inform me, when there are a lot of mothers and children and few health care workers present, the women might end up waiting the whole day to get the child weighed.

Picture 1 Mikanjuni health clinic, were mothers bring their children for weighing.

Picture 2 Husna Rajabu (interpreter) and mother Mariam Eliasa and her son Shahada Mohamedi who is being weighed.

Picture 3 Ngamiani health clinic.

Picture 4 Mikanjuni health clinic.

Picture 5 Mikanjuni health clinic.

While staying in Tanga, I had the opportunity to discuss child feeding practises with the nurses working at TICC and at the health clinics. They told me that child feeding practices is especially important these days, because they see an increase in malnourished children at the local clinics. They experience that the children have a relatively high intake of carbohydrates and lower consumption of protein. With a diet mainly consisting of carbohydrates from rice and maize, and high consumption of sugary drinks and snacks some children also develop overweight, and some become malnourished and grow poorly. Also, after spending some time at Ngamiani and Mikanjuni health clinics in Tanga, the only vaccine mentioned by name when we ask if the child had received all vaccinations as scheduled, was the booster dose of the measles vaccine, which was scheduled at 18 months. Some of the mothers explained that lacking the booster dose was often due to the vaccine being out of stock at the day of the vaccination. As data above shows, the booster dose of the measles vaccine has an immunization coverage of only 57 % in Tanzania (38).

Conclusion

The negative Z-scores for WFA and LFA indicates that children in this study population is below the median weight and length for their respective ages. Generally, their weight and height is below the standard, with LFA deviating more than WFA as a reflection of some degree of chronic undernutrition. The trend is also negative, with a decreasing change in WFA Z-scores over the last, approximately, five months.

There was no significant difference of WFA or LFA between children that was exclusively breastfed for 0-5 months and children that was exclusively breastfed for 6 months. The prevalence of exclusive breastfed children was higher than expected, with more than half of the child population still being exclusively breastfed at 6 months and total duration of breastfeeding exceeding one year and lasting up to two years. The prevalence of underweight and stunted children is relatively stable in the study population of children between one to two years old in Tanga compared to the national numbers from 2006. The findings of this study reveal that mothers with secondary, university or college education had children with significantly higher length and weight measurements for their respective ages. Having a mother staying at home as a house wife rather than working outside the house does not seem to affect child length or weight, but increases total duration of breastfeeding. There were no significant differences in child growth between the children who had an up to date immunization coverage for their age compared to those who had not. 95 % of the children in this study had an up to date immunization coverage for their age at the time of the interviews. This cross-sectional study does not depict the causal relationship between the parameters, which has to be investigated further in order to understand the outcomes.

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Attachment 1

Questionnaire in English ID No.

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UNIVERSITY OF TROMSØ

EARLY GROWTH OF CHILDREN AGED 12-24 MONTHS IN THE TANGA-REGION, TANZANIA

Name of Interviewer: _____

Name of facility: _____

Date: _____

1. Age of the respondent (in years) _____
2. Age of the child (in months) _____
3. Sex of the child
   - Male
   - Female

4. Education level of the respondent (tick the one that apply)
   - None
   - Primary education
   - Secondary Education
   - University college

5. Occupation of the respondent (tick the one that apply)
   - Peasant
   - Business
   - Employee
   - House wife
   - Student

6. Gravida (ask for the number of pregnancies) _____
7. Parity (number of births including live and stillbirths) _____
8. Number of children alive _____

9. Date of birth of each child (if cannot remember write year)
    1. Child 1 _____
    2. Child 2 _____
    3. Child 3 _____
    4. Child 4 _____
    5. Child 5 _____

10. How long have you exclusively breastfed the last child? (months)_____
11. How long have you practiced mixed feeding with the last child? (months) _____
12. What is the total duration you have been breastfeeding? (months) _____
13. Did the child receive all the vaccination as scheduled? (tick the one that apply)
    - ☐ Yes
    - ☐ No

14. What was the child's weight in kg and height in cm up to the current age?
    1. Visit 1 _____kg and _____cm
    2. Visit 2 _____ kg and _____cm
    3. Visit 3 _____ kg and _____cm
    4. Visit 4 _____ kg and _____cm
    5. Visit 5 _____ kg and _____cm
    6. Current_____ kg and _____cm

Thank you for your participation.

<table>
<tr><td colspan="3">References Nordang S, Shoo T, Holmboe-Ottesen G, Kinabo J, Wandel M. Women's work in farming, child feeding practices and nutritional status among under-five children in rural Rukwa, Tanzania. Br J Nutr. 2015;114(10):1594-603.</td><td>GRADE
Documentation: III
Recommendation: C</td></tr>
<tr><td>Purposes</td><td>Material and method</td><td>Results</td><td>Discussion/ Comments</td></tr>
<tr><td>Assessing the nutritional status of children under 5 years of age, feeding practices and risk factors of undernutrition in a rural village in the Rukwa region, as well as to discuss the results of a similar study conducted in 1987/1988.
Conclusion
The underweight prevalence was found to be at the same level in 2010 as was recorded in 1987/1988. Current child-feeding practices were not in line with WHO recommendations. Women working in farms, food shortage, dry-season cultivation and diseases partly explain the children’s poor nutritional status.
Countries
Tanzania
Year (of data collection)
2010</td><td><u>Study design</u>
Cross-sectional study.
<u>Recruitment</u>
One rural village (the same as in 1987/1988) was selected to discuss the results in the light of earlier findings. The main caretaker of the child and the household head were interviewed face to face in Kiswahili.
<u>Inclusion/exclusion criteria</u>
Households without children under 5 years of age and those who became residents of the village after September 2009 were excluded.
<u>Basis of data</u>
152 children. The study participants: one child <5 years of age from each of the 152 households, the child’s main caretaker and the household head.
<u>Outcome</u>
<u>Statistical methods</u>
Frequency distributions, median and the 25th–75th percentile or range, mean and standard deviation or CI were used. Pearson’s χ^2 test was used to test for differences between the sexes in nutritional status.
Risk factors for stunting and underweight were assessed using the χ^2 test and logistic regression.</td><td>The prevalence of stunting, severe stunting included, was very high – 63·8 %. The prevalence of both stunting and underweight increased with age. Stunting was over 70 % at 12–48 months of age, and declined thereafter, whereas the percentage of underweight remained high up to 59 months.The prevalence of wasting and overweight were both approximately 3 %</td><td><u>Checklist cross-sectional study:</u>
Were the criteria for inclusion in the sample clearly defined? YES
Were the study subjects and setting described in detail? YES
Was objective, standard criteria used for measurement? YES
Was confounding factors identified? YES
Were strategies to deal with confounding factors stated? UNCERTAIN
Were the outcomes measured in a valid and reliable way? YES
Was appropriate statistical analysis used? YES

<u>Strengths:</u>
The study location was the same as the previous study conducted in Rukwa, which was used for comparison. The study was conducted in the child’s home, so the participants did not have to seek the interviewers. Although, recall bias, the children’s feeding practices was only to be remembered from the previous day, and not far back in time.
<u>Weaknesses:</u>
The main limitation of this study was that the methods used to estimate days spent on farming and the economic indicator have not been validated. Recall bias is likely to have occurred when estimating the days spent on farming. Unfortunately, it was not possible to directly compare women working in farms in the two studies due to differences in the methods used. Further, the data analysis would have been strengthened with a larger sample size, and it would have been possible to disaggregate data according to age. In addition, the cross-sectional study design did not allow us to make conclusions regarding causal relationships.
<u>Other literature confirming these results?</u>
M Wandel & G Holmboe-Ottesen (1992) Food availability and nutrition in a seasonal perspective - a study from the rukwa region in Tanzania. Hum Ecol 20, 89–107.</td></tr>
</table>

References Hashim TH, Mgongo M, Katanga J, Uriyo JG, Damian DJ, Stray-Pedersen B, et al. Predictors of appropriate breastfeeding knowledge among pregnant women in Moshi Urban, Tanzania: a cross-sectional study. International Breastfeeding Journal. 2017;12(1):11.			**GRADE** Documentation: III Recommendation: C
Purposes	**Material and method**	**Results**	**Discussion/ Comments**
This study aimed to assess the knowledge of women on optimal breastfeeding during pregnancy and associated factors as well as performance of the health system in reaching women with information on breastfeeding and infant feeding issues. **Conclusion** The health system failed to reach the 49% of women who did not receive counselling on infant feeding. Pregnant women who had received counselling on optimal breastfeeding and women with more than one child were more likely to have knowledge of optimal breastfeeding practices. **Countries** Tanzania **Year (of data collection)** 2013-2014	Study design: Cross-sectional study. Recruitment: The study population included pregnant women, who were in their third trimester and attending routine care at the two clinics. Purposive sampling was used to recruit participants for the study. Inclusion/exclusion criteria: All pregnant women who were attending antenatal clinic from the 2 clinics in Moshi, and gave consent, were considered eligible for the study. Basis of data: 536 women Outcome: 51% women reported that they had received counselling on breastfeeding or infant feeding during this current pregnancy. Most of the pregnant women had knowledge of giving colostrum (75%), knowledge of the initiation of breastfeeding within 1 h after delivery (70.7%), knowledge of EBF (81%) and 83% had knowledge on appropriate time to introduce complementary foods. Only 61.2% of the women were able to answer all of the three components correctly. Many (54%) reported to have received the information from health facilities, followed by media 36.0% Statistical methods: The data were entered, cleaned and analyzed using SPSS versions 22. The odds ratio (OR) with its associated 95% confidence interval was used to assess the strength of association between knowledge on optimal breastfeeding practices and predictor variables. Logistic regression analysis was used to control for confounding factors.	Only 51% reported to have received counselling on breastfeeding from their healthcare providers during the current pregnancy. More than seven out of ten pregnant women were knowledgeable about key issues regarding appropriate breastfeeding practices (importance of colostrum (95%), time of breastfeeding initiation (71%), exclusive breastfeeding (EBF) (81%), and time of introducing complementary feeding (83%). Receiving counselling on breastfeeding during the current pregnancy, having two children, having three or more children, and intention to breastfeed the child exclusively were significantly associated with appropriate breastfeeding knowledge.	Checklist cross-sectional study: Were criteria for inclusion clearly defined? YES Were the study subjects and setting described in detail? YES Was the exposure measured in a valid and reliable way? UNCLEAR Were objective, standard criteria used for measurement of the condition? UNCLEAR Were confounding factors identified? YES Were strategies to deal with confounding factors stated? YES Were the outcomes measured in a valid and reliable way? YES Was appropriate statistical analysis used? YES Strengths: This study is among the few studies that have addressed the knowledge on all optimal breastfeeding practices and not only exclusive breastfeeding. Weaknesses: The study included pregnant women in urban Kilimanjaro hence the findings cannot be generalised for rural women in Kilimanjaro or Tanzania in general. Further, the study evaluated knowledge on optimal breastfeeding practices during pregnancy hence it is difficult to assess whether knowledge would lead to practice after delivery. Other literature confirming these results? (healtcare workers) Chale LE, Fenton TR, Kayange N. Predictors of knowledge and practice of exclusive breastfeeding among health workers in Mwanza city, northwest Tanzania. BMC Nurs. 2016;15:72.

References	GRADE	
Afnan-Holmes H, Magoma M, John T, Levira F, Msemo G, Armstrong CE, et al. Tanzania's Countdown to 2015: an analysis of two decades of progress and gaps for reproductive, maternal, newborn, and child health, to inform priorities for post-2015. The Lancet Global Health.3(7):e396-e409.	Documentation	III
	Recommendation	C

Purposes	Material and method	Results	Discussion/ Comments
Tanzania is on track to meet Millennium Development Goal (MDG) 4 for child survival, but is making insufficient progress for new born survival and maternal health (MDG 5) and family planning. To understand this mixed progress and to identify priorities for the post-2015 era, Tanzania was selected as a Countdown to 2015 case study.	Study design Large-scale multi-analysis case study Basis of data Mortality estimates for maternal mortality ratio, neonatal mortality rate, under-5 mortality rate, and stillbirth rate from estimates by the United Nations (UN), the Institute for Health Metrics and Evaluation, and nationally representative Demographic and Health Surveys. Outcome The reduction in mortality for children aged 1–59 months between 2000 and 2012 had an average annual rate of reduction (ARR) of 8·5%. Neonatal mortality decreased at half this rate win an ARR of 4·3%. Statistical methods A health systems evaluation framework was used to assess coverage and equity of interventions along the continuum of care, health systems, policies and investments, while also considering contextual change (eg, economic and educational). Five objectives assessed each level of the health systems evaluation framework and the Lives Saved Tool (LiST) and multiple linear regression analyses was used to explain the reduction in child mortality.	Reductions in maternal, new born, and child mortality accelerated during the MDG era, especially since 2000, most notably for under-5 mortality. Tanzania met MDG 4 through a substantial reduction in mortality for children aged 1-59 months between 2000 and 2012. Neonatal mortality decreased at half this rate. Projections to 2030 indicate that, if present trends continue, Tanzania could achieve child and possibly also neonatal targets.	Strengths: This is a large -scale study with a large study population derived from national numbers from UN, Institute for Health Metrics and Evaluation and nationally representative Demographic and Health Surveys. Because the data is solely obtained from national surveys, the outcomes are very transferable. Weaknesses: This is not a systematic review and the study includes surveys dating back to the 90's. The infrastructure in Tanzania may also contribute to a higher proportion of missing cases from national surveys.
Conclusion The interventions with the greatest effects on deaths averted include immunisations, insecticide-treated bed nets, and HIV interventions. For neonates, the five most effective interventions were skilled attendance at birth and emergency obstetric care, essential new born care and neonatal resuscitation, case management of severe neonatal, antenatal corticosteroids for preterm birth, and kangaroo mother care. Improvements in breastfeeding and complementary feeding led to 2400 additional lives saved in neonates and children. Almost three-quarters of the effect for maternal mortality was skilled attendance at birth and emergency obstetric care, with additional effects from active management of the third stage of labour and clean birth practices. Increasing contraceptive use reduces mortality rates through fewer pregnancies and births, which provides substantial cost savings.			
Countries Tanzania			
Year (of data collection) 1990-2014			

References			**GRADE**	
Agostoni C, Braegger C, Decsi T, Kolacek S, Koletzko B, Michaelsen KF, et al. Breast-feeding: A Commentary by the ESPGHAN Committee on Nutrition. Journal of Pediatric Gastroenterology and Nutrition. 2009;49(1):112-25.			Documentation	IV
			Recommendation	C
Purposes	**Material and method**	**Results**	**Discussion/ Comments**	
The purposes of this article are to summarise the current situation regarding breast-feeding, knowledge of the composition of human milk, advisable duration of exclusive and partial breast-feeding, growth of the breast-fed infant, health benefits associated with breast-feeding, supplementation of breast-fed infants and contraindications to breast-feeding, as well as defining the role of paediatricians in the implementation of health policies seeking to promote breast-feeding.	Study design: This is not a study but a medical position article. Evidence is obtained from expert committee opinions. There is no material and method described. The article summarises current knowledge of the European Society for Paediatric Gastroenterology, Hepatology, and Nutrition (ESPGHN).	There are no quantifiable results in this study, but the conclusion from the expert committee can be read under "Conclusion".	Strengths: ESPGHN is a serious and well respected medical authority that bases their recommendations on scientific information. Weaknesses: This is not a scientific study, but an article from ESPGHN that summarises the status and knowledge of health benefits of breastfeeding in Europe. No material and methods was presented, and there was no clear assessment of previous studies, no analyses and results, only the opinions of the organization and a list of references. Also, some of the findings in this study is already outdated. Other literature confirming these results? The recommendations given in this article is widely practiced and used as national guidelines in several European countries.	
Conclusion				
Breast-feeding is the natural and advisable way of supporting the healthy growth and development of young children. There are numerous indicators of benefits of breast-feeding on child health, both during infancy and later in life; a reduced risk of infectious diarrhoea and acute otitis media are the best documented effects. Exclusive breast-feeding for around 6 months is a desirable goal, but partial breast-feeding as well as breast-feeding for shorter periods of time are also valuable.				
Countries				
Europe				
Year (of data collection)				
No data collection				

References	GRADE	
Patil CL, Turab A, Ambikapathi R, Nesamvuni C, Chandyo RK, Bose A, et al. Early interruption of exclusive breastfeeding: results from the eight-country MAL-ED study. Journal of Health, Population, and Nutrition. 2015;34:10.	Documentation	II
	Recommendation	B

Purposes	Material and method	Results	Discussion/ Comments
The goal is to describe early infant feeding practices in the cohort and evaluate factors associated with termination of exclusive breastfeeding the 1st month of life. Data is collected as a part of the "Malnutrition and Enteric Infections: Consequences for Child Health and Development" (MAL-ED) study, where the goal is to examine inter-relationships between diet and enteric infections over time as these relate to the development of intestinal inflammation, malnutrition and cognition in children from birth to 24 months of age. **Conclusion** The results revealed diversity across the sites, but an overall trend of early transition away from exclusive breastfeeding in the first month of life. Interventions which introduce or reinforce the WHO/UNICEF Ten Steps for Successful Breastfeeding are needed in these sites to improve breastfeeding initiation, to reinforce exclusive breastfeeding and delay introduction of non-breast milk foods and/or liquids. **Countries** Bangladesh, India, Nepal, Pakistan, Brazil, Peru, South Africa, Tanzania **Year (of data collection)** 2009-2012	Study design: Prospective longitudinal birth cohort study Recruitment: Trained study personnel identified pregnant women through a community survey as well as through health clinics or by referral. Inclusion/exclusion criteria: 1) Healthy singleton new born (≤17 days of age); 2) Mother 16 + years of age; 3) Family intended to stay in the study area for the next 6-month period; 4) No other child from the same family was enrolled in the study; 5) Birth weight or enrolment weight was greater than 1500 grams; 6) The child did not have a diagnosable congenital disease or severe neonatal disease. Basis of data: 2053 children Outcome Only 6/2053 infants were never breastfed. By one month, the prevalence of exclusive breastfeeding was <60% in 6/8 sites, and of partial breastfeeding (or no) were >20% in 6/8 sites. The median frequency of reporting of formula was 43-87% across 5 sites, and for other animal milks the median frequency was 14-63% across 7 sites. Among those receiving semi-solids, the median frequency of consumption thereafter was 14-63% of visits. Statistical methods: Logistic regression	By one month of age, the proportion of infants exclusively breastfed had declined in all sites. Formula was reportedly given to some infants in 7/8 sites. At the PKN site, only 7.4% were put to the breast in the 1st hour, and 20.9% did not initiate until day 1 or later. At the other 7 sites, rates were higher with 41-83% of infants being put to the breast within one hour of birth, and 90-98% breastfed within 24 hours of birth. In BGD, BRF, NEB, PEL and SAV, < 5% of mothers reported not giving their infant colostrum, but in TZH, PKN and INV the reported rates were higher, ranging from 8.6 -16.4%. In PKN, 63.2% of infants were given a prelacteal feeding, substantially higher than the incidence of 12.4 -17.7% in the other South Asian sites, and 3.7-9.2% in the remaining foursites. The likelihood of partial (or no) breastfeeding at one month was associated with early feeding practices. The provisioning of a prelacteal feed increased the risk of partial breastfeeding. There was a tendency for the initiation of breastfeeding within the first hour to be associated (p = 0.09) with decreased risk of partial breastfeeding at one month. Being a first-time mother was indicative of higher risk of partial breastfeeding.	Strengths: This was a prospective study with a large basis of data. Data was collected from home visits (and not clinic visits), so that children who lives in the periphery also was included. The individuals are representative for a defined population. Weaknesses: The main limitation of this study is that it was not designed specifically to assess risk factors associated with partial breastfeeding. Another component is that infants were enrolled from birth to 17 days, and thus, the period of maternal recall of initiation and the level of certainty regarding breastfeeding practices in the early days varies across the sites. There is also some diversity across the different sites, as this is a multinational study. No dropout analysis was executed. Discussions of the authors? "We did not collect additional information at each visit that would allow us to understand the reasons for the reported feeding practices. The MAL-ED study was designed to be an observational study, and we did not want to call attention to specific practices and thereby influence the results. Ultimately, we wish to detect differences in early infant feeding practices in order to relate this information to other data on gut function, enteric illness, child growth and development, all of which are being simultaneously collected in the study».