School of Public Health

A cohort study of feeding patterns and health outcomes of infants in the Rufiji district of Tanzania

Ester Elisaria

This thesis is presented for the degree of Doctor of Philosophy in Public Health of Curtin University

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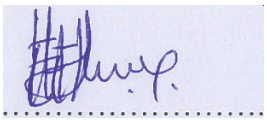
Declaration

To the best of my knowledge and belief this thesis contains no material previously published by any other person except where due acknowledgment has been made.

This thesis contains no material which has been accepted for the award of any other degree or diploma in any university.

The research presented and reported in this thesis was conducted in accordance with the National Health and Medical Research Council National Statement on Ethical Conduct in Human Research (2007) — updated March 2014. The proposed research study received human research ethics approval from the Curtin University Human Research Ethics Committee (EC00262), Approval Number **HR 155/2011** and Ifakara Health Institute in Tanzania, Approval number **IHI/IRB/No:** 43.

Name: Ester Elisaria

Signature: 

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Abstract

Introduction

'Exclusive breastfeeding' is recommended by the World Health Organisation (WHO) as the optimal way of feeding infants aged less than six months. Despite the efforts made by the WHO and other organisations to promote 'exclusive breastfeeding' to six months, a considerable number of infants are given complementary foods within their first month of life. The long-term and short-term effects of 'exclusive breastfeeding' have been established. However there has been limited community based longitudinal studies from developing countries, particularly Tanzania, looking at the association between infant feeding practices and health outcomes under unhygienic environmental conditions. This present study explored the association between infant feeding patterns and health outcomes in the Rufiji rural community of Tanzania mainland among infants aged less than six months.

Method

A prospective mother-infant pair cohort study was undertaken from February 2012 to March 2013. The study was integrated into the ongoing Health and Demographic Surveillance System (HDSS) activities being conducted every four months by the Ifakara Health Institute. Mother-infant pairs were enrolled consecutively at their home by a trained enumerator within four weeks postpartum. The mother-infant pair was visited again at three and six months by the same enumerator. During each visit mothers were interviewed on infant feeding practices using a well-structured questionnaire. A total of 1302 women and their infants were recruited and 1056 were available at six months. Data were analysed using the Statistical Package for Social Science (IBM SPSS statistics version 21). Descriptive statistics were used for baseline and feeding patterns, chi-square for categorical variables, univariate analysis for mean differences and logistic regression for factors influencing 'exclusive breastfeeding' and adjusting for confounding factors.

Results

This mother-infant pair prospective study demonstrated that breastfeeding was a common way of feeding infants aged 0-6 months in Rufiji. Nearly 99% of infants were still breastfeeding at the age of six months and over 95% of infants were not

exposed to pre-lacteal feeds. Sixty one percent of infants were breastfed within one hour indicating positive infant feeding practices in this rural community. However, there was a rapid decline in the 'exclusive breastfeeding' rates. At the age of one month 70% of infants were exclusively breastfed but the rates declined to 22% at three months of age and to 2% at six months of age.

Logistic regression indicated a negative association between 'exclusive breastfeeding' and exposure to pre-lacteal feeds (OR 0.41 95% CI 0.24-0.70), low maternal education level (OR 0.58 95% CI 0.33-1.01) and lack of maternal ownership of radio (OR 0.69 95% CI 0.52-0.92) at the age of one month. However, at the age of three months 'non-exclusive breastfeeding' was practiced by mothers with husbands who did not attain secondary education (OR 0.41 95% CI 0.27-0.61), were Muslim (OR 0.53 95% CI 0.33-0.84) and without ownership of radio (OR 0.45 95% CI 0.30-0.67). These results indicated that factors influencing breastfeeding may change over time.

Early complementary feeding was common in this community whereas only 2% of infants received 'exclusive breastfeeding' at the age of six months. Mostly water and maize porridge were provided to infants as first complementary foods whereas 86% of infants drank water and over 80% were given maize porridge at the age of six months. Only a small proportion of infants (14.3%) started receiving stiff porridge (maize meal) at the age of six months. Majority of the mothers (58%) mentioned "baby crying too much" and inadequate breastmilk supply (10%) as the main reasons for early exposure to complementary foods. This indicates that a successful breastfeeding promotion program must contemplate infant behaviours such as "baby crying too much" which may not infer hunger.

A gender disparity in infant growth was observed in Rufiji. Boys in the study were nearly twice as likely (17.5% 95% CI 14.2%-21.0%) to be stunted than girls 8.3% (95% CI 6.2%-11.1%) at the age of six months. Overall these findings have a profound implication when addressing the persistent high level of stunting (over 40%) in Tanzania. A more robust study should be implemented to identify key variables that predispose boys to stunting before embarking into any major interventions.

There was no statistically significant difference in growth of infants who were exclusively breastfed and those who were not ‘exclusively breastfed’. Weight for age, length for age and weight for height at one, three and six months was similar. Though not statistically significant, at one month ‘exclusively breastfed’ infants were less likely to be underweight (Adjusted RR 0.57 95% CI 0.29-1.04) and at three months (Adjusted RR 0.98 95% CI 0.49-1.98). Stunting was also 20% less in exclusively breastfed infants at the age of one month compared with non-exclusively breastfed infants and over 30% protective effect on stunting (RR 0.67 95% CI 0.34-1.33) at the age of three months. However, in the univariate analysis, ‘exclusive breastfed’ infants had lower weight than ‘predominantly’ and ‘partially breastfed’ infants. It is less likely that the observed absolute difference of 74 grams between exclusive and ‘predominant breastfed’ infants and 195 grams for ‘partial breastfed’ infants would have a biological plausible effect.

Due to the low rates of ‘exclusive breastfeeding’ at six months, the data collected at one and three months were used to find an association between ‘exclusive breastfeeding’ and morbidity. There was no statistical significant difference in morbidity rates (cough, fever, vomiting, diarrhoea, eye and ear infections and respiratory tract symptoms) between exclusive and ‘non-exclusive breastfed’ infants in Rufiji at one and three months of age. The lack of significant association might have been related to the sustained high rates of ‘any breastfeeding’, non-exposure to pre-lacteal feeds and high rates of timely breastfeeding initiation in this community.

Conclusion

This was the first home based prospective cohort study to be implemented in the Rufiji community of the Tanzania mainland to assess infant feeding patterns and health outcomes. The high rates of ‘any breastfeeding’ observed in this community together with the non-exposure to pre-lacteal feeds need to be maintained. This may involve the use of trained community health workers to continue educating mothers on the benefits of breastfeeding and ideal ways of managing related problems. Breastfeeding promotion programs need to address child behaviours such as ‘baby crying too much’ and the perceived low maternal milk supply that were mentioned as the main reasons for early complementary feeding in Rufiji. Policy makers need to

implement programs such as Baby Friendly Initiatives to promote ‘exclusive breastfeeding’ in Rufiji. The programs may employ need-based counselling, formal and informal breastfeeding education integrated with the ongoing antenatal services since antenatal attendance was high in Rufiji. Early complementary feeding should be discouraged since it does not provide any additional benefit on child health as compared with ‘exclusive breastfeeding’. Factors influencing ‘exclusive breastfeeding’ such as maternal education, ownership of radio, maternal religion, pre-lacteal feeds and partner’s education level need to be addressed.

Abbreviations

AFASS: Affordable, feasible, accessible, safe and sustainable

AIHWA: Australia Institute of Health and Welfare

ARR: Adjusted relative risk

BFHI: Baby-Friendly Hospital Initiative

BMI: Body mass index

CCHS: Canadian Community Health Survey

CDC: Centre for Disease Control

CI: Confidence interval

DHS: Demographic and Health Survey

G: Gram

HAZ: Height for age Z-score

HDSS: Health and Demographic Surveillance System

HIV: Human immunodeficiency virus

HR: Hazard ratio

IMR: Infant mortality rate

IQ: Intelligence quotient

LAZ: Length for age Z-score

LBW: Low birth weight

MDG: Millennium development goal

MMR: Maternal mortality rate

MTCT: Mother-to-child transmission of HIV

NBS: National Bureau of Statistics

OR: Odds ratio

PCR: Polymerase chain reaction

RNA: Ribonucleic acid

RR: Relative risk

SES: Social economic status

SlgA: Secretory immunoglobulin A

SPSS: Statistical package for social science

TACAIDS: Tanzania Commission for AIDS

TDHS: Tanzania Demographic and Health Survey

TMHIS: Tanzania Malaria and HIV/AIDS Indicator Surveys

UNICEF: United Nations Children Fund

UNAIDS: United Nations Programme on HIV/ Acquired Immune Deficiency Syndrome

WAZ: Weight for age Z-score

WHO: World Health Organisation

Definitions

Any breastfeeding: Requires that the baby obtain some breastmilk and any food or liquid with other non-human milk (World Health Organisation, 2008c).

Breastfeeding: "Is an unequalled way of providing ideal food for the healthy growth and development of infants; it is also an integral part of the reproductive process with important implications for the health of mothers" (World Health Organisation, 2003, p. 7).

Colostrum: Is the thick yellow milk secreted by the breasts during the first few days after delivery, which gradually evolves into mature milk at 3–14 days postpartum. It contains more antibodies and white blood cells than mature breast milk.

Complementary feeding: Means giving an infant breastmilk and solid or semi-solid foods. It comprises any food or liquids including non-human milk (World Health Organisation, 2008c).

Complementary foods: Refers to any solid or liquid foods, whether factory-made or locally prepared, provided to a child in addition to the breastmilk (Barros, Halpern, Victora, Teixeira, & Beria, 1994).

Confidence Interval: Is a range of values well-defined that there is a known chance (mostly 95%) showing that the value of a population parameter lies within it (Ramoo, Trinh, Hirst, & Jeffery, 2014).

Cohort study: Denotes prospectively studying a segment of a population over a period of time where exposure is normally measured before the outcome (Ramoo et al., 2014).

Early initiation of breastfeeding: Placing newborns to the breast within one hour after delivery.

Exclusive breastfeeding: Refers to when an infant receives only breastmilk; it excludes other liquid and solids except oral rehydration solution, drop and syrup (vitamins, mineral and medicines) (World Health Organisation, 2008c).

Infant: Refers to all children aged below twelve months.

Mixed feeding: Providing breastmilk to an infant or a child together with other foods or liquids including non-human milk.

Malnutrition: Refers to different forms of poor nutrition as a result of low or excessive intake of specific foods.

Non-breastfeeding: Refers to when the infant did not receive breastmilk (Mihrshahi, Oddy, Peat, & Kabir, 2008).

Odds ratio (OR): An odds ratio is a measure of the strength of association between exposure and the disease (or problem). In a cohort study it suggests a ratio of two odds: the odds of developing a certain condition or disease among exposed compares to the odds of getting the condition/disease among non-exposed individuals (Ramoo et al., 2014)

Partial breastfeeding: Refers to giving an infant breastmilk in addition to complementary foods (Mihrshahi et al., 2008).

Predominant breastfeeding: When the infant receives breastmilk (including expressed milk or milk from wet nurse) as a main source of nourishment. It includes, water, drops, juice, vitamins, minerals, medicine but excludes infant formula of other milk (World Health Organisation, 2008c).

Pre-lacteal feeds: Refers to any feeds provided to a newborn before the start of lactogenesis II, which implies the beginning of copious breastmilk ejection that happens within four days after birth (Mihrshahi et al., 2008; Njai & Dixey, 2013)

Stunting: Known as chronic malnutrition which indicates a failure to attain biological potential in growth among children as a result of under-nutrition. Normally it is calculated as Height-for-age < –2 standard deviations (SD) of the WHO child growth standards median (National Bureau of Statistics & ICF Macro, 2011b)

Underweight: Signifies stunting and or wasting which suggests short-term and long-term under-feeding normally calculated as Weight-for-age < –2 standard deviations (SD) of the WHO child growth standards median (National Bureau of Statistics & ICF Macro, 2011b).

Wasting: Reflects present nutritional status which implies seasonal food insecurity, severe infections and natural calamities such as war. Usually it is calculated as Weight-for-height < –2 standard deviations (SD) of the WHO child growth standards median (National Bureau of Statistics & ICF Macro, 2011b).

Z-score: Implies the deviance 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) (World Health Organisation, 2006c).

Chapter 1: Background information

1.1 Introduction

Changing patterns of infant feeding pattern have been observed in both developed and developing countries as a result of urbanisation and economic development (K. G. Dewey & Brown, 2003), participation of women in the paid labour force, and the availability of infant formula and associated promotions (Cattaneo & Quintero-Romero, 2006; Flack & Shaw, 2003; King & Ashworth, 1987). In many developing countries these changes have resulted in increased exposure of infants to infant formula, liquids and homemade foods in their first months of life (World Health Organisation, 2013). The World Health Organisation (WHO) recommends early breastfeeding initiation (within one hour) and 'exclusive breastfeeding' for six months and continued breastfeeding while receiving safe and nutritious food until two years of life (World Health Organisation, 2003b). Globally only 37% of infants were exclusive breastfed for the first six months in 2013 (World Health Organisation, 2013).

Recently Black et al (2013) conducted an analysis of breastfeeding patterns using survey data generated from 78 countries. Rates of breastfeeding initiation within one hour in Latin America was 58%, Africa and Asia both had an average level of 50% (R. E. Black et al., 2013). The findings clearly indicated that a large proportion of infants never benefitted from breastfeeding in the first days of life. Rates of 'exclusive breastfeeding' have remained low in most developing countries in recent years. In China, only 28% of the infants benefited from breastfeeding in 2008 while Nepal experienced a decline in breastfeeding from 68% reported in 2001 to 53% observed in 2006 (World Health Organisation & United Nations for Children Fund, 2012). More than half (54%) of Indian infants were never exclusively breastfed in 2006 despite the high rates of malnutrition in that country (World Health Organisation & United Nations for Children Fund, 2012). In 2013 low income countries had rates of 42% 'exclusive breastfeeding' while in middle-income countries 38% of infants were exclusively breastfed for the first six months (World Health Organisation, 2013).

In African nations, a countdown report published by UNICEF and WHO reported a large variation of 'exclusive breastfeeding' rates for the first six months ranging from 1% in Djibouti to 85% in Rwanda (World Health Organisation & United Nations for Children Fund, 2012).

In Tanzania there has been limited longitudinal/cohort studies analysing infant feeding patterns and most presented data were collected through Demographic and Health Surveys conducted at intervals of five years. Relying on survey data create a likelihood of overestimating breastfeeding due to memory bias, misclassification of breastfeeding patterns (R. Li, Scanlon, & Serdula, 2005) and using cumulative percentage when presenting breastfeeding rates. According to a recent survey conducted in Tanzania by the National Bureau of Statistics (NBS) and Macro International (2010), the rate of breastfeeding initiation within one hour of birth was 49% which was less than the presented rate of 59% in 2004. Rates of 'exclusive breastfeeding' among infants aged less than two months was 81%, with a decrease to 51% at the age of two to three months and 23% at four to five months. The national median duration of 'exclusive breastfeeding' for Tanzania children was 2.4 months (National Bureau of Statistics and ICF Macro, 2011). Considering the sub-optimal feeding practices in Tanzania, establishment of its effect on infant health in a longitudinal study is paramount.

1.2 Overview of the importance of optimal infant feeding patterns

The World Health Organisation (WHO) documented the short-term (Horta & Victora, 2013b) and long-term benefits (Horta & Victora, 2013a) of breastmilk to infants which may be influenced by the duration of feeding, volume of breastmilk and maternal nutrition (Flack & Shaw, 2003; Kent, 2007). Breastmilk contains nutrients, living cells, hormones and enzymes needed for growth and development (Alexander & Reginald, 2005; Gupta & Dadhich, 2008; Novotny et al., 2007; World Health Organisation, 2007). The secretory immunoglobulins (secretory IgA), oligosaccharides and the protein lactoferrin found in colostrum and in breastmilk protect the gastro-intestinal tract from infections (Novotny et al., 2007; Petherick, 2010). Optimal infant feeding has been

consistently associated with reduced risk of child morbidity and mortality (R. E. Black et al., 2013; Edmond, Kirkwood, Amenga-Etego, Owusu-Agyei, & Hurt, 2007; Horta & Victora, 2013b; Kramer & Kakuma, 2004; World Health Organisation, 2000), reduced risk of sudden infant death syndrome, atopic eczema, asthma, childhood and adulthood overweight/obesity (Owen, Martin, Whincup, Smith, & Cook, 2005), chronic non-communicable diseases, improvement of psychomotor changes (K. G. Dewey, Cohen, Brown, & Rivera, 2001), IQ level (Cope & Allison, 2008; Kramer, 2010; Viner, Hindmarsh, Taylor, & Cole, 2008; World Health Organisation, 2007), cognitive function (Tanaka, Kon, Ohkawa, Yoshikawa, & Shimizu, 2009) and academic performance (McCrory & Layte, 2011b). 'Exclusive breastfeeding' increases mother to child bonding, prolongs lactational amenorrhea (Kramer & Kakuma, 2004; Kramer & Kakuma, 2012), reduces postpartum bleeding, reduces the risk of breast, ovarian and uterine cancer (Labbok, 2006) and can result in less weight retention after delivery (K. G. Dewey et al., 2001; Kramer & Kakuma, 2004; Ostbye, Krause, Swamy, & Lovelady, 2010).

1.3 Background information about Tanzania

The United Republic of Tanzania is in East Africa with an area of 886,000 square kilometres (National Bureau of Statistics, 2013b). Tanzania is bordered by Kenya and Uganda in the north, Rwanda, Democratic of Congo and Burundi in the west, Zambia and Malawi in the south west, Mozambique in the south and the Indian ocean provides the eastern border (National Bureau of Statistics, 2013b). According to the 2012 census, conducted by the National Bureau Statistics (NBS), the population of Tanzania was 44.9 million people of which 21.8 million were females and 23.1 million were males, and 7.3 million (16.2%) children were below the age of five (National Bureau of Statistics, 2013a). The total life expectancy at birth has improved from 51 years in 2002 to 60 years in 2012 (58 years for males and 62 years for females) with annual births of 49,026 and 12,530 deaths (National Bureau of Statistics, 2013b; National Bureau of Statistics & ICF Macro, 2003). The review of the five year Tanzania National Strategy for Growth and Poverty Reduction indicated an economic growth of 7% per year in 2010 which was an improvement from 6% in 2009 (Ministry of Finance, 2012). However, the

improvement in the economic growth has not translated into an improvement in household income since over one third of Tanzanians were living below the poverty line (1.25$ per day) in 2012 (Ministry of Finance, 2012).

1.3.1 Maternal and child health in Tanzania

Although the overall maternal mortality ratio has declined from 870 deaths per 100,000 live births in 1990 to 460 deaths per 100,000 live births in 2010, the country will struggled to reach the millennium development goal (MDG) reduction of 220 by 2015 2015 (World Health Organisation & United Nations for Children Fund, 2012). At the time of publication of the present thesis, no reliable data is available for maternal mortality rates for 2015. Pregnancy-related deaths dropped from 578 in 2004 to 556 in 2010 per 100,000 live births (National Bureau of Statistics & ICF Macro, 2011b; National Bureau of Statistics & ORC Macro, 2004). Overall, the number of pregnant women who delivered in a health facility was 47% in 2004 and increased slightly to 50% in 2010. The percentage with assisted delivery was 46% in 2004 and increased to 51% in 2010. However, there was a large discrepancy between urban and rural areas where only 42% of rural women gave birth in a health facility compared with 83% of urban women (National Bureau of Statistics & ICF Macro, 2011b; National Bureau of Statistics & ORC Macro, 2004). The increase in the number of women delivering at a health facility and attended by a health professional might have contributed to the reduction of maternal mortality.

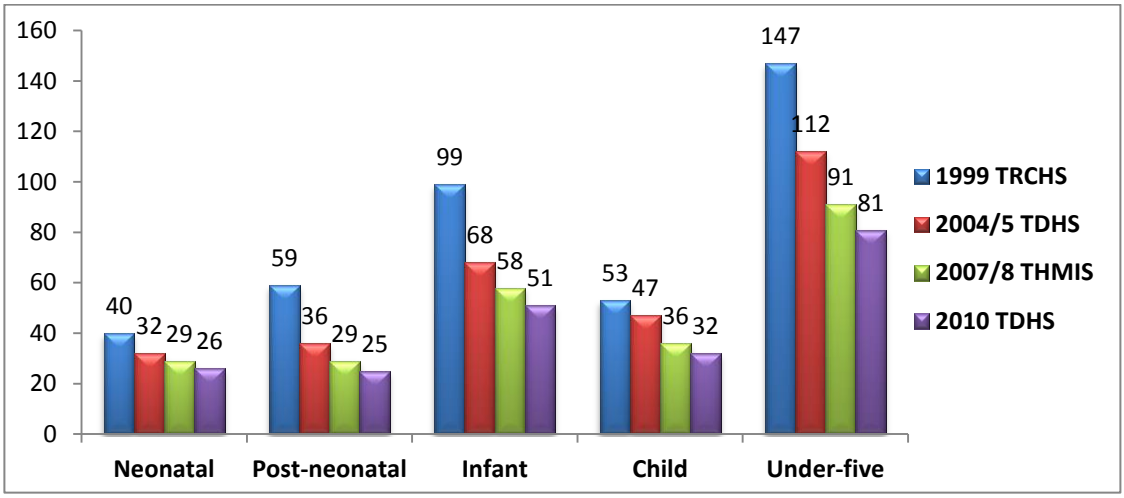
The 2010 Demographic and Health Survey also assessed the nutritional status of women aged 15-49 years. Assessment of nutritional status of women at reproductive age is vital as it is indicative of child health (National Bureau of Statistics and ICF Macro, 2011). The survey indicated that 11% of women who gave birth in the two months preceding the survey were undernourished (BMI less than 18 kg/m^2) and 22% were either overweight or obese with an average BMI of 23 kg/m^2 (National Bureau of Statistics & ICF Macro, 2011b). Parallel to the Demographic and Health Survey, a micronutrient survey included several biomarkers to measure micronutrient levels among women of

reproductive age (15-49 years). Results obtained indicated that 30% of women were iron deficient and 41% had anaemia (National Bureau of Statistics & ICF Macro, 2011a).

Infections with Human Immunodeficiency Virus (HIV) were not a focus in this present study. However, recognising its existence is paramount as it may have an effect on infant feeding patterns and other child and maternal health indicators. Results obtained from the Tanzania Malaria and HIV/AIDS Indicator Surveys (THMIS) showed a decline in HIV prevalence among adults aged 15-49 from 7.0% (6.3% among males and 7.7% among females) in 2003 to 6% (5% in men and 7% in females) in 2007/8 (Tanzania Commission for AIDS (TACAIDS), Zanzibar AIDS Commission (ZAC), National Bureau of Statistics (NBS), Office of the Chief Government Statistician (OCGS), & Macro International Inc, 2008). A decline was also observed among antenatal clinic attendees from 8.7% in 2003 to 8.4% in 2005/6, an absolute decrease of 0.3%. Mother to child transmission was responsible for about 18% of new HIV infections in Tanzania (Tanzania Commission for AIDS, 2008). Approximately 200,000 children under the age of 15 were HIV positive in Tanzania in 2010 (UNAIDS, 2010). This equates to a rate of approximately 11/1000 children.

Results from Demographic and Health Surveys also indicate an improvement in child health and nutritional indicators (Figure 1). Findings from the Tanzania Demographic and Health Surveys (DHS) indicated a decline in the under-five mortality rate from 171 per 1000 live births in 1991 to 112 in 2004/5 and to 81 in 2010 (National Bureau of Statistics & ICF Macro, 2011b; National Bureau of Statistics & Macro International Inc, 1991; National Bureau of Statistics & ORC Macro, 2004). The recent report showed that Tanzania has managed to attain the MDG four which requires Tanzania to reduce the mortality rate of under-fives to 47 per 1000 live births by 2015 (United Nations Economic Commission for Africa, 2014). Masanja (2008) attributed the decline in under-fives mortality to an increase in the funds allocated to support health interventions, increased priority given to low cost effective interventions such as vitamin A supplementation, breastfeeding and the use of insecticide-treated bed nets. The gain in

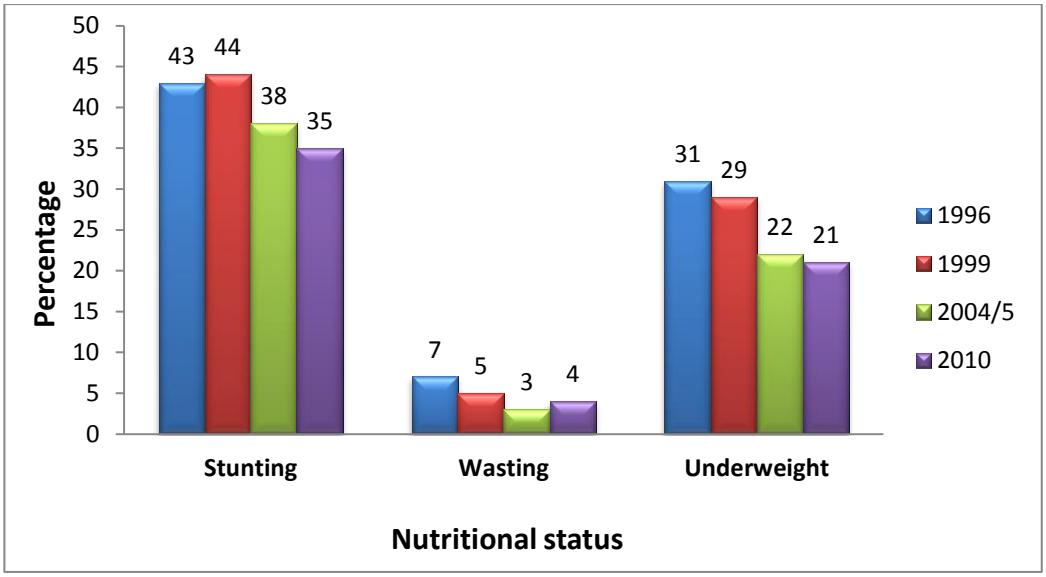
mortality reduction was also attributed to an Integrated Management of Childhood Illnesses (IMCI) program and increased immunisation coverage (Masanja, 2008)



Adopted from : (National Bureau of Statistics & ICF Macro, 2011b; National Bureau of Statistics & Macro international Inc, 2000a; National Bureau of Statistics & ORC Macro, 2004; Tanzania Commission for AIDS (TACAIDS) et al., 2008)

Figure 1 Trend of under-fives deaths per 1000 live births in Tanzania

Alongside mortality, the proportion of moderately stunted children dropped from 43% in 1991 to 35% in 2011 (Figure 2), but is still unacceptably high by WHO standards (high prevalence: 30-39%) (World Health Organisation, 2010b). The proportion of underweight children dropped from 31% in 1991 to approximately 21% in 2010 but is still high according to the WHO classification (High prevalence: 20-29%). This reduction in underweight children slightly missed the MDG goal of a 15% reduction. Wasting dropped from 7% to 4% which was within acceptable levels according to WHO cut-off points (Acceptable: <5%) (National Bureau of Statistics & ICF Macro, 2011b; World Health Organisation, 2010b). At the age of less than six months, 18% of children were chronically malnourished (stunted) and 9% were underweight in 2010 (National Bureau of Statistics & ICF Macro, 2011b). However, due to the cross-sectional nature of data collection when conducting surveys, factors precipitating high malnutrition at a lower age were not explored.



Source: National Bureau of Statistics and ICF Macro. (2011). *Tanzania Demographic and Health Survey 2011*. Dar es Salaam: Author

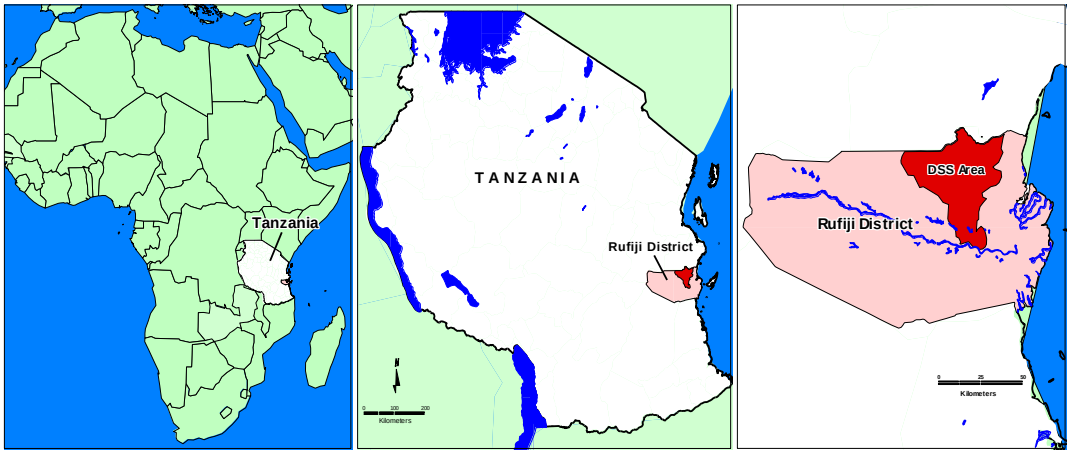
Figure 2 Trend of under-five nutritional status in Tanzania

1.4 Background to the study area

In an effort to collect longitudinal data to complement existing surveys, Ifakara Health institute (an independent research institute) established three sentinel sites (i) Rufiji rural in Coast Region, (ii) Kigoma urban and (iii) Ifakara rural and urban district in the Morogoro region. The current study was completed in Rufiji district which is one of the six districts of Coast Region of Tanzania Mainland. For the purpose of this present research, the Ifakara site was excluded due to existing studies that were likely to jeopardise the findings of this research. Kigoma was also excluded due to distance and the associated expenses of air travel to the area

The Rufiji district covers approximately 14,500 square kilometers with a population of 217,274 (112,423 females and 104,851 males). The district has an average of 4.4 people per household (National Bureau of Statistics, 2013a). The majority of the population resides in a rural area crowding a small township beside the main road going through Mtwara region (Mrema et al., 2009). The Ifakara Health Institute established a Health and Demographic Surveillance System (DHSS) in Rufiji district in 1998 (Figure 3). The

Rufiji HDSS area comprises 1813 square kilometers (out of approximately 14,500 square kilometers covered by the Rufiji district). The Rufiji HDSS collects data from 85,000 inhabitants which is approximately 40% of the population in Rufiji district (Mrema, Shamte, Selemani, & Masanja, 2012).



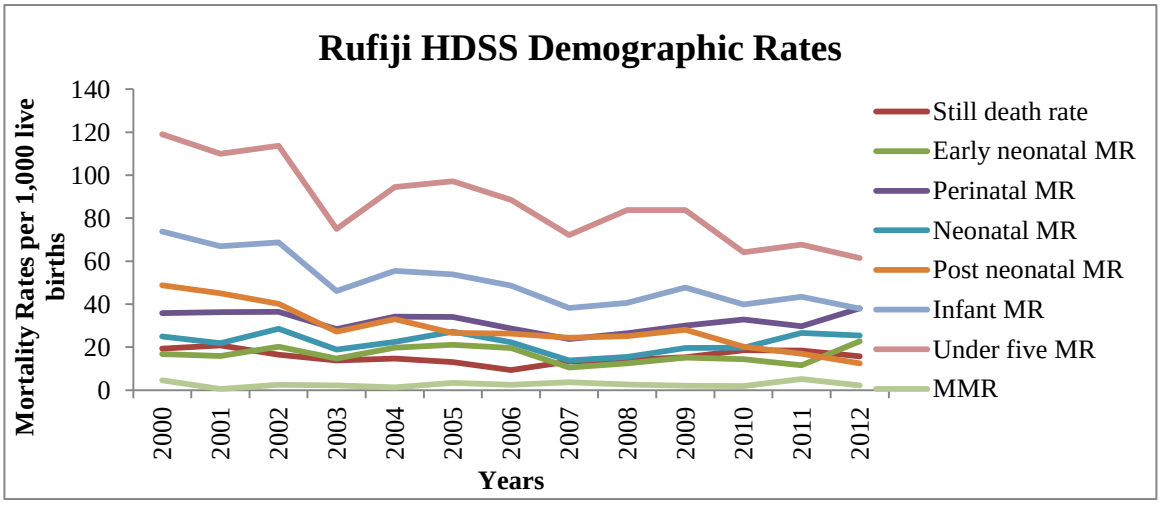
Source: S. Mrema., A. Shamte., M. Selemani., & H. Masanja. (2012). The influence of weather on mortality in rural Tanzania: a time-series analysis 1999-2010. *Glob Health Action, 5*, 33-43.

Figure 3 Map of Rufiji Health and Demographic Surveillance System (HDSS)

The Rufiji HDSS has 18 health facilities and the majority of the population live within 5 kilometres of a health facility (Mrema et al., 2012). The surveillance system collect data every four months covering births, pregnancies, deaths, migration, marriage and a variety of other indicators at varying intervals, including asset ownership (to form a wealth index), access to water and sanitation, occupation of head of household and other adults, educational status of family members, vaccination records of children, and bed net ownership and use. The surveillance system also acts as a platform for research conducted by the Institute and other organisations (Ifakara Health Institute, 2011).

The data collected from Rufiji surveillance in 2012 indicated slightly different patterns in life expectancy. The population of the Rufiji HDSS has a life expectancy of 64.4 for females and 63 for males, slightly higher than the average life expectancy in Tanzania (Ifakara Health Institute, 2011). Maternal mortality rate (MMR) and under-five mortality

was also different from what was found in the Tanzania Demographic and Health Surveys. Overall, there was a decline in maternal and under five mortality except for neonatal mortality which has been increasing since 2009 (Figure 4). Possible causes of increased neonatal mortality were unknown and require further investigation.



Source: Ifakara Health Institute, 2012*: Data from Demographic and Health Surveillance System*. Dar es Salaam. Ifakara Health Institute.

Figure 4 Rufiji HDSS maternal and under-five mortality trend

1.4.1 Nutrition indicators in Rufiji DHSS

There is limited information on the nutritional status of children less than six months of age in the Rufiji surveillance area. The finding from an unpublished study conducted by the Ifakara Health Institute with the support of UNICEF in 2010 revealed that 42% of children aged 6-59 months were stunted (47.5% boys and 37.3% female), 16.2% were underweight (16.5% for males and 16% for females) and 3.6% were wasted (3.8% for males and 3.5% for females) (Elisaria, Saronga, Mohamed, & Watson, 2010). Information regarding breastfeeding was not collected in Rufiji district and the surveillance. Existing data at zonal level (Central zone) covering Dar es Salaam, Morogoro and the Coast region where Rufiji lies indicated that 99.7% children under six months had been breastfed. 'Exclusive breastfeeding' for the six months was practiced by only 3.4% of the mothers and 4.3% implemented 'predominant breastfeeding'. It is to

be noted, however, that the sample size of infants under the age of six months for the entire zone was only 83.

1.5 Rationale of the study

Despite the efforts made by the WHO and other organisations to promote 'exclusive breastfeeding' for six months, a considerable number of infants are given complementary foods within their first months of life (R. E. Black et al., 2013). The impact of sub-optimal infant feeding, particularly non-breastfeeding and the early cessation of breastfeeding, has been established in several cultures (World Health Organisation, 2007). However, limited studies on the effects of early exposure to the complementary foods and infant health in developing countries has meant that most existing findings were generated from the Demographic and Health Surveys conducted over a five-year interval. The assessing infant feeding practices over such a long duration of time increases the likelihood of memory bias and misclassification of feeding patterns. An understanding of the health consequences of early exposure to food from a well-conducted community based study will broaden the knowledge of feeding patterns and infant health. It will also provide policy makers and other organisations promoting infant feeding with evidence-based information of the effects of early exposure to foods and assist in the development of focused interventions. Studies have shown that focusing on the early stage of a child's life is critical because damage occurring afterwards may be irreversible (UNICEF, 2005)

Breastfed infants are typically shorter and lighter than formula fed infants at 12 months (Kramer et al., 2004) and the differences are greater when compared with the WHO growth reference (C. Binns & Lee, 2006). Those studies, however, were not done in the less-than-optimal conditions of rural Africa where infants are normally exposed to cereal based foods and contaminated water. If growth failure is perceived in the breastfed infants, this could lead to the early cessation of 'exclusive breastfeeding'. Knowing the factors contributing to the early exposure to complementary foods and the sources of

information influencing these decisions is paramount in the development of communication strategies targeting the promotion of appropriate infant feeding patterns.

Tanzania, like other developing countries, has a large number of children exposed to family foods in early life. There are limited longitudinal studies indicating how sub-optimal feeding in an unhygienic environment contributes to infections, hospitalisation and impaired growth. Though this present study will not focus on HIV, early exposure to family foods has shown a significant increase of HIV transmission (Becquet et al., 2008). The outcomes from this study will help promote appropriate infant feeding behaviours in Tanzania and contribute to improved child health through a reduced rate of hospitalisation. Knowledge of how maternal factors influence infant feeding will assist the strengthening of the existing efforts of integrating maternal and child health.

1.6 Objectives

Aim: To assess the impact of feeding patterns on the growth and health status of infants aged less than six months in rural Tanzania.

1.6.1 Specific objectives

The specific objectives of the present study are as follows.

1. To determine feeding patterns of infants (exclusive breastfeeding, predominant and partial breastfeeding) aged less than six months in the Rufiji district of Tanzania.
2. To document complementary feeding patterns of infants 0-6 months in the Rufiji district.
3. To assess the impact of feeding patterns on infant growth in the first six months of life in the Rufiji district.
4. To evaluate associations between feeding patterns and child morbidity in the Rufiji district.

5. To establish factors for the early exposure of infants to complementary foods and information sources used by parents in establishing feeding patterns in the Rufiji district.

1.7 Research questions

Eight research questions guided the design of this research.

1. What are the feeding patterns (exclusive breastfeeding, predominant and partial breastfeeding) of infants aged less than six months in rural Tanzania?
2. Are feeding patterns in the first six months of life related to growth?
3. What are the most common complementary foods introduced to children aged less than six months?
4. Is there any relationship between morbidity and feeding infant patterns?
5. Are there any changes in feeding patterns during infant illnesses?
6. Do feeding patterns change with employment of the mother?
7. What are the factors contributing to the early introduction of complementary foods among infants aged less than six months?
8. Who influences changes in feeding patterns in the first six months of life?

1.8 Intended 0utcome

1. Proportion of infants who received exclusive or predominant or partial breastfeeding at one, three and six months).
2. Proportion of infants exposed to early complementary feeding (before six months) and common foods introduced.
3. Infants feeding pattern in association with growth (height, weight, Weight for Age, Height for Age and Weight for Height Z-scores).
4. Infant feeding pattern and morbidity (respiratory, diarrhoea, eye and ear infections) at the age of one, three and six months.
5. Factors associated with feeding pattern (exclusive, predominant and partial breastfeeding) at one, three and six months.

1.9 Outline of the thesis

This thesis is presented in six chapters. Chapter one provides the background information, overview of the importance of optimal infant feeding, maternal and child health and nutrition in Tanzania, rationale of the study, and research objectives and questions. The second chapter provides a comprehensive literature review about changes of infant feeding patterns in developing countries, infant feeding and HIV, infant feeding patterns in Tanzania and Rufiji district, common complementary foods, and the importance of optimal infant feeding in relation to growth, morbidity and mortality. Optimal infant feeding in relation to maternal health, factors associated with non-exclusive breastfeeding together with maternal sources of decision are also presented in chapter two. Chapter three details the methodology of the study including study design, target population, study area, data collection tools, sample size, study profile and definition used, data analysis, validity and reliability, and ethics. Chapter four presents the results of the study in a sequential order to cover the specific objectives of the study. Chapter five is an extensive discussion of the findings. Chapter six presents the summary of the key findings, limitations of the study, further research areas and recommendations. Chapter seven comprises of a list of references arranged in alphabetical order. A list of appendices includes; the study tools (baseline and infant feeding questionnaires), consent forms and ethical approvals.

Chapter 2: Literature review

2.1 Introduction

This section details the overview of infant feeding patterns, feeding patterns in the context of HIV, current breastfeeding rates in developing countries including Tanzania, common complementary foods, the composition of breastmilk, and infant feeding patterns and the association with maternal and child health. The section also presents the factors associated with infant feeding patterns and the source of decision influencing infant feeding choices.

2.2 Changing infant feeding patterns in developing countries

While developed countries experienced a decline in rates of 'exclusive breastfeeding' and duration of 'any breastfeeding' between the 1870s and 1970s (Hendershot, 1984; Herman, 1958; Martinez & Nalezienski, 1979; Meyer, 1958; World Health Organisation, 2003b), with an increased use of animal milk and formula during the same period (Kintner, 1985), developing countries demonstrated an inconsistent experience (King & Ashworth, 1987).

Traditionally, developing countries were characterised by a long duration of breastfeeding (0-3 years) (I. S. Rogers, Emmett, & Golding, 1997) and with a discard of colostrum which was replaced by mashed bananas, water, oil, sugar, honey and traditional herbs (King & Ashworth, 1987). However, Malaysia and the Caribbean embraced a westernised model of infant feeding around the 1920s where infants who were living in urban areas and born to wealthy families received infant formula (King & Ashworth, 1987). In Nigeria similar infant feeding patterns appeared around the 1960s while countries like Zaire (currently known as the Democratic Republic of Congo) preserved the traditional methods of feeding (King & Ashworth, 1987). In China, nearly all children under the age of one year received breastmilk in the 1930s with a medium of 12 months of breastfeeding (Zhao, Niu, Xu, Garrett, & Greiner, 2003). However, in the late 1970s, China observed a rapid deterioration in the prevalence and duration of 'any

breastfeeding', particularly in the metropolitan area (Zhao et al., 2003). The main reason associated with the decline in the breastfeeding rates in China was westernisation particularly promotion of infant foods (Zhao et al., 2003).

The inconsistency was also revealed in a review of breastfeeding duration conducted by Notzon (1984) among seven developing countries (Notzon, 1984). The review indicated that in Taiwan the average duration of breastfeeding was 13.56 months in 1967-1968, declined to 9.59 months in 1973 and further declined to 4.41 months in 1979-80. Compared with Taiwan, the proportion of infants in Malaysia who were ever breastfeed was higher (94.1%) before 1950 and declined to 74.6% in the 1970s. The mean duration of 'any breastfeeding' also declined from 13 to 10 months in the same years (Notzon, 1984). In Malaysia, women who were more likely to breastfeed for a short period or bottle feed were living in semi-urban or urban areas, were younger, had a modest income, were well-educated and had a husband working in a skilled job (Manderson, 1984).

Findings for the 1990s show an inconsistency in feeding patterns across developing countries (Lauer, Betrán, Victora, de Onís, & Barros, 2004; Perez-Escamilla, 1993). Perez-Escamilla (1993) generated a summary of breastfeeding initiation and duration rates from the 13 Demographic and Health Surveys conducted in African countries. The data, collected between 1986 and 1990, shows the percentage of 'any breastfeeding' from birth to four months ranged from 92% in Egypt to 99% in Burundi. A medium range of breastfeeding duration was 15.2 months in Morocco to 24.2 months in Burundi. Rates of 'exclusive breastfeeding' at the age of four months ranged between 2% in Ghana to 86% in Burundi (Perez-Escamilla, 1993). The study revealed higher rates of breastfeeding in rural communities and among women with a lower education level (Perez-Escamilla, 1993). Factors contributing to the disparities between countries were urbanisation, education level and better economic production of a country. The author stated that an increase of $450 in per capita income of the country translated to 3.3 months decline in the median duration of 'any breastfeeding' indicating an inverse

relationship between the per capita income growth and breastfeeding duration. (Perez-Escamilla, 1993).

Findings generated from most research indicates a decline in breastfeeding pattern around early 19th century in most Asian countries particularly those who experienced a rapid economic development. However African countries has maintained high rate of "any breastfeeding" and with an inconsistence pattern of exclusive breastfeeding. The differences were brought by urbanisation, availability and exposure to infant formula particularly in urban area and the differences in social economic status.

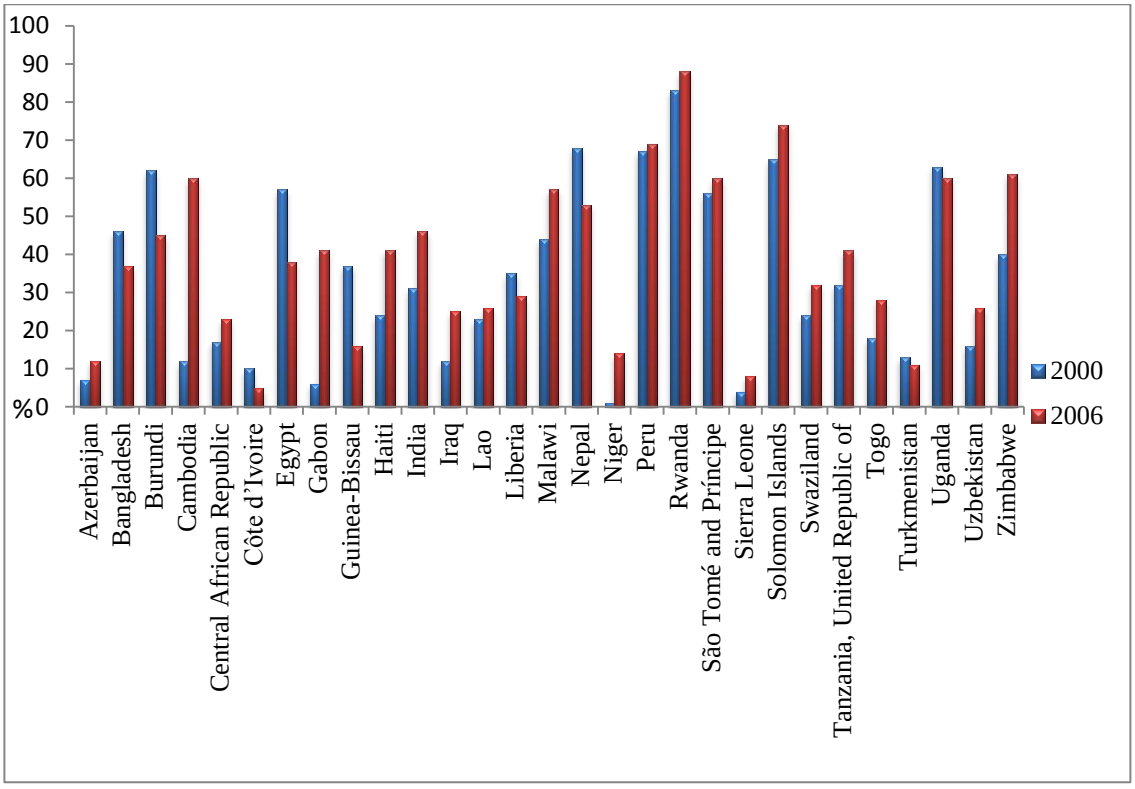
2.3 Infant feeding and HIV in developing countries

Although there is limited information on the decline in breastfeeding due to infection with Human Immunodeficiency Virus (HIV), the emergence of HIV infection, particularly in African countries more than 25 years ago, has posed great challenges to investigators, mothers surviving with HIV, non-infected people, public health specialists and policy makers due to an increased risk of mother to child transmission of HIV through breast milk (World Health Organisation, 2000, 2003b). A review conducted by De Cock (2000) revealed a rate of 15-30% HIV infection in the absence of breastfeeding, 25-35% infection rate when breastfeeding continued for six months and 30-45% if breastfeeding proceeded until two years of age (De Cock, 2000). Although both the developed and developing countries faced HIV challenges, in sub-Saharan Africa there was a greater impact. The transmission rates ranged from 14% to 32% among non-treated breastfeeding populations in westernised countries as compared with 25% to 48% in sub-Saharan countries (De Cock, 2000). It was argued that the difference was brought about by the universal breastfeeding situation in poorly resourced countries, high viral load, low immunity and elongated rupture of membrane before delivery (De Cock, 2000). To minimise HIV transmissions, the WHO issued recommendations to replace breastfeeding when feeding options were affordable, feasible, acceptable, safe and sustainable (AFASS), or else breastfeeding was suggested for one month only (World Health Organisation, 2000). The recommendations were then reviewed in 2006 and the new recommendations advocated 'exclusive breastfeeding' for six months or

avoidance of breastfeeding by HIV infected women when replacement feeding was AFASS (World Health Organisation, 2006a). Due to the increased likelihood of infections and deaths associated with non-breastfeeding among infants born to HIV positive mothers (Creek, 2006), the WHO (2010) issued another guideline which promoted breastfeeding among HIV positive mothers with advocacy for the use of antiretroviral viral drugs (World Health Organisation, 2010a). It is likely that changes in the WHO recommendations have influenced infant feeding patterns in most countries but more research is needed for verification.

2.4 Current breastfeeding rates in developing countries

Reaching a universal level of 'exclusive breastfeeding' in developing countries is still a challenge (Lauer et al., 2004; World Health Organisation & United Nations for Children Fund, 2012) and most likely will require a change in advocacy approaches (Servaes, 2010). A recent report which tracked 'exclusive breastfeeding' patterns using Demographic and Health Survey data from 75 countries located in developing countries was released by the WHO and UNICEF. Findings indicated that rates of 'exclusive breastfeeding' were less than 50% in most developing countries and initiation of breastfeeding within one hour ranged from 18-81% (World Health Organisation & United Nations for Children Fund, 2012). Figure 5 (below) was generated using the WHO and UNICEF data. For comparison, data on 'exclusive breastfeeding' collected in 2000 was compared with those collected in 2006, since very few countries had recent information of breastfeeding.



Adapted from: WHO & UNICEF. (2012). *Countdown to 2015: Maternal, newborn and child survival.* Geneva: World Health Organisation.

Figure 5 Proportion of 'exclusive breastfeeding' among children aged less than six months from 29 developing countries

Some countries experienced a rapid increase in 'exclusive breastfeeding' rates (Cambodia, Gabon, Niger and Zimbabwe) in the period of 2000 to 2006 while others experienced a decline in rates of 'exclusive breastfeeding' among infants aged less than six months (Bangladesh, Burundi, Egypt Guinea-Bissau, Nepal and Uganda) (World Health Organisation & United Nations for Children Fund, 2012). The disparities observed between the countries were likely to be contributed to by the differing political, economic, social and environmental factors from one country to another.

2.5 Infant feeding patterns in Tanzania

A long duration of breastfeeding has been the norm in Tanzania for decades (Kimati, 1983). Data extracted from the five Demographic and Health Surveys conducted with an interval of five years indicates the rate of 'any breastfeeding' to be almost universal in Tanzania (National Bureau of Statistics & ICF Macro, 2011a; National Bureau of Statistics & Macro International Inc, 1991; National Bureau of Statistics & ORC Macro, 2004). However, 'exclusive breastfeeding' was not as traditional as indicated in Table 1. 'Exclusive breastfeeding' at any time point increased from 23.5% in 1992 to 51% in 2010 and 'exclusive breastfeeding' at the age of 4-5 months increased slightly from 13.5% in 2004 to 23% in 2010 (Table 1). The median duration of breastfeeding has continued to be over 20 months for more than 22 years (National Bureau of Statistics & ICF Macro, 2011a; National Bureau of Statistics & Macro International Inc, 1991; National Bureau of Statistics & ORC Macro, 2004). However, using data from the Demographic and Health Survey suggests the likelihood of overestimating breastfeeding due to a misclassification of breastfeeding as a result of recall bias. The misclassification may be as high as 30% when mothers were asked to recall breastfeeding in a period of 47 months after delivery (Huttly, Barros, Victora, Beria, & Vaughan, 1990).

Table 1 Infant feeding patterns among infants under six months in Tanzania from 1992-2010

Practice	Year	Age in months		
		0-1	**2-3**	**4-5**
No Breastfeeding (%)	1992	0.8	0.8	0
	1996	0.6	1.3	2.7
	1999	1.1	3	3
	2004/5	2.4	0.3	3.8
	2010	0.8	2.0	2.2
Exclusive Breastfeeding (%)	1992	42	23.5	7.6
	1996	55.2	27.5	8
	1999	57.8	25.4	15.5
	2004/5	70	42.4	13.5
	2010	80.5	51.1	22.9
Complementary feeding (%)	1992	21.6	47	76.6
	1996	19.9	50.2	77.0
	1999	18.5	47.6	73.3
	2004/5	7.2	32.1	57.9
	2010	10.9	33.4	63.5

Adapted from (Muhimbula & Issa-Zacharia, 2010; National Bureau of Statistics & ICF Macro, 2011a)

Despite the observed high level of breastfeeding in Tanzania, the discard of colostrum was a common practice in some places, which denies the newborn the right to immunity from their mothers. In rural southern Tanzania, a study which focused on caring practices for neonates reported the discard of colostrum to be practiced in Mtwara region of Tanzania mainland as it was perceived dirty (Mrisho et al., 2008). In addition, giving pre-lacteal feeds was a concurrent practice in Tanzania and 32% of rural and 24% of urban children received a pre-lacteal feed in 2010 (National Bureau of Statistics & ICF Macro, 2011b). Early complementary feeding was also common practice in Tanzania with 63.3% of infants aged 4-5 months receiving complementary foods in 2010. However, a small proportion of children (8.4%) had delayed to receive complementary feeding until the age of 7-9 months (National Bureau of Statistics & ICF Macro, 2011b). A review in Tanzania revealed early complementary feeding of poor quality foods and

delayed complementary feeding to be the main causes of persistent malnutrition, particularly stunting (Muhimbula & Issa-Zacharia, 2010).

2.5.1 Variation of breastfeeding in Tanzania

Disparities in infant feeding patterns have existed in Tanzania in past decades. A study conducted in six regions of Tanzania from 1977 to 1979 observed a lower rate of breastfeeding among 628 Indian women of Ismaili Muslims living in Dar es Salaam capital city compared with other Tanzanian women. For example, 510 Indian women breastfeed for one week while 55 mothers never breastfed at all (Kimati, 1983). Compared with the Indian women, the mean breastfeeding rates among women from other regions were 76.1% at the age of 18 months and 30% at the age of two years. The variations were also observed between regions during a national survey conducted in 2010 in which Kigoma Region located in western Tanzania reported 86.3% of women practicing 'any breastfeeding' while other remaining regions had rates of over 90-100% of 'any breastfeeding' (National Bureau of Statistics & ICF Macro, 2011b). Though reasons for the variations were never explored, it is possible that the levels of urbanisation, social-economic and cultural differences within the country may have contributed to the disparities.

Variations existed even within the regions. For example, in the Morogoro region in Central Tanzania, Mosha (1998) conducted a child-mother pair study of 400 women delivered in 1993-1996 from 17 postnatal maternal and child health clinics. Rates of breastfeeding were 22.2 months in rural communities compared with 20.7 months in urban. The study also found that breastfeeding on demand was higher in rural Morogoro (98%) than in the urban area (68%) (Mosha, 1998). Eighty nine percent of mothers from rural areas provided complementary foods to their infants at the age of 4.5 months while 95% of urban mothers introduced complementary foods at the age of 3.5 months (Mosha, 1998). A recent cross-sectional study conducted in the Kilimanjaro region reported a small disparity in the rate of 'exclusive breastfeeding' between urban (22.7%) and rural (20.1%) (Mgongo, Mosha, Uriyo, Msuya, & Stray-Pedersen, 2013). The study

involved 624 mothers with infants aged 6-24 months of whom 483 were from the rural area.

Despite the challenges, Tanzania has been committed to promoting appropriate infant feeding patterns, particularly 'exclusive breastfeeding'. The 'exclusive breastfeeding' agenda was flagged in the Tanzania National Strategy on Infant and Young Child Nutrition in 2004 (Ministry of Health and Social Welfare, 2004). A National Nutrition Strategic Plan also presented strategies to increase 'exclusive breastfeeding' from 50% to 60% by 2015 (Ministry of Health and Social Welfare, 2011). To make it effective, the Nutrition Strategic Plan was in-line with strategies proposed in the National Poverty Reduction Framework Strategies aiming to promote child health (Ministry of Finance and Economic Affairs, 2010).

2.6 Common foods introduced to infants under-six months in developing countries

Giving foods and liquids to infants is common practice in most developing countries (Darmstadt et al., 2007; Egata, Berhane, & Worku, 2013; Hajeebhoy, Nguyen, Mannava, Nguyen, & Mai, 2014; Semega-Janneh, Bohler, Holm, Matheson, & Holmboe-Ottesen, 2001; Xu, Qiu, Binns, & Liu, 2009) and may start as early as before a neonate receives breastmilk (Becker, Remmington, & Remmington, 2011). Some foods might be provided to a newborn once in a life time for rituals while others may be supplemented with breastmilk and, in some instances, replaces colostrum (McKenna & Shankar, 2009; N. L. Rogers et al., 2011). It is important to focus on foods or liquids provided to newborns as they may interfere with breastfeeding initiation and duration (Barros et al., 1995; Becker et al., 2011; Lakati, Binns, & Stevenson, 2002; L. Qiu, X. Xie, A. Lee, & C. W. Binns, 2007b), impair child growth (Kalanda, Verhoeff, & Brabin, 2006; Sloan, 2008) and increase neonatal morbidity and mortality (Edmond et al., 2007).

Foods provided during infancy varied across developing countries though there might be some commonalities. A cross-sectional study which combined both qualitative and quantitative design was conducted in Pakistan among 525 women who gave birth in July to November 2000 (Fikree, Ali, Durocher, & Rahbar, 2005). The study reported 55% of

women practiced pre-lacteal feeding and 77% practiced early complementary feeding. The common pre-lacteal feeds were honey (27.7%), herbal paste known as *ghutti* (17%) and infant formula or animal milk (3.1%). Complementary foods provided were honey (28.7%), *ghutti* (27.8%) and water which was given by 11.8% of mothers (Fikree et al., 2005). The perceived benefits of pre-lacteal feeds included decreasing colic or acting as purgative, allowing baby to urinate, to make them hungry and cleaning the stomach to allow passage of stool. Predictors for provision of pre-lacteals were maternal ethnicity and birth attendant during birth (Fikree et al., 2005).

In three regions of Egypt, 42% of mothers provided neonates with pre-lacteal feeds including sugar water (51%), anise and caraway (37%) and other foods (24%). More than half (51%) of mothers provided neonates with complementary foods before six months which again included anise (34%), caraway (23%), water (15%), sugar water (8%), infant formula (5%) and other foods (15%) (Darmstadt et al., 2007). The study was conducted among 217 women who were interviewed within seven days of giving birth, however reasons for giving pre-lacteal feeds and complementary foods were not explored (Darmstadt et al., 2007).

Unlike the two studies above, exposure to infant formula, water and cow's milk as pre-lacteal feeds was practiced in a cohort study conducted in China involving 638 women who were recruited in 2005. Exit interviews were done during hospital discharge and at a systematic interval until the infants were aged six months (L. Qiu, X. Xie, A. Lee, & C. Binns, 2007a). The study found that 26% of mothers provided pre-lacteal feeds with infant formula being more common, followed by water and cow's milk. Only 36% percent of mothers practiced 'exclusive breastfeeding' during hospital discharge. Mother education level and admission to intensive care unit were the main contributors to pre-lacteal feeds ($P< 0.05$) (Qiu et al., 2007a). Nonetheless, a review conducted in the same country found large regional variations in mothers who provided pre-lacteal feeds. In Shandong in Eastern China 72.4% of infants received pre-lacteals while in Xinjiang 23% of infants received water, 6% solid food and 2% cow's milk before hospital discharge.

The review also found that five out of seven studies indicated an inverse relation between breastfeeding and pre-lacteal feeding (T. Li, Katie, & Chuan, 2012).

Giving pre-lacteal feeds and early complementary feeding was slightly common in Kenya (Lakati, Makokha, Binns, & Kombe, 2010). A prospective mother-infant pair (n = 692) involving five big hospitals in Nairobi and following infants from birth to six months reported 26.8% exposure to pre-lacteal feeds. Common pre-lacteal feeds provided in the hospital were infant formula and glucose solution. Giving pre-lacteal feeds was reported as the main cause of breastfeeding termination before the age of six months (Lakati et al., 2010). A similar level of exposure to pre-lacteal feeds was reported in Tanzania. The 2010 Demographic and Health Survey indicated that 32% of neonates received pre-lacteal feed with a slightly higher proportion in the rural (34%) than urban area (24%). The findings also indicated a large regional variation with Mara region having 55% while Iringa region had only 2% of neonates who received pre-lacteal feeds (National Bureau of Statistics & ICF Macro, 2011b). Thirty seven percent of women who were attended by traditional birth during delivery gave their neonates pre-lacteal feeds compared with 40% delivered by non-health professionals and 24% by health professionals (National Bureau of Statistics & ICF Macro, 2011b). Common pre-lacteal feeds were not mentioned, however the survey indicated that at the age of four to five months, 2.3% of infants received infant formula, 15.4% received non-human milk, 24.6% other liquids, 1.5% fortified baby food and 60.3% received foods made from grain (National Bureau of Statistics & ICF Macro, 2011b).

There has been some variation of pre-lacteals feeds and complementary foods provided in some regions in Tanzania. In Mtwara region of Tanzania mainland, a study that integrated qualitative and quantitative approaches determined home care practices of neonates among 243,000 households. The study indicated that giving sugar, sweetened coconut juice, tinned milk, cow's milk and water mixed with sugar and salt among neonates were common (Mrisho, 2012). Main reasons for early exposure of neonates to other liquids and milk was a perception that colostrum was dirt and insufficient breastmilk. Similar findings were reported among pastoralists of Tanzania (the Datoga

community) where 79% of mothers (n = 81) who participated in a cohort study reported discard of colostrum. Mothers believed that colostrum would contribute to stomach problems, was too dense or rotten. Common pre-lacteal foods included water, non-human milk and ash mixed with water (Sellen, 1998). Complementary foods introduced at less than six months of age were water, maize gruel, fresh or curdled non-human milk and ghee (Sellen, 1998).

Giving infant formula and high starch based cereals was also reported in South Africa in a birth to nine months cohort study involving 276 mothers with infants from nine randomly selected clinics. However, in this community infant formula was the main pre-lacteal feed unlike other countries such as Tanzania and Egypt. The study reported that 59.7% of infants were breastfed, 38.1% of infants received breastmilk and formula and 2.2% received only formula as first feeds (Mamabolo et al., 2004). Complementary foods were also provided alongside breastmilk or formula. At the age of one month (n = 134), 17.2% received maize meal, 20.9% received *Mabella* (sorghum porridge) and 8.9% commercial infant cereals. At the age of three months 36.9% of infants received maize meal, 44.9% *Mabella* (sorghum) and 15.4% commercial infant cereals (Mamabolo et al., 2004). In this cohort, stunting became apparent in the first month of life (30%) but reasons for early complementary feeding were not explored.

Kalanda (2006) conducted a cohort study in Malawi which assessed the usual complementary foods provided to infants aged less than three months compared with those aged above three months. The study enrolled 561 infants and 458 had information about feeding. At the age of six weeks, 48.7 % (n = 171) infants received water, 17.1% (n = 60) received *phala* (local porridge) and 4.6 (n = 16) received solid foods. At the age of 12 weeks 83.5% (n = 283) received water, 65.2% (n = 221) received *phala* and 33.1% (n = 112) received other solids (Kalanda, 2006). In the same country, a cross-sectional study conducted among 160 caregivers with children aged 6-48 months reported common foods given to a child in the first month in Malawi were two herbal infusions (*mzuwula* and *dawale*), water and porridge. Herbal infusions were introduced by grandmother for rituals and the water and porridge were given due to perceived hunger

(Kerr, Berti, & Chirwa, 2007). The main reasons for early exposure of infants to foods were "baby was crying too much" or was feeling hungry and being thirsty. Herbal infusions were provided to protect the baby from illnesses (Kerr et al., 2007). The findings from Malawi indicated clearly that infant feeding varies even within the same communities, which demands different approaches when promoting breastfeeding.

Unlike African countries where the majority of infants were given starch based foods, in Mexico a review of seven studies which included infants aged 0-24 months reported feeding fruit and vegetable purees, fruit jams, citric fruits and cow's milk to be common among infants aged less than six months (Pantoja-Mendoza, Melendez, Guevara-Cruz, & Serralde-Zuniga, 2014). The discernment of mother on infant's movement as a need to eat together, insufficient breastmilk supply and "baby's crying too much' was the main reasons for the early complementary feeding (Pantoja-Mendoza et al., 2014).

Overall, giving pre-lacteal feeds and early complementary feeding was common in most developing countries. Common foods introduced to infants were carbohydrate based foods, water, herbal infusions, liquid based products and non-human milk. Some variations were observed within and between the countries demanding different approaches when promoting ideal infant feeding. The most common mentioned reasons for early exposure to complementary foods include " baby crying too much" insufficient breastmilk, baby feeling hungry or thirsty and the perception that colostrum was dirt or rotten.

2.7 Importance of optimal infant feeding for child health

2.7.1 Introduction

Optimal infant nutrition remains vital for the health, growth, development and survival of children and contributes greatly to the economy of the country (Bartick, 2010; R. E. Black et al., 2013; World Health Organisation, 2003b). According to Black (2013), 'non-exclusive breastfeeding' contributed to 804,000 child deaths in low and middle

income countries in 2011 which equates to 11.6% of all under-five deaths (R. E. Black et al., 2013). Bartick (2010) performed a pediatric cost analysis of suboptimal infant feeding in the United States of America using national survey data collected by the Centre for Disease Control and Prevention (CDC) in 2005. In this study, adherence of 90% in 'exclusive breastfeeding' rates for six months reportedly averted 13 billion dollars expended on 10 pediatric sicknesses and precluded a further 911 deaths per year of which 95% of the costs and mortality were during infancy. 'Exclusive breastfeeding' at 80% rates was thought to avert 10.5 billion dollars spent to treat pediatric illnesses during childhood and 741 deaths per year (Bartick, 2010). Research and programs targeting the first years of life are therefore necessary to reduce costs and damage which may be irreversible in the later stages of life, and to break the vicious circle of social-economic and health disparities in society (M. M. Black & Hurley, 2014; Campbell et al., 2014).

2.7.2 Breast milk composition

The value of breastmilk stands on its unique composition which changes slightly over time to serve the need of a growing infant (Petherick, 2010). Human milk is considered to be a sole source of nutrients for full-term, premature and low-birth weight babies during the first half of infancy (World Health Organisation, 2003b, 2006d) and has anti-infective factors which act as a first immunisation to the newborn (WHO 1998). The composition does not change significantly over time (Table 2 below) during production of colostrum (0–5 days), interim milk (6–14 days) and mature milk (15–30 days) (Petherick, 2010). Colostrum (the first yellowish milk) contains short chain human oligosaccharides, whey protein, immunoglobulin particularly IgA, lactoferin, vitamin A and E, carotenoids, cytokines, enzymes, hormones, macrophages, neutrophils and growth factors (Alexander & Reginald, 2005; Kent, 2007; Petherick, 2010). The presence of immunoglobulin IgA minimises the chance of infections including HIV transmission by protecting the passage of the HIV virus through coating the infant mucosal surface (World Health Organisation, 2007). In 1993, a cohort study conducted in Rwanda among HIV infected women found a lack of anti-HIV antibodies of IgA and

IgM types in breastmilk to be associated with a higher chance of HIV infections among children who lived up to 18 months (Van de, 1993).

Breast-milk comprises over 200 oligosaccharides used to impede growth of detrimental bacteria. The oligosaccharides also feed certain useful bacteria in the gut such as *Bifidobacterium infantis* which protects against diarrhoea (Ward, 2006). The milk stays rich in a wide range of lactic-acid bacteria which prevents the detrimental bacteria by discharging hydrogen peroxide and compound bacteriocins (Petherick, 2010) which contribute to human milk being considered as a probiotic food (McGuire & McGuire, 2015). Breast milk comprises adequate water to quench infant thirst in the first six months of life even under hot environmental conditions. Providing water reduces dependency on breast milk and increases the chance of infections (World Health Organisation, 2006b).

Although breastmilk content (particularly energy, vitamin A, vitamin D and vitamin B6) does not change over time (Table 2) the composition of protein, iron, calcium and zinc does change over time as shown in Table 2. Protein contributes 8% of energy required during the first six months of life and provides amino acids necessary for protein synthesis. Failure to provide adequate energy during infancy triggers the utilisation of protein as a source of energy and subjects infants to protein deficiency malnutrition (Butte, Lopez-Alarcon, & Garza, 2002). 'Exclusive breastfeeding' for six months will provide an adequate amount of energy needed (620$Kcal_{th}$/day for boys and 578$Kcal_{th}$/day for girls), however at the age of 12-23 months only 35-40% of total energy comes from breast milk and 60-65% originates from complementary foods (Butte et al., 2002; K. G. Dewey & Brown, 2003).

Table 2 Breast-milk composition during infancy

Age (Months)	Energy (Kcal/g)	Protein (g/l)	Vitamin A (µmol/l)	Vitamin D (ng/l)	Vitamin B6 (mg/l)	Calcium (mg/l)	Iron (mg/l)	Zinc (mg/l)
1	0.67	11	1.7	645	0.13	266	0.5	2.1
2	0.67	9	1.7	645	0.13	259	0.4	2
3	0.67	9	1.7	645	0.13	253	0.4	1.5
4	0.67	9	1.7	645	0.13	247	0.35	1.2
5	0.67	9	1.7	645	0.13	241	0.35	1
6	0.67	9	1.7	645	0.13	234	0.3	1
7	0.67	9	1.7	645	0.13	228	0.3	0.75
8	0.67	9	1.7	645	0.13	222	0.3	0.75
9	0.67	9	1.7	645	0.13	215	0.3	0.75
10	0.67	9	1.7	645	0.13	209	0.3	0.5
11	0.67	9	1.7	645	0.13	203	0.3	0.5
12	0.67	9	1.7	645	0.13	197	0.3	0.5

Source: (Butte et al., 2002; World Health Organisation, 2002)

The content of energy and fat remain stable even during fasting periods in the first five months. A cohort study conducted in Turkey among 21 breastfeeding mothers aged 17 to 38 years who fasted and had infants aged 2 and 5 months reported no change in composition of the macronutrients. However, fasting affected levels of zinc, magnesium and potassium (Rakicioğlu, Samur, Topçu, & Topçu, 2006). A more recent prospective study which compared fat composition of 48 mothers aged ≥ 35 years and 42 mothers aged <35 observed a higher level of fat content in colostrum among old women compared with young mothers (R^2 = 0.11, p = 0.006) which was contrary to their gestation age (R^2 = 0.1, p = 0.03). The composition of fat after two weeks did not differ considerably among the two clusters (Hausman, 2013) indicating a temporal effect of age on breastmilk composition.

Iron concentration tends to drop from approximately 0.4–0.8 mg/l in colostrum to around 0.2–0.4 mg/l in mature milk. Conversely, the bioavailability of iron is high compared with cow's milk (Table 3) probably due to a reduced quantity of phosphate and protein in human milk. Its absorption is largely enhanced by binding of iron with

protein lactoferrin which is present in the human milk. After six months, growing infants require approximately 0.7mg absorbed iron per day to meet increased demand (Food and Nutrition Board Institute of Medicine, 2000). The World Health Organisation recommends supplementation with 12.5 mg iron and 50 µg folic acid daily to infants aged 6-24 months in regions where anaemia prevalence exceeds 40% (World Health Organisation, 2001).

Unlike human milk, cow's milk contains high level of protein suitable for calves. Exposing infants aged less than six months to animal milk creates difficulties in excreting excess protein and can damage immature kidneys (WHO, n.d.). Cow's milk also contain more casein which creates thick, non-indigestible curds in the infant's stomach as indicated in Table 3 below. Both cow's milk and human milk contain a minute quantity of iron, however merely 10% of the iron in cow's milk is absorbed compared with virtually 50% of the iron from breast milk (Calvo, Galindo, & Aspres, 1992).

Table 3 Dissimilarities between human m/ilk and other non-human milk

Component	Human Milk	Animal Milk	Formula
Bacterial Contaminants	None	Likely	Likely during mixing
Ant-infective factors	Present	Absent	Absent
Growth Factor	Present	Absent	Absent
Protein	Correct amount and digestible	Too much and difficult to digest	Partly correct
Fatty acids	Essential fatty acids present Lipase to digest	No essential fatty acids No lipase	No essential fatty acids No lipase
Iron	Small amount, high bioavailability	Small amount and low bioavailability	Extra amount and low bioavailability
Vitamins	Enough	Inadequate in A and C vitamins	Vitamin added
Water	Enough	Need more water	May need more

Adapted from: WHO (n.d) "*Breastfeeding counselling: A training course"* Geneva: World Health Organisation

2.7.3 Feeding patterns and growth in developing countries

The association between feeding patterns and infant or child growth in developing countries has been partially studied with inconclusive findings. The disparities of results obtained when assessing feeding patterns and growth may be related to the definition of 'exclusive breastfeeding' which was found to be inconsistently used (Colin. W Binns, Fraser, Lee, & Scott, 2009), the use of WHO standards versus the National Centre for Health Statistics (NCHS) growth references (C. Binns, James, & Lee, 2008), the lack of standardisation of growth measurements and differences in social-economic indicators between countries. Understanding the association between breastfeeding and growth is vital since a reduced increase in infant weight may precipitate breastfeeding cessation or trigger early complementary feeding (C. Binns & Lee, 2006; Kramer, Moodie, Dahhou, & Platt, 2011; Martines, Ashworth, & Kirkwood, 1989; Odom, Li, Scanlon, Perrine, & Grummer-Strawn, 2013). According to Black et al (2013) 165 million children were stunted in 2011 and overall under-nutrition contributed to 3.1 million deaths which was nearly half of all deaths in 2011, using new WHO cut-off points (R. E. Black et al., 2013). The majority of these children were found in Asia and Africa (R. E. Black et al., 2013). However, it has been argued that the use of new WHO Z-scores to trace growth-faltering trajectories among children aged less than six months requires an extra precaution as it places more infants, particularly from developing countries, in the underweight zone compared with the growth curve used by the National Centre for Health Statistics (C. Binns & Lee, 2006). The authors explained that the divergence was related to sample selection bias which was related to WHO picking health infants (birth weight 3.3kg) (C. Binns & Lee, 2006). Globally, approximately 16% (20.6 million) of infants are born with low birth weight and developing countries account for 97% of all cases (World Health Organisation, 2011).

There have been limited reviews focusing on infant feeding in relation to growth from developing countries. The review conducted by Kramer (2012) observed no difference in length for age (Adjusted risk ratio: 1.18 95% CI 0.56, 2.50), weight for age (Adjusted risk ratio: 2.14 95% CI 0.74, 6.24) and weight for length (Adjusted risk ratio 1.38 95% CI 0.17, 10.98) among infants who were exclusively breastfed for six months and those

who were breastfed for four months in developing countries (Kramer & Kakuma, 2012). Though this was a recent review covering controlled trials, most articles were published in 1994 to 1999 where feeding and morbidity patterns are likely to be different in the current situation.

There have been several individual publications in this area from developing countries which require consideration. A multicenter (Burkina Faso, South Africa and Uganda) community based control trial which focused on peer counselling to promote 'exclusive breastfeeding' in 2579 infants from 82 clusters found inconsistent results (Engebretsen et al., 2014). 'Exclusive breastfeeding' was higher in the intervention group than control group in all countries at the age of twelve weeks: in Burkina Faso (79% versus 35%), Uganda (82% versus 44%) and South Africa (10% versus 6%). Infants from the intervention communities in Burkina Faso and Uganda had low mean weight for length Z-score with adjusted mean difference (-0.20 95% CI -0.39, -0.01) and (-0.23, 95% CI -0.43, -0.03) respectively as compared with control communities. However, infants in the intervention group from South Africa had higher mean weight for length Z-scores than control communities with a mean difference (0.23 95% CI 0.03, 0.43). Infants aged less than 24 weeks from the intervention group in Uganda were also likely to be stunted with adjusted mean difference (-0. 26 95% CI -0.44, -0.08). Other growth indicators remained similar between the intervention and control communities (Engebretsen et al., 2014). It was possible that the differences observed were related to large differences in social-economic indicators between the countries. South Africa had higher social economic status and had more women who attained a higher level of education than other countries. Since 'exclusive breastfeeding' was low in South Africa, it was possible that infants were likely to receive infant formula which is well known to increase adiposity. The use of infant formula was not assessed in this study. In addition South Africa had higher birth weight than Uganda and Burkina Faso which may contribute to the subsequent growth. The study also used different measuring tools and enumerators between countries, making it difficult to rule out the influence of inter-rater variations and measuring tools.

Another recent randomised control study exposing lactating women to breastfeeding counselling or routine child care education was conducted in Manila Philippines. It found no significant variation in overall infant weight, length and head circumferences in 'exclusively breastfed' and non-breastfed or 'partial breastfed' low birth weight infants, despite increased morbidity in the non-breastfed and 'partial breastfed' group. The study followed full term infants born with low birth in 2001 to 2002 and were followed from birth to six months. However there were more infants in the 'partially breastfed' group (n = 134) as compared with 24 and 21 in the 'exclusive breastfeeding' and the infant 'formula fed' groups, respectively (Agrasada, Ewald, Kylberg, & Gustafsson, 2011) creating a likelihood of underestimating the effect of 'exclusive breastfeeding' due to less power to establish the effect as a result of a small sample. The study used CDC references for calculating growth trajectories which normally yield better results than when WHO cut-off points are used. In addition, the study covered first time mothers from low social economic status and with low birth weight infants in the Philippines which limits generalisation.

Similar findings were observed in Bangladesh among women who were randomly allocated to receive either counselling on 'exclusive breastfeeding' for six months or routine health education. The study was integrated with food supplementation together with micronutrient supplementation or iron and folic supplements program. Of the 1607 women who received breastfeeding counselling, 15% practiced 'exclusive breastfeeding' for six months compared with 6% (n = 1607) in the control group (Islam, 2013). The growth trajectories were calculated using recent WHO cut-off points. The "intention to treat" analysis yielded no differences in weight, height, stunting, underweight and wasting between intervention and control groups among children 0-54 months. However, mothers who received multiple micronutrients had children with lower linear growth with a mean difference of -0.17 standard deviation score compared with those who received iron and folic acid. Proportion of stunting at the age of 0-54 months among children with mothers who received multiple micronutrients was also higher with a difference of 7.2% compared with groups which received iron and folic acid (P = 0.008) (Islam, 2013). Loss of follow-up observed in this study comprised of young and

first time mothers who were likely to have children with squat growth. The decline in linear growth and increased stunting among children with mothers who received multiple micronutrients may be confounded by delayed/suboptimal complementary feeding rather than effect of multivitamin. Nonetheless, the study did not assess timing of complementary feeding.

In Tanzania a two-year cohort study which followed 939 children born to HIV positive mothers reported that 'exclusive' or 'partial breastfeeding' did not significantly produce growth faltering among children aged six months or older ($P<0.05$). The multivariate analysis of minus two Z-score in exclusive breastfed infants yielded a relative risk of 1.29 (95% CI 0.75-2.21) for underweight, 1.34 (95% CI 0.82-2.20) for stunting and 0.77 (95% CI 0.31-1.92) for wasting. Weight for age, height for age and weight for height comparisons were made using reference population growth by age from the National Centre for Health Statistics. The study did not collect information on the use of water, teas or other non-nutritive liquids given to infants (Mwiru et al., 2011), an inherent problem of using improper breastfeeding definition (Colin. W Binns et al., 2009). Then again, there was a sharp decline in rates of 'exclusive breastfeeding' in this cohort whereas at the age of five months none of the HIV positive mothers practiced 'exclusive breastfeeding' creating a likelihood of underestimating the value of the 'exclusive breastfeeding' on infant growth.

Different results were obtained from Taiwan where a cohort study of infants from birth to 18 months found no significant effect on weight at first six months of age and, after seven months, infants who were breastfed for greater than six months, were lighter than non-breastfed infants (S. C. Li et al., 2010). However, at the age of six months, there was only a mean difference of 55g in weight ($P>0.05$) among infants who were breastfed for less than six months compared with those who were breastfed for over six months. The difference increased to 219.8g at the age of 12 months ($P<0.001$) and remained slightly lower at the age of 18 months (214g) which was also statistically significant ($P<0.001$) (S. C. Li et al., 2010). Height was also slightly lower among infants who were breastfed for more than six months compared with those who were formula fed. At the

age of six months, there was a deficit of 0.4 cm, at 12 months 0.5 cm and at 18 months 0.3cm ($P<0.001$). Overall, boys were heavier and taller than girls in all feeding patterns (never breastfeeding, breastfed for less than six months and breastfeeding for more than six months). In the study all demographic characteristics (age, education, start time of feeding, sex, parity and urbanity) were different between the child feeding groups and the study did not separate 'exclusive breastfeeding' from general breastfeeding which creates difficulties in ruling out the effect size observed.

Conflicting findings were obtained in an earlier cohort study conducted in Busia district in Kenya which followed 264 children aged 9-18 months. In this study, the classification of breastfeeding duration was based on the study period. Children who were breastfed at 0-49% of the study duration were classified as breastfed for shorter period, 50-99% as an intermediary level and throughout study period as longer duration. Children who were breastfed for longer duration had an increase of 3.4 cm in height and 370g in weight compared with those in the shorter duration group (0.6 cm and 230g) (Onyango, Esrey, & Kramer, 1999). Even though this study was prospective, collection of breastfeeding information was retrospective and therefore subject to memory bias. In addition, the definition of breastfeeding used in the study creates a likelihood of misclassification of breastfeeding duration.

Findings from different studies intending to establish association between infant feeding pattern and growth produced inconclusive results. A more robust research is need which will take into account several components: i) the definition of exclusive breastfeeding ii) diverse birth weights iii) varied socio-economic status iv) accounting for confounding factors and v) calculation of growth indicators based on different standards (WHO standards versus the National Centre for Health Statistics (NCHS) growth references)

2.7.4 Early complementary feeding and infant growth in developing countries

Early complementary feeding remains a norm in most developing countries (Lauer et al., 2004; Nasreddine, Zeidan, Naja, & Hwalla, 2012; Xu et al., 2009) which exposes infants to pathogens at a tender age. However, findings from developing countries regarding its

impact on growth are limited. Early exposure to complementary foods even when they are perceived healthy is likely to displace human milk which is considered rich in all nutrients (Petherick, 2010) and appropriate food for the first half of infancy (Alexander & Reginald, 2005; World Health Organisation, 2003b).

A large nested cohort study (n = 17,046) of infants from 0-12 months was conducted in the Republic of Belarus to determine the effect of exposure to different feeding patterns on growth (Kramer et al., 2004). At the age of one and three months infants who were exposed to breastfeeding and formula or other milk had a larger mean difference on length for age Z-score (LAZ) +0.038 (95% CI +0.001 to+0.074) and +0.047 (95% CI +0.007 to +0.087) respectively compared with infants exposed to other foods (cereals, water, juice and other solids) (Kramer et al., 2004). The positive effect of breastfeeding and formula or other milk on length for age continued even at the age of six months. However, continued practicing breastfeeding resulted in low length for age at six to nine months with a mean difference on length for age (-0.004 95% CI –0.014 to +0.064). There was a larger negative association between intake of cereal and length for age at the age of three to six months with the mean difference (-0.240 95% CI -0.353 to -0.127) indicating a large impact of cereal based meals on stunting at younger age (Kramer et al., 2004). However, the effect declined at the age of six to nine months. That study considered to be healthy, full term infants born with weight above 2.5 kg, but did not adjust for maternal body mass index (BMI) during analysis (a recognised confounder) and sampling bias may not be ruled out since infants were selected from health facilities.

In Malawi, Kalanda (2006) assessed the effect of early complementary feeding (giving local porridge called *phala)* before or after three months of age on the growth of 561 infants who were followed from birth to twelve months. Sixty five percent of infants aged three months received complementary foods and nearly 75% were still receiving some breastmilk at the age of nine months. Early introduction to complementary foods (i.e. consumption of *phala* before three months) was associated with lower weight at the age of three months (P = 0.002) and six months (P = 0.049). There was a 200g shortfall

in weight among infants in the early complementary feeding group (Kalanda et al., 2006). Infants who were exposed to complementary foods below the age of three months were nearly twice as likely (OR 1.8 95% CI 1.1-3.1) to experience lower length for age (LAZ) at the age of nine months. However, it was not clear whether the difference in weight was due to early complementary feeding or infections since the group that received *phala* before three months had experienced high morbidity. High rates of morbidity tend to compromise food intake and increase nutrient demand creating a reverse causality. In addition, as the study was conducted in the health facility self-selection bias might have been introduced and the definition of 'exclusive breastfeeding' included water. The definition of solid foods included vegetables, fruits and staples. Tea and broth were classified as water suggesting a violation of WHO standard definitions.

The effect of early complementary feeding on childhood growth was also documented in South Africa. Mamabolo, Alberts, Mbenyane, Steyn and Nthangen (2004) conducted a cohort study that followed 276 mothers from third trimester of pregnancy to 12 months after delivery to assess impact of feeding practices on infant growth. 'Exclusive breastfeeding' was less common with 56% of one-month old infants being given family foods and by the age of three months only 10% were exclusively breastfed. Most common supplementary foods were maize and sorghum porridge. Using the 1976 National Centre for Health Statistics (NCHS) reference, stunting was highly prevalent at one month (30%) and was similar at the age of twelve months (34%). Stunting was more pronounced among females at the age of three months compared with males ($P = 0.039$) but other growth trajectories were similar (Mamabolo et al., 2004). Infants born with low HAZ (Z-score of -2 SD) remained stunted in the first twelve months of life, which signifies the need of considering preconception and pregnancy nutritional status. Weight for age increased sharply at the age of three months and declined continuously up to twelve months. Underweight was 0.7% at one month, 4.4% at the age of six months and increased to 10.9% at the age of twelve months (Mamabolo et al., 2004). The attrition rate in that study was very high: 134 infants were lost at one month, 170 at six months and 156 at twelve months, creating the likelihood that most infants who were more malnourished and probably supplemented early were lost.

The effect of early complementary feeding was not limited to African countries only. A cross-sectional study that compared the type of feeding of urban (Guangdong Province) and rural infants (Gaoyao County) on growth was conducted in southern China. Urban children included 384 infants aged four months and 375 infants aged eight months. Data was extracted from villages for 394 infants aged four months only (He et al., 2001). The effect of feeding on growth was estimated by calculating exposure load to foods, which was a multiplication of one week feeding frequency with the weeks that infants were exposed to specific food. At the age of four months, all growth parameters of urban infants were higher than rural infants possibly due to pre-existing differences in birth weight, height, WAZ, LAZ and WLZ at birth and exposure to high quality complementary foods. At the age of four months, weight for age (WAZ) of urban infants was negatively associated with exposure load to infant formula, honey or sugar but positively related with exposure load to breast milk, egg yolk, vitamin supplementation and fruits (He et al., 2001). Consumption of formula was negatively associated with weight for age (WAZ) and weight for length (WLZ) among rural infants aged four months perhaps due to a small number of infants who received infant formula in the rural area (He et al., 2001). However there was no association between the exposure load of these specific foods on infant length for age (LAZ) in rural infants (He et al., 2001).

In conclusion, a positive association between exposure to infant formula and rapid growth was observed. However, exposure to carbohydrate/starch foods before six months indicated to trigger early malnutrition particularly stunting. Although these findings are important, most studies used definition of exclusive breastfeeding inconsistently, recruitment of children was done in the health facilities where stunted children are likely to be found and several studies failed to adjust for confounding factors including birth weight, maternal BMI and child morbidity.

2.7.5 Infant feeding patterns and infections in developing countries

Pneumonia and diarrhoea was the leading cause of underfive deaths with around 700,000 mortality cases from diarrhoea and 1.3 million deaths from pneumonia in 2011

(Walker et al., 2013). A high proportion of morbidity and mortality associated with diarrhoea and pneumonia occurred in the first two years of life and 50% occurred in sub-Saharan Africa (Walker et al., 2013). There have been several reviews documenting the benefit of optimal infant feeding patterns in relation to infections particularly diarrhoea and respiratory infections (Farrukh, Basheer, & Jalil, 2013; Horta & Victora, 2013b; Kramer & Kakuma, 2004; World Health Organisation, 2000). The effect of exposure to formula feeds in association with increased rates of infections has also been documented (Hengstermann et al., 2010) and the economic burden related to treatment (Colchero, Contreras-Loya, Lopez-Gatell, & Gonzalez de Cosio, 2015) and mortality is considered high in developing countries (Creek et al., 2010). However, the possibility that reviews might arrive at a similar conclusion (protective effect) lies in the fact that a majority of reviewers include the same articles. In addition, most reviews found a strong association when comparing "ever breastfeeding" versus "never breastfeeding", which is not a typical infant feeding pattern in African countries, including Tanzania.

The World Health Organisation recently reviewed several studies to establish the association between diarrhoea and breastfeeding but only 11 studies included infants under six months of age (Horta & Victora, 2013b). The review reported a pooled relative risk of 0.46 (95% CI 0.28-0.78) for reduced risk of diarrhoeal morbidity due to breastfeeding, a pooled relative risk of 0.28 (95% CI 0.16-0.50) for diarrhoea-related hospitalisation and a pooled relative risk of 0.23 (95% CI 0.13-0.42) for mortality related to diarrhoea at the age of six months (Horta & Victora, 2013b). The review also reported a low risk of pneumonia in relation to breastfeeding among 16 studies that included infants aged below six months. Breastfeeding had a protective effect on risk of hospitalisation with respiratory infections (Pooled relative risk: 0.43 95% CI 0.33-0.55) and for mortality related to respiratory infections (Pooled relative risk: 0.30 95% CI 0.16-0.56). Higher protective effect was reported when comparing breastfed with non-breastfed infants (Pooled relative risk: 0.33 95% CI 0.24-0.46). Although the findings were promising, most studies reviewed were conducted before 2000. This is a major concern due to changes in feeding and disease patterns (Cohen, 2000) and there has been overall improvement in sanitation in most countries. Of the few cohort studies and

randomised control trials reviewed, some of the studies were either cross-sectional or case-control studies which were prone to bias and most of the studies assessed breastfeeding against non-breastfeeding which is never a typical infant feeding pattern in Tanzania.

Kramer (2004) also reported a lower rate of diarrhoea in developing countries among infants who were breastfed exclusively for six months compared with those who were exclusively breastfed for three to four months (Kramer & Kakuma, 2004). The mean difference of 29 days with diarrhoea was -0.74 (95% CI -2.34-0.86) indicating that infants who were exclusively breastfed for six months had less days with diarrhoea compared with those who were exclusively breastfed for four months but the difference was not significant (P = 0.36). This review focused only on two randomised control trials which were conducted in 1994 and 1999.

Beside the two reviews and meta-analysis, several other individual studies have been conducted in developing countries to determine the effect of feeding patterns on child infections. Bhandari (2003) conducted a randomised paired community intervention which covered eight communities of India. Four communities were treated as control with 473 infants and the remaining were the intervention group with 552 infants. The study took place in 1998-2002 with the focus on promotion of 'exclusive breastfeeding' for six months, breastfeeding for at least eight hours and behavioural change on specific foods given to newborns. 'Exclusive breastfeeding' was practiced by 79% of mothers at three months in the intervention group and 48% in the control group. At the age of six months 42% of infants in the intervention group were 'exclusive breastfed' compared with 16% in the control group. The rates of diarrhoea at the age of three months was reduced in the intervention group (OR 0.64 95% CI 0.44-0.95) and at six months was OR 0.85 (95% CI 0.72-0.99) indicating a decline of protective effect with age. Despite the study being randomised and with convincing results, infant feeding information at the age of four, five and six month was collected when the child was nine months old which created a likelihood of memory bias. In addition, the level of 'exclusive

breastfeeding' obtained in the intervention group was higher than normal practices in most communities.

The role of breastfeeding in reducing morbidity was also presented by a cohort study conducted by Seema Mihrshahi (2008) in Chittagong, Bangladesh, who followed infants from 0-6 months. The study involved 341 women who were recruited in September 1999 to March 2001 and 272 completed the six month study period. The rate of 'exclusive breastfeeding' was 87.1% at one month, 77.2% at three months and 64.1% at six months. Mothers were requested to provide information about breastfeeding patterns and morbidity in the past seven days. Rate of Diarrhoea attributed to lack of 'exclusive breastfeeding' was 2.5 (95% CI 1.10-5.69) and 2.31 (95% CI 1.33-4.00) for respiratory infections. There was no significant protection of 'exclusive breastfeeding' against diarrhoea infection compared with 'predominant breastfeeding'. However there were only 27 infants in the 'predominant breastfeeding' group compared with 167 in the 'exclusive breastfeeding' group. The definition of 'exclusive breastfeeding' included infants who received pre-lacteal feeds. In that study, the women who were lost to follow-ups were single mothers who did not own a house and who were likely to have children with diarrhoea or respiratory infections. Also, the reverse causality may not be ruled out since feeding may change with infection and vice versa. The author should have collected information regarding changes in feeding pattern during morbidity.

The importance of 'exclusive breastfeeding' in reducing diarrhoea and respiratory infections has been observed even among infants born to women who live with HIV 1 in Tanzania. A prospective study was conducted by Mwiru (2010) among 666 children aged 0-24 months born in Tanzania in 1995-1997. Multivariate analysis found a strong protective effect of 'exclusive breastfeeding' on cough (OR 0.49 95% CI 0.40-0.60), acute diarrhoea (OR 0.29 95% CI 0.19-0.44) and fever (OR 0.49 95% 0.39-0.64) in early half of infancy. The study did not observe any protective effect at the age of six months to two years. Conversely, the author did not gather information on infant supplementation with water, teas and other liquids without nutritional values. The data in this study was collected in 1995 and more infants were exposed to 'mixed feeding'

much earlier than the current situation, which might have contributed to the higher morbidity reported in the study. In addition, the women involved in the study were participating in a randomised multivitamin supplementation study creating a likelihood of residual confounding related to increased immunity in the exclusively breastfed infants of supplemented mothers.

The importance of 'exclusive breastfeeding' on infections has been observed in a cross-sectional study implemented in Bangladesh in 2003 including 1633 infants aged 0-3 months. The study reported reduced risk of diarrhoea and respiratory infections in exclusively breastfed infants from 0-3 months (OR 0.69 95% CI 0.49-0.98) and OR 0.69 95% CI 0.54-0.88) respectively compared with 'non-exclusive breastfeeding' (Mihrshahi et al., 2007). However, the study observed no difference in rates of diarrhoea between 'exclusive and 'predominant breastfeeding'. The limitations when using a cross-sectional study design should not be ignored particularly the possibility of memory bias and inability to ascertain association or causality due to confounding. A common problem of breastfeeding definition was observed where the 'exclusive breastfeeding' definition included pre-lacteal feeds. Nonetheless, the study did not account for the low birth weight and maternal nutrition status as confounding variables.

The value of breast milk does not only stand on the exposure to 'exclusive breastfeeding' but even exposure to 'predominant breastfeeding' has been shown to confer protection against infections in low income countries. A hospital based cohort study conducted in Mexico among 154 mother-infant pairs in 2004 observed a reduced risk of infections in the 'predominantly breastfed' infants (Monterrosa et al., 2008). A reduced likelihood of gastrointestinal infections in the first six months of life was reported in the 'predominant breastfeed' group (OR 0.4 95% CI 0.2-1.0) compared with the 'partially breastfed' and 'formula fed' groups. In-terms of percentage the 'predominant breastfeed' group had 18% compared with 33% reported gastrointestinal cases among the 'non-predominant breastfeed' group ($p = 0.04$). However this study had a small sample size, included healthy full-term infants who were less likely to acquire infections, and the description of 'predominant breastfeeding' included human milk and

partly infant formula. In addition, the study recruited 250 mother-infant pairs but only 154 were followed till the end of the study, creating a possibility of bias related to loss to follow-up (Monterrosa et al., 2008). This explains the marginal significant results observed.

'Exclusive breastfeeding', even within a short period, provides a protective effect. In Hong Kong, China, a large prospective birth cohort of 8327 children recruited from 49 public hospitals in 1997 were followed for 8 years (Zhao et al., 2003). 'Exclusive breastfeeding' for three months reduced the rate of hospitalisation with respiratory infections in the first six months on life (Hazard ration 0.64 95% CI 0.42-0.97) and reduced the rate of diarrhoea (Hazard ratio 0.51 95% CI 0.25-1.05). Rates of other infections were reduced too (Hazard ratio 0.61 95% CI 0.44-0.85) (Zhao et al., 2003). The protective effect of 'exclusive breastfeeding' and infections was not observed beyond six months. Failure to determine the effect of 'exclusive breastfeeding' beyond six months in China was probably due to the small proportion of mothers who were breastfeeding at three (6%) and six months of age (3%).

Most findings indicate a reduced risk of infant morbidity and hospitalization with diarrhoea and respiratory infections when exclusive breastfeeding was practiced. The protective effect was more pronounced when exclusive breastfeeding was compared with never breastfeeding. In addition, the protective effect appeared to decline with age. Although some studies indicated a reduced risk of diarrhoea and respiratory infections when predominant or partial breastfeeding was practiced, the results were inconclusive. There is a need to compare exclusive breastfeeding versus non-exclusive breastfeeding rather than breastfeeding versus "never breastfeeding" since majority of African countries including Tanzania barely practice never breastfeeding.

2.7.6 Early complementary feeding and infections

Early exposure of infants to family foods has been shown to increase the likelihood of infections among infants. An mother-infant pair (n=561) cohort study was conducted in rural Malawi in 1993-1994 which sought to compare the morbidity among children who

received complementary food before three months and after three months (Kalanda et al., 2006). Early exposure to complementary food was associated with an increased chance of respiratory infection (OR 1.31 95% CI 1.13-1.49), eye infections (OR 1.49 95% CI 1.30-1.68) and malaria (OR 1.31 95% CI 1.13-1.49) (Kalanda et al., 2006). That study was conducted in two health facilities creating likelihood of selection bias since children with morbidity were likely to visit the hospital, making it possible to have an overestimated effect.

The risk of infections among infants born to HIV mothers was greater when early mixed feeding and prolonged breastfeeding for more than six months was practiced. In Cote de'Ivoire an open cohort of 622 infants not infected with HIV but born to HIV positive mothers aged over 18 months was conducted in 2001-2003 to determine HIV transmission at the age of 18 months (Becquet et al., 2008). Exposing infants to mixed feeding (breastmilk, liquid foods, solid foods or non-human milk) during the first months of life contributed to an increased risk of HIV transmission (RR = 6.3, 95% CI 1.1-36.4) despite the use of antiretroviral viral drugs. When breastfeeding was prolonged beyond six months, it translated to a much higher HIV transmission risk (OR 7.5 95% CI 2.0-28.2). Among formula fed infants, the rate of HIV transmission at the age of 18 months was less and not significant (OR 0.99 95% CI 0.97-1.00) (Becquet et al., 2008). In this study, it was possible that some infections occurred during pregnancy, intra-partum or during delivery, however the RNA PCR completed at the age of less than 30 days showed positive results for only three infants. The increased rate of infection as a result of mixed feeding may be due to interference in the integrity of the intestinal mucosal as a result of early exposure to family foods and contaminants, and hence increased the opportunity for HIV transmission to the infant (Kourtis, Butera, Ibegbu, Belec, & Duerr, 2003).

Although the value of breastfeeding on infections such as diarrhoea, respiratory infections and HIV is well documented in developing countries, there has been limited information concerning the role of breastfeeding on the prevention of otitis media. Existing literature suggests that maternal antibodies present in human milk reduce the

risk of otitis media (Abrahams & Labbok, 2011; Mew & Meredith, 1992; Sabirov, Casey, Murphy, & Pichichero, 2009). Data collected by the WHO in 2004 indicated that the prevalence of chronic otitis media in African countries ranged from 0.4%-4.2%. The prevalence seems small due to diagnosis at late age (school children) (World Health Organisation, 2004). Though not in Africa, a mother-infant pair cohort study conducted in Greece among 926 infants who were followed for 12 months in 2004-2005 reported a marginal protective effect of 'exclusive breastfeeding' for six months against otitis media (OR 0.37 95% CI 0.13-1.05) after modifying for possible confounders. 'Exclusive breastfeeding' for more than six months reduced infection incidence (P = 0.019) and regularity of hospitalisation (P = 0.037) during 12 months of age. 'Partial breastfeeding' did not offer significant protective effect (Ladomenou, Moschandreas, Kafatos, Tselentis, & Galanakis, 2010). The study depended on maternal ability to memorise illnesses, which created the likelihood that breastfeeding mothers might have reported more illnesses due to the closeness with the child. In addition, rates of hospitalisation used combined data for non-breastfeeding and 'partially breastfeeding' versus 'exclusive breastfeeding'. Lack of proper categorisation of feeding patterns masked the effect of the sub-category of feeding patterns e.g. 'predominant breastfeeding'.

There have been limited studies from developing countries, particularly Africa, documenting the effect of formula feeding on infections. This may be related to a low number of infants who are exposed to infant formula, which demands a large sample size to determine the association. One case-control study involving 191 infants and 208 control infants aged three weeks to six months was conducted in the Philippines. Cases were selected from three major public hospitals and controls from five health facilities; cases and controls were recruited from the same catchment area (Hengstermann et al., 2010). Infants who were fed exclusively on infant formula had nearly four times the risk of any infections, three times the risk of pneumonia and 10.5 times the risk of diarrhoea when compared with exclusively breastfed infants (Hengstermann et al., 2010). As a case-control study this was likely to suffer from recall and selection bias; further, the study did not match participants to potential confounding factors such as birth weight, maternal age, education level and social-economic status.

2.7.7 Infant feeding patterns in relation to obesity

Approximately 150 million adults and 15 million children were obese in 2010 with an increased rate of up to 10 times of what was observed in the 1970s (Horta, Bahl, Martines, & Victora, 2007). However, there is limited research associating infant feeding and obesity or chronic diseases in African countries. Decline in life expectancy as a result of obesity was observed in the United States (Olshansky, 2005). Since the treatment of obesity is challenging, the American Academy of Pediatrics issued a policy to prevent obesity through an emphasis on early life measures, including breastfeeding (American Academy of Pediatrics, 2003).

Over 50 years, several researchers had worked to determine long-term effects of breastfeeding on adiposity but results were controversial. McCance (1962) conducted a review of animal feeding and weight gain. The review revealed that three rats fed by one mother gained more weight compared with 15-18 litters fed from another mother. The weight difference was apparent even after exposure to abundant food at the age of three weeks. Beside changes in weight, malnourished rats had frequent morbidity, experienced changes in bone structure, scull and teeth, and had delayed maturity (McCance, 1962). This study generated valuable findings which triggered further research.

Kramer (1981) built from animal model and conducted a case-control study among 639 adolescent aged 12 to 18 years who joined an adolescent clinic in Montreal children's hospital in Canada (Kramer, 1981). The study also involved 533 adolescents who attended Montreal high school in 1980 as control group. Non-breastfeeding was positively associated with obesity during adolescence (OR = 4.09, 95% CI 1.59-10.54) and the effect remained stronger even after adjustment for social-economic variables. The protective effect of breastfeeding in obesity increased with breastfeeding period ($P<0.025$) (Kramer, 1981). The observed strong effect might be confounded by non-breastfeeding mothers practicing other behaviours such as watching movies and feeding infants junk food, which contributes to obesity.

To strengthen the evidence of infant feeding and obesity, in 2007 World Health Organisation performed a systematic review and meta-analysis of observational and randomised control trials conducted in 1966 to March 2006. The review aimed to discover long-term consequence of breastfeeding when compared with non-breastfeeding amongst people with an age range of one to 19 years. Thirty three studies with 39 odds ratio estimates were included. The WHO reported a small effect of breastfeeding on overweight and obesity with a pooled odds ratio of 0.78 (95% CI: 0.72-0.84) (Horta et al., 2007). Breastfeeding reduced chance of hypertension by lowering systolic blood pressure (adjusted mean difference: -1.19; 95% CI: -1.70 to -0.69) and diastolic blood pressure (mean difference: -0.61; 95% CI: -1.12 to -0.10). Compared with the non-breastfeeding group, breastfed subjects had a low cholesterol level (mean difference: -0.18; 95% CI: -0.30 to -0.06 mmol/L) in adulthood but with no substantial influence in childhood. The breastfed group had less chance of developing type II diabetes (pooled odds ratio: 0.63; 95% CI: 0.45-0.89) (Horta et al., 2007). However, the study failed to discuss other confounding factors including watching TV, short sleeping hours and breakfast eating habits. Most published data was collected from Western Europe and North America which limits the generalisability to African countries. In addition, some studies included in the meta-analysis were conducted in the 1950s creating a likelihood of bias due to life style factors and breastfeeding rate changes. It was likely that people who were born in earlier decades were likely to be breastfed more and to benefit from polyunsaturated fat acids which is readily available in breast-milk (Brenna et al., 2007; Petherick, 2010), and might have an effect on blood pressure. However, a recent review and meta-analysis by the WHO, which included 1500 participants, still suggest a slightly reduced effect (10%) in the reduction of obesity among children who were breastfed for more than six months (Horta & Victora, 2013a).

Cape and Allison (2008) undertook a critical review of the WHO review conducted in 2007 and concluded that breastfeeding has an unjustifiable effect on overweight and obesity. The review was able to show that the 2007 WHO report neglected some valuable unpublished papers showing no positive association between breastfeeding and overweight/obesity. They also indicated that out of 39 odds ratio presented, seven were

from samples consisting of people aged more than 18 years and out of the seven, six had odds ratio of less than one which indicated publication bias (Cope & Allison, 2008).

A more robust meta-analysis of 25 studies with 226,508 participants generated data from developed countries and two Asian countries (China and Japan) reported a protective effect of breastfeeding in obesity (Yan, Liu, Zhu, Huang, & Wang, 2014). The study included papers published from 1997 to August 2014. It found that breastfeeding for seven months reduced the risk of obesity (Adjusted OR 0.79 95% CI 0.70-0.88). However breastfeeding for less than three months yielded only a 10% less risk of obesity, indicating a dose-response effect. This percentage was comparable to the results reported by the WHO review (Horta & Victora, 2013a) (10%) when breastfeeding was practiced for more than six months. The majority of studies included in the meta-analysis compared 'never' versus 'ever breastfeeding' or 'ever breastfeeding' and 'infant formula' which is not a typical feeding patterns in African countries. Studies focusing on infant feeding and obesity in African setting will be valuable since 'any breastfeeding' is common.

A non-significant effect of 'exclusive breastfeeding' in relation to obesity was reported in a nurses health study conducted among 35,526 respondents aged 25-42 years in the USA for the period 1989-2001. The study asked mothers of the nurses to report if their daughters were ever breastfed or given infant formula, evaporated milk or solid foods. The age when non-human milk or solids foods was given was recorded as well. The study did not find a significant association between duration of breastfeeding or 'exclusive breastfeeding' on adolescent or adulthood Body Mass Index (BMI) (Michels et al., 2007). The risk of obesity was (OR 0.94 (95% (CI) 0.83-1.07) among women who were exclusively breastfed for over six months compared with the non-breastfed women. Self-reported weight and height together with posted questionnaires were administered during the data collection (Michels et al., 2007). Studies have shown self-reported obesity measures are subject to memory bias and have reduced validity (Nyholm, 2007).

Similar results were reported in Hong Kong in a retrospective birth cohort conducted in 1997 with a large sample size (n = 8327) and a high follow-up rate (84%). The study found no relationship between 'exclusive breastfeeding' for ≥ 3 months and BMI of children aged seven years (adjusted Z-score average difference 0.07, 95% (CI) -0.05 to 0.19) (Kwok, Schooling, Lam, & Leung, 2010). The study did not take into account maternal BMI, a predictor of breastfeeding duration and infant weight gain (Michels et al., 2007). Another possible reason for the failure to find protective effect was the reported short duration of breastfeeding.

Breastfeeding had been shown to impact the onset of diabetes type I in children aged less than 18 years who were diagnosed with diabetes below 15 years of age in the Czech Republic (Malcova et al., 2006). This was a case control study of 868 diabetic children and 1466 controls were nominated from a school where diabetic children attended. The study had shown increased risk of type I diabetes when non-breastfeeding was practiced (OR = 1.93 (95% CI: 1.33-2.80) and a protective effect from diabetes type I when breastfeeding was practiced over 12 months (OR = 0.42 (95% CI 0.22-0.81). Though not stated in this study, the effect may be attributed by increased exposure to infant formula among non-breastfed infants since infants exposed to formula have high insulin response, contributing to the accumulation of fat (Lucas et al., 1980).

There have been inconclusive results from the studies that focused on the association between breastfeeding and obesity or non-communicable diseases. The lack or weak association may be related to inability to adjust for confounding factors (birth weight, watching television, consumption of junk food, maternal BMI and socio-economic status). In addition, memory bias was prevalent due to retrospective nature of data collection in most studies.

2.7.8 Optimal infant feeding and cognitive development

Breastfeeding has long been documented to have beneficial effect in cognitive development among children (Johnson, 1996). Most of these studies, however, were completed in developed countries. A review conducted by the WHO to determine long-

term effect of breastfeeding reported an average difference of 4.9 (95% CI 2.97-6.92) in intellectual performance tests among the breastfed group aged one to 19 years compared with the non-breastfed group indicating a higher intellectual test as a result of breastfeeding (Horta et al., 2007).

The effect of breastfeeding on cognitive development was observed even among preterm children. A cohort study which combined 8568 full-term and preterm nine year old children born 1997-1998 was undertaken in Ireland. The study showed a higher test score in percentage for reading 8.67 (95% CI 7.55-9.80) and 7.42 (95% CI 6.23-8.16) in the mathematic score among 'ever breastfed' children compared with non-breastfed children. After adjusting for the social and economic factors, 'ever breastfed' children still had a higher percentage score in reading ($P<0.001$) and in mathematics ($P< 0.001$) (McCrory & Layte, 2011a). However, only 44.4% of children were 'ever breastfed' by the age of 15 weeks, which creates the likelihood of an underestimating breastfeeding effect.

In Poland, a longitudinal study aiming to discover the effect of 'exclusive breastfeeding' and cognitive development was conducted. The study was carried out in 2001-2004 among 468 seven-year old children who were born after 36 weeks of pregnancy. Children who were exclusively breastfed for three months had an average of 2.1(95% CI 0.24-3.9) higher intelligence quotient (IQ) compared with those who were exposed to complementary foods. 'Exclusive breastfeeding' for six months or more increased IQ to an average point of 3.8 (95% CI 2.11-5.45) compared with children exposed early to complementary foods (Jedrychowski, 2012). The beneficial effect of breastfeeding on cognitive performance has been consistent with what was found in recent studies. Bernard (2013) conducted a mother-child pair cohort study in France between 2003 and 2006 to determine language ability in relation to breastfeeding among 1387 children aged two years and overall development among 1199 children aged three years. The study revealed that children who were 'ever breastfed' scored higher in language ability test and overall development score (6.2 Points) compared with non-breastfed children (Bernard et al., 2013). A further one month of breastfeeding translated to an increase of

0.75 communication ability points and a single point increase in overall development (Bernard et al., 2013)

Breastfeeding not only has an impact on the cognitive ability in childhood but its effect is carried though to adolescence. A recent study conducted in Canada among 599 adolescents (12-15 years old) observed an increased cortical thickness ($t = 2.31$, $P = 0.02$) among adolescents who were breastfed for 16 weeks or more compared with non-breastfed adolescents. Overall intelligence also increased ($t = 2.69$, $P = 0.008$) with a longer duration of breastfeeding (Kafouri et al., 2013). Brenna (2007) hypothesised that the higher cognitive development associated with breastfeeding was thought to be due to the presence of polyunsaturated fatty acids particularly docosahexaonic acid and arachidonic acid in human milk. These bioactive compounds concentrate in the retina and brain and have said to impact visual and neuro-cognitive development in early life (Brenna et al., 2007).

Despite the reported positive association between breastfeeding and intelligence quotient in the studies above, a large prospective population based birth-6 years cohort study conducted in the Netherlands did not find a significant association between breastfeeding and non-verbal intelligence (Sajjad et al., 2015). The study included 3761 participants born from April 2002 to January 2006. When comparing the mothers who initiated breastfeeding with those who did not breastfeed, no significant difference (IQ points 3.10 95% CI -0.95-2.10) was observed after adjusting for child and maternal confounders. Compared with children who were weaned before three months, breastfeeding beyond three months did not yield a statistical significant difference in IQ points in the adjusted model (IQ points 0.57 95% CI-0.24-1.78). Exclusive breastfeeding for four months did not result in an increase in IQ level compared with never breastfed infants (IQ points 2.07 95% CI 0.31-3.82) (Sajjad et al., 2015). The observed non-significant effect was related to the adjustment for several maternal social-demographic factors including maternal IQ level, which weakened the strong effect observed in the univariate analysis. Maternal IQ contributed to 40% variations in the effect, which indicates a strong influence of maternal variables on child IQ level. Most of the studies

that found an association between breastfeeding and IQ did not adjust for maternal IQ, which might contribute to the observed strong positive effect of breastfeeding on IQ level.

Majority of the reviewed studies indicates a higher IQ level among infants exposed to exclusive breastfeeding as compared to those exposed to "never breastfeed" or those exposed to complementary feeding before six months. A recent study conducted in the Netherland by Sajjad et al. (2015) emphasized the need to include maternal IQ level as a key confounding factor during data analysis since it was not adressed in most previous studies.

2.7.9 Infant feeding patterns and mortality

Mortality was not a target in this present study, however understanding the role of infant feeding in relation to mortality is vital since it is inextricably linked to feeding patterns. Breastfeeding contributes to the saving of lives in developing countries, particularly mortality related to diarrhoea and respiratory infections (World Health Organisation, 2000). Early breastfeeding initiation contributes to infant survival (Edmond et al., 2006; World Health Organisation, 2001). A cohort study conducted in Ghana among 10,942 neonates indicated a 2.6 increased risk (95% CI 1.68-4.04) of neonatal mortality as a result of delayed breastfeeding initiation for more than one day and increased the risk of death by four times when infants were exposed to mixed feeding (milk based liquids foods or solids and breastmilk) (Edmond et al., 2007; Edmond et al., 2006). Increased mortality as a result of delayed initiation might be related to lack of consumption of colostrum (the yellowish milk) which is considered to act as a first immunisation as it is fully packed with growth factor, immunoglobulins, oligosaccharides, and anti-inflammatory and other nutrients essential for child protection, growth and development (Petherick, 2010; World Health Organisation, 1998b).

The impact of infant feeding on mortality related to infection in developing countries was documented by a pooled analysis conducted by the WHO which covered six developing countries (WHO, 2000). The analysis included 1223 mortality data of

children aged less than two years collected from six countries in 1980 to 1998. The ability of breastmilk to protect infants from mortality due to infections dropped with age. A pooled odds ratio of 5.8 (95% CI 3.4-9.8) was observed at age less than two months compared with pooled odds ratio of 2.6 (95% CI 1.6-3.9) at the age of 4-5 months (WHO, 2000). During the first half of infancy, the protection provided by breastmilk on mortality related to diarrhoea was six times (95% CI 4.9-9.0) compared with acute respiratory infection (OR 2.4 95% CI 1.6-3.5) and remained the same thereafter. Infant mortality due to non-breastfeeding varied between countries with Pakistan having the highest (OR 7.9 95% CI 3.8-16.3) and the Philippines having the lowest (OR 1.9 95% CI 1.3-2.7). The variability might have been contributed by maternal level of education. The pooled analysis indicated that odds of infections-related mortality among children 0-5 months was higher among low educated mothers (OR 7.6 95 % CI 4.7-12.3) than among educated mothers (OR 2.7 95% CI 1.8-4.1). Generalising the WHO findings to all developing countries should be done with caution since there were only eight studies in six countries (Brazil, Gambia, Ghana, Pakistan, the Philippines and Senegal). It is to be noted that data from African countries was not included in the analysis due to persistent high rates of ‘any breastfeeding’ up to the second year of life.

Breastfeeding prevents mortality even among children born to HIV positive mothers. A cohort study of 690 mother-infants pair conducted in Tanzania from 1995 to 1997 when the antiretroviral drugs were not available indicated reduced risk of mortality among breastfed infants (Natchu et al., 2012). The study targeted children age 0-60 months of mothers who participated in the multivitamin trial to establish its effect on HIV progression. In this study, at the age of five months, none of these children were exclusively breastfed (Natchu et al., 2012). The finding indicated that ‘exclusive breastfeeding’ for an extra one month translated to a reduced mortality rate of 49% at the age of six months (Relative risk: 0.51 95% CI 0.28-0.93) but did not reduce HIV related mortality (Relative risk: 0.85 95% CI 0.71-1.01) (Natchu et al., 2012). The protective effect of ‘exclusive breastfeeding’ on mortality was not observed at the higher age possibly due to low levels of ‘exclusive breastfeeding’ in this study.

Several other reviews and meta-analysis have indicated positive correlation or association between breastfeeding and mortality (R. E. Black et al., 2013; Boccolini, de Carvalho, de Oliveira, & Pérez-Escamilla, 2013; Lamberti, Fischer Walker, Christa, et al., 2011; Lamberti et al., 2013). Analysis conducted by Black (2013) indicated that promoting breastfeeding for 0-23 months could avert 804,000 deaths globally each year which was almost 11.6% of all deaths occurring among under-five year old children in 2013 (R. E. Black et al., 2013). According to Jones (2003), promotion of 'any breastfeeding' up to 90% in low and middle income countries could avert 13-15% of all causes of under-five deaths (Jones, Steketee, Black, Bhutta, & Morris, 2003). Lamberts (2011) review recounted a 10.5 fold increased chance of deaths among non-breastfed infants compared with exclusively breastfed infants aged 0-5 months. The author also indicated that after six months, 'not breastfeeding' was associated with a twofold risk of deaths indicating a decreased protective effect as the child grew (Lamberti, Fischer Walker, Noiman, Victora, & Black, 2011). Lambert (2013) also reported nearly 15 times (Relative risk: 14.97 95% CI 0.67-332.72) mortality from pneumonia among 'non-breastfed' infants as compared with 'exclusive breastfed' infants aged 0-5 months. The effect was less at 6-23 months (Relative Risk: 1.92 95% CI 0.79-4.68) (Lamberti et al., 2013). Therefore, findings from the reviewed studies indicate a reduced risk of mortality when exclusive breastfeeding is practiced. More protection is offered at younger age than older age.

2.8 Infant feeding patterns and maternal health

2.8.1 Introduction

Although this present study did not target maternal health in relation to breastfeeding and infant health, it is well established that breastfeeding affects maternal health and may impact infant feeding practices and health (Brown & Lee, 2011; Hatsu, McDougald, & Anderson, 2008; Micali, Simonoff, & Treasure, 2009). For example, a mother who practices 'exclusive breastfeeding' will establish strong bonding with a child and that may influence the ability to detect infant illnesses. Realising the role of breastfeeding on maternal health will facilitate integration of maternal and child health

services. This section documents maternal benefit as a result of breastfeeding including maternal postpartum weight retention, lactation amenorrhea, breast cancer and maternal-child bonding. However, the majority of the studies included are from developed countries due to limited studies from developing countries.

2.8.2 Infant feeding and maternal weight retention

Retaining weights during postpartum increases the chance of obesity in the later stages of life (Gore, Brown, & West, 2003). Infant feeding, particularly breastfeeding, has been reported to contribute to the reduction of maternal obesity after delivery and that, its effect depended on the weight gained during pregnancy (Baker et al., 2008; Chapman, 2009).

In the USA, women who participated in the nutrition supplementation program in 1996-2004 were assessed for weight retention in relation to breastfeeding (Krause, Lovelady, Peterson, Chowdhury, & Østbye, 2010). At three months, no association between breastfeeding and weight retention was observed. However, at six months postpartum, mothers who practiced 'any breastfeeding' were 1.38 kilograms less, compared with formula fed women. Practicing 'mixed feeding' or 'full breastfeeding' contributed to low weight retention at six months than in mothers who opted to provide infant formula only (Krause, Lovelady, Peterson, Chowdhury, & Østbye, 2010). Finding an effect on weight at six months indicates that there might be a required breastfeeding period to be able to observe the effect on maternal weight or it might be related to sample selection since weight measurements were never collected from the same woman. There were 14,330 women when measurements were done at three months and only 4922 at six months with women who were selected separately. The study also used self-reported weight; obese mothers who might be less likely to breastfeed might have under-reported their weight and overestimated the breastfeeding period (Krause, Lovelady, Peterson, Chowdhury, & Østbye, 2010).

Another study conducted in the period 2001-2004 by Agrasada (2011) in the Philippines among 204 women from low economic quintiles reported no difference in weight and maternal BMI among mothers who did not breastfeed or who were 'partially

breastfeeding' or practiced 'exclusive breastfeeding' (Agrasada et al., 2011). Lack of association may be related to the small sample size of women who were practicing 'exclusive breastfeeding'(n = 24) compared with 'partially breastfeeding' (n = 134) (Agrasada et al., 2011). To produce consistent results, the use of appropriate definitions, adequate sample size and inclusion of heterogeneous population was paramount. Conversely, the inconclusive results obtained from these studies conducted in developed and developing countries demands more research.

2.7.3 Infant feeding and lactation amenorrhea

The World Health Organisation recognises the biological and social link between maternal and child feeding (World Health Organisation, 1998b). Breastfeeding has been documented to induce lactation amenorrhea (Kramer & Kakuma, 2012) and in some cases it has been used as a sole source of contraception (Sipsma, Sipsma, & Bradley, 2013). The effect of breastfeeding on lactation amenorrhea varies across countries and the exact duration of amenorrhea needs to be established with consideration of the frequency of 'exclusive breastfeeding'.

A former multicentre prospective study was conducted by the WHO among 4118 mother-infant pairs in four developing countries (India, China, Santiago Guatemala, Nigeria) and two developed countries (Sweden and Australia) (World Health Organisation, 1998b) to establish the effect of breastfeeding on lactation amenorrhea. Breastfeeding women reported to benefit from lactation amenorrhea but with significant variations between the countries. In India, amenorrhea lasted for a median of 3-4 months among breastfeeding women while in China it lasted for a period of nine months. The study also observed a noticeable difference in infant feeding patterns between the sites with China and developed countries experiencing delayed introduction of complementary foods for up to three months while remaining countries started to introduce complementary foods as early as one week (World Health Organisation, 1998b). It is, however, unusual that China, although reporting long duration of amenorrhea, in fact had the shortest average frequency of suckling in 24 hours (World Health Organisation, 1998b), a situation requiring further investigation.

A much longer duration of lactation amenorrhea was observed in a cross-sectional study conducted in the United Arab Emirates (Dubai, Abu Dhabi and Al Ain). The researchers interviewed 200 mothers who were selected through purposive sampling from three sites (Radwan, Mussaiger, & Hachem, 2009). On average lactation amenorrhea was 6.1 months among the selected sites. Al Ain had the longest duration of lactation amenorrhea (7.2 months), then Dubai (6.9 months) and Abu Dhabi had the least (4.3 months). There was a correlation between the length of lactation amenorrhea and the time an infant was exposed to complementary foods. However, the study used purposive sampling to select women with a child aged less than two years. It is likely that women who participated were conscious of their health, had different socio-economic status and had intrinsic motivation to breastfeed, creating a likelihood to confound the presented results.

Despite the variation observed between countries, the lactation amenorrhea was used in Niger as a sole family planning method. A recent study which re-analysed data from the 2006 Demographic and Health Survey reported that 52% of women were using lactation amenorrhea as a sole source of family planning method and only 21% used it correctly (Sipsma et al., 2013). Ability of breastfeeding to induce lactation amenorrhea was reported to be related with a suckling effect which suppress hormones responsible with maturation of ovaries (McNeilly, 2001).

2.8.4 Infant feeding patterns and maternal breast cancer

The estimate made by the WHO in 2008 indicated that nearly 460,000 women die every year due to breast cancer with 1.38 million reported new cases (World Health Organisation, 2008a)**.** Most of the breast cancer mortality (269,000) had occurred in developing countries. Breastfeeding for a long duration could avert some incidence of breast cancer among pre- and postmenopausal women (World Health Organisation, 2008a). The ability of breastfeeding to reduce chances of breast cancer is not well known and several theories have been developed. Lactation facilitates "differentiation of mammary cells and excretions in the milk of breast carcinogens" (Freund, 2005 p. 739)

and the effect seems strong when primigravida was relatively young (Freund, Mirabel, Annane, & Mathelin, 2005).

Researchers in Korea recruited 753 breast cancer cases and 753 matched controls in 1997-2003 to establish the association between breastfeeding and cancer of the breasts. The study found a 35% reduced chance of breast cancer among women who breastfed for more than 13 months compared with those who breastfed for one to four months. The effect was more pronounced among women aged less than 22 years who managed to breastfeed the first child with an odds ratio of 0.32 (95% CI 0.26-0.58) as compared with older women (Kim et al., 2007).

Another large case control study conducted in India among 1866 cases and 1873 controls in 2002-2005 found a reduced incidence of breast cancer among premenopausal women (Gajalakshmi et al., 2009). The odds of breastfeeding for two years were 0.75 (95% CI 0.47-1.18) and when breastfeeding was extended for six years the odds was 0.52 (95% CI 0.31-0.88). There was no protective effect observed among postmenopausal women probably due to long-term ability to remember their past experience of breastfeeding, which could trigger misclassification of breastfeeding duration.

2.8.5 Infant feeding patterns and mother to child bonding

An affectionate relationship is established between mother and child when breastfeeding is established. The breastfeeding mechanism stimulates production of oxytocin and prolactin hormones which play an important role in modifying maternal behaviour and is also associated with reduced levels of stress (Katrine & Colin, 2003). Cernadas (2003) carried out an observation study among 579 mothers with infants aged less than six months in Italy. Mothers were interviewed by telephone at one, four and six months. ‘Exclusive breastfeeding’ for six months was positively associated with mother to child bonding (Risk ratio 1.24 95% CI 1.04-1.47). The finding was somewhat contradictory when Jansen (2008) indicated in the review that the reported maternal to child bonding when breastfeeding was initiated was never reinforced by firsthand evidence, but rather

through a rigorous documentation of its effect. In Jansen's (2008) review, five out of six studies did not establish any effect of breastfeeding on maternal bonding (Jansen, Weerth, & Riksen-Walraven, 2008). More experimental research or pooled analysis may be required to solidify existing evidence of breastfeeding and mother to child bonding rather than relying on anecdotal theories or observational studies.

2.9 Factors contributing to non-exclusive breastfeeding in developing countries

2.9.1 Introduction

Promotion of 'exclusive breastfeeding' has been singled out as one of the most cost effective interventions to alleviate malnutrition and to increase child survival (Bhutta, 2008). However, implementation of a breastfeeding promotion program requires a clear understanding of factors precipitating 'non-exclusive breastfeeding' and sources of information influencing mother's decision. Avoiding early complementary feeding is necessary in the process of maximising uptake of breastmilk (World Health Organisation, 2003b). Several studies have documented factors associated with 'non-exclusive breastfeeding' in developing countries (Aidam, Perez-Escamilla, Lartey, & Aidam, 2005; Esteves, Daumas, de Oliveira, de Andrade, & Leite, 2014; Issaka et al., 2015; A. Patel, Banerjee, & Kaletwad, 2013; Roy, Mohan, Singh, Singh, & Srivastava, 2014; Seid, Yesuf, & Koye, 2013; Senarath, Dibley, & Agho, 2010; Tamiru, Belachew, Loha, & Mohammed, 2012; Teka, Assefa, & Haileslassie, 2015; Victor, 2013). However, this section will cover maternal and paternal education levels, knowledge of breastfeeding, breastfeeding intention, perceived breastfeeding sufficiency, employment, child sex and other factors.

2.9.2 Maternal and paternal education level

Education is a major source of women empowerment and facilitates an informed choice on infant feeding. The Demographic and Health Survey conducted in Tanzania indicated that 59% of educated mothers were likely to initiate breastfeeding within one hour compared with 44% among non-educated mothers (National Bureau of Statistics & ICF

Macro, 2011b). Similar findings were reported in Ethiopia among 382 mothers who were interviewed about factors related to sub-optimal infant feeding. The study found an increased (Adjusted odds ratio:1.05 95% CI 1.03-1.94) likelihood for non-educated women to not initiate breastfeeding within one hour compared with educated mothers (Tamiru et al., 2012). It is important to note that there is a link between late initiation of breastfeeding and early provision of pre-lacteal feeds (Giridhar & Lakshmi, 2012).

Another longitudinal study was conducted in Kenya among 4299 women who gave birth between September 2006 and January 2010. The study found a 10% less chance of early complementary feeding among women who attained secondary education (Kimani-Murage et al., 2011). A much stronger association was found in Malawi in a cohort study of 561 mother-infant pairs. A low level of education was associated with higher chance OR 2.1 (95% CI 1.3-3.2) of introducing complementary foods before a child's age of three months (Kalanda et al., 2006). In Egypt, the chance of introducing complementary food at the right time increased as women's levels of education increased. Attaining secondary education translated to almost seven times (95% CI 3.5-12.9) the chance of introducing complementary food at the right time. Though the odds ratio seemed strong, the calculated P-value indicated a borderline significant level ($p = 0.07$) (El Shafei & Labib, 2014). While education levels seemed to play a positive role in breastfeeding and ideal timing in complementary feeding, in South Africa, women with tertiary education were more likely to terminate breastfeeding by 12 weeks (OR 2.3 95% CI 1.0-5.5) compared with less educated women (Doherty et al., 2012). This was probably due to greater opportunities for employment among women with a tertiary education which may affect 'exclusive breastfeeding'.

In one Muslim country (Kuwait), the rate of 'exclusive breastfeeding' was low (2%) at the age of six months (Dashti, Scott, Edwards, & Al-Sughayer, 2014). In this community, mothers with twelve or more years of education were 36% more likely to practice 'any breastfeeding' and 26% more likely to practice 'exclusive breastfeeding' than women with less than twelve years of schooling (Dashti et al., 2014). This was a

cohort study which involved 373 women recruited from four maternity clinics and followed them from the birth of their infants to six months.

Having educated partners seems to have a great influence on optimal feeding. In the Kigoma region of Tanzania, having a partner who attained secondary education yielded a higher odds ratio of 2.9 (95% CI 1.4-6.00) of practicing 'exclusive breastfeeding' (Nkala & Msuya, 2011). The findings indicate a great contribution of partner education to infant feeding decisions. However, it is less clear whether the involvement of educated or non-educated partners during promotion of 'exclusive breastfeeding' would yield a different effect.

2.9.3 Adequate knowledge on infant feeding

Access to information seems to affect a mother's decision on child feeding. In Kigoma region of Tanzania, a cross sectional study of 402 women with children aged 6-12 months reported that the chance of women to exclusively breastfeed was increased five times if they had adequate knowledge on 'exclusive breastfeeding' (Nkala & Msuya, 2011). However, lack of 'exclusive breastfeeding' information did not trigger early complementary feeding in Ethiopia but access to radio had an influence **(**Tamiru et al., 2012). The same results were found in Tanzania where the availability of radio to lactating mothers was associated with an increased duration of 'exclusive breastfeeding' ($P = 0.001$) and predominant infant feeding ($p = 0.04$). The effect was more pronounced in rural, but not in urban, areas (Shirima, Gebre-Medhin, & Greiner, 2001; Tamiru et al., 2012). Probably the availability of radio acted as an intermediary variable to gain breastfeeding knowledge particularly in Tanzania because since 1994 radio programs were utilised during the celebration of breastfeeding week (Shirima et al., 2001).

Among Egyptian women, exposure to health education about breastfeeding contributed to an increased chance of practicing 'exclusive breastfeeding' (AOR 9.4 (95% CI 4.0-22.4) (El Shafei & Labib, 2014). However, there was a possibility that breastfeeding knowledge may lead to intention but not necessarily to breastfeeding continuation in Malaysia. A cross-sectional study there, which included 213 middle aged women found

a higher knowledge on breastfeeding among women with breastfeeding intention and a more knowledge on infant formula among women intending to practice artificial feed. However, knowledge of breastfeeding did not translate to higher breastfeeding continuation ($p = 0.074$) among women with knowledge on breastfeeding and who intended to breastfeed compared with those who intended to provide formula (Ishak, Shareena, 2014). The author concluded that there might be other factors prompting breastfeeding decisions.

2.9.4 Women employment

Developing countries are facing the growing challenge of an increased number of women joining the labour force (Blackden, Rwebangira, & Ramin, 2004) and, at the same time, trying to balance maternal roles. To sustain breastfeeding, a regular steady contact between mother and a child is paramount (World Health Organisation, 1998a). In Tanzania, maternity leave is 84 days for mothers who deliver a single baby and 100 days for twins or triplets, which makes it difficult to maintain frequent contact after three months (The Gorvement of Tanzania, 2004). Several studies have documented the detrimental effect of womens full time or part time employment on breastfeeding initiation and duration (Lakati et al., 2002). Lakati (2002) interviewed 433 women with children aged 16-48 weeks in Kenya to determine the reasons for early breastfeeding cessation and complementary feeding. The study found that around 28% of interviewed mothers said that ‘return to work’ was the main reason for not practicing ‘exclusive breastfeeding’ (Lakati et al., 2002).

Other studies found an increased likelihood of breastfeeding discontinuation if the mother worked full time or for more than 34 hours per week (Mandal, Roe, & Fein, 2010; Ryan, Zhou, & Arensberg, 2006) and if their work environment did not support breastfeeding; for example a care room and breastmilk expression equipment may not be available (Mlay, Keddy, & Stern, 2004). In Malaysia, of 213 women who were interviewed for knowledge and attitude towards breastfeeding, two-thirds were working mothers. Despite having a good initial intention to breastfeed, twenty three mothers stopped breastfeeding at 8 weeks and 57% of those who discontinued breastfeeding

pointed out return to work as a main reason (Ishak et al., 2014). In South Africa, women nominated the necessity to generate their own income as the main reason to cease breastfeeding before 12 weeks. The study was conducted among 999 women participated in a randomised control trial promoting 'exclusive breastfeeding'. The need to generate an income increased the likelihood of breastfeeding cessation (AOR 1.9 (95% CI 1.3-2.8) compared with those who did not want to generate their income (Doherty et al., 2012).

In Taiwan 4028 postpartum women who were identified through a national birth registration database were interviewed when infants were at six months, on the effect of employment on breastfeeding initiation and continuation (C. H. Chuang et al., 2007). Among foreign mothers living in Taiwan, unemployed mothers breastfed for a longer duration [hazard ratio (HR) 0.54; 95% CI 0.42-0.70] compared with unemployed Taiwanese mothers (HR 0.76; 95% CI 0.66-0.88) (C. H. Chuang et al., 2007). The study also found that being a Taiwanese mother and employed resulted in early complementary feeding than a non-Taiwanese mother, indicating interaction between ethnicity and employment.

Beside employment, a prospective study conducted in 1520 mothers who delivered in a health facility in Zhejiang province of China found an increased likelihood of breastfeeding and 'exclusive breastfeeding' cessation when mothers had a decent job and income (Qiu, Binns, Zhao, Lee, & Xie, 2010). For example, the percentage of breastfeeding amongst laborers was 60.7% while in office workers it was 38.3%. Sixty two percent of mothers with an income less than three thousand Yuan practiced breastfeeding compared with 35% among mothers with income more than five thousand Yuan (Qiu et al., 2010).

2.9.5 Maternal breastfeeding intention

Intention to breastfeed is among the fundamental factors influencing breastfeeding initiation and duration in developing countries (Doherty et al., 2012). Existing literature from DiGirolamo, (2005) quoted in Bailey & Sherriff (1992) suggested that 50-90% of

women decide how to feed their newborn before pregnancy or during the early stage of pregnancy (DiGirolamo, Thompson, Martorell, Fein, & Grummer-Strawn, 2005). In South Africa, antenatal women who had no intention to breastfeed had almost sixfold (95% CI 3.4-9.4) chance of terminating breastfeeding before 12 weeks compared with those antenatal women with breastfeeding intention. The study also found that those who were not decided on the feeding had a fourfold (95% CI 1.5-10.8) chance of breastfeeding termination (Doherty et al., 2012). Not only intention but the timing of intention had a great influence on 'any breastfeeding' and 'exclusive breastfeeding' practices. In Zhejiang province of China, a prospective cohort study of 1520 mothers who delivered in the health facilities in 2004-2005 found an increased chance of 'any breastfeeding' cessation among mothers who made their decision after pregnancy (HR 1.64 95% CI 1.10–2.43) compared with those who made their decision to breastfeed before pregnancy. The length of 'exclusive breastfeeding' was also affected by the time intention was made (P = 0.048). The study also reported a higher chance of introducing formula among mothers who made their decision on infant feeding during pregnancy (OR 1.9 95% CI 1.2 – 3.0) and after delivery (OR 3.1 95% CI 1.8 – 5.3) compared with those who made a decision before pregnancy (Qiu et al., 2010).

A qualitative study conducted in Vietnam found breastfeeding intention was affected when child growth was compromised. Despite an intention to breastfeed, mothers gave a combination of breastmilk and infant formula to make their infant grow (Lundberg & Thu, 2012). A similar situation was reported in Brazil in earlier cohort studies where inadequate growth was cited as the main reason to stop breastfeeding before three months (Martines et al., 1989). The relative risk of breastfeeding cessation before three months when weight for age was low was 1.84 (95% CI 1.03-3.28) and the risk for termination at four months was even higher (RR 2.22 95% CI 1.16-4.34).

2.9.6 Perceived inadequate milk production

In developing countries, insufficient breast milk has long been identified as the main reason for women to stop breastfeeding before six months or to practice early complementary feeding (Forman, 1984; Martines et al., 1989). Recent reviews still

indicate perceived inadequate milk supply to affect 'exclusive breastfeeding' in developing countries (Balogun, Dagvadorj, Anigo, Ota, & Sasaki, 2015). Despite women reporting insufficient milk production, existing evidence suggests only 5% of women were truly having such a problem (Hector & King, 2005).

In Brazil, a cohort of 538 infants aged less than six months with mothers residing in urban areas but earning less than 200 USD found an increased proportion of women who introduced complementary feeding early due to a perception of insufficient or poor quality of breastmilk. When an infant was aged one month, 40% of mothers introduced complementary foods and 42.4% stopped breastfeeding due to the perception of inadequate or poor quality breastmilk (Martines et al., 1989). In Zambia a qualitative study found the factor that contributed to insufficient 'exclusive breastfeeding' was the perception that breastmilk was inadequate (Fjeld et al., 2008). A more recent review conducted in China (Xu et al., 2009) also identified insufficient breastmilk among common factors hastening early complementary feeding before four months. In the review, eight out of 12 studies revealed perceived insufficient breastmilk to be the main reason for discontinuing breastfeeding before four months (Xu et al., 2009).

2.9.7 Child gender

A few studies have indicated that male infants were more susceptible to early complementary feeding than girls (Kimani-Murage et al., 2011; Martines et al., 1989). The question remains, however, whether a gender preference affects feeding choice or whether an increased demand of food by male infants triggers early breastfeeding cessation and complementary feeding. It is important to establish any existing gender difference in relation to breastfeeding since breastfeeding reduces mortality (World Health Organisation, 2000) and therefore gender preference in feeding may be used to explain any existing variations in mortality by gender. In Brazil mothers with male children had an increased chance of stopping breastfeeding at three months (RR 1.39 95% CI 1.04-1.97) and six months (RR 1.43 95% CI 1.04-1.97). Child gender was also reported in Kenya as being among the factors associated with sub-optimal infant

feeding. Boys had a higher chance of being introduced early to complementary foods (Hazard ratio: 1.05) than girls (Kimani-Murage et al., 2011).

Similar findings were reported in a non-published study which analysed 32 Demographic and Health Survey data from 17 African countries. The study revealed some gender disparities in breastfeeding (Chakravarty, 2011). There was only an average of 0.1 months more breastfeeding for males in sub-Saharan countries and that did not change with subsequent children. However, in North Africa, the first male son benefited from breastfeeding by an average of 0.6 months and the benefit was reduced for subsequent births. In India, the male son benefited from breastfeeding for an average of 0.4 month, slightly lower than North Africa (Chakravarty, 2011). Contrary to these findings, Nigerian girls were twice as likely to receive 'exclusive breastfeeding' than boys (Adjusted OR: 2.13 95% CI 1.03-4.39) indicating a preference to give female infants breastfeeding (Agho, Dibley, Odiase, & Ogbonmwan, 2011).

2.9.8 Maternal breast condition

Any pain or discomfort related to breastfeeding may result in breastfeeding cessation, reduced breastfeeding frequency or duration**.** According to Digirolamo et al., 2005, any discomfort in breastfeeding as a result of sour nipple, engorgement or abscess affected breastfeeding for the short-term but not long-term (DiGirolamo et al., 2005). Among Tanzanian women, having no problem with their nipples resulted in a sixfold (95% CI 3.2-13.6) chance of sustaining 'exclusive breastfeeding' for six months compared with women who experienced nipple problems (Nkala & Msuya, 2011). Similar findings were reported in South Africa where the chance of stopping breastfeeding prior to 12 weeks was three times (95% CI 1.7-5.7) higher because of breast condition (Doherty et al., 2012). In Brazil, although 17 out of 406 women stopped breastfeeding due to breast condition, this was never mentioned among the main reasons for their breastfeeding cessation (Martines et al., 1989).

2.9.9 Other factors

Beside the aforementioned factors, several other factors are known to have influenced 'exclusive breastfeeding'. In China's Zhejiang Province, a prospective cohort study established a considerably lower possibility of 'exclusive breastfeeding' at discharge among mothers aged over 24 years old (Qiu, Zhao, Binns, Lee, & Xie, 2009). However, no association between maternal age and breastfeeding during hospital discharge was found in another prospective study among Chinese women in Xinjiang Uygur Region (Xu, Binns, Yu, & Bai, 2007). Maternal and child illness, (C. Chuang et al., 2010; Xu et al., 2009), maternal smoking and stress, and/or anxiety during pregnancy were also acknowledged as factors influencing child feeding patterns (Kehler, Chaput, & Tough, 2009). Marital status, use of family planning, observed child birth weight and neighborhood were reported in Kenya as among factors causing sub-optimal infant feeding (Kimani-Murage et al., 2011). Other studies suggest the place of delivery as being among factors contributing to an increased or decreased likelihood of breastfeeding. In Tanzania, delivery at the health facility translated to three times the likelihood of practicing 'exclusive breastfeeding' (Nkala & Msuya, 2011). Provision of water, admission to special care nursery, early introduction to water or complementary foods and residential place was associated with early breastfeeding cessation in China (Qiu et al., 2010). The method of delivery, particularly caesarean section, has also been consistently reported as interfering with 'exclusive breastfeeding' probably due to delayed breastfeeding initiation (Esteves et al., 2014; Sithara et al., 2014; Victor, 2013).

There were limited studies from developing countries relating maternal Body Mass Index (BMI) and breastfeeding. In a rural community of Western Australia, maternal pre-pregnancy obesity was significantly associated with breastfeeding cessation before six months of age (Nakamura & Yamanouchi, 2000). A systematic review conducted by Amir (2007) reported that obese mothers intended to breastfeed for a shorter period and were less likely to initiate and continue the breastfeeding (Amir & Donath, 2007). Similar findings were established in a more recent review (Turcksin, Bel, Galjaard, & Devlieger, 2014). In Belgium, women who were obese or underweight before pregnancy had low breastfeeding intention and initiation compared with women with normal

weight (Guelinckx, Devlieger, Bogaerts, Pauwels, & Vansant, 2012). In the same study, 92% of women with normal BMI initiated breastfeeding compared with 64% among underweight women and 68% among obese women (Guelinckx et al., 2012).

2.10 Who influence breastfeeding decisions?

2.10.1 Family and non-family members

In most developing countries, particularly Africa, living in extended families is a custom, with elders and men having more power and decisions in many things including child feeding (Kerr, Dakishoni, Shumba, Msachi, & Chirwa, 2008). This indicates the complexity of addressing 'exclusive breastfeeding' in African countries. In Malawi, grandmothers and the father of the child were identified as among the people influencing breastfeeding decisions (Fjeld et al., 2008) despite the mother's knowledge of 'exclusive breastfeeding'. The qualitative study reported grandmothers tended to not prefer 'exclusive breastfeeding'. One of the grandmothers argued: *"How can a baby be healthy with breastmilk only? They need some porridge as well and a bit of water too"* (Fjeld, 2008, p.5). Similar findings were found in the same country where grandmothers introduced herbal infusions to newborns in the belief that it protects the child from illness (Kerr et al., 2007). Introduction to herbal infusions was higher among women from low socio-economic status possibly due to a perception that they have not enough milk supply or low education.

Another study found that, beside mothers, a paternal grandmother and sometimes grandfather influenced the child feeding decision (Kerr et al., 2007) with a possibility of improving breastfeeding initiation and duration when both mother and grandmothers living together were counselled on breastfeeding. When counselling was provided to Brazilian mothers and maternal grandmothers living in the same house, it resulted in a median of 67 days of delayed introduction to liquid foods (water and herbal tea) than when mother was living separate from grandmother (44 days) (Nunes, Giugliani, Santo, & de Oliveira, 2011). The influence on infant feeding may go beyond related family members. In Cameroon 320 women who volunteered in the survey were interviewed

about the obstacles limiting ‘exclusive breastfeeding’ (Kakute et al., 2005). Forty three percent of women identified pressure from village elders and family members as being among the factors which hastened mixed feeding in the village despite the reinforcement to exclusively breastfeed from the health workers. In this population, 96% of women introduced water and 30% introduced complementary foods to infants at the age of three months (Kakute et al., 2005). It was not clear whether this was a true situation in Cameroon since the study involved volunteers who might not represent the true population.

2.10.2 Health professional and non-health professional influence

Studies suggest that support from health professionals and non-health professionals tend to influence ‘exclusive breastfeeding’ duration. Several studies have indicated that any support provided to the mother, whether by a health professional or peer, translated to increased ‘exclusive breastfeeding’ (Britton, McCormick, Renfrew, Wade, & King, 2007; Meedya, Fahy, & Kable, 2010; Renfrew, McCormick, Wade, Quinn, & Dowswell, 2012). The review by Britton, which included 34 quasi and randomised control trials with 29,385 mother-infant pairs from 14 developed and developing countries found a prolonged duration of breastfeeding (RR prior 4-6 weeks was 0.65, 95% CI 0.51-0.82; RR before two months 0.74, 95% CI 0.66-0.83) when the mother was provided with any form of assistance by unprofessional or professional person. Another extensive review which included 52 studies with a sample size of 56,451 mother-infant pairs from 21 countries indicated an increased duration of ‘exclusive breastfeeding’ (Renfrew et al., 2012) for six months (RR 0.86 95% CI 0.82-0.91) with any support provided to the mother compared with usual care (Renfrew et al., 2012). The study also indicated a significant increase in breastfeeding duration when lay and professional workers provided support to the mother.

Review made indicates a diversity of influence on mother’s decision regarding breastfeeding. The number of people who were mentioned to influence infant feeding decision includes village elders, mother or mother in law, grandparents, village leaders

and health professionals. This indicates the complexity of addressing infants feeding practices in African countries.

Chapter 3: Methodology

3.1 Study design

A prospective cohort study of mother-infant pairs was undertaken in Rufiji district of rural Tanzania mainland from February 2012 to March 2013. The study was integrated into the ongoing Health and Demographic Surveillance System (HDSS) activities being conducted every four months by the Ifakara Health Institute. The study included all mothers who delivered between February and September 2012 and were followed by the same enumerator for a period of six months. Enrolment was done consecutively within four weeks after delivery. Mothers and infants were followed again at three and six months.

3.2 Eligibility criteria

The study excluded all infants aged above one month at the time of the first interview, twins, infants born with a severe congenital illness, or mothers who were sick and unable to participate in the study. Mothers who did not reside in the surveillance area for a period of six months after delivery or who were mentally handicapped or had died were also excluded.

3.3 Study area

The study was conducted in Rufiji district of coast region of Tanzania Mainland. Rufiji is one of five districts of the Coast region and is home to numerous tribal groups. The main group is the Ndengereko who, according to the spoken tradition, are the original inhabitants of the area. Other tribes are the Matumbi, Nyagatwa (concerted in the delta area), Ngindo, Pogoro and Makonde (Mrema et al., 2009). The majority of the people are of the Muslim faith with a few Christians and followers of traditional beliefs. Kiswahili and local languages are spoken. In 1998, Ifakara Health Institute (IHI) established the Health and Demographic Surveillance System (HDSS) in the Rufiji district of Coast region (Figure 6) (Mrema et al., 2012). The surveillance covers 31 out of 94 villages in the district with an area of 1813 km^2 (Mrema et al., 2012). It has a total

population of 85,000 which is approximately 40% (Mrema et al., 2009) of the total population of Rufiji district (217,274) reported in the 2012 census (National Bureau of Statistics, 2013a). The vegetation of the HDSS is mainly tropical forests and grassland. The weather is hot and moist during the year with two rainy seasons. The average annual rain in the district is between 800 and 1,000 mm (Mrema et al., 2012).

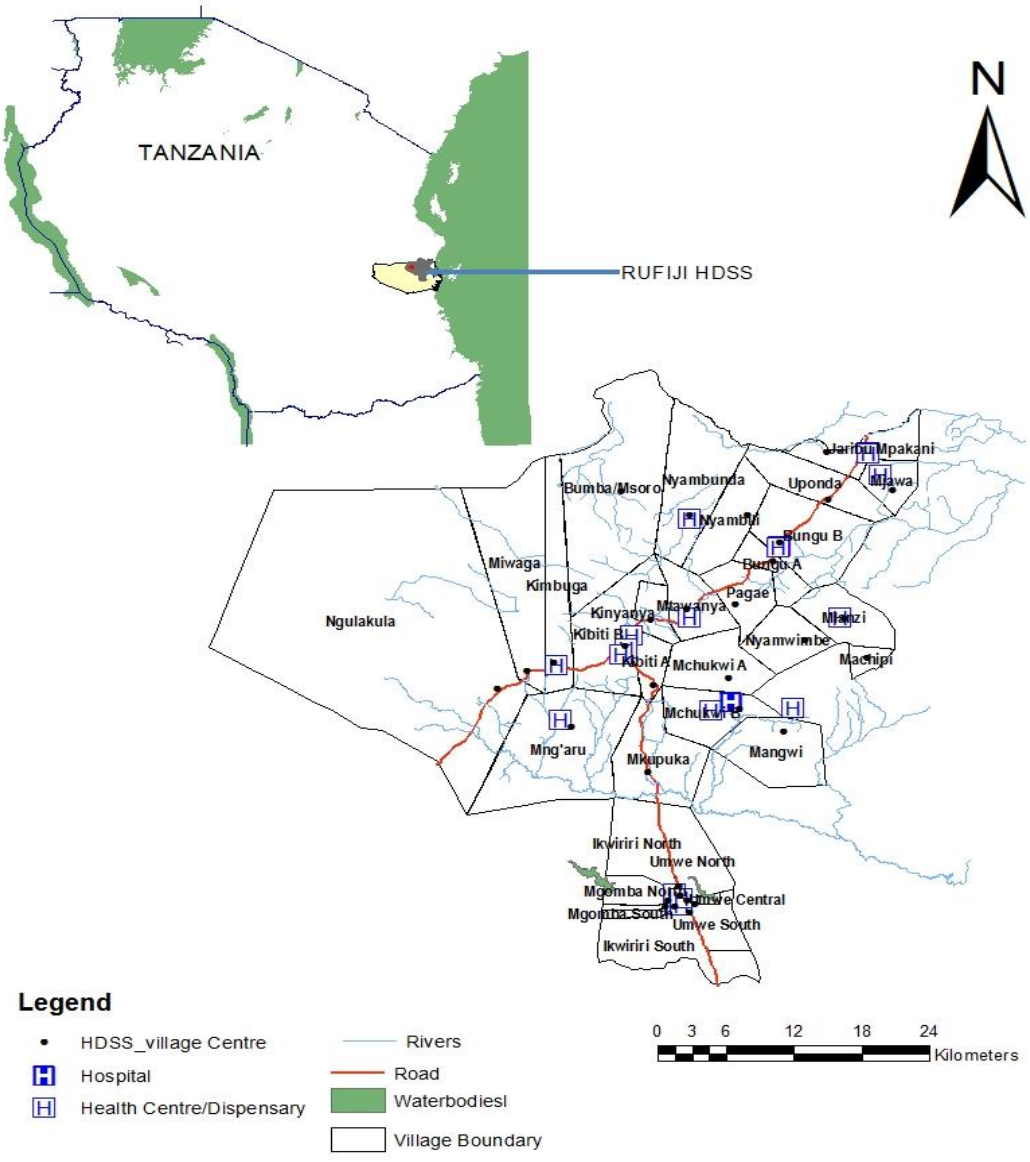


Figure 6 Location of the Rufiji Health and Demographic Surveillance System and coverage area

3.4 Data collection tools

Baseline characteristics and infant feeding questions were established using the existing validated Demographic and Health Survey (DHS) questionnaire which was used in Tanzania by Macro International in 2010 (National Bureau of Statistics & ICF Macro, 2011b). More food items were added to the DHS questionnaire together with a question about frequency of exposure to foods. The information on morbidity and vaccination history was generated from the questionnaire designed by the WHO to assess efficacy of neonatal vitamin A supplementation in Tanzania.

3.4.1 Baseline questionnaire

The baseline questionnaire consisted of nine sections (Appendix 1). The first section focused on basic information including a maternal identification number, visit date, visit time, date of delivery, gestational age and infant birth weight. The second section detailed maternal and paternal social demographics (age, education level, marital status, religion, parity, income source, employment status, household size, ownership of assets and frequency of meat consumption). The family life-style behaviours were reported in section three of the questionnaire where mothers were asked about the use of alcohol, cigarette smoking, mosquito repellent treated bed nets and a place where they disposed child faeces. To gain a better understanding of maternal health during pregnancy, mothers were asked to report the number of antenatal visits, any health problems they experienced and the use of medications. Mothers were also asked about the main source of breastfeeding information and a series of questions testing maternal knowledge on breastfeeding. Section five sought to document maternal health information after delivery. Mothers were asked to report their place of delivery, gender of their child, source of support during delivery, time for breastfeeding initiation after delivery and use of vitamin A-mega dose. More comprehensive information regarding infant feeding was documented in section six. This section covered all questions which did not require repetition during follow-ups such as the time when the mother made a decision to feed the baby after birth, the period they expected to stop breastfeeding, who influenced their

decision to breastfeed, family support, any problems experienced during breastfeeding initiation and possible solutions. Section seven focused on maternal employment and the possibility to sustain breastfeeding while continuing to work. The eighth section documented the maternal level of confidence to breastfeed when exposed to different people or environment. Mothers were asked about their level of confidence to breastfeed in front of a male and female family member, male and female friends, a public place, public transport and other peoples' homes. Section nine covered maternal anthropometric measurements and section ten was left for mothers to provide their personal comments. In total, the baseline questionnaire had 117 questions.

3.4.2 Infant feeding questionnaire

Infant feeding questionnaire (Appendix 1) was a much shorter version which was used when infants were one month, three and six months old. The questionnaire had only five sections with a total of 77 questions. The initial section focused on infant feeding practices. Mothers were asked a series of questions such as, are you breastfeeding? If no, how long have you been breastfeeding? How are you currently feeding your new baby now? For the mothers who were no longer practicing 'exclusive breastfeeding', they were asked to mention specific liquids or foods consumed in the past 24 hours and the frequency of consumption. The questions were guided by a pre-determined list of 38 food items with a section to fill-in the frequency of feeding (Appendix 1). Mothers were also asked to list the main solid, liquid, fruits and vegetables that were introduced first, and the main reason for introducing their infant to those foods. The second section explored medical conditions experienced by the child. The remaining three sections required mothers to report about hospitalisation, changes in feeding patterns when the child was sick and immunisation history. Weight and height of a child was recorded in the last section of the questionnaire in each visit.

3.5 Sample size

The Rufiji DHSS district had approximately 2400 infants below one year of age in 2010. This study enrolled 1302 infants aged 0-6 months. At the probability of 95% and 80% power, a sample of 1302 allowed measuring infant feeding patterns, changing in growth

and infections at a CI of ± 3% and a 10% estimated dropout rate. Since 'exclusive breastfeeding' rates at the age of six months reported by the Demographic and Health Surveys was low (23%), a large sample size was necessary to observe any existing differences in sub-categories of feeding pattern. The study sample size was similar to that of a Ghanaian study which was included in the WHO pooled analysis. The study aimed to determine the effect of breastfeeding on mortality among infants and children in developing countries (Victora & Barros, 2000a). The sample of our study was higher than that of a cohort study of infant feeding pattern and morbidity conducted in Tanzania (Mwiru et al., 2011).

3.6 Data collection and definition of terms

This mother-child pair cohort study involved conducting home based baseline and follow-up interviews. The first visit was done by a trained enumerator within four weeks postpartum. The mother-infant pair was visited again at three and six months by the same enumerators. All mothers who participated in this study were given a pair of baby socks and a cap after the interview as a gift for the newborn. To maximise our sample size, mothers were identified either from the maternity ward where they gave birth and were tracked through their home or through village leaders (key informants) who were requested to identify all births. The key informants received fifty cent US dollar for timely reporting. The flow chart below elaborates the recruitment and retention of participants in the present study (Figure 7).

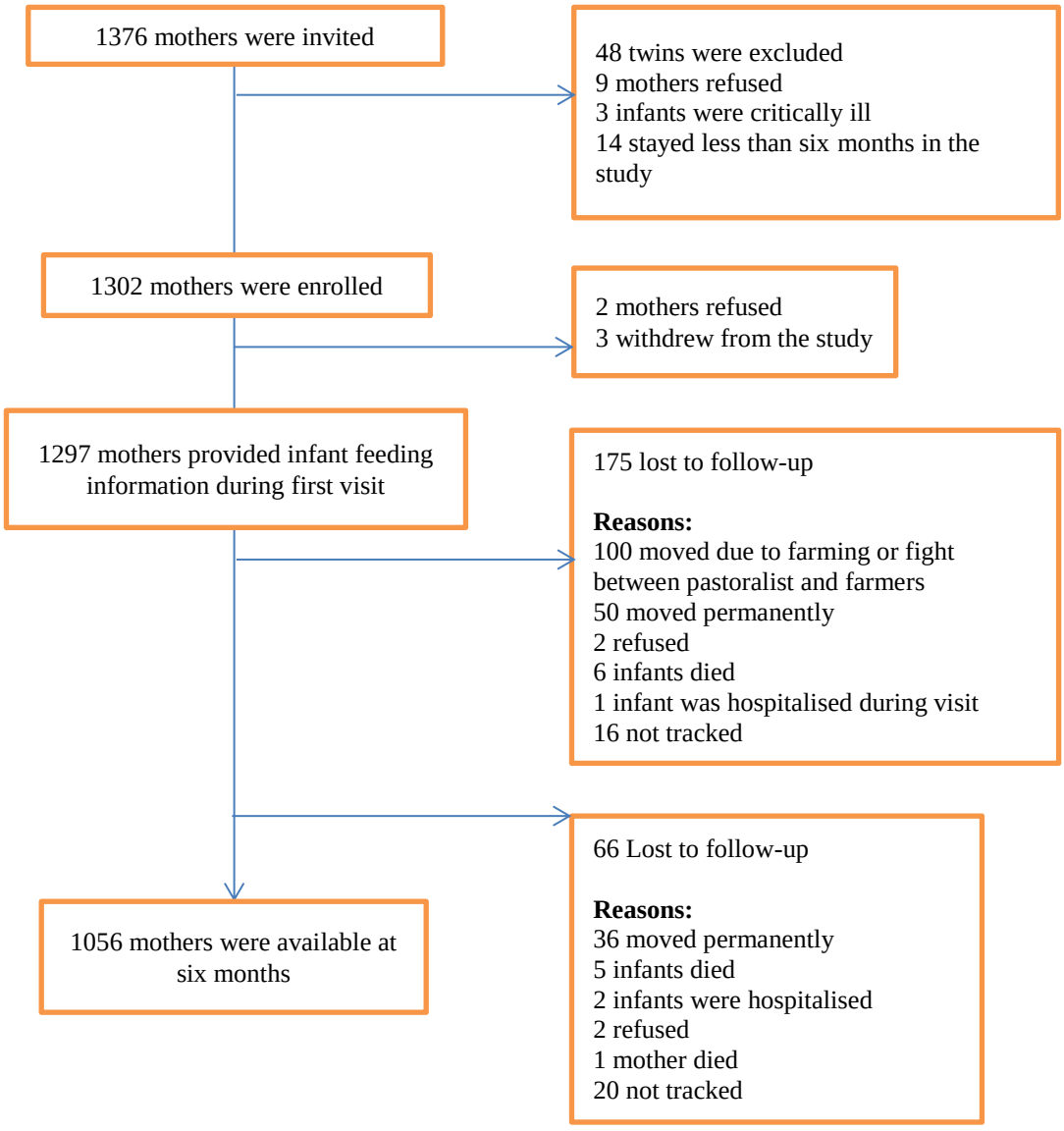


Figure 7 Cohort study Profile

3.6.1 Definitions used

During the first visit, a trained enumerator collected maternal and paternal social-demographic and environmental information. The variables included age, marital status, employment, education level, income level and religion, type of delivery, place of delivery and disposal of waste product. In each subsequent visit, mothers were asked to report about infant feeding practices, morbidity, hospitalisation and vaccination. In all visits maternal and child anthropometrics measurements were taken. Several definitions were used during the collection of information regarding feeding patterns in this study.

- *Feeding pattern:* For the purpose of this study, feeding pattern implies different infant feeding practices (exclusive, predominant and partial breastfeeding) at the age of one, three and six months.
- *Exclusive breastfeeding:* Referred to when an infant received only breastmilk but excludes other liquids and solids except oral rehydration solution, drop and syrup (vitamins, mineral and medicines) (World Health Organisation, 2008c).
- *Predominant breastfeeding:* This is when the infant received breastmilk (including expressed milk or milk from wet nurse) as the main source of nourishment. It includes, water, drops, juice, vitamins, minerals, medicine but excludes infant formula of other milk (World Health Organisation, 2008c).
- *Partial breastfeeding:* Refers to exposure of infants to breastmilk in addition to complementary foods (Mihrshahi et al., 2008).
- *Non-breastfeeding:* Refers to when the infant did not receive breastmilk (Mihrshahi et al., 2008).
- *Complementary feeding:* Refers to when infant receive breastmilk and solid or semi-solid foods. It includes any food or liquid such as non-human milk and infant formula (Mihrshahi et al., 2008).
- *Any breastfeeding:* Requires that the baby obtain some breastmilk and any food or liquid with other non-human milk (World Health Organisation, 2008c).

3.6.2 Respiratory infection and diarrhoea information

This study collected information from the mother regarding all symptoms related to respiratory infections and diarrhoea for the past two weeks prior to the interview. The

information was collected using a well-structured questionnaire developed by WHO and Ifakara Health Institute to assess morbidity in the "Neonatal Vitamin A supplementation" project which followed children for one year. The symptoms of a cough, fever, difficulty breathing, rapid breathing, noise during breathing and chest in-drawing, were used to signify presence of respiratory infections. Mothers were also requested to report diarrhoea for the past two weeks prior to the interview. Diarrhoea was defined as passing watery stools three or more times a day and with or without blood or mucus (Mwiru et al., 2011). Information regarding other morbidity such as eye, ear and malaria infection was also collected. Mothers who reported having an ill child were requested to report about hospitalisation, number of days a child was hospitalised and any re-currencies or new infection after the reported episode and changes in feeding patterns during illness.

3.6.3 Anthropometry measurements

The weight of infants and mothers was assessed using the calibrated United Nations Children Funds (UNICEF) SECA Digital Scales made specifically to measure mother and infant weight at one time point. Height was measured using a height board for both infant and mother however, the infant's length was obtained while lying on the length board and while mothers stood upright on the board. Mothers and infants were weighed wearing light clothes. Weight was recorded to the nearest 0.1kg and height to the nearest 0.1cm. Food And Nutrition Technical Assistance (FANTA) guidelines were used to standardise and calibrate anthropometric measurements to minimise error (Cogill, 2003). Maternal Body Mass Index (BMI) was computed by calculating the weight divided by height in metres squared. Infant growth was determined by computation of weight for age (WAZ) standardised Z-score, height for age (LHZ) standardised Z-score and weight for height (HAZ) standardised Z-score values. Infants were reported to have experienced severe underweight, stunting or wasting if WAZ, LAZ and WLZ were falling below -3 of the WHO child growth standards median. An infant was classified as having moderate underweight, stunting or wasting when WAZ, LAZ and WLZ were below -2 and $\geq$ -3. Overall malnutrition was established for all infants with WAZ, LAZ and WHZ

below -2 of the WHO child growth standards median (National Bureau of Statistics & ICF Macro, 2011b; World Health Organisation, 2006c).

3.7 Validity and reliability

To ensure reliability and validity of the study, a prospective mother-infant pair was conducted at the household level to reduce selection bias. All study tools were reviewed by experts' in breastfeeding area. Questionnaires were translated to Kiswahili and back-translated to English to ensure the meaning was maintained. One week intensive training was provided to 25 enumerators, eight supervisors, three data clerks and one site manager. All enumerators and supervisors were provided with a protocol to guide survey delivery. The training was followed by two days of pre-testing of data tools and necessary changes were made. All weighing scales were calibrated using an object with a known weight during each visit. Weight and height/length measurements were standardised using FANTA guidelines. Supervisors and enumerators were supervised to measure ten children repeatedly to observe the within-measurement variability. To account for the between-measure variability, supervisors measured ten children and, without seeing the results, the enumerator measured the same children and recorded the result. Their values were substrated to establish the difference. If the difference in infant weight between enumerator and supervisor was 0.3kg or more, the value was considered large, a difference of 0.2kg was considered medium difference and a difference of 0.00-0.1kg was small. For length measurement, a length difference of 1.0cm or more was considered large, 0.6-0.9cm was medium difference and 0.00-0.5cm was small difference (Cogill, 2003). All enumerators and supervisors who produced medium or large differences in values obtained were re-trained. Data obtained from the field was entered twice (double entry) to minimise error related to wrong data entry.

3.9 Ethics

The applications were submitted to the Curtin Human Ethics Research Committee (Appendix iii). The study was approved in 2011 with protocol approval number HR 155/2011. The approved project protocols and questionnaires from Curtin University were submitted to the Ifakara Health Institute Ethics Committee for their approval. On

8th December 2011, the protocol and tools were approved with reference number IHI/IRB/No.43. Each interviewed participant was informed about the purpose of the study and their rights using an information letter. The sheet was read out to each mother to save her from embarrassment if she was not able to read (Appendix ii). The information sheet and consent form was read individually to each participant in their own preferred language by a native speaker of that language. They were then asked to confirm their understanding of the project and their agreement to participate by signing the consent form. The participation was voluntary and participants were offered the right to withdraw from the study at any time without any negative consequence. Mothers who declined to participate were not discriminated against in any way. All data and records were kept confidential and no identified information was used or released to anyone. Access to the data and records was limited to the trained researchers. Data collected from this study was kept in a locked cupboard in Ifakara Health Institute office. All questionnaires will be destroyed after 10 years.

3.10 Data cleaning and statistical analysis

All complete questionnaires from the field were sent to Ifakara Health Institute data unit. The principal investigator checked all the questionnaires once each week to allow for immediate correction. All checked questionnaires were sent to three data clerks working with the Ifakara Health Institute. All data analysis was performed using IBM SPSS version 21. Descriptive statistics were done to obtain the mean and percentage of baseline characteristics and feeding pattern (breastfeeding initiation, exclusive or predominant or partial breastfeeding). Breastfeeding initiation was computed by finding the number of infants who were put to the breast within one hour after birth. The exclusive breastfeeding was calculated by dividing the proportion of infants received only breastmilk at a particular age divided by number of infants who were falling in that particular age. The independent sample t-test was used to compare mean weight, height and Z-scores of exclusive versus predominant and partial breastfeeding. Also comparison was made for exclusive and non-exclusive breastfed infants. Chi-square testing was done to examine the duration of breastfeeding in different age groups, the prevalence of diarrhoea and acute respiratory infection among infants who were

exclusively breastfed, and those who were not exclusively breastfed. Chi-square was also used during analysis of category variables to establish the socio-demographic differences among the participants who finished the study and those lost to follow-up. In a situation where the cell produced a value less than five, Fischer Exact test or likelihood ratio test was used instead of the Chi-square test. ANOVA was used to determine the mean difference in weight and height based on infant feeding patterns. Univariate and multivariate analysis was performed to evaluate the association between infant feeding patterns and growth of infants. Logistic regression was done for binary outcome variables to establish the relationship between infant growth and feeding patterns and was adjusted for confounders (sex, birth order, maternal BMI and socio-economic status). Logistic regression was also conducted to establish the factors predictive of 'exclusive breastfeeding'.

3.10.1 Analysis of socio-economic status

Principal Components Analysis (PCA) using Stata 7.0 (Stata Corporation) was applied to the socio-economic data to obtain an index as a proxy for household socio-economic status.

The PCA involves breaking down assets (e.g. radio, tv) or household services accessed by a household (e.g. water, electricity) into category or interval variables. The variables are then processed in order to obtain weights and principal components. The results obtained from the first principal component (explaining the most variability) are usually used to develop the asset index based on the formula below (Deon & Pritchett, 2001):

$$A_j = f_1 \, x \, (a_{ji}\text{-}a_1) / (S_1) + \ldots\ldots f_N \;\; x \, (fa_{jN}\text{-}a_N) / (S_N)$$

Where aji = 1 if household j owns asset i, and aji = 0 otherwise and f_1 is the scoring factor or weights for the first asset, x is the variable (asset or service), a_{ji} is the value for the assets, and a_1 and S_1 are the mean and standard deviation of assets respectively. Based on this equation, wealth indices of households were assigned to the residents of those households and wealth quintiles that then represented proxies for socio-economic

status. This analysis included the following items in the PCA: ownership of animals, TV, bicycle, radio, fan, fridge and a car. Also the type of cooking materials, the source of drinking water, house roofing material and floor material were included.

Wealth quintiles are thus expressed in terms of quintiles of individuals of the population in the household. Finally, all households were grouped into five categories: poorest, poorer, poor, less poor or least poor according to their household wealth score. To make a comparison more feasible, the poorest, poorer and poor were categorised as poor, and the less poor and least poor were categorised as less poor since this was a homogenous population (all rural mothers) and the variability between subcategories was likely to be small.

Chapter 4: Results

4.1 Introduction

This chapter presents findings of the descriptive, univariate and multivariate analysis of the cohort study conducted in Rufiji. The initial sections present descriptive statistics of the results of participants at baseline and the subjects who were lost to follow-ups. The results in each subsequent section correspond to a specific research objective. The descriptive, chi-square, univariate and multivariate analysis results are presented.

4.2 Social-demographic information of study participants

A total of 1376 mothers were invited to participate in the study, 48 mothers had twins and were excluded, nine mothers refused to participate and three infants were critically ill. Fourteen mothers were excluded as they were going to stay less than six months in the study area. Of 48 twins who were excluded, 38 were born with low birth weight. 1302 infants aged less than four weeks and their mothers were enrolled consecutively and followed up at 3 and 6 months. The maternal, paternal and infant socio-demographic information is presented in Table 4 below and missing information in some questions accounts for a lack of 1302, a totals number of participants enrolled. The majority of the mothers were aged between 19-35 years old (73.8%) with a mean age of 26.7 years. A large proportion of mothers were of the Muslim religion (91.3%), married or lived with partners (75.7%), house wives (91.9%), had a low level of literacy (92.9%) and poor socioeconomic status (68.9%). The majority of mothers attended an antenatal clinic more than three times (53.8%) with only 3.7% mothers not attending an antenatal clinic. Delivery at a health facility was common (80.3%) and the majority of mothers who delivered at the health facility were assisted by trained health professionals (93%). Non-health professionals assisted only 6.2% mothers during delivery and twelve mothers had no assistance.

Literacy levels of the partner/husbands were low with only 12% having attained a secondary education and the majority was unemployed (55%). Just over half of the

infants in the sample were male (50.5%) and, overall, 10.7% of infants were born with a low birth weight with a mean of 3.2 kilograms. Birth weight information was available from 1057 out of 1302 enrolled infants since some infants were born at home and were not weighed.

Table 4 Maternal, paternal and child socio-demographic characteristics

Variable (N=1302)	Categories	n	%
Maternal age	<18 years	159	12.2
	19-35 years	961	73.8
	>35 years	180	13.8
Marital status	Married or cohabitating	986	75.7
	Single	316	24.3
Education level	>than secondary education	1208	92.9
	≤ Secondary education	92	7.1
Mother employment	Employed	99	7.6
	Not employed	1196	91.9
SES	Poor	893	68.9
	Less poor	409	31.4
Maternal BMI	>18.5	151	11.6
	18.5-24.5	967	74.3
	25 – 30	151	11.6
	<30	19	1.5
Type of delivery	Vaginal	1185	91.0
	Caesarian	116	8.9
Place of delivery	Home delivery	255	19.6
	Health facility	1046	80.3
Maternal religion	Christian	112	8.6
	Muslim	1186	91.2
	Tradition	2	0.2
Partner education	>than secondary education	1122	87.8
	≤ Secondary education	156	12.0
Partner employment	Employed	576	44.2
	Not employed	716	55.0
Child sex	Male	657	50.5
	Female	643	49.4
Birth weight	<2.5 kg	113	10.7
	≥ 2.5 kg	944	89.3

4.3 Response rate of the study participants

Of the 1302 mothers and infants who agreed to participate in the study, information on infant feeding was available from 99.6% during the first visit since five infants had incomplete data. Eighty six percent were traced during the second visit and 81.1% were available during the third visit (Table 5).

Table 5 Response rates of participants

Visit	Number of respondents N	Response rates (%)
Baseline	1302	100
1 month	1297	99.6
3 months	1122	86.2
6 months	1056	81.1

4.4 Characteristics of participants who missed both second and third visits

A comparison was made to explore any existing differences between participants who finished the study (N = 1189) and those who were not traced during both the second and third visit (N = 102). Eleven infants died during follow-ups. There was no difference for almost all social-demographic variables (Table 6) except for marital status. Among those who missed both visits there were more single mothers (single, widow, separated and divorced) than those who were found during follow-up ($P<0.005$). Paternal and child demographic information did not differ between groups (Table 6).

Table 6 Socio-demographic characteristics of mothers who missed both second and third visit

Variable	Categories	Participants N (1189)	Non-participants N = 102	P-Value
		n (%)	n (%)	
Maternal age	<18 years	141 (11.9)	16 (15.7)	
	19-35 years	875 (73.7)	78 (76.5)	0.127
	>35 years	171 (14.4)	8 (7.8)	
Marital status	Married or cohabitating	914 (77)	65 (63.7)	
	Single	275 (23)	37 (36.3)	**0.003**
Education level	>secondary education	1101 (92.8)	97 (95.1)	
	≤ Secondary education	86 (7.2)	5 (4.9)	0.375
Mother employment	Employed	94 (7.9)	5 (4.9)	
	Not employed	1088 (92)	97 (95.1)	0.268
SES	Poor	811 (68.2)	74 (72.5)	
	Less poor	378 (31.8)	28 (27.5)	0.365
Maternal BMI	>18.5	135 (11.5)	15 (15.2)	
	18.5-24.5	882 (74.9)	77 (77.8)	0.193
	25-30	143 (12.1)	6 (6.1)	
	<30	18 (1.5)	1 (1)	
Type of delivery	Vaginal	1082 (91.1)	94 (92.2)	
	Caesarian	106 (8.9)	8 (7.8)	0.712
Place of delivery	Home delivery	232 (19.5)	17 (16.7)	0.482
	Health facility	956 (80.5)	85 (83.3)	
Maternal religion	Christian	104 (8.8)	6 (5.9)	
	Muslim	1082 (91.1)	95 (94.1)	0.503
	Tradition	2 (0.2)	0 (0)	
Partner education	>secondary education	1031 (88.2)	80 (81.6)	
	≤ Secondary education	138 (11.8)	18 (18.4)	0.058
Partner employment	Employed	523 (44.3)	46 (46)	
	Not employed	658 (55.7)	54 (54)	0.740
Child sex	Male	596 (50.2)	50.5 (52)	
	Female	591 (49.8)	49.5 (48)	0.734
Birth weight	<2.5 kg	101 (10.5)	9 (10.3)	0.964
	≥ 2.5 kg	861 (89.5)	78 (89.7)	

4.5 Maternal health information at baseline interview

Mothers were asked about smoking behaviour and about family members' smoking status to establish any existing passive smoking. Very few mothers smoked and a relatively low proportion were exposed to passive smoke (24%) (Table7). Use of a treated mosquito net and tea during pregnancy was common. Few mothers were sick during pregnancy and nearly half (47%) of mothers used a megadose of vitamin A supplementation within four weeks after delivery.

Table 7 Maternal health information

	N	**Yes N (%)**
Ever smoked	1300	22 (1.7)
Current smoking	1302	12 (0.9)
Family member smoke	1292	312 (24)
Use alcohol	1284	30 (2.3)
Use treated mosquito net	1287	1110 (85.3)
Used tea during pregnancy	1302	1232 (94.6)
Sick during pregnancy	1302	240 (18.4)
Used vitamin A after delivery	1291	616 (47.3)

4.6 Antenatal visits

Over 96.3% of mothers had at least one antenatal visit and almost 64% had three or more visits during pregnancy. Only 3.7% of mothers did not attend any antenatal clinic indicating a low non-adherence to the antenatal attendance (Figure 9).

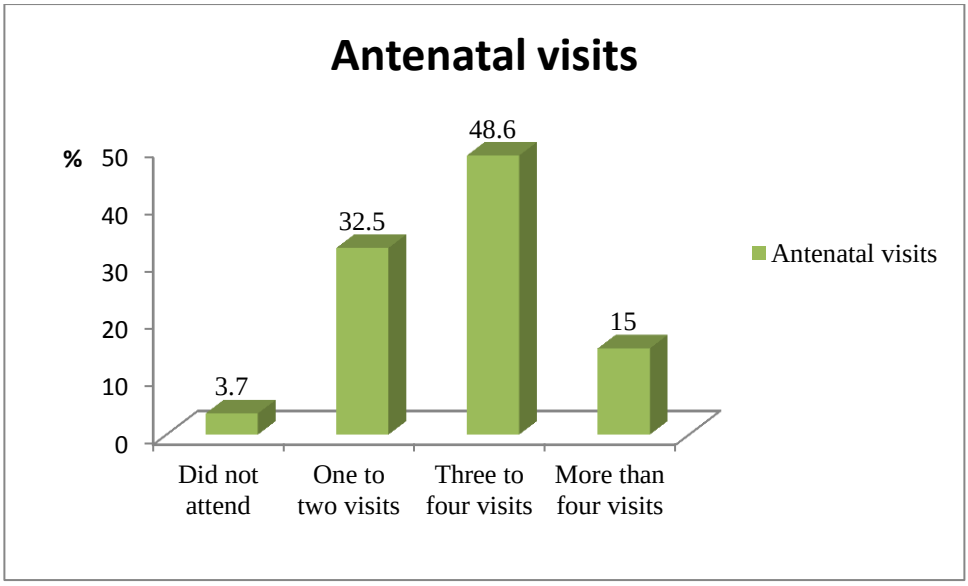


Figure 8 Percentage of antenatal visits for the current pregnancy

4.7 Breastfeeding education and source of information during pregnancy

Despite high adherence to the antenatal clinic attendance, 82% of mothers did not receive any education about breastfeeding during pregnancy (Table 8). Of those who received education (N = 217), over 95% received it during the antenatal clinic or during their hospital stay or in the labour ward. Of the 211 mothers whose data on the source of breastfeeding information was available, 91% mentioned individual consultation during the antenatal visit or in-class sessions from health professionals as their main source of the information. Nearly three percent of mothers mentioned other sources of breastfeeding education including their mothers, community nurse visit or sessions and radio program.

Table 8 Breastfeeding education during pregnancy and source of information

Variable	Frequency	Percentage
Breastfeeding education (n = 1302)		
During the current pregnancy	194	14.9
During previous pregnancy	35	2.7
Never had breastfeeding education	1071	82.3
Place received education (n = 217)		
Antenatal clinic	185	85.3
During hospital stay	12	5.5
Labour ward	10	4.6
Other	10	4.6
Main source of breastfeeding information (n = 211)		
Individual consultation	97	46.0
In-class sessions	94	44.5
Television	6	2.8
Booklets/brochure	5	2.4
Other	6	2.8

4.8 Time mothers decided to feed their new born babies

Mothers were asked to state when they first decided how they would feed their newborn baby (Table 9). The majority of mothers decided on how to feed their newborn after delivery (68%) and nearly 21% were undecided during the first visit.

Table 9 Time mothers decided to feed their newborn

Time of decision N = 1302	**Frequency**	**Percentage**
Before pregnancy	52	4.0
Before 20 weeks of pregnancy	54	4.1
After 20 weeks of pregnancy	34	2.6
After baby was born	886	68.0
Not decided	272	20.9

4.9 Mothers source of help to decide on how to breastfeed the baby after delivery

The majority of mothers (73%) made the decision on how to feed their newborn by themselves (Figure 8). and 23% of mothers relied on health professionals. Very few mothers mentioned family members or friends as their source of infant feeding decision.

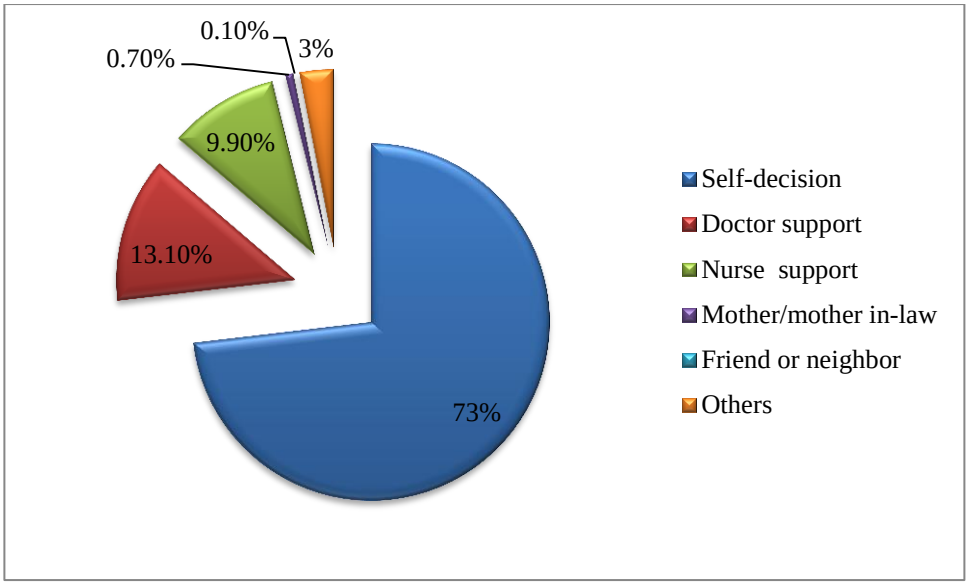


Figure 9 Maternal source of decision on how to feed the infant

4.10 Support to breastfeed after delivery

Mothers were asked about any support they received to assist breastfeeding their infant immediately after delivery and if they were instructed how to position the child (Table 10). A large proportion of mothers (62%) were not encouraged to breastfeed immediately after delivery, 55% were never assisted with proper positioning and 65% had no support with mouth attachment.

Table 10 Mothers support to breastfeed after delivery

Support provided (n = 1302)	Frequency (%)
Encourage breastfeeding right after birth Yes No	 487 (37.4) 811 (62.3)
Proper positioning during breastfeeding Yes No	 426 (32.7) 711 (54.6)
Mouth attachment during breastfeeding Yes No	 284 (21.8) 847 (65.1)

4.11 Maternal Infant feeding knowledge in Rufiji

Mothers were asked several questions to ascertain their level of understanding regarding infant feeding (Table 11). The majority of mothers thought that breastfeeding was a natural process, formula fed babies sleep longer (62%) and the majorities (64%) were aware that breastfeeding more often would lead to increased breastmilk supply. Nearly half (47.5%) of the mothers knew that babies needed to feed more when they experience growth failure. The majority of mothers (63%) were not aware that feeding infant formula to a one-month old child would reduce breastmilk supply. Over ninety percent of mothers knew that having rest or relaxation would increase breastmilk supply.

Table 11 Maternal knowledge on infant feeding in Rufiji

Questions N = 1302	True n (%)	False n (%)	Don't know n (%)
Babies naturally know how to breastfeed	1207 (92.7)	64 (4.9)	31 (3.4)
Formula-fed babies sleep longer at night	187 (14.4)	305 (23.4)	802 (61.6)
Feeding more often increase breastmilk supply	835 (64.1)	212 (16.3)	253 (19.4)
Babies need to feed more when they are having growth spurt	618 (47.5)	385 (29.7)	294 (22.6)
There are a lot of women who need to give their babies formula because they can't make enough milk	538 (41.3)	299 (23)	462 (35.5)
Birth control pills can reduce milk supply	214 (16.4)	348 (26.7)	729 (56.7)
Getting extra rest and relaxation is necessary to ensure a good milk supply	1209 (92.7)	62 (4.9)	31 (2.4)
Feeding formula to a one month old baby will not reduce the amount of milk produced by the mother	823 (63.2)	119 (14.7)	284 (21.8)

4.12 Maternal level of confidence in breastfeeding

Mothers were requested to provide information about their level of confidence in breastfeeding in a public place and in someone's house, or with male or female family members or friends. The questions were in a scale of one to five, one being not comfortable at all and five being very comfortable. Overall, mothers were more comfortable to breastfeed when they were with female relatives (42.5%) and friends (28.5%) than when they were with male relatives or friends. The level of confidence on other conditions varies considerably as indicated in Table 12 below.

Table 12 Prevalence of maternal level of confidence to breastfeed in different situations

Conditions (N = 1302)	Very comfortable n (%)	Comfortable n (%)	Moderately comfortable n (%)	Not comfortable n (%)	Not comfortable at all n (%)
Public place	92 (7.1)	369 (28.3)	240 (18.4)	417 (32.0)	181 (13.9)
Female friends	371 (28.5)	693 (53.2)	128 (9.8)	86 (6.6)	21 (1.6)
Female relatives	554 (42.5)	573 (44.0)	87 (6.7)	66 (5.1)	18 (1.4)
Male friends	55(4.2)	273 (21.0)	297 (22.8)	477 (36.6)	194 (14.9)
Male relatives	46 (3.5)	242 (18.6)	282 (21.7)	409 (31.4)	320 (24.6)
Someone's house	62 (4.8)	373 (28.6)	511 (39.2)	256 (19.7)	92 (7.1)
Public transport	42 (3.2)	224 (17.2)	357 (27.4)	414 (31.8)	260 (20)
Public eating place	38 (2.9)	199 (15.3)	277 (21.3)	442 (33.9)	341 (26.2)
Open market	36 (2.8)	145 (11.1)	233 (17.9)	389 (29.9)	489 (37.6)

4.13 Maternal problems during breastfeeding

Problems with breastfeeding or their breasts were reported by 33% (427) of the mothers (Table 13). Only 25 (2%) reported that the infant experienced some problem. Approximately 50% had no support when they experienced a problem.

Table 13 Prevalence of breastfeeding problems and support

Condition (n = 1302)	Yes n (%)
Maternal conditions	
Inverted nipples	14 (1.1)
Cracked or sore nipples	46 (3.5)
Breast engorgement	51 (3.9)
Mastitis	12 (0.9)
Delayed milk	142 (10.9)
No enough milk	22 (1.7)
Too much milk	133 (10.2)
Other	7 (0.5)
Child condition	
Baby too tired to feed	10 (0.8)
Baby had sucking problem	8 (0.6)
Baby does not work-up to feed	3 (0.2)
Baby not gaining enough weight	4 (0.4)
Source of support (n = 313)	
Husband	26 (8.3)
Family member	70 (22.4)
Mother in-law	15 (4.8)
Health professional	43 (13.7)
No support	155 (49.5)
Others	4 (1.3)

4.14 Objective 1

To determine feeding patterns of infants aged less than six months in the Rufiji district of Tanzania.

4.14.1 Infant feeding patterns in Rufiji during 0-6 months

Of the 1302 infants included in this cohort study, 62.2% were breastfed within one hour and 37.8% established breastfeeding after one hour. Pre-lacteal feeding was not common. The first feeds were colostrum (95.1%), (1.5%) honey, (1.4%) water, (0.9%) sugar water, (0.3%) cow's milk, (0.2%) formula and (0.2%) other. Six infants had missing data on pre-lacteal feeds. Information collected from the infant feeding questionnaire showed that 'any breastfeeding' rates were almost universal. At the age of one month, 99.7% of infants were breastfed and this dropped slightly to 99% at the age of three months and 98.6% at the age of six months. 'Exclusive' and 'predominant breastfeeding' decreased while 'partial breastfeeding' increased with age (Table 14). Over ninety percent of infants aged less than six months received complementary foods at the age of six months. Four mothers did not breastfeed their infants from birth.

Table 14 Prevalence of breastfeeding indicators at 0-6 months

Age	Breastfeeding Indicators		
	Exclusive N (%)	Predominant N (%)	Partial N (%)
One month	908 (70.2)	307 (23.7)	79 (6.1)
Three Months	242 (21.6)	227 (20.3)	651 (58.1)
Six Months	19 (1.8)	73 (7.0)	954 (91.2)

4.14.2 Gender and breastfeeding indicators at 0-6 months

Descriptive analysis established any gender disparities in breastfeeding indicators. Until six months of age, the rate of 'any breastfeeding' was over ninety eight percent in both genders. There was no statistical difference between gender in relation to 'exclusive', 'predominant' and 'partial breastfeeding' (Table 15).

Table 15 Breastfeeding indicators at 0-6 months by gender

Feeding patterns	One month		Three months		Six months	
	Male n (%)	Female n (%)	Male n (%)	Female n (%)	Male n (%)	Female n (%)
Exclusive breastfeeding	447 (68.5)	460 (72.0)	114 (20.3)	126 (22.6)	10 (1.9)	9 (1.7)
Predominant breastfeeding	164 (25.1)	142 (22.2)	111 (19.8)	116 (20.8)	386 (6.8)	37 (7.2)
Partial Breastfeeding	42 (6.4)	36 (5.8)	336 (59.9)	315 (56.6)	487 (91.0)	467 (90.9)

4.15 Objective 2

To document complementary feeding patterns of infants 0-6 months in the Rufiji district

4.15.1 Common complementary foods introduced to infant at one, three and six months

A questionnaire with 38 food items was used to obtain information about twenty four hour feeding at one, three and six months, and the frequency of feeding (Table 16). Twenty nine percent of infants had water and 1.5% received maize porridge at the age of one month. At the age of three months the proportion of infants exposed to water was 69.2% and maize porridge was 45.4%. Nearly ninety percent of infants were exposed to water and over eighty percent were exposed to maize porridge at six months. Few infants started to receive stiff porridge (maize meal made by mixing hot water and flour) at six months of age (14.3%). Exposure to other food items was very low and none of the infants were exposed to organ meat and yams under six months of age. Overall there was a tendency to expose infants to water and starch based foods characterised by bulkiness and low nutrient density.

Table 16 Complementary foods introduced to infant at one, three and six months

	One Month N = 1297	Three Months N = 1122	Six Months N = 1058
Food	**Yes n (%)**	**Yes n (%)**	**Yes n (%)**
Plain water	381 (29.4)	776 (69.2)	916 (86.1)
Honey	10 (0.8)	3 (0.3)	1 (0.1)
Traditional Medicine	5 (0.4)	1 (0.1)	0 (0)
Commercial baby foods	0 (0)	0 (0)	1 (0.1)
infant formula	0 (0)	3 (0.3)	4 (0.4)
Goat or soya milk	0 (0)	2 (0.2)	2 (0.2)
Cow milk	2 (0.2)	14 (1.2)	29 (2.7)
Cassava porridge	8 (0.6)	146 (13)	111 (10.5)
Maize porridge	19 (1.5)	509 (45.4)	865 (81.8)
Rice porridge	4 (0.3)	33 (2.9)	23 (2.2)
Porridge from mixed cereals and legumes	1 (0.1)	8 (0.7)	22 (2.1)
Porridge from other cereal (sorghum, millet)	2 (0.2)	7 (0.6)	19 (1.8)
Tea or coffee	8 (0.6)	38 (3.4)	76 (7.2)
Any other liquids (ORS, medication, supplements)	0 (0)	2 (0.2)	3 (0.3)
Juice (homemade or commercial)	1 (0.1)	3 (0.3)	11 (1)
Bread	0 (0)	0 (0)	3 (0.3)
Cooked maize mixed with Legumes	0 (0)	0 (0)	1 (0.1)
Cooked Banana	0 (0)	0 (0)	4 (0.4)
Stiff porridge	0 (0)	6 (0.5)	151 (14.3)
Rice	0 (0)	0 (0)	6 (0.6)
Pumpkin, carrots, yellow/orange sweet potato	0 (0)	0 (0)	2 (0.2)
Cooked Irish potatoes	0 (0)	0 (0)	3 (0.3)
Cooked sweet potatoes	0 (0)	0 (0)	1 (0.1)
Cooked yams	0 (0)	0 (0)	0 (0)
Cooked cassava	0 (0)	0 (0)	9 (0.9)
Any dark green, leafy vegetables	0 (0)	2 (0.2)	26 (2.5)
Ripe mangoes bananas or papayas, orange, *Mabungo* and any other fruits	0 (0)	40 (3.6)	66 (6.2)
Liver, kidney, heart or other organ meats	0 (0)	0 (0)	0 (0)
Red meat (beef, goat) or duck	0 (0)	0 (0)	1 (0.1)
Eggs	0 (0)	0 (0)	2 (0.2)
Fresh or dried fish or shellfish	0 (0)	0 (0)	10 (0.9)
Chicken , duck any other bird	0 (0)	0 (0)	1 (0.1)
Any foods made from beans, peas, lentils, or nuts	0 (0)	1 (0.1)	1 (0.1)
Cheese, yogurt or other milk products	0 (0)	1 (0.1)	1 (0.1)
Any oil, fats, ghee or butter, or foods made with any of these	0 (0)	0 (0)	2 (0.2)
Any sugary foods such as chocolates, sweets, candies	1 (0.1)	1 (0.1)	1 (0.1)
Pastries, cakes, or biscuits	0 (0)	1 (0.1)	9 (0.9)
Any other solid or semi-solid food	0 (0)	2 (0.2)	18 (1.7)

4.15.2 Frequency of exposure to complementary foods at 0-6 months of age in Rufiji

Of the 355 infants whose information about the use of water was available at the age of one month, 39% were exposed once per day, 47% twice day and 14% three times or more. The number of infants who drank water and ate porridge increased with age (Figure 9). None of the infants were exposed to stiff porridge at the age of one and three months.

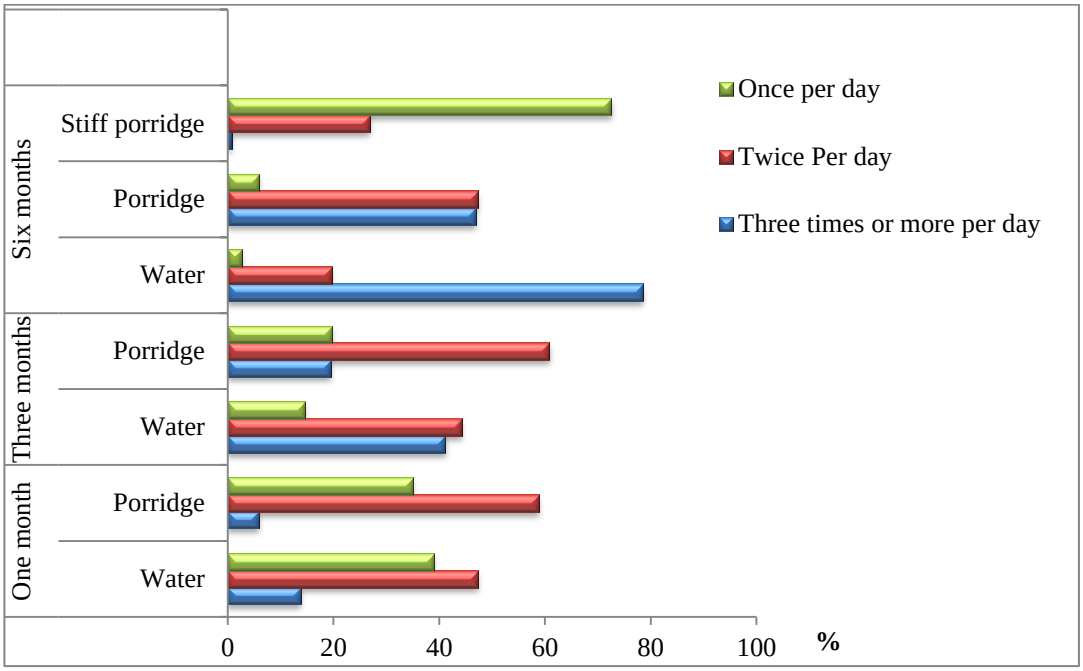


Figure 10 Frequency of exposure to common complementary foods at the age of 0-6

4.15.3 Common complementary foods by gender

There was no statistically significant difference in consumption of water, cassava porridge and stiff porridge at one, three and six months between genders. However, a slightly higher proportion of boys were given maize porridge (84%) than girls (80%) at the age of six months (Table 17)

Table 17 Common complementary foods consumed at one, three and six months by gender

Food	One month			Three months			Six Months		
	Male N (%)	Female N (%)	P Value	Male N (%)	Female N (%)	P value	Male N (%)	Female N (%)	P value
Water	202 (30.9)	178 (27.8)	0.218	392 (69.9)	384 (68.7)	0.668	462 (86.2)	454 (87.0)	0.710
Maize Porridge	7 (1.1)	12 (1.9)	0.230	256 (45.6)	253 (45.3)	0.900	450 (84.0)	415 (79.5)	0.061
Cassava Porridge	5 (0.8)	3 (0.5)	0.726	70 (12.5)	76 (13.6)	0.578	53 (9.9)	58 (11.1)	0.516
Stiff Porridge	0 (0)	0 (0)	-	0 (0)	0 (0)	-	78 (14.6)	73 (14.0)	0.792

4.15.4 Reasons for early exposure of infants to family foods

Mothers were asked about the main reason for exposing an infant to family foods before six months of age. The question was repeated at each visit because the time of exposure was different among children. The values in the Table 18 are cumulative percentages. Mothers consistently mentioned “baby crying too much” as the main reason of exposing infants to family foods before six months followed by inadequate breastmilk (Table 18). Though the percentages were low, early exposure to family foods and liquids increased when the father of the child, grandmother and relatives or friends preferred other foods over breastmilk. More than 10% of the mothers mentioned other reasons such as culture, child feeling thirsty, too much sun, dry throat, heavy/thick breastmilk and late milk production as reasons for the early introduction of water and other liquids.

Table 18 Prevalence of main reasons for early exposure of infants to family foods and liquids

Reasons	One Month (N = 1302)	Three months (N = 1122)	Six Months (N = 1058)
	n (%)	n (%)	n (%)
Baby cry too much	180 (13.8)	525 (46.8)	608 (57.5)
No enough breast milk	13 (1.0)	73 (6.5)	105 (9.9)
Father of the baby prefer other feeds	5 (0.5)	31 (2.8)	44 (4.2)
Baby father can help with feeding	0 (0)	2 (0.2)	1 (0.1)
Grandmother suggested other feeds	1 (0.1)	44 (3.9)	51 (4.8)
Mother had health problem	1 (0.1)	1 (0.1)	0 (0)
Child had health problem	1 (0.1)	3 (0.3)	6 (0.6)
I want to know how much the baby feeds	1 (0.1)	0 (0)	0 (0)
Friends and relatives suggested other feeds	13 (1.0)	13 (1.2)	14 (1.3)
Health workers or doctor suggested other feeds	0 (0)	2 (0.2)	15 (1.4)
Baby is not gaining enough weight	0 (0)	6 (0.5)	10 (0.9)
Going back to work	0 (0)	1 (0.1)	0 (0)
Other reasons	134 (10.3)	191 (17.0)	190 (18.0)

4.16 Objective 3

To assess the impact of feeding patterns on infant growth in the first six months of life in the Rufiji district.

4.16.1 Infant feeding and growth in Rufiji

This study intended to establish the growth patterns of infants in Rufiji and if there was an association with growth. Approximately eleven percent (10.7%) of infants was born with low birth weight. The average birth weight was 3.19kg ± 0.47 and males had a slightly higher mean birth weight (3.24 ± 0.49) than girls (3.13 ± 0.45). Since the first visit was made within four weeks after birth, the mean weight at first visit was slightly higher (3.82 ± 0.65) than birth weight. The mean weight for age, length for age and weight for length declined slightly with age (Table 19).

Table 19 Descriptive analysis to indicate infant growth at one, three and six months

Measurements	One month		Three months		Six Months	
	N	Mean (sd)	N	Mean (sd)	N	Mean (sd)
Weight (kg)	1297	3.82 (0.65)	1122	6.07 (0.84)	1056	7.36 (0.99)
Height (cm)	1296	51.36 (2.48)	1116	59.89 (2.67)	1023	65.12 (2.75)
WAZ	1293	-0.16 (1.07)	1114	-0.23 (1.08)	1051	-0.37 (1.12)
HAZ	1292	-0.62 (1.14)	1114	-0.51 (1.23)	1017	-0.70 (1.19)
WHZ	1293	0.36 (1.36)	1114	0.30 (1.31)	1017	0.17 (1.24)

4.16.2 Infant growth trajectories in Rufiji compared with WHO growth charts

The cumulative distribution graphs of infant growth were established to assess stunting when compared with the WHO standards (Figures 10 and 11). At the age of three months, the cumulative probability of length for age Z-score for Rufiji infants was skewed to the left of the WHO Z-score. The deviation from the WHO length for age Z-score was higher among Rufiji boys than girls. Despite the increased left skewness of length for age Z-score among infants aged six months as compared with the WHO values, the deviation between sexes was similar before the 70th percentile. After the 70th percentile, more boys were stunted than girls (Figure 12).

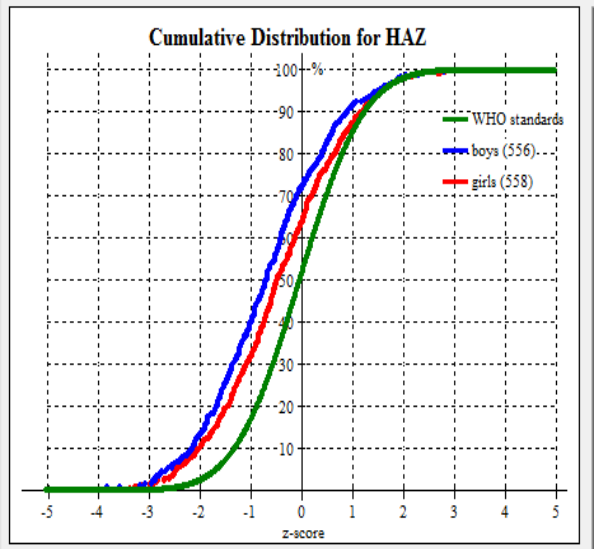


Figure 11 Cumulative distribution of stunting at three months of age as compared with the WHO standards

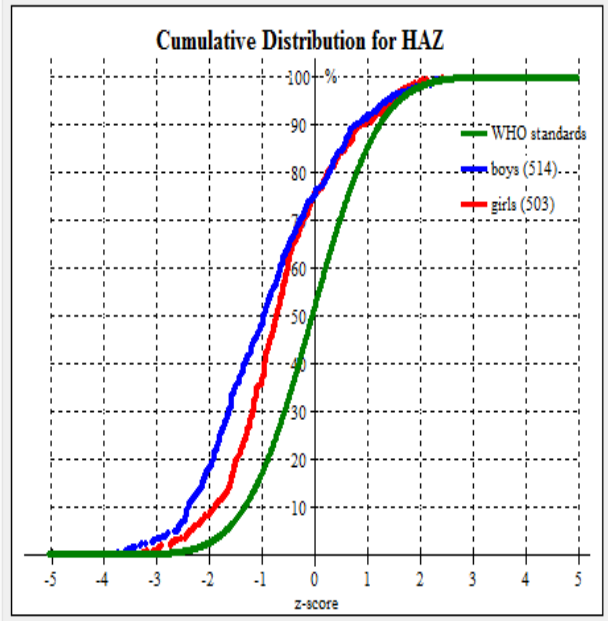


Figure 12 Cumulative distribution of stunting in six months infants compared with the WHO standards

4.16.3 Prevalence of overall underweight, stunting and wasting in 0-6 month infants

Weight for age Z-score (WAZ), length for age Z-score (LAZ) and weight for length Z-score (WLZ) were computed to establish the prevalence of nutritional status among infants 0-6 months of age. Table 20 below indicates a general prevalence of underweight, stunting and wasting (Z-score < -2) in Rufiji. Overall there was an increased prevalence of underweight and stunting with age (Table 20). For example, at the age of one month, 5% of infants were underweight while at six months the prevalence of underweight was 7%. Stunting also increased with age where 8% of infants were stunted at one month, 11% at three months and 13% at six months. Though not statistically significant, all growth trajectories were poorer for boys than girls at the age of one and three months. At the age of six months, however, a statistically significant difference (P< 0.05) in stunting was observed where twice the proportions of boys (18%) were stunted compared with 8% among girls (Table 20).

Table 20 Prevalence of overall underweight, stunting and wasting in 0-6 month infant

Nutritional status	**One Month**			**Three months**			**Six Months**		
<-2 Z-score	N	n (%)	95% CI	N	N (%)	95% CI	N	n (%)	95% CI
Under-weight									
Overall	1293	65 (5.0)	(3.7-6.0)	1120	63 (5.6)	(4.4-7.1)	1051	75 (7.1)	(5.7-8.9)
Boys	653	36 (5.8)	(4.3-7.9)	561	42 (7.5)	(5.6-10.0)	531	46 (8.7)	(6.6-11.4)
Girls	640	27 (4.2)	(2.9-6.1)	559	21 (3.8)	(2.5-5.7)	520	29 (5.6)	(3.9-7.9)
Stunting									
Overall	1292	99 (7.7)	(6.3-9.2)	1114	126 (11.3)	(9.6-13.3)	1017	132 (13.0)	(11.1-15.2)
Boys	653	60 (9.2)	(7.2-11.6)	556	71 (12.8)	(10.2-15.8)	514	90 (17.5)	**(14.2-21.0)**
Girls	639	39 (6.1)	(4.5-8.2)	558	55 (9.9)	(7.7-12.6)	503	42 (8.3)	**(6.2-11.1)**
Wasting									
Overall	1293	63 (4.9)	(3.8-6.2)	1114	52 (4.7)	(3.6-6.1)	1021	44 (4.3)	(3.2-5.7)
Boys	653	34 (5.2)	(3.7-7.2)	556	29 (5.2)	3.7 – 7.4)	518	30 (5.8)	(4.1-8.1)
Girls	640	29 (4.5)	(3.2-6.4)	558	23 (4.1)	2.8-6.1)	503	14 (2.8)	(1.7-4.6)

4.16.4 Prevalence of moderate underweight, stunting and wasting in infants 0-6 months

Z-scores (< -2 Z-score and ≥ -3 Z-score) were calculated to determine the proportion of infants with moderate underweight, stunting and wasting in Rufiji (Table 21). There was an increased prevalence of overall moderate underweight at one month (3.3%), three months (5.2%) and six months (5.8%). Moderate stunting also increased with age and more boys were moderately stunted than girls. A significant difference in moderate stunting was observed at the age of six months where 14.2% (95% CI 11.4-17.5) boys were stunted compared with 7.2% (95% CI 5.2-9.7) among girls. The prevalence of moderate wasting remained relatively similar between sexes at one, three and six months.

Table 21 Prevalence of moderate underweight, stunting and wasting in infants 0-6

Malnutrition **<-2 Z –score and ≥ -3 Z-score**	**One Month**			**Three months**			**Six Months**		
	N	**n (%)**	**95% CI**	**N**	**n (%)**	**95% CI**	**N**	**n (%)**	**95% CI**
Under-weight									
Overall	1293	45 (3.5)	(2.6-4.6)	1120	55 (4.9)	(3.8-6.3)	1051	62 (5.9)	(4.6-7.5)
Boys	653	24 (3.7)	(2.5-5.4)	561	34 (6.1)	(4.4-8.3)	531	40 (7.5)	(5.6-10.1)
Girls	640	21 (3.3)	(2.2-5.0)	559	21 (3.8)	(2.5 – 5.7)	520	22 (4.2)	(2.8-6.3)
Stunting									
Overall	1292	85 (6.6)	(5.3-8.1)	1114	110 (9.9)	(8.3-11.8)	1017	109 (10.7)	(9.0-12.8)
Boys	653	49 (7.5)	(5.7-9.8)	556	62 (11.2)	(8.8-14.0)	514	73 (14.2)	**(11.4-17.5)**
Girls	639	36 (5.6)	(4.1-7.7)	558	48 (8.6)	(6.5-11.2)	503	36 (7.2)	**(5.2-9.7)**
Wasting									
Overall	1293	51 (3.9)	(3.0-5.1)	1114	45 (4.0)	(3.0-5.4)	1021	41 (4.0)	(3.0-5.4)
Boys	653	29 (4.4)	(3.1-6.3)	556	26 (4.7)	(3.2-6.8)	518	27 (5.2)	(3.6-7.5)
Girls	640	22 (3.4)	(2.3-5.1)	558	19 (3.4)	(2.2-5.3)	503	14 (2.8)	(1.7-4.6)

4.16.5 Prevalence of severe underweight, stunting and wasting in infants 0-6 months

Severe underweight, stunting and wasting (≥ -3 Z –score) was established among infants 0-6 months in Rufiji (Table 22). There was an inconsistent pattern for severe underweight, stunting and wasting with age. Overall, there was no statistical difference in severe underweight, stunting and wasting between sexes.

Table 22 Prevalence of severe underweight, stinting and wasting in infants 0-6 months

Malnutrition ≥ -3 Z-score	One Month			Three months			Six Months		
	N	n (%)	95% CI	N	n (%)	95% CI	N	n (%)	95% CI
Underweight									
Overall	1293	20 (1.5)	(1.0-2.4)	1120	8 (0.7)	(0.4-1.4)	1051	13 (1.2)	(0.7-2.1)
Boys	653	14 (2.1)	(1.3-3.6)	561	8 (1.4)	(0.7-2.8)	531	6 (1.1)	(0.5-2.4)
Girls	640	6 (0.9)	(0.4 – 2.0)	559	0 (0)	(0.0-1.7)	518	7 (1.3)	(0.7-2.8)
Stunting									
Overall	1292	14 (1.1)	(0.6-1.8)	1114	16 (1.4)	(0.9-2.3)	1017	23 (2.3)	(1.5-3.4)
Boys	653	11 (1.7)	(0.9-3.0)	556	9 (1.6)	(0.9-3.0)	514	17 (3.3)	(2.1-5.2)
Girls	639	3 (0.5)	(0.2-1.4)	558	7 (1.3)	(0.6-2.6)	503	6 (1.2)	(0.5-2.6)
Wasting									
Overall	1293	12 (0.9)	(0.5-1.6)	1114	7 (0.6)	(0.3-1.3)	1021	3 (0.3)	(0.1-0.9)
Boys	653	5 (0.8)	(0.3-1.8)	556	3 (0.5)	(0.2-1.6)	518	3 (0.6)	0.2-1.7)
Girls	640	7 (1.1)	(0.5-2.2)	558	4 (0.7)	(0.3-1.8)	503	0.0	(0.0-0.8)

4.15.6 Association between infants feeding patterns and growth in 0-6 months infants

The analysis of variance test (ANOVA) was performed to establish if there was any difference in the mean of growth indicators in relation to feeding method (Table 23). At the age of one month, there was a statistically significant difference in mean weight between infants who received ‘exclusive breastfeeding’ (Mean = 3.788) and those who received ‘predominant’ (Mean = 3.864) or ‘partial breastfeeding’ (Mean = 3.983). Overall there was an absolute difference of 74 grams between infants who received only breastmilk (exclusive) and those received ‘predominant breastfeeding’ and 195 grams for those who were ‘partially breastfed’. “Post hoc analysis (Bonferroni Method)” indicated that the observed mean difference in weight among ‘exclusive’ and ‘partial breastfed’ infants was statistically significant (P< 0.05). Other growth trajectories were similar between feeding methods at one month.

At the age of three months, there was no difference in all growth trajectories except length and weight for length Z-score (WLZ). There was a statistical significant difference (P<0.05) in mean length between feeding methods. According to the post-hoc

analysis, there was a mean difference of 0.56cm between 'predominant' and 'partial breastfeeding' group which was statistically significant (P<0.05). Mean weight for length was different between groups (P<0.005). The post hoc analysis revealed a statistical difference in mean weight for length Z-score of 0.25 between 'predominant' and 'partial breastfeeding' group (P<0.05). There was no statistical difference in mean weight, height, WAZ, LAZ and WLZ at the age of six months (P> 0.05).

Table 23 Infant growth in relation to feeding mode in Rufiji

Growth indicators	Exclusive breastfeeding		Predominant breastfeeding		Partial Breastfeeding		P-Value
Weight (kg)	**N**	**Mean (SD)**	**N**	**Mean (SD)**	**N**	**Mean (SD)**	
One Month	908	3.788 (0.65)	307	3.864 (0.67)	79	3.983 (0.61)	**0.018**
Three months	242	6.064 (0.84)	227	6.058 (0.86)	651	6.076 (0.83)	0.952
Six months	19	7.21 (0.94)	73	7.343 (1.03)	954	7.362 (0.99)	0.798
Height (cm)							
One Month	907	51.267 (2.46)	307	51.535 (2.56)	79	51.860 (2.45)	0.051
Three months	240	59.902 (2.71)	227	59.468 (2.72)	647	60.032 (2.63)	**0.024**
Six months	18	64.711 (1.96)	71	65.001 (2.80)	924	65.25 (2.77)	0.780
WAZ							
One Month	905	-0.120 (1.08)	307	-0.241 (1.05)	79	0.219 (0.93)	0.195
Three months	240	-0.177 (1.08)	227	-1.180 (1.09)	651	-0.273 (1.08)	0.352
Six Months	19	-0.540 (1.03)	73	-0.387 (1.20)	950	-0.372 (1.12)	0.809
LAZ							
One Month	904	-0.570 (1.14)	307	-0.717 (1.14)	79	-0.747 (1.18)	0.086
Three months	238	-0.424 (1.21)	227	-0.619 (1.30)	642	-0.509 (1.21)	0.228
Six Months	18	-0.864 (0.99)	71	-0.749 (1.19)	920	-0.691 (1.22)	0.786
WLZ							
One Month	907	0.337 (1.40)	306	0.382 (1.27)	79	0.522 (1.16)	0.477
Three months	238	0.269 (1.37)	227	0.495 (1.35)	647	0.242 (1.26)	**0.040**
Six Months	18	-0.107 (1.13)	71	0.188 (1.15)	922	0.174 (1.25)	0.816

4.16.7 Growth patterns of infant exposed to 'exclusive breastfeeding' as compared with non-exclusive breastfed infants

At the age of one month, the univariate analysis provided a significant difference in weight and length among infants who were exclusively breastfed compared with non-exclusively breastfed group. The mean weight at one month for exclusively breastfed infants was 3.79 ±0.65 and for the non-exclusively breastfed infants it was 3.89 ± 0.66

as indicated in Table 24 below. Mean length was slightly higher for the 'non-exclusive breastfed' group (Mean = 51.60 ± 2.54) compared with the exclusive breastfed group (Mean = 51.27 ±2.46). The obtained mean difference in weight and height between the two groups was statistically significant (P<0.05). The mean weight and length did not differ between the two groups at the age of three and six months and there was no statistical difference in WAZ, LAZ and WLZ at one, three and six months.

Table 24 Univariate analysis to determine growth patterns of 'exclusive breastfed' infants as compared with 'non-exclusive breastfed' infants

Exclusive breastfeeding				**Non-Exclusive breastfeeding**			**P-Value**
Outcome	**N**	**Mean (SD)**	**95%CI**	**N**	**Mean (SD)**	**95% CI**	
Weight (kg)							
One Month	908	3.79 (0.65)	3.75, 3.83	386	3.89 (0.66)	3.82, 3.95	**0.013**
Three months	242	6.06 (0.84)	5.96, 6.17	878	6.07 (0.83)	6.02, 6.13	0.902
Six months	19	7.21 (0.94)	6.77, 7.66	1027	7.36 (0.99)	7.30, 7.42	0.511
Height (cm)							
One Month	907	51.27 (2.46)	51.11, 51.42	386	51.60 (2.54)	51.35, 51.84	**0.027**
Three months	240	59.90 (2.71)	59.56, 60.20	874	59.89 (2.66)	59.71, 60.06	0.933
Six months	18	64.71 (1.96)	63.44, 65.99	995	65.12 (2.76)	64.95, 65.29	0.536
WAZ							
One Month	905	-0.12 (1.08)	-0.19, -0.05	385	-0.24 (1.03)	-0.34,--0.13	0.072
Three months	240	-0.18 (1.08)	-0.31, -0.04	878	-0.25 (1.08)	-0.32, -0.18	0.360
Six Months	19	-0.54 (1.03)	-0.11, -0.04	1023	-0.37 (1.12)	- 0.44, -0.31	0.521
LAZ							
One Month	905	-0.57 (1.14)	-0.65, -0.50	385	-0.73 (1.14)	-0.84,- -0.61	0.027
Three months	238	-0.42 (1.21)	-0.58, -0.27	874	-0.54 (1.23)	-0.62, -0.46	0.205
Six Months	18	-0.86 (0.99)	-1.43, -0.30	991	- -0.70 (1.23)	-0.77, -0.62	0.563
WLZ							
One Month	907	0.34 (1.40)	0.25, 0.43	384	0.41 (1.25)	0.28, 0.55	0.367
Three months	238	0.27 (1.37)	0.11, 0.44	874	0.31(1.29)	0.22, 0.39	0.732
Six Months	18	-0.01 (1.13)	-0.58, 0.56	993	0.18 (1.24)	0.10, 0.25	0.528

4.16.8. Multivariate analysis to determine growth of exclusive breastfed infants 0-6 month compared with non-exclusive breastfed infants.

The multivariate analysis indicated that those infants who were exclusively breastfed exhibited similar growth patterns to non-exclusive breastfed infants (Table 25). There was no difference in growth indicators when infants were exclusively breastfed

compared with non-exclusive breastfeeding at one, three and six months of age (P> 0.05).Though not statistically significant, exclusive breastfed infants at one month were slightly less likely to be underweight (ARR 0.57 95% CI 0.29-1.04) and three months (ARR 0.98 95% CI 0.49-1.98). Stunting was also 20% less among exclusive breastfed infants at the age of one month compared with non-exclusive breastfed infants and over 30% protective effect on stunting (RR 0.67 95% CI 0.34-1.33) at the age of three months. There was no statistical difference in wasting among exclusive breastfed infants at one, three and six months as compared with non-exclusively breastfed infants. All results obtained at six months had a wider confidence interval due to a small number of exclusively breastfed infants. During the multivariate analysis, birth weight was the main predictor of infant growth at one, three and six months (P<0.001). When birth weight was excluded in the model at one month, the multivariate RR was 0.88 and when included is 0.57. The RR for the birth weight was 0.058 with 95% CI of 0.003 to 0.111.

Table 25 The association between 'exclusive breastfeeding' and growth indicators at 0-6 months compared with 'non-exclusive breastfeeding' in Rufiji

Univariate analysis					**Multivariate analysis**		
Outcome	**cases**	**RR**	**95%CI**	**P-Value**	**RR**	**95% CI**	**P-Value**
Z-score ≤ -2 1st month							
WAZ (Underweight)	64	0.80	0.47-1.37	0.417	0.57	0.29-1.06	0.067
LAZ (Stunting)	99	0.71	0.46-1.10	0.122	0.69	0.41-1.16	0.160
WLZ (Wasting)	63	1.67	0.89-3.11	0.107	1.61	0.81-3.21	0.176
Z-score ≤ -2 3rd months							
WAZ (Underweight)	63	0.95	0.52-1.76	0.881	0.98	0.49-1.98	0.96
LAZ (Stunting)	126	0.85	0.53-1.36	0.494	0.92	0.57-1.48	0.716
WLZ (Wasting)	51	1.41	0.75-2.66	0.283	1.42	0.76-2.67	0.276
Z-score ≤ -2 6th months							
WAZ (Underweight)	75	2.48	0.71-8.70	0.157	1.85	0.59-13.56	0.189
LAZ (Stunting)	131	0.84	0.19-3.68	0.812	1.27	0.27-5.90	0.763
WLZ (Wasting)	44	1.30	0.17-9.99	0.801	1.79	0.86-3.76	0.549

Adjusted for infant birth weight, gender, age and maternal age, education level, social economic status and Body Mass Index (BMI)

4.17 Objective 4

To evaluate associations between feeding patterns and child morbidity in the Rufiji district.

4.17.1 Morbidity among infants 0-6 months in Rufiji

Mothers were asked to report any illness during the past fourteen days prior to the visit at one, three and six months of age. The number and proportions of infants with a specific illness are presented in Table 26. The proportion of infants who had a cough was (3.4%) at one month, (11.9%) at the age of three months of age and (11.4%) at six months. There was also an increased prevalence of fever in each visit. At the age of one month 1.2% infants had a fever, 10.9% at three months and 19% at six months. The prevalence of diarrhoea also increased with age, however only two cases were reported at one month, 14 cases at two months and 62 cases at six months. The frequency of other illnesses remained relatively similar in each visit.

Table 26 Prevalence of morbidity among one, three and six month infants in Rufiji

Disease	**One month N = 1295**	**Three months N = 1122**	**Six months N = 1058**
	Yes n (%)	Yes n (%)	Yes n (%)
Cough	44 (3.4)	133 (11.9)	121 (11.4)
Refuse to eat or drink	6 (0.5)	12 (1.1)	12 (1.1)
Fever	16 (1.2)	122 (10.9)	201 (19.0)
Difficulty in breathing	14 (1.1)	14 (1.2)	12 (1.1)
Chest in-drawing	1 (0.1)	2 (0.2)	2 (0.2)
Convulsion	2 (0.2)	1(0.1)	1 (0.1)
Vomiting	5 (0.4)	11 (1.0)	20 (1.9)
Noise during breathing	7 (0.5)	7 (0.6)	5 (0.5)
Rapid breathing	9 (0.7)	5 (0.4)	3 (0.3)
Diarrhoea	3 (0.2)	14 (1.2)	62 (5.9)
Eye infection	47 (3.6)	33 (2.9)	28 (2.6)
Ear infection	3 (0.2)	4 (0.4)	5 (0.5)

4.17.2 Infant feeding patterns and morbidity at one months

The prevalence of infections was determined between exclusively breastfed and non-exclusive breastfed infants. Due to a lower level of infections at one month, only six infections were included (see Table 27). Overall the prevalence of morbidity was comparable between infant feeding groups. There was no difference in prevalence of combined respiratory symptoms (cough, difficulty in breathing, rapid breathing, chest-indrawn, noise during breathing) between feeding groups.

Table 27 Prevalence of infections among 'exclusive' and 'non-exclusive breastfed' infants at one month in Rufiji

Disease	**Exclusive breastfeeding** N =908	**Non-exclusive breastfeeding** N = 386
	n (%)	n (%)
Cough	26 (2.9)	18 (4.7)
Fever	10 (1.1)	6 (1.6)
Diarrhoea	2 (0.2)	0 (0)
Difficulty in breathing	8 (0.9)	6 (1.6)
Rapid breathing	6 (0.7)	3 (0.8)
Eye infection	27 (3.0)	20 (5.2)
Combined RTI symptoms	34 (3.8)	19 (4.9)

4.17.3 Morbidity among infants aged three months in Rufiji.

Table 28 shows the morbidity of infants in relation to feeding patterns at the age of three months in Rufiji. There was no statistical significant difference in morbidity at the age of three months between infants who were exclusive breastfed and those who received 'predominant' or 'partial breastfeeding' (P> 0.05).

Table 28 Prevalence of morbidity at three months in relation to feeding patterns

Disease	Exclusive breastfeeding N = 242	Predominant breastfeeding N = 227	Partial breastfeeding N = 651	P-Value
	n (%)	n (%)	n (%)	
Cough	27 (11.2)	32 (14.1)	74 (11.4)	0.509
Refuse to eat or drink	3 (1.2)	2 (0.9)	7 (1.1)	0.925
Fever	28 (11.6)	20 (8.8)	74 (11.4)	0.527
Difficulty in breathing	4 (1.7)	1 (0.4)	9 (1.4)	0.528
Chest in-drawing	0	0	3 (0.3)	1.00
Convulsion	0	1 (0.4)	0	0.203
Vomiting	1 (0.4)	2 (0.9)	8 (1.2)	0.648
Noise during breathing	1 (0.4)	0	6 (0.9)	0.512
Rapid breathing	2 (0.8)	1 (0.4)	2 (0.3)	0.588
Diarrhoea	1 (0.4)	3 (1.3)	10 (1.5)	0.495
Eye infection	8 (3.3)	9 (4.0)	16 (2.5)	0.478
Ear infection	2 (0.8)	3 (1.3)	0	0.009

4.17.4 Morbidity and 'exclusive breastfeeding' at three months in Rufiji

A comparison of morbidity prevalence was made among exclusively breastfed infants versus non-exclusive breastfed infants. Overall, the proportion of infants with morbidity was comparable between the two groups (Table 29).

Table 29 Prevalence of infections at three months of age in exclusive and non-exclusive breastfed infants

Disease	Exclusive breastfeeding N = 242	Non-exclusive breastfeeding N =878	P-Value
Cough	27 (11.2)	106 (12.1)	0.697
Refuse to eat or drink	3 (1.2)	9 (1.0)	0.729
Fever	28 (11.6)	94 (10.7)	0.702
Difficulty in breathing	4 (1.7)	10 (1.1)	0.517
Chest in-drawing	0 (0)	2 (0.2)	1.000
Convulsion	0 (0)	1 (0.1)	1.000
Vomiting	1 (0.4)	10 (1.1)	0.473
Noise during breathing	1 (0.4)	6 (0.7)	1.000
Rapid breathing	2 (0.8)	3 (0.3)	0.296
Diarrhoea	1 (0.4)	13 (1.5)	0.323
Eye infection	8 (3.3)	25 (2.8)	0.708
Ear infection	2 (0.8)	3 (0.3)	0.296
Combined RTI symptoms	28 (11.6)	112 (12.8)	0.617

4.17.5 Prevalence of infections in relation to feeding patterns at six months of age

Despite the lower rate of 'exclusive breastfeeding' at six months, none of the 'exclusively breastfed' infants had experienced infections except two infants who had a fever (Table 30). The presence of a cough was much higher among 'predominantly breastfed' infants than 'partially breastfed' infant with an absolute difference of 8%. The prevalence of fever was also much higher among 'predominantly breastfed' infants (32%) than 'partially breastfed' infants (19%). The prevalence of diarrhoea was higher among 'predominantly breastfed' infants (12%) than among 'partially breastfed' infants (6%).

Table 30 Prevalence of morbidity in relation to feeding patterns at six months of age

Disease	**Exclusive breastfeeding N = 19** n (%)	**Predominant Breastfeeding N = 73** n (%)	**Partial Breastfeeding N = 954** n (%)
Cough	0	14 (19.2)	107 (11.2)
Refuse to eat or drink	0	3 (4.1)	9 (0.9)
Fever	2 (10.5)	23 (31.5)	176 (19.2)
Difficulty in breathing	0	2 (2.7)	10 (1.0)
Chest in-drawing	0	1 (1.4)	1 (0.1)
Convulsion	0	0	1 (0.1)
Vomiting	0	1 (1.4)	19 (2.0)
Noise during breathing	0	2 (2.7)	3 (0.3)
Rapid breathing	0	2 (2.7)	1 (0.1)
Diarrhoea	0	9 (12.3)	53 (5.5)
Eye infection	0	1 (1.4)	27 (2.8)
Ear infection	0	1 (1.4)	4 (0.4)

4.17.6 Risk of infections in association with 'exclusive breastfeeding' at the age of three months

The logistic regression was only done for infants aged three months due to a low number of infections at one month and the small number of infants who were exclusively breastfed at six months of age. All respiratory tract infection symptoms (cough, difficulty in breathing, rapid breathing, chest-indrawn, noise during breathing) were combined to increase the power to detect an effect of 'exclusive breastfeeding' on respiratory infections. The results for cough were also presented separately as the

number of cases was adequate. Though not statistically significant, 'exclusive breastfeeding' conferred protection on cough (ARR 0.92 95% CI 0.57-1.47), vomiting (ARR 0.50 95% CI 0.06-4.32), diarrhoea (ARR 0.46 95% CI 0.06-3.73) and respiratory tract infections (ARR 0.92 95% CI 0.55–1.55). 'Exclusive breastfeeding' did not reduce the risk of fever, eye and ear infections, however the interpretation of the results require caution due to the wide confidence intervals in this small number of cases.

Table 31 Risk of morbidity in relation to 'exclusive breastfeeding' at the age of three

Univariate analysis					**Multivariate analysis**		
Outcome	Cases	RR	95% CI	P-Value	RR	CI	P-Value
Cough	133	0.92	0.58-1.43	0.697	0.85	0.50-1.45	0.543
Fever	122	1.09	0.69-1.71	0.703	1.24	0.74-2.09	0.416
Refuse to eat	12	1.21	0.33-4.51	0.774	1.15	0.24-5.69	0.863
Vomiting	11	0.36	0.05-2.83	0.331	0.50	0.06-4.32	0.527
Diarrhoea	14	0.28	0.036-2.12	0.216	0.46	0.06-3.73	0.468
Eye infection	33	1.12	0.52-2.62	0.709	1.45	0.55-3.81	0.457
RTI's symptoms Combined	140	0.89	0.58-1.40	0.617	0.92	0.55-1.55	0.762

Adjusted for maternal age, BMI, education, social economic status and infant sex, birth weight, exposure to pre-lacteal, WAZ, LAZ and WLZ

4.17.7 Hospital visit and hospitalisation in relation to feeding patterns

Overall 39 infants were sent to the hospital to seek medical services at one month and seven were hospitalised. Of the 39 infants who visited hospital, 25 (2.8%) were exclusively breastfed and 14 (3.6%) were 'non-exclusively breastfed. Among those who were hospitalised, four were exclusively breastfed.

The number of infants sent to the hospital at three months due to sickness increased to 125. Twenty four (9.9%) were exclusively breastfed and 101 (11.5%) were from non-exclusively breastfed group. The difference in hospital visit did not yield statistically significant results. Only two infants were hospitalised at the age of three months.

Out of 19 infants who were exclusively breastfed at six months, only one infant was sent to the hospital due to morbidity. The non-exclusive breastfed group had 125 (21.9%) infants who visited hospital due to illnesses and five infants who were hospitalised.

4.17.8 Infant feeding during illness

To account for the reverse causality, mothers were asked to report if there was any change in feeding practice when the child was sick. The information provided in figure 13 below covers mean percentage of the mothers who reported change in feeding time during illness. The majority of mothers reported that they did not make any changes of feeding time during infant illness at one month (99.1%), three months (94.1%) and six months (90.6%). However the actual information recorded indicated that few mothers breastfed their sick infants for less than fifteen minutes and there was a tendency to increase the average breastfeeding time from thirty minutes to one hour when the child was sick (Figure 13).

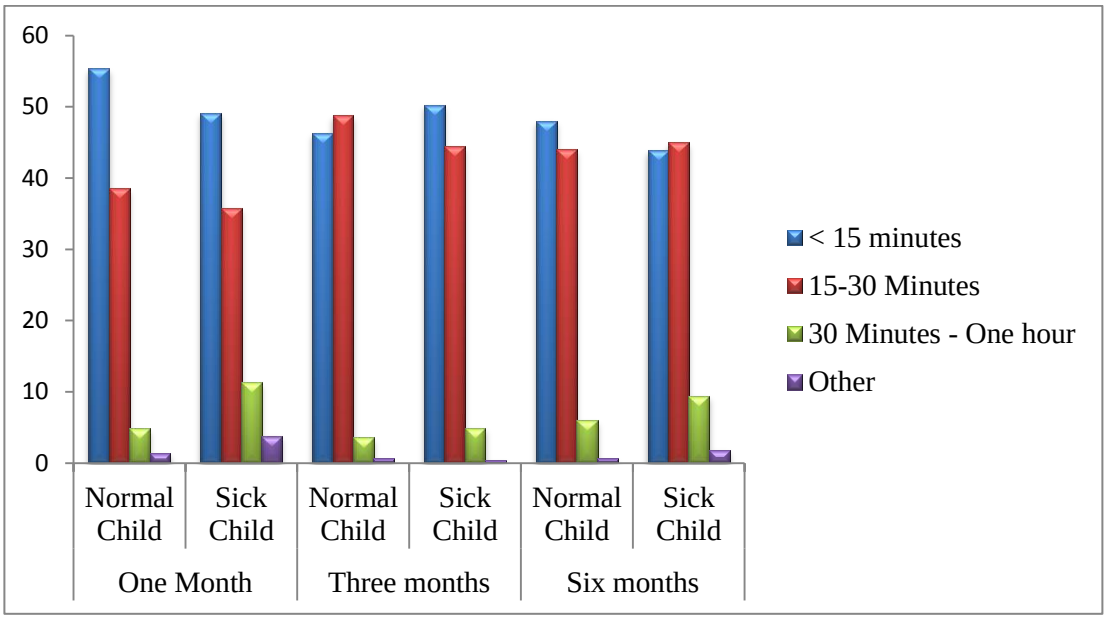


Figure 13.Time spent at the breast for feed when the 0-6 month child was sick in Rufiji

4.18 Objective 5

To establish reasons for the early exposure of infants to complementary foods and information sources used by parents in establishing feeding patterns in the Rufiji district.

4.18.1 Prevalence of factors associated with breastfeeding patterns at one and three months

Infant feeding information was collected at one, three and six months in Rufiji. The factors associated with any and exclusive breastfeeding at one and three months are shown in Tables 32 and 33. The prevalence of the factors at six months was not calculated due to small proportion of mothers (2%) who practiced exclusive breastfeeding making it difficult to compare across sub-groups of feeding methods.

There was a significant difference in the proportion of mothers who practiced ‘exclusive breastfeeding’ in relation to education level. At the age of one month (Table 32), 82.2% of mothers who attained secondary education practiced ‘exclusive breastfeeding’ compared with 69.2% among mothers who did not attain secondary education ($P<0.05$). A similar trend was observed at three months (Table 33) where more mothers who attained secondary education practiced ‘exclusive breastfeeding’ (36%) compared with nearly 21% among mothers with less than a secondary education ($P<0.05$). Almost 60% of mothers with less than a secondary education exposed their infants to ‘partial breastfeeding’ at three months compared with 40% among mothers who attained a secondary education.

There was a slightly high prevalence of ‘exclusive breastfeeding’ among employed mothers than unemployed mothers. The proportion of employed mothers who practiced ‘exclusive breastfeeding’ at one month was 81% compared with nearly 70% among unemployed mothers (Table 32). At three months the prevalence of ‘exclusive breastfeeding’ among employed mothers was 31% versus 21% among unemployed mothers (Table 33).

The prevalence of ‘exclusive breastfeeding’ also varied with social economic status. Mothers who were ‘less poor’ had a higher prevalence of ‘exclusive breastfeeding’ (75%) at one month (Table 32) compared with ‘poor’ mothers (68%). At three months, however, the prevalence of ‘exclusive breastfeeding’ was low overall and there was an absolute difference of 7% in the proportion of mothers who were ‘less poor’ and practiced ‘exclusive breastfeeding’ compared to ‘poor’ mothers (Table 33)

There was no significant difference in the prevalence of ‘exclusive breastfeeding’ at one month between mothers who had a vaginal delivery or those who experienced a caesarean section (Table 32). However at the age of three months, more mothers who gave birth through caesarean section exposed their infants to ‘non-exclusive breastfeeding’ ($P<0.05$). Religion did not contribute to any variation in feeding patterns at one month. Nonetheless, at three months (Table 33) more Muslim mothers practiced ‘partial breastfeeding’ (60%) than Christian mothers (38%). The prevalence of ‘exclusive breastfeeding’ was higher at one ($P<0.05$) and three months ($P <0.01$) among mothers who owned a radio and at three months among mothers with a partner or husband who had attained a secondary education ($P<0.01$).

Table 32 Prevalence of factors associated with breastfeeding patterns at one month of age

Variable		Exclusive Breastfeeding	Predominant Breastfeeding	Partial breastfeeding	P-Value
Maternal age	**N**	**n (%)**	**n (%)**	**n (%)**	
≤18 years	157	106 (67.5)	42 (26.8)	9 (5.7)	0.722
19-35 years	955	667 (69.8)	228 (23.9)	60 (6.3)	
>35 years	180	133 (73.9)	37 (20.6)	10 (5.6)	
Marital status					
Married or cohabitating	983	687 (69.9)	235 (23.9)	61 (6.2)	0.918
Single	311	221 (71.1)	72 (23.2)	18 (5.8)	
Education level					
<than secondary education	1202	832 (69.2)	294 (25.4))	76 (6.3)	
≥Secondary education	90	74 (82.2)	13 (14.4)	3 (3.3)	**0.024**
Maternal SES					
Poor	887	603 (68.0)	231 (26.0)	53 (6.0)	**0.015**
Less poor	407	305 (74.9)	76 (18.7)	26 (6.4)	
Maternal employment					
Employed	1029	826 (80.2)	15 (15.8)	4 (4.1)	0.068
Not employed	98	79 (80.6)	288 (24.2)	26 (6.3)	
Maternal BMI					
<18.5	150	98 (65.3)	43 (28.7)	6 (6.0)	
18.5-24.5	961	669 (69.6)	225 (23.4)	67 (7.0)	
25-30	151	115 (76.2)	35 (23.2)	1 (0.7)	**0.010**
<30	19	15 (78.9)	3 (15.8)	1 (5.3)	
Type of delivery					0.255
Vaginal	1179	830 (70.4)	281 (23.8)	68 (5.8)	
Caesarian	114	77 (67.5)	26 (22.8)	11 (9.6)	
Place of delivery					
Home delivery	254	170 (66.9)	70 (27.6)	14 (5.5)	0.274
Health facility	737	737 (70.9)	237 (22.8)	65 (6.3)	
Maternal religion					
Christian	112	86 (76.8)	22 (19.6)	4 (3.6)	0.326
Muslim	1178	818 (69.4)	285 (24.2)	75 (6.4)	
Tradition	2	2 (100)	0 (0)	0 (0)	
Partner education					
<secondary education	1115	774 (69.4)	271 (24.3)	70 (6.3)	0.476
≥Secondary education	155	115 (74.2)	32 (20.6)	8 (5.2)	
Radio ownership					
Yes	977	704 (72.1)	215 (22.0)	58 (5.9)	**0.017**
No	307	196 (63.8)	91 (29.6)	20 (6.5)	
Breastfeeding decision					
Before delivery	136	106 (76.3)	23 (16.5)	10 (7.2)	0.256
After delivery	883	615 (69.6)	218 (24.7)	50 (5.7)	
Not Decided	268	183 (68.3)	66 (24.6)	19 (7.1)	
Assistance during delivery					
Health professional	1058	749 (70.8)	242 (22.9)	67 (6.3)	0.414
Traditional birth attendant	140	98 (70.8)	35 (25.0)	7 (5.0)	
Non-health professional	92	58 (68.0)	29 (31.5)	5 (5.4)	

Table 33 Prevalence of factors associated with breastfeeding patterns at three month of age

Variable	Sample	Exclusive Breastfeeding	Predominant Breastfeeding	Partial breastfeeding	P-Value
Maternal age	**N**	**n (%)**	**n (%)**	**n (%)**	
≤18 years	130	17 (17.7)	34 (26.2)	73 (56.2)	0.218
19-35 years	825	181 (21.9)	168 (20.4))	476 (57.7)	
>35 years	163	37 (22.7)	25 (15.3)	101 (62.0)	
Marital status					
Married or cohabitating	866	185 (21.4)	170 (19.6)	511 (59.0)	0.501
Single	254	54 (22.4)	57 (22.4)	140 (55.1))	
Maternal education level					
<than secondary education	1038	213 (20.5)	208 (20.0)	617 (59.4)	**0.001**
≥Secondary education	80	29 (36.3)	19 (23.8)	32 (40.0)	
Mother employment					
Employed	87	27 (31.0)	19 (21.8)	41 (47.1)	**0.052**
Not employed	1026	214 (20.9)	206 (20.1)	606 (59.1)	
Maternal SES					
Poor	574	146 (19.4)	159 (21.1)	449 (59.5)	**0.031**
Less poor	366	96 (26.2)	68 (18.6)	202 (55.2)	
Maternal BMI					
<18.5	126	22 (17.5)	36 (28.6)	68 (54.0)	
18.5-24.5	830	175 (21.1)	162 (19.5)	493 (59.4)	
25-30	135	37 (27.4)	23 (17.0)	75 (55.6)	0.163
>30	18	5 (27.8)	4 (22.2)	9 (50.0)	
Type of delivery					
Vaginal	1020	226 (22.2)	198 (19.4)	596 (58.4)	**0.038**
Caesarian	99	15 (15.2)	29 (29.3)	55 (55.6)	
Place of delivery					
Home delivery	225	41 (18.2)	48 (21.3)	136 (60.4)	0.399
Health facility	894	200 (22.4)	179 (20.0)	515 (57.6)	
Maternal religion					
Christian	99	34 (34.3)	27 (27.3)	38 (38.4)	**0.001**
Muslim	1020	208 (20.4)	200 (19.6)	612 (60.0)	
Partner education					
<secondary education	973	187 (19.2)	196 (20.1)	590 (60.6)	**0.001**
≥Secondary education	128	48 (37.5)	26 (20.3)	54 (42.2)	
Radio ownership					
Yes	842	207 (24.6)	169 (20.1)	466 (55.3)	**0.001**
No	269	33 (12.3)	57 (21.2)	179 (66.5)	
Breastfeeding decision					
Before delivery	123	30 (24.4)	27 (22.0)	66 (53.7)	0.442
After delivery	767	164 (21.4)	146 (19.0)	457 (59.6)	
Not Decided	226	46 (20.4)	54 (23.9)	126 (55.8)	
Assistance during delivery	909	205 (22.6)	183 (20.1)	521 (57.3)	0.562
Health professional	124	22 (17.7)	27 (21.8)	75 (60.5)	
Traditional birth attendants	83	14 (16.9)	16 (19.3)	53 (63.9)	
Non-health professional					

4.18.2 Factors associated with excusive breastfeeding at the age of one month

Several factors were significantly associated with ‘exclusive breastfeeding’ at one month including maternal level of education, employment, social economic status, ownership of a radio and exposure to pre-lacteal feeds (Table 34). ‘Exclusive breastfeeding’ was practiced more by mothers who had attained a secondary education 82% than those who had not attained a secondary education (70%). Though employment was not common in this community, mothers who were employed had a higher prevalence of ‘exclusive breastfeeding’ (81%) than unemployed mothers (70%). More mothers who were in the ‘less poor’ category were exclusive breastfeeding their infants when compared with the ‘poor’ mothers ($P<0.05$). There was an absolute difference of 8% in the prevalence of ‘exclusive breastfeeding’ between mothers who owned a radio compared with mothers who did not own a radio. More mothers practiced ‘exclusive breastfeeding’ when infants were not exposed to pre-lacteal feeds (71%) than when they were exposed to pre-lacteal feeds (52%).

Some factors affected prevalence of ‘exclusive breastfeeding’ at the age of three months in Rufiji (Table 35). However two factors (maternal religion and partner education) which were never statistically significant at the age of one month became apparent at the age of three months. More Christian mothers (34%) practiced ‘exclusive breastfeeding’ compared with Muslim mothers (20%) and 38% of mothers with an educated partner practiced ‘exclusive breastfeeding’ compared with 19% with uneducated partners ($P<0.05$).

Table 34 Prevalence of factors associated with 'exclusive breastfeeding' at the age of one month

Factor	N	Exclusive breastfeeding	Non-exclusive breastfeeding	P-Value
		n (%)	n (%)	
Maternal Age				
<18 years	157	106 (67.5)	51 (32.2)	
19-35	955	667 (69.8)	288 (30.2)	
> 35	180	133 (73.9)	47 (26.1)	0.414
Marital status				
Married/cohabitating	983	687 (69.9)	296 (30.1)	
Single mothers	311	221 (71.1)	90 (28.9)	0.694
Maternal education level				
Secondary education	90	74 (82.2)	16 (17.8)	
No secondary education	1202	832 (69.2)	370 (30.8)	**0.009**
Maternal Employment				
Employed	98	79 (80.6)	19 (19.4)	
No employment	1189	826 (69.5)	363 (30.5)	**0.02**
Maternal SES				
Poor	887	603 (68.0)	284 (32.0)	
Less Poor	407	305 (74.9)	102 (25.1)	**0.011**
Maternal BMI				
<18.5	150	98 (65.3)	52 (34.7)	
18.5-24.5	961	669 (69.6)	292 (30.4)	
25-30	151	115 (76.2)	36 (23.8)	
<30	19	15 (78.9)	4 (21.1)	0.166
Type of delivery				
Vaginal delivery	1179	830 (70.4)	349 (29.6)	
Caesarian section	114	77 (67.5)	37 (32.5)	0.525
Place of delivery				
Home delivery	254	170 (66.9)	84 (33.1)	
Health facility delivery	1039	737 (70.9)	302 (29.1)	0.211
Assistance during delivery				
Health professional	1058	749 (70.8)	309 (29.2)	
Traditional birth attendants	140	98 (70.0)	42 (30.0)	
Others	92	58 (63.0)	34 (37.0)	0.297
Maternal religion				
Christian	112	86 (76.8)	26 (23.2)	
Muslim	819	819 (69.5)	360 (30.5)	0.106
Ownership of radio				
Yes	977	704 (72.1)	273 (27.9)	
No	307	196 (63.8)	111 (36.2)	**0.006**
Partner education				
Secondary education	115	115 (74.2)	40 (25.8)	
No secondary education	1115	774 (69.4)	341 (30.6)	0.224
Partner employment				
Employed	574	413 (72.0)	161 (28.0)	
Not employed	710	488 (68.7)	222 (31.3)	0.21
Infant Sex				
Male	653	447 (68.5)	206 (31.5)	

Female	639	460 (72.0)	179 (28.0)	0.165
Infant birth weight				
<2500g	111	82 (73.9)	278 (29.6)	
≥ 2500g	938	660 (70.4)	29 (261)	0.442
Exposure to pre-lacteal				
No	1232	875 (71.0)	357 (29.0)	
Yes	58	30 (51.7)	28 (48.3)	**0.002**

Table 35 Prevalence of factors associated with 'exclusive breastfeeding' at the age of three months

Factor	**N**	**Exclusive breastfeeding**	**Non-exclusive breastfeeding**	**P-Value**
		n (%)	**n (%)**	
Maternal Age				
<18 years	130	23 (17.7)	107 (82.3)	
19-35	825	181 (21.9)	644 (78.1)	0.51
> 35	163	37 (22.7)	126 (77.3)	
Marital status				
Married/cohabitating	866	185 (21.4)	681 (78.6)	
Single mothers	254	57 (22.4)	197 (77.6)	0.713
Maternal education level				
Secondary education	80	29 (36.3)	51 (63.8)	
No secondary education	1038	213 (20.5)	825 (79.5)	**0.001**
Maternal Employment				
Employed	87	27 (31.0)	60 (69.0)	
No employment	1026	214 (20.9)	812 (79.1)	**0.027**
Maternal SES				
Poor	754	146 (19.4)	608 (80.6)	
Less Poor	366	96 (26.2)	270 (73.8)	**0.009**
Maternal BMI				
<18.5	126	22 (17.5)	104 (82.5)	
18.5-24.5	830	175 (21.1)	655 (78.9)	
25-30	135	37 (27.4)	98 (72.6)	
<30	18	5 (27.8)	13 (72.2)	0.212
Type of delivery				
Vaginal delivery	1020	226 (22.2)	794 (77.8)	
Caesarian section	99	15 (15.2)	84 (84.8)	0.105
Place of delivery				
Home delivery	225	41 (18.2	184 81.8)	
Health facility delivery	894	200 (22.4)	694 (77.6)	0.176
Assistance during delivery				
Health professional	909	205 (22.6)	704 (77.4)	
Traditional birth attendants	124	22 (17.7)	102 (82.3)	
Others	83	14 (16.9)	69 (83.1)	0.263
Maternal religion				
Christian	97	33 (34.0)	64 (66.0)	
Muslim	1021	208 (20.4)	813 (79.6)	**0.002**
Ownership of radio				
Yes	842	207 (24.6)	635 (75.4)	

No	269	33 (12.3)	236 (87.7)	**<0.001**
Partner education				
Secondary education	128	48 (37.5)	80 (62.5)	
No secondary education	973	187 (19.2)	786 (80.8)	**<0.001**
Partner employment				
Employed	495	103 (20.8)	392 (79.2)	
Not employed	617	136 (22.0)	418 (78.0)	0.619
Child gender				
Male	561	114 (20.3)	447 (79.7)	
Female	557	126 (22.6)	431 (77.4)	0.349
Infant birth weight				
<2500g	92	16 (17.4)	76 (82.6)	
≥ 2500g	811	182 (22.4)	629 (77.6)	0.267
Exposure to pre-lacteal				
No	1066	233 (21.9)	833 (78.1)	
Yes	51	9 (17.6)	42 (82.4)	0.476

4.18.3. The determinants of 'exclusive breastfeeding' at the age of one month

The binary logistic regression analysis (Table 36) indicated that, at one month, mothers with no secondary education were 42% less likely (OR 0.58 95% CI 0.33-1.01) to practice 'exclusive breastfeeding' at one month as compared with educated mothers. This was a borderline significant factor (P = 0.055). Mothers who did not own a radio were less likely to practice 'exclusive breastfeeding' (OR 0.69 95% CI 0.52-0.92) as compared with mothers with a radio. Exposure to pre-lacteal feeds contributed to nearly 60% of 'non-exclusive breastfeeding' (OR 0.41 95% CI 0.24-0.70) as compared with non-exposure to pre-lacteal feeds. Maternal socio-economic status and employment did not significantly influence 'exclusive breastfeeding' at one month.

Table 36 Logistic regression for the factors associated with 'exclusive breastfeeding' at one month

Variable	N	Odds Ratio	95% CI	P-Value
Maternal education				
Secondary education	90	1	1	
No secondary education	1182	0.58	0.33-1.01	**0.055**
Maternal employment				
Employed	96	1	1	
Not employed	1176	0.602	0.35-1.03	0.065
Maternal SES				
Less poor	401	1	1	
Poor	871	0.78	0.59-1.03	0.078
Maternal radio ownership				
Own radio	968	1	1	
Do not own radio	304	0.69	0.52-0.92	**0.01**
Pre-lacteal provided to infant				
No	1215	1	1	
Yes	57	0.41	0.24-0.70	**0.001**

Logistic regression: variables maternal age, education, employment, social economic status (SES), BMI, religion, place of delivery, assistance during delivery, radio ownership and paternal level of education and employment, child gender, birth weight and exposure to pre-lacteal

4.18.4. Determinants of 'exclusive breastfeeding' at three month of age in Rufiji

Only a few variables became predictors of 'exclusive breastfeeding' at the age of three months (Table 37). The effect of paternal education on exclusive breastfeeding became obvious at the age of three months. 'Exclusive breastfeeding' was less practiced by mothers with a partner or husband without a secondary education (OR 0.41 95% CI 0.27-0.61) as compared with mothers with husbands or partners who had attained a secondary education. The effect of religion on 'exclusive breastfeeding' was not apparent at the age of one month. However, at the age of three months more Christian mothers practiced 'exclusive breastfeeding' than Muslim mothers (OR 0.51 95% CI 0.33-0.84). Ownership of a radio consistently affected the rate of 'exclusive

breastfeeding'. Fifty five percent of mothers were less likely to practice 'exclusive breastfeeding' due to a lack of radio (P<0.001).

Table 37 Logistic regression for the factors associated with 'exclusive breastfeeding' at three months of age

Variable	N	Odds Ratio	95% CI	P-Value
Paternal education				
Secondary Education	127	1		
No secondary education	963	0.41	0.27-0.61	<**0.001**
Maternal religion category				
Christian	94	1		
Muslim	996	0.53	0.33-0.84	**0.007**
Maternal radio ownership				
Yes	830	1		
No	260	0.45	0.30-0.67	<**0.001**

Logistic regression: variables used were maternal age, education, employment, social economic status (SES), BMI, religion, place of delivery, assistance during delivery, radio ownership and paternal level of education and employment, child sex, birth weight and exposure to pre-lacteal.

Chapter 5: Discussion of the results

5.1 Introduction

This chapter presents a detailed discussion of the results obtained from the previous chapter and it discusses them with relation to previous studies. The discussion will focus on the main five objectives which are:

1. To determine feeding patterns of infants aged less than six months in the Rufiji district of Tanzania. (Section 5.2)
2. To document complementary feeding patterns of infants 0-6 months in the Rufiji district**.** (Section 5.3)
3. To assess the impact of feeding patterns on infant growth in the first six months of life in the Rufiji district. (Section 5.4)
4. To evaluate associations between feeding patterns and child morbidity in the Rufiji district. (Section 5.5)
5. To establish reasons for the early exposure of infants to complementary foods and information sources used by parents in establishing feeding patterns in the Rufiji district. (Section 5.6)

5.2 The feeding patterns of infants 0-6 months in Rufiji-Tanzania

5.2.1 Rates of 'any breastfeeding'

The prospective cohort study of mother-infant pair has found that breastfeeding was the almost universal way of feeding infants aged 0-6 months in Rufiji. Nearly 99% of infants were still breastfeeding at the age of six months. Over ninety five percent of infants were not given pre-lacteal feeds and 61% were breastfed within one hour. While there were positive findings in breastfeeding initiation and 'any breastfeeding' overall, there was a rapid decline in 'exclusive breastfeeding' early in the infant's lives. At the age of one month 70% of infants were 'exclusively breastfed', but the rates declined to 22% at three months and 2% at six months.

High rates of ‘any breastfeeding’ have been consistently reported in Tanzania for over 30 years and breastfeeding has always been the cultural norm. A cross-sectional study conducted in 1983 including 2130 rural and urban mothers of Tanzania mainland reported rates of above 97% of ‘any breastfeeding’ (Kimati, 1983). In the same study, Lindi region had a 100% prevalence of ‘any breastfeeding’ at the age of twelve months. Similar findings were obtained from several Demographic and Health Surveys conducted in Tanzania (National Bureau of Statistics & ICF Macro, 2011b; National Bureau of Statistics & Macro International Inc, 1991, 1996, 2000b; National Bureau of Statistics & ORC Macro, 2004). Other studies conducted in developing countries have also demonstrated high rates of ‘any breastfeeding’ (Marriott, Campbell, Hirsch, & Wilson, 2007). In Kenya, a birth cohort study of infants born in the period 2006-2010 reported a 99% rate of ‘any breastfeeding’ and at the age of 11 months 85% of infants were still breastfeeding (Kimani-Murage et al., 2011). In South Africa, over 80% of infants aged nine months were breastfeeding (Mamabolo et al., 2004). Higher rates (98%) of ‘any breastfeeding’ were also reported in Ethiopia among infants aged 0-6 months (Tamiru et al., 2012). These findings were better than rates reported in some Asian and developed countries. According to the 2010 national infant feeding survey, in Australia only 60% of infants received some breastmilk at the age of six months (Australian Institute of Health and Welfare, 2011) and 68% among rural mothers in Western Australia (Cox, Binns, & Giglia, 2015). Among urban mothers residing in China, 64% provided some breastmilk to infants aged four months (He et al., 2001). The proportion of infants aged six months who received ‘any breastfeeding’ at 2010 was much lower (49%) in the USA (Centre for Disease Control, 2012).

5.2.2 Timing of breastfeeding initiation

Breastfeeding initiation within one hour of birth is a positive predictor of breastfeeding duration (Nakao, Moji, Honda, & Oishi, 2008; Raghavan, Bharti, Kumar, Mukhopadhyay, & Dhaliwal, 2014). In this present study timely initiation of breastfeeding was considered to be within one hour after birth. Sixty one percent of mothers in the Rufiji community initiated breastfeeding within one hour after birth. A similar proportion (59%) was reported in the Demographic and Health Survey conducted

in Tanzania in 2004 (National Bureau of Statistics & ORC Macro, 2004). However the 2010 Demographic and Health Survey reported a much lower percentage (49%) (National Bureau of Statistics & ICF Macro, 2011b). Inconsistency in reporting breastfeeding initiation between the surveys might be related to the cross-sectional nature of the data collection or an actual decline in the timely breastfeeding initiation. In Brazil, a cross-sectional study reported an increased breastfeeding initiation among mothers with vaginal delivery (Vieira et al., 2010). In the present study 91.2% of mothers had a vaginal delivery and only 8.8% mothers had caesarian section, a slightly higher percent than the reported (5%) in the 2010 Demographic and Health Survey (National Bureau of Statistics and ICF Macro, 2011). Fewer caesarean sections may explain the timely breastfeeding initiation reported in our study. Another study which re-analysed the Demographic and Health Survey data from Tanzania reported lower rates of breastfeeding initiation among mothers with younger age, working and illiterate who gave birth through caesarean section or who received support from traditional birth attendants (Victor, 2013).

In some situations cesarean delivery may result in lower rates of breastfeeding initiation. The reasons given include the pain associated with caesarean section, separation of the newborn from the mother (Chiou, Chen, Yeh, Wu, & Chien, 2014), hormonal differences between mothers with vaginal delivery and those with caesarean section (Nissen et al., 1996), and low level of appetite-modulating hormone among infants born through caesarean section (Yoshimitsu, Douchi, Kamio, & Nagata, 2000). A systematic review found that needs-based one-to-one formal or informal pre-birth education was an effective way of supporting breastfeeding initiation in a low-social economic groups (Dyson, McCormick, & Renfrew, 2005). Adopting the recommendation might be vital when promoting programs to increase breastfeeding initiation in Rufiji. However, since Tanzania is a large country, a robust multi-regional study exploring the reasons for the delayed breastfeeding initiation might be important prior to implementing the recommendations of the present study.

5.2.3 Exposure to pre-lacteal feeds

The use of pre-lacteal feeds was not common in the Rufiji community. Only a small proportion (4.8%) of infants were given water, sugar water, honey, glucose and other liquids as pre-lacteal feeds. The percentage was similar to the data obtained from Iringa region of Tanzania mainland which was included in the 2010 national Demographic and Health Survey. Only 2% of infants from the Iringa region were given pre-lacteal feeds (National Bureau of Statistics and ICF Macro, 2011). Nonetheless the overall results obtained from the Demographic and Health Survey indicated that 31% of children were introduced to pre-lacteal feeds in Tanzania (National Bureau of Statistics and ICF Macro, 2011). The percentage obtained in the survey was larger than the rates obtained in the present study probably due to differences in the data collection methods. Malawi also had a low percentage (8.9%) of infants who received pre-lacteal feeds. The percentages in Malawi was also generated from a cross-sectional study conducted among 634 caregivers (Katepa-Bwalya et al., 2015).

The low rate of infants who were given pre-lacteal feeds in this community may be associated with higher rates of health facility delivery (80%) than that reported in the 2010 Demographic and Health Survey (50.2%). According to Roy (2012) home deliveries was associated with a twofold risk of introducing pre-lacteal feeds among Northern Indian mothers from a rural community (Roy et al., 2014). Another reason for low rates of the use of pre-lacteal feeds may be a result of the long-term participation of this community in the surveillance activities, which might have improved some health behaviours the 'Hawthorne effect'(Landsberger, 1958).

Several other studies have reported pre-lacteal feeds to be widely practiced in different countries (Darmstadt et al., 2007; Fikree et al., 2005; Qiu et al., 2007a; Srivastava & Awasthi, 2014; Tang, 2013). Education level, social economic status and urbanity were mentioned in the 2010 Demographic and Health Survey as factors influencing pre-lacteal feeding in Tanzania (National Bureau of Statistics & ICF Macro, 2011b). Other studies indicated ethnicity and birth attendants (Fikree et al., 2005), age, status and place of delivery (Roy et al., 2014) to be among the factors contributing to pre-lacteal feeding.

5.2.4 'Exclusive breastfeeding' rates

A lower level of 'exclusive breastfeeding' was observed in this present study than that reported in the 2010 Demographic and Health Survey conducted in Tanzania (National Bureau of Statistics and Macro International, 2011) and in the urban and rural cross-sectional study conducted in Kilimanjaro region in Tanzania (Mgongo et al., 2013). Only 2% of infants were exclusively breastfed at the age of six months compared with 20% in Kilimanjaro and 23% in the Demographic and Health Survey. The variation of the rates obtained may be related to the cross-sectional nature of the data collection in the surveys which is subject to recall bias causing misclassification of feeding patterns.

Findings from this research are comparable to the results obtained from another cohort study conducted in Tanzania among HIV infected women. None of these high risk mothers were practicing exclusive breastfeeding with infants at the age of six months (Mwiru et al., 2011). However in the Mwiru et al (2011) study, the definition of 'exclusive breastfeeding' included water, tea and non-nutritive liquids, as opposed to the definition provided by the WHO (World Health Organisation, 2008b). Lower rates of 'exclusive breastfeeding' were also reported in prospective cohort studies conducted in South Africa and Malawi where 4% of infants were exclusively breastfed at the age of six months (Kerr et al., 2007; Mamabolo et al., 2004).

The disparities in the results obtained from the present study and cross-sectional studies could be related to methodological differences and the retrospective nature of assessing breastfeeding in the cross-sectional studies. It is worth noting that cohort studies with short term recall are better than retrospective studies (Huttly et al., 1990). To obtain reliable and valid results regarding breastfeeding duration, information should be collected for a recall period of less than three years (R. Li et al., 2005). Bland (2003) proposed a much shorter duration for collection of breastfeeding information (Bland, Rollins, Solarsh, Van den Broeck, & Coovadia, 2003).

The low level of 'exclusive breastfeeding' observed in Rufiji was associated with maternal low level of education, ownership of radio, religion, paternal level of education

and exposure to pre-lacteal feeds. In addition, the reported lack of support and encouragement to breastfeed, and low breastfeeding knowledge, might have affected exclusive breastfeeding. Despite the variations in the findings and low rates of 'exclusive breastfeeding' observed in most countries including Tanzania, what is more important is the possibility of increasing 'exclusive breastfeeding' rates (Haroon, Das, Salam, Imdad, & Bhutta, 2013) through informal (Tylleskär et al., 2011) and formal counselling sessions (Khan et al., 2013; Kramer et al., 2001) while utilising the existing primary health facilities (Bhandari et al., 2003).

In conclusion, the higher rate of 'any breastfeeding' and the low level of exposure to pre-lacteal feeds observed in Rufiji community needs to be preserved. This is a very valuable contribution to public health. The strategies to promote 'any breastfeeding' may include utilisation of trained village health workers to educate mothers at community level and the involvement of family members during education sessions. More effort is needed to improve timely initiation through face-to-face counselling on the need, informal education during antenatal attendance and supporting women who give birth by caesarean section. The promotion of exclusive breastfeeding to reach 90% prevalence at the age of six months, recommended by the WHO, should be undertaken. Focusing on factors such as maternal level of education, ownership of a radio and paternal involvement in antenatal and postnatal care will be necessary to improve exclusive breastfeeding in rural Tanzania.

5.3 Complementary feeding patterns of infants 0-6 months

5.3.1 Common complementary foods

This study focused on infants aged 0-6 months and their use of complementary foods. The WHO advises that infants of this age group generally do not require complementary foods. The early introduction of complementary foods may increase morbidity (World Health Organisation, 2003a). In this study early exposure to complementary food was common with only 2% of infants being exclusively breastfed at the age of six months. No infants aged 0-3 months in Rufiji were given solid foods unlike other communities in

Tanzania and Africa (Kalanda, 2006; National Bureau of Statistics and ICF Macro, 2011; Yotebieng, Chalachala, Labbok, & Behets, 2013). However, infants under three months of age from Rufiji were frequently given water or food based liquids. Approximately ninety percent of infants had been given water and over eighty percent were given maize porridge by the age of six months. Only a small proportion of infants (14.3%) had received stiff porridge at the age of six months.

Similar patterns of exposure to water and porridge were reported in a cohort study conducted in Malawi where over ninety nine percent of infants aged 26 weeks were exposed to water and 96% to local porridge (*Phala*) (Kalanda, 2006). The early introduction to solids was more common in Malawi with about sixty eight percent of infants being exposed to solid foods by 26 weeks (Kalanda, 2006). Among infants from the urban slums of Nairobi, Kenya, introduction to water and liquid foods was common at the age of one month and solids were introduced at a mean age of 3.5 months (Kimani-Murage et al., 2011**)**. Common liquids received at one month were water and sweetened water; at 2-3 months the majority received fresh or powdered milk and at 4-5 months introduction to porridge was common. The reasons for early exposure to complementary foods were inadequate breastmilk and lack of understanding on ideal time for complementary feeding **(**Kimani-Murage et al., 2011).

Among Vietnamese mothers who were interviewed within 48 hours after delivery, only 7% practiced 'exclusive breastfeeding' and almost eighty percent provided infants with "mixed feeding" (Ramoo et al., 2014). Determinants to breastfeeding were parental breastfeeding knowledge, help from health professionals and household members. In this present study 82% of mothers did not receive breastfeeding education during an antenatal visit and 73% had no support, both of which might have contributed to the early complementary feeding observed.

5.3.2 Reasons for the early exposure to complementary foods in Rufiji

In this predominantly Muslim-based community, the main reasons for early exposure to complementary foods were 'baby crying too much' (58%) and inadequate breastmilk

supply (10%). ‘Baby crying too much’ was previously mentioned as one of the key factors limiting the continuation of breastfeeding in Brazil (Barros et al., 1994). In Tanzania, giving porridge was the way to calm down a crying baby (Omer-Salim, Persson, & Olsson, 2007). This indicates that an effective breastfeeding promotion program must contemplate infant behaviour such as “baby crying too much” as not suggesting a lack of food. The behaviour of an unsettled child was also mentioned in a cohort study conducted in Australia as a reason for breastfeeding cessation before the infant was two weeks old (Ajetunmobi et al., 2015). Similarly, in a qualitative study conducted in Gambia, a “baby crying too much” and inadequate breastmilk were singled out as key reasons for early exposure to complementary foods (Njai & Dixey, 2013). A traditional birth attendant who was interviewed in the Gambia study said: *“If the child cries all the time, the grandmothers usually conclude that the child needs food and not breast milk and they start encouraging mothers to introduce complementary foods at an early stage”* (p. 76). In the same study a grandmother who participated in a focus group discussion said: *“If some mothers are sick they have insufficient milk supply and in that case the milk they produce cannot satisfy the breastfeeding child and thus they introduce complementary foods so early to the child”* (p.76). The statements indicated a gap in knowledge provided to the mothers. A review study conducted in China also identified insufficient breastmilk as one of other factors that contributed to early complementary feeding. Other factors were work, maternal illness and breast condition (Xu et al., 2009).

Overall, infants in Tanzanian study were exposed to less nutritious water-based foods. According to Michaelsen (1998), if such gruel is provided to a child weighing ten kilograms without adding any ingredients, it will yield approximately 0.25–0.5 kcal/g. Therefore, the infant will need to consume 2000-4000 grams per day to fulfil the energy requirement per day (950kcal/day). Such an amount of intake is impossible for the infant to consume due to their low intake rate (Michaelsen & Friis, 1998). Therefore early complementary feeding should be discouraged and triggers to early complementary feeding such as ‘baby crying too much’ and ‘inadequate breastmilk’ need to be addressed to attain optimal infant feeding in Tanzania.

5.4 The association of feeding patterns and infant growth in the first six months of life

5.4.1 Gender disparities in growth

Despite having similar birth weight, frequency of feeding and the rate of morbidity between genders, boys in this study were two times more likely to be stunted than girls at the age of six months. Overall, 13% of the infants were stunted at the age of six months, which was similar to the prevalence (18%) reported in the 2010 Demographic and Health Survey (National Bureau of Statistics & ICF Macro, 2011b). Other growth trajectories remained alike between genders.

Similar results were reported in Ethiopia, being of male gender with exposure to pre-lacteal feeds and the existence of diarrhoea in the previous 14 days contributed to childhood stunting. The chance of boys being stunted was nearly twice as much as for girls (N. L. Rogers et al., 2011). A meta-analysis which included data from 10 developing countries reported a higher prevalence of stunting among boys (40%) than girls (36%). In the analysis, boys from households with the lowest socio-economic status were likely to be stunted than girls in the same socio-economic category (Wamani, Åstrøm, Peterson, Tumwine, & Tylleskär, 2007). However, there was no statistically significant variation in socio-economic status between genders in the present study, which is less likely to explain the observed variations. The 10-nation meta-analysis did not analyse the differences in the morbidity pattern between countries in relation to gender. Also the researchers did not separate the analysis in relation to the growth standard used (i.e. whether WHO or NCHS) as the two standards tend to yield different results.

The justification for gender disparities provided in a study conducted in the Mbeya region of Tanzania mainland might support the differences observed in this present study. In the Mbeya study, 60% (n=375) of infants were stunted and more boys (65.3%) were stunted than girls (54.7%). Maternal preference for girls was highlighted as the reason for the disparities (McAuliffe, Zwickey, & Connelly, 2011). Probably this might

be related to favouring girls when breastfeeding, as reported in Nigeria where girls were twice as likely to receive 'exclusive breastfeeding' than boys (Agho et al., 2011) or it could be related to early exposure of boys to complementary foods than girls as reported in Cote d'Ivoire and Senegal (Issaka et al., 2015). In the study conducted by Issaka (2015), diarrhoeal morbidity among infants aged 3-5 months was associated with early introduction to complementary foods, however males and females were not analysed separately.

In the present study, though prevalence of exposure to complementary foods was slightly higher among boys, the difference was not statistically significant and morbidity patterns were similar. Another reason may be related to gender differences in energy metabolism (Wu & O'Sullivan, 2011). Overall, these findings have a profound implication when addressing the persistent high level of stunting (over forty percent) in Tanzania. Further research should be implemented to identify key variables predisposing boys to stunting before embarking on any major interventions.

5.4.2 'Exclusive breastfeeding' and growth

There was no statistically significant difference in growth of infants between those who were 'exclusively breastfed' and those who were 'not exclusively breastfed'. Weight for age, length for age and weight for height at one, three and six months were similar between feeding groups. The findings was similar to that reported by Kramer (Kramer & Kakuma, 2012). Though not statistically significant, the WAZ of exclusive breastfeeding group was slightly higher than non- exclusive group. The differences were probably due to lower age among exclusive breastfeeding group. The univariate analysis also indicated that 'exclusive breastfed' infants in the Tanzanian study were slightly lighter and shorter than 'non-exclusive breastfed' infants at one and three months. However, the LAZ of exclusive breastfeeding group was slightly higher for exclusive breastfeeding than non-exclusive breastfeeding group. The variation was associated with having more infants in exclusive breastfeeding group who were visited at younger age i.e. before 28 days (84%) as compared to the non-exclusive

group (75%).

There were no differences in weight and height at six months. At the age of one month, 'predominantly breastfed' infants were slightly heavier (74g) than 'exclusively breastfed' infants and 'partially breastfed' infants were 195g heavier than 'exclusively breastfed' infants. In the multivariate analysis, There was no statistical significant in all growth indicators (WAZ, HAZ and LAZ). It has been documented previously that 'exclusively breastfed' infants grow at a little lower rate than the reference population (K.G. Dewey, 1998; Kramer et al., 2004). However, this was in comparison with formula-fed infants and not with infants exposed to liquid and solid foods under less hygienic situations. There has also been a discussion about the use of the WHO growth chart with infants under the age of six months as the number of infants falling under the percentile lines normally used to measure sufficiency of growth is greater when compared with the older CDC growth reference (C. Binns et al., 2008). Early growth is important because it determines breastfeeding duration, timing of complementary feeding and has an influence in later health, a theory emphasised by Barker (2012) and Langley-Evans (2014) (Barker, 2012; Langley-Evans, 2015).

Several other prospective cohort studies have not found any differences in growth trajectories between exclusive and non-exclusive breastfed infants (Aarts, Kylberg, Hofvander, & Gebre-Medhin, 2003; Agrasada et al., 2011; Kalanda, 2006; Mwiru et al., 2011). In addition even more robust randomised control trials targeting 'exclusive breastfeeding' counselling versus standard health messages have not found any statistical difference in growth of exclusive versus non-exclusive breastfed infants (Bhandari et al., 2003; Islam, 2013; Khan et al., 2013; Kramer et al., 2007) despite increased infections in the non-exclusively breastfed group. An extensive review of data from eleven countries has not found any statistically significant alteration of growth indicators among exclusive versus non-exclusive breastfed infants (Kramer & Kakuma, 2012).

A few studies have found an association between 'exclusive breastfeeding' and infant or child growth indicators. In Belarus, a large nested prospective cohort study reported

more weight and length of infants who were ‘exclusive breastfed’ for three months and who were exposed to mixed feeding thereafter as compared with infants who were ‘exclusively breastfed’ for six months (Kramer et al., 2003). However, there was only a difference of 29 grams and 1.1mm at 3-6 months and this elevated growth did not continue into later infancy indicating a temporary effect. At the age of 9-12 months, the ‘exclusively breastfed’ infants had a greater length (0.9mm) and larger head circumference (0.19cm). The interpretation of these findings requires consideration since all infants included in this Belarus study were heavier (birth weight >2.5 kg), born full term and there was no calibration of measurements despite gathering the data from 31 large childbearing hospitals (Kramer et al., 2003). In Malawi, ‘exclusive breastfeeding’ did not affect weight, length, weight for age, length for age and weight for length in infants 0-6 months (Kamudoni, Maleta, Shi, & Holmboe-Ottesen, 2015). The increase in height was observed in infants 6-12 months who were exclusively breastfed for six months but other growth indicators remained similar. In addition boys were also more likely to be stunted than girls (Kamudoni et al., 2015) which was similar to the findings of the present study.

Human milk is considered to be a sole source of nutrients for full-term, premature and low-birth weight babies during the first half of infancy (World Health Organisation, 2003b, 2006d). Its value, recognised worldwide (C. W. Binns & Lee, 2014), stands on the unique composition of human milk including anti-infective and growth factors. This implies that exclusive breastfed infants tend to exhibit a normal growth patterns, and exposure to other foods or liquids below six months (particularly in a less hygienic condition) may endanger growth. Patel hypothesised that introduction of carbohydrate foods during the tender age is likely to have long-term consequences particularly obesity and metabolic syndrome during adulthood (M. S. Patel & Srinivasan, 2010).

The present study had several strengths compared with other cohorts. The prospective nature of collecting data from the community, rather than the health facility setting, has contributed to a reduction in self-selection bias. Also, the collection of infant feeding information and growth measurements prospectively and repeatedly, together with

standardisation of measurements, increased the reliability and validity of the findings. The study had two major limitations, however, which was the small number of infants who were exclusive breastfed at six months which might have contributed to the reduced power to detect a significant effect of 'exclusive breastfeeding' on growth. Secondly, the reverse causality may not be ruled out since growth failure may trigger early complementary feeding and vice versa.

In conclusion,' exclusively breastfed' infants had similar growth patterns to infants who were provided with complementary feeding at an early age. This justifies the need to adhere to the WHO recommendations emphasising 'exclusive breastfeeding' until six months since early supplementary feeding does not yield a better growth pattern and is likely to compromise infant health.

5.5 Associations between feeding patterns and child morbidity

In the Rufiji community, infection rates were low possibly due to the sustained high level of breastfeeding, low exposure to pre-lacteal feeds and timely initiation of breastfeeding. According to Edmund (2006, 2007) early exposure of infants to foods and delayed breastfeeding initiation after one day increased the probability of infections and death in neonates in Ghana (Edmond et al., 2007; Edmond et al., 2006).

In this study in the Rufiji district of Tanzania, there was no statistically significant difference in morbidity between 'exclusively breastfed' infants and non-exclusively breastfed infants at one and three months. The absence of significant effect when comparing the 'exclusive' versus 'non-exclusive breastfeeding' does not imply that 'exclusive breastfeeding' is not effective in preventing infections at a one and three months of age. The non-significant findings might be related to the sustained higher rates of 'full breastfeeding' in this cohort and low exposure to pre-lacteal feeds.

At the age of six months, 19 infants who were exclusively breastfed had no infections except two who had a fever. 'Predominant' and 'partially' breastfed infants experienced a higher prevalence of cough, fever and diarrhoea. However, it was not possible to run a

multivariate analysis due to the limited sample size of exclusively breastfed infants. Comparable morbidity rates were found in the Philippines among low birth weight infants aged 0-6 months (Agrasada et al., 2011). In the Philippines study, none of the exclusive breastfed infants (n = 24) were sick. However the 'predominant breastfed' infants (n = 134) had a high prevalence of diarrhoea (32.4%) and respiratory infections (26.1%). Formula fed infants (n = 21) had much higher rates of diarrhoea (71.4%) and respiratory infections (57.1%) (Agrasada et al., 2011).

There has been an inherent problem in finding a strong positive association when comparing 'exclusive breastfeeding' with 'non-exclusive breastfeeding' in relation to infections probably due to the absence of a true control group. A cohort study conducted in Hong Kong among 0-6 month infants did not find a statistically significant difference in rates of hospitalisation (HR 0.51 95% CI 0.25-1.05) in 'exclusive' versus 'non-exclusive breastfed' infants (Tarrant, Kwok, Lam, Leung, & Schooling, 2010). Similar findings were reported in Bangladesh in a birth cohort study of 0-6 month old infants. The study did not find any statistically significant difference in risk of acute respiratory infections (Adjusted OR 0.48 95% CI 0.06-3.93) and diarrhoea (Adjusted OR 1.85 95% 0.76-4.69) in infants aged 0-6 months who were exclusively breastfed for six months and those who were 'predominantly breastfed' (Mihrshahi et al., 2008). However, the 'exclusive breastfeeding' definition which was used in that study included pre-lacteal feeds which were nearly 70% in that community. Another prospective multicentre cohort study conducted in Ghana, India and Peru did not discover any statistically significant difference in hospitalisation and mortality related to diarrhoea, respiratory and other infections in infants aged 0-6 months infants who were 'exclusively breastfed' compared with those who were 'predominantly breastfed' (Tang, 2013)

Unlike other studies, a cohort study conducted in Tanzania found a strong protective effect of 'exclusive breastfeeding' in diarrhoea, respiratory infection and fever in infants aged 0-6 months as compared with the non-exclusive breastfed infants. However, the protective effect did not continue until 6-24 months (Mwiru et al., 2011). That cohort study had higher rates of morbidity cases than those observed in the Rufiji community,

possibly due to higher supplementary feeding with solid foods below six months of age and the inclusion of infants born by HIV mothers create difficulties to generalize the findings.

Most studies conducted thus far have found a strong protective effect on infections when comparing ‘exclusive’ or ‘predominant breastfeeding’ with never breastfeeding (Bahl et al., 2005; Horta & Victora, 2013b; Lamberti, Fischer Walker, Christa, et al., 2011; Victora & Barros, 2000b). However this comparison was not possible in the present study due to the limited number of infants who were never breastfed (n = 4). In the Bahl (2005) study, non-breastfeeding was associated with a ten-fold increase in chance of death compared with ‘predominant breastfeeding’ in infants aged 0-12 months (Bahl et al., 2005). Similar findings were reported by Lambert (2011) in a systematic review which included studies from developing countries. The chance of death from diarrhoea was 10 times more in infants aged 0-5 months who were never breastfed compared with those who were exclusively breastfed (Lamberti, Fischer Walker, Noiman, et al., 2011).

The protective nature of exclusive breastmilk on infections is because of its nutritive value and protection from exposure to pathogens through consumption of unclean water and complementary foods (World Health Organisation, 2006d). The presence of immunoglobulin IgA diminishes the likelihoods of infections by covering the infant’s mucosal surface in the gut (World Health Organisation, 2007). Breastmilk contains more than 200 oligosaccharides to inhibit growth of harmful bacteria. The oligosaccharides help to feed certain beneficial bacteria in the gut such as *Bifidobacterium infantis* which protects against diarrhoea (Ward, 2006). Breastmilk is rich in wide-ranging lactic acid bacteria which prevent damaging bacteria by releasing hydrogen peroxide and compound bacteriocins (Petherick, 2010).

The findings from the present Rufiji study were less likely to be confounded by the reverse causality since over 95% of the mothers did not change feeding patterns during illness. In addition, to account for the reverse causality, the analysis was done to find the association between ‘exclusive breastfeeding’ at one month in relation to morbidity at

three months and ‘exclusive breastfeeding’ at three months in relation to morbidity at six month. No statistically significant association was found between ‘exclusive breastfeeding’ and reduced mortality at three and six months as compared to ‘non-exclusive breastfeeding’ indicating that reverse causality was unlikely

The prospective nature of collecting feeding information limits recall bias. The quality of the collected data was high since the information was collected at home, reducing self-selection bias and one enumerator followed the same mother over time, and repeated measures were taken. However, there was a possibility that the reported cases of morbidity were underestimated, particularly where an infant was sick for more than once in the two-month period. The ‘Hawthorn effect’ (Landsberger, 1958) cannot be ruled out since the community has been involved in the Health and Demographic Surveillance System for over 30 years. In addition, the small number of exclusively breastfed infants might have limited the power to detect the statistically significant association between ‘exclusive breastfeeding’ and infections.

In conclusion, ‘exclusive breastfeeding’ protects infants from morbidity during the first half of infancy. Its promotion is vital particularly in a resource-poor setting where contamination of water and complementary foods is likely to occur.

5. 6 Factors influencing rate of ‘exclusive breastfeeding’ at one and three months

5.6.1 Introduction

Due to the low rates of ‘exclusive breastfeeding’ at the age of six months, focusing on factors influencing ‘exclusive breastfeeding’ at the age of six months was not possible and therefore three months of age was considered. After adjusting for the confounding factors, the logistic regression analysis found that maternal education level, ownership of a radio set and exposure to pre-lacteal feeds were the factors influencing rates of ‘exclusive breastfeeding’ at the age of one month in Rufiji. However the effect of these factors was not evident until three months of age except maternal ownership of radio. At the age of three months, being a Christian mother, having a husband with secondary

education and maternal ownership of radio increased the likelihood of practicing ‘exclusive breastfeeding’.

5.6.2 Maternal education level

In this cohort study, mothers who did not attain secondary education were less likely to practice ‘exclusive breastfeeding’ compared with mothers who had achieved secondary education. Several other studies did find a positive association between ‘exclusive breastfeeding’ and maternal education. The 2010 Demographic and Health Survey conducted in Tanzania found that mothers with a low education level had delayed breastfeeding initiation which translated to early exposure to pre-lacteal feeds (National Bureau of Statistics and Macro International, 2011). In Brazil, a mother-infant 0-6 months cohort study found a positive association between maternal education for less or equal to eight years and increased likelihood of early cessation of exclusive breastfeeding (Cox et al., 2015). Other studies have also found a low education level to be associated with ‘non-exclusive breastfeeding’ (El Shafei & Labib, 2014; Inoue, Binns, Otsuka, Jimba, & Matsubara, 2012; Kalanda et al., 2006; Kimani-Murage et al., 2011; Ladomenou, Kafatos, & Galanakis, 2007).

The reverse results were obtained from South Africa where women with tertiary education were likely to terminate breastfeeding before 12 weeks compared with women with no tertiary education. However, there was a possibility that highly-educated mothers were likely to be employed. Employment, particularly full time, has been associated with a low chance of practicing ‘exclusive breastfeeding’ (Mandal et al., 2010; Ryan et al., 2006) due to limited child-mother contact resulting in reduced milk production and failure to breastfeed exclusively (Balogun et al., 2015).

5.6.3 Maternal ownership of a radio

Maternal ownership of a radio contributed to the increased chance of practicing ‘exclusive breastfeeding’ at one month and its effect continued up to the age of three months in Rufiji. Similar findings were reported in Tanzania (Shirima et al., 2001). One explanation provided by Shirima (2001) for the increased ‘exclusive breastfeeding’ in

Tanzania with ownership of radio was that mothers with a radio had the opportunity to receive breastfeeding education through a radio program which has been implemented in Tanzania since 1994. As such, the program facilitated an increase in breastfeeding knowledge. Nkala and Msuya (2012) reported a fivefold increased chance of practicing 'exclusive breastfeeding' amongst mothers with breastfeeding knowledge in Tanzania (Nkala & Msuya, 2011). In Ethiopia, availability of radio also increased rates of 'exclusive breastfeeding' (Tamiru et al., 2012).

5.6.4 Exposure to pre-lacteal feeds

This study found a significant association between exposure to pre-lacteal feeds and reduced rates of 'exclusive breastfeeding' in Rufiji at one months and no significant association at the age of three months. However the proportion of infants exposed to pre-lacteal feeds was low (4.8%) in this community which explains the short-term effect observed between exposure to pre-lacteal feeds and 'exclusive breastfeeding'. Several other studies have found an association between exposure to pre-lacteal feeds and 'non-exclusive breastfeeding' (El-Gilany, Sarraf, & Al-Wehady, 2012; Lakati et al., 2010). The mechanism underlying the reduction in 'exclusive breastfeeding' when pre-lacteal feeds were provided may be related to delayed sucking which in turn delays breastmilk production (Hurst, 2007).

Varying reasons for giving pre-lacteal feeds were found from other studies since the current study did not focus on that aspect. The nurses provided pre-lacteal feeds due to the perception that breastmilk was not enough, doctors provide pre-lacteal feeds to prevent low blood sugar (hypoglycemia), desiccation and neonate jaundice (Akuse & Obinya, 2002). Non-medical practitioners provided pre-lacteal feeds to quench thirst and make the infant gut ready to digest food (Akuse & Obinya, 2002). In Malawi, grandmothers gave water and herbal infusions for rituals aimed at protecting infants from illnesses (Kerr et al., 2007; Kerr et al., 2008), in Ethiopia pre-lacteals were used to prevent evil eyes, sickness and to clean an infant's stomach (Legesse, Demena, Mesfin, & Haile, 2014) while in Egypt and India, traditions and customs played a role (Khan et al., 2013; Wamani et al., 2007).

5.6.5 Maternal religion

The association between maternal religion and breastfeeding is an area which has not been well studied. This present study found a 67% less chance of practicing 'exclusive breastfeeding' in Muslim mothers as compared with Christian mothers at the age of three months and a non-significant association at the age of one month. Similar findings were reported in Tanzania where Ismaili Moslem mothers practiced breastfeeding for a shorter duration than non-Ismaili Moslem group (Kimati, 1983). That study found that, of the 565 Ismaili Moslem mothers who were interviewed, 510 breastfed for one week only and 55 mothers did not breastfeed at all. However, the majority of the Ismaili Moslem group was residing in the urban area while mothers from the other groups were from a rural community. The association between residing in an urban area with less likelihood of practicing 'exclusive breastfeeding' was reported in China and Tanzania (He et al., 2001; National Bureau of Statistics and Macro International, 2011). In Bangladesh a study which utilised data from a Demographic and Health Survey found that Muslim mothers were nearly two times as likely of ceasing breastfeeding than non-Muslim mothers (Mazumder & Hossain, 2012). On the other hand, Burdette (2012) found a positive association between the frequency of attending church services and longer breastfeeding duration (Burdette & Pilkauskas, 2012).

The negative association which was found between Muslim mothers and 'non-exclusive breastfeeding' at three months in this study may have an explanation. In this community, Christian mothers were slightly more educated than Muslim mothers (P = 0.061). A higher education level has been known to have a positive influence on 'exclusive breastfeeding' rates (Cox et al., 2015; Kimani-Murage et al., 2011). In addition, this present study was carried out for a period of one year and some follow-up visits were done during the Ramadhan (Muslim fasting period), and hence its effect was observed in the later age (three months of age). A Turkish study has shown that of 164 mothers who participated in a cross-sectional study, 52% fasted while breastfeeding and 76% believed that fasting would reduce the breastmilk supply. In Zambia, perceived low breastmilk supply was associated with 'non-exclusive breastfeeding' (Fjeld et al., 2008) and, in China, breastfeeding cessation (Xu et al., 2009). According to Rashid (2007) who

quoted the Muslim book (*Figh us-Sunnah-1989*), Muslim mothers fast to obey the Quran which requires an ordinary Muslim breastfeeding mother to fast during Ramadhan, if fasting will not harm the mother's and/or a child's health (Sapna et al., 2009). A robust prospective study is needed to account for the effect of religion, particularly fasting, on breastfeeding.

5.6.6 Husband/partner level of education level

For many years, researchers have focused on the maternal parent in order to increase 'exclusive breastfeeding' (Bhandari et al., 2003; Katepa-Bwalya et al., 2015; Pugh et al., 2010) but neglecting co-parenting dynamics. In this mother-infant pair cohort study a strong negative association ($P<0.001$) was found between paternal low level of education and 'exclusive breastfeeding' at the age of three months but not at the age of one month which may suggest a consideration of paternal entry time when promoting 'exclusive breastfeeding'. Several other studies have found an association between low paternal education and non-'exclusive breastfeeding' (Hajeebhoy et al., 2014; Kimani-Murage et al., 2011). However the study conducted by da Silva (2012) in Brazil found a low paternal education level to be associated with early weaning at the age of one month and no effect at the subsequent age (Silva et al., 2012).

The negative association between 'exclusive breastfeeding' and low paternal education level may be related to low access in breastfeeding knowledge among illiterate fathers which translates to a low awareness of benefits related to 'exclusive breastfeeding'. Several other studies have reported an increased 'exclusive breastfeeding' rates when fathers were involved in a breastfeeding promotion programs (Senarath et al., 2010; Wolfberg et al., 2004). However Susin and Giuglimani (2008) establish that the involvement of men with less than eight years of learning or education resulted in a decline of breastfeeding rates than when the intervention was targeting mothers alone (Rosane Odeh Susin & Regina Justo Giugliani, 2008). In conclusion, involvement of educated partners during the promotion of breastfeeding might contribute to better rates of 'exclusive breastfeeding' in rural communities of Tanzania.

5.7 Who influences the decision on infant feeding?

In the Rufiji rural community, the majority of mothers (73%) made their own decision on how to feed their infants. Only a few mothers (23%) were influenced by health professionals and four percent relied on friends or family members. The findings were contrary to several studies conducted in African countries and other developing countries. Grandmothers and fathers were mentioned as key people who influence infant feeding in Malawi even when mothers were knowledgeable about the importance of 'exclusive breastfeeding' (Fjeld et al., 2008). Kerr (2007) also reported that Malawian grandmothers were responsible for introducing herbal infusions to new-borns in the belief that it protected the child from illness (Kerr et al., 2007) and in most cases the infusions were provided before the initiation of breastfeeding. However this was more practiced by mothers who came from low socio-economic communities (Kerr et al., 2007). In Brazil, counselling sessions, which included maternal grandmothers, resulted in a delayed introduction of herbal infusions and tea than when the mothers were counselled alone. The findings indicated that grandmothers had a great influence on the timing of an infant's introduction to complementary foods (Nunes et al., 2011). In Cameroon, the infant feeding decision was influenced by village elders and family members rather than the mother (Kakute et al., 2005). Pressure from village elders and family members contributed to a 96% introduction to water at an age below three months (Kakute et al., 2005). These findings indicate clearly the complexity of addressing optimal infant feeding patterns in rural communities in developing countries. Several studies have indicated that any support provided by health professionals or peers, influenced mothers to breastfeed exclusively (Britton et al., 2007; Meedya et al., 2010; Renfrew et al., 2012). In the Rufiji community, however, few mothers decided how to feed their infants based on health professional advice (19%) possibly due to the low exposure to breastfeeding education during the antenatal visit.

Chapter 6: Conclusions and recommendations

6.1 Introduction

In this final chapter a summary of key results from each research objective is presented, along with limitations of the study, future research needed and recommendations for future implementation of infant feeding programs in rural communities.

6.2 Benefit of the study

This was the first mother-infant community based longitudinal study to be conducted in Rufiji Tanzania to establish the association between infant feeding patterns and health. The study was able to document the prevalence of breastfeeding, complementary feeding and its association with growth and morbidity. Factors associated with 'non-exclusive breastfeeding' were presented. The findings of this study can greatly contribute to the development of programs aiming to improve infant feeding practices in the rural communities.

6.3 Summary of the main findings

- This study has demonstrated that the Rufiji rural community had high rates of full breastfeeding (99%) at the age six months. A high rate of 'any breastfeeding' has been reported in Tanzania for over thirty years (Kimati, 1983) and has been sustained in the Tanzanian communities (National Bureau of Statistics and Macro International, 2011).
- Early exposure to pre-lacteal feeds was not common (4.8%) and a large proportion of mothers (61%) initiated breastfeeding within one hour. 'Exclusive breastfeeding' was less practiced in this community with only 2% of infants receiving 'exclusive breastfeeding' at the age of six months.
- In the Rufiji rural community, a majority of infants was given complementary liquid foods at the age below six months. Water (86%) and maize porridge (81%) were the most common liquids provided to infants at the age of six months. Introduction to solid foods was less common in this community (14.3%). Nearly

half of the mothers mentioned ‘baby crying too much’ and ‘inadequate breastmilk supply’ as the main reasons to trigger early complementary feeding.

- Thirteen percent of infants in this community were stunted, 7% were underweight and 4% were wasted. Boys were twice as likely [14.2% (95% CI 11.4-17.5)] to be stunted than girls [7.2% (95% CI 5.2-9.7)]. There was no statistical difference in growth among ‘exclusively breastfed’ and those who were not ‘exclusively breastfed’. Weight for age (WAZ), length for age (LAZ) and weight for length (WLZ) was similar at the age of one, three and six months.
- Morbidity rates were low in this community probably due to the sustained high rate of ‘full breastfeeding’, non-exposure to pre-lacteal feeds and increased timely initiation of breastfeeding. ‘Exclusive breastfeeding’ had a protective effect on cough, vomiting, diarrhoea and respiratory tract infections as compared with ‘non-exclusive breastfeeding’. However, the association was not statistically significant.
- Maternal level of education, exposure to pre-lacteal feeds and household availability of a radio set was associated with ‘exclusive breastfeeding’ at the age of one month. However, at the age of three months, being a Christian mother, having a husband with secondary education and maternal ownership of a radio increased the likelihood of practicing ‘exclusive breastfeeding’.
- Seventy three percent of mothers made their own decision on how to feed their infant. There was less dependency on health professionals (19%) and other people (3.6%) for the infant feeding decision.

6.4 Limitations of the study

There were some limitations that require consideration when interpreting the results of this research.

1. The study recruited 1302 mother-infant pairs at the community setting over a period of six months and infants were followed for half of the year. It was likely that some infants were missed out during enrolment. However, in 2010, the Health and Demographic Surveillance System from Rufiji reported a total of

2040 infants aged one year which indicates a high representation of the sample had been obtained.

2. Information about infant feeding was self-reported. Despite being a standard method of gathering infant feeding information, there was a possibility of overestimating breastfeeding particularly by mothers who knew the importance of breastfeeding. However, overall infant feeding knowledge was low in this community.

3. There was a 19% loss to follow-up which was higher than the estimated 10%. The majority of mothers were missed due to the frequency of fighting between pastoralist and farmers, causing regular family displacement. However, there was no difference in the demographic factors of those who finished the study and those who were lost follow-up except for marital status. The majority of the mothers lost to follow-up were single.

4. Low rates of 'exclusive breastfeeding' at the age of six months (2%) limited a comparison of infant growth and morbidity in sub-categories of infant feeding and might have contributed to the lesser power to detect the associations.

5. Since exclusive breastfeeding is a social desirability and the information was collected via interviews, there might be a courtesy bias marking a pyridoxal association between exclusive breastfeeding and child health outcome. For example, if the mother perceives the health status of the child to be good, they are likely to disclose the non-exclusive breastfeeding practices and vice versa.

6. The observed low rate of morbidity in this community might be related to the failure to detect cases particularly when an infant was sick for more than once at a period of two months preceding the interview. However, the study managed to collect information on whether the infant was hospitalised for more than once.

6.5 Recommendations for future research

I. As Tanzania is a large country with diverse regional features, feeding patterns may vary between regions. A more robust multi-regional cohort study will be required to document feeding practices in Tanzania.

II. This study found increased likelihood of stunting in boys than girls. More research is needed to find out factors predisposing boys to increased risk of chronic malnutrition. Probably looking at genetic factors, metabolism and family behaviours will yield better results.

III. This study found paternal education level to be associated with 'exclusive breastfeeding' at the age of three months and not at the age of one month. The reasons behind this change need to be explored.

IV. Exposure to pre-lacteal feeds was low and timely initiation of breastfeeding was high in Rufiji than other communities. A qualitative study exploring the reasons for these positive milestones would generate useful information for future promotion of infant feeding practices.

V. This present study found association between 'exclusive breastfeeding' and maternal ownership of radio. Studies exploring awareness and comprehension of radio programs in relation to infant feeding will be of added value.

6.6 Recommendations for better clinical practice and health policies

I. Higher rates of 'any breastfeeding' and non-exposure to pre-lacteal feeds observed in the Rufiji community need to be preserved. This may involve the utilisation of trained village health workers to educate mothers at the community level and encourage the involvement of family members during education sessions.

II. More effort is needed to improve timely initiation of breastfeeding. The efforts may include face to face counselling on the need, informal education during antennal attendance and supporting women who give birth by caesarean section.

III. Strategies to promote ‘exclusive breastfeeding’ to reach the required 90% coverage recommended by World Health Organisation at the age of six months need to be implemented. Such programs may include the Baby Friendly Initiative, peer counselling and routine counselling through antenatal cervices. Consideration of paternal and maternal education level, religion, ownership of radio sets and exposure to pre-lacteal feeds when promoting exclusive breastfeeding is important.

IV. Early complementary feeding should be discouraged as it does not confer additional benefit over ‘exclusive breastfeeding’ and triggers for early complementary feeding such as baby ‘crying too much’ and inadequate breastmilk need to be addressed to attain optimal infant feeding in Tanzania.

V. Health facilities providing maternal and child services should strictly adhere to the ten steps of Baby Friendly Hospital Initiative as recommended by the WHO.

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Appendix 1: Questionnaires

BASELINE QUESTIONNAIRE

MOTHID: | | | | | | | | | | | | **INFANTID** | | | | |

Baseline Questionnaire will administered once throughout study period

I. Basic Data

1. Visit Date: | | | / | | | / | | | | | VISDT
d d m m y y y y

2. Visit Time: | | : | | | (*24 hrs.*) _____ VISTM

3. Visit #: | | VISNO

4. Field interviewer's initials: | | INIT

7. Date of Delivery: | | | | | | | | DOB
d d m m y y y y

8. Birth weight in Kilogram. | | . | | KG

9. Gestation age at delivery (Weeks) | | GAGE

10. Maternal Weight at delivery | | | . | | DELIVWT

11. Estimated maternal weight before conception | | | | PRECONWT

II. SOCIO-DEMOGRAPHICS INFORMATION

12. Age of the mother in complete years | | AGMOTHER

13. Religion: 1= Christian 2 = Muslim 3 = Tradition religion 4. Other specify_____ | | RELIGN

14. Tribe of the Mother: 1 = Ndengereko 2 = Ngindo 3 = Pogoro
4 = Makonde 5 = Matumbi 6 = Nyagatwa 7 = Other (specify)_____ | | TRIBE

15. Marital status

What is your current marital status? Are you: *Check only one option.* ✓				MARITAL
Married – monogamously*	☐ 1	Widowed	☐ 5	
Married – polygamously*	☐ 2	Divorced	☐ 6	
Living with a sexual partner, but not married*	☐ 3	Separated	☐ 7	
Single	☐ 4			

16. Education level

What is the highest level of formal education you have completed in school? ✓		
Never to school	☐ 1	EDULEVEL
Drop in primary school	☐ 2	
Primary school	☐ 3	
Secondary School	☐ 4	
High school/Occupational school	☐ 5	

17. Income source

Income ✓	**Yes**	**No**	
Do you have your own income?	☐ 1	☐ 2	OWNINC
Do you depend on another person for your income?	☐ 1	☐ 2	OTHINC

18. Employment status

How would you describe your employment? *Allow participant to describe their employment in their own words, then mark the most appropriate response. Do not ask them directly. Check only one option.* ✓		EML
government job	☐ 1	
private job	☐ 2	
self employed	☐ 3	
farming only	☐ 4	
daily wage earner	☐ 5	
does not work	☐ 6	
Other, *specify:* _____	☐ 7	

19. Parity and pregnancies

Children and Pregnancies	**Yes**	**No**	
How many pregnancies have you had? *Record # of pregnancies:*	☐☐		PREGNO

Have you ever had another child? ✓	☐ 1 ☐ 2	CHLDANY
How old is the next younger child? *Record # of children:*	☐☐	CHLDNO
Number of live children	☐☐	

20. Household Size

How many of the following currently live in your household? (If *none, write "00").*		
Children aged < 5 years	☐☐	CHLDFV
Children aged 5-14	☐☐	CHLDFR
Those aged 15 or older	☐☐	ADLTNO

21. Type of House

What type of housing do you live in? Do you: *Check only one option.*			✓	HOUSTY
Own your own house	☐ 1	Stay with other relatives	☐ 5	
Rent a house	☐ 2	Not have a home	☐ 6	
Live at your workplace (staff quarters)	☐ 3	Other, *specify:* _____	☐ 7	HOUSPE
Live with parent(s)	☐ 4			

22. Type of Roof

What type of roof does your home have? *Check only one option.*			✓	ROOFTYP
Thatched	☐ 1	Other, *specify:* _____	☐ 5	
Metal (i.e., tin or aluminum)	☐ 2	Don't know	☐ 6	
Dried leaves	☐ 3	Not applicable	☐ 7	
Concrete	☐ 4			

23. Type of floor

What type of floor does your home have? *Check only one option.*			✓	FLRTYP
Mud or dirt	☐ 1	Other, *specify:* _____	☐ 5	FLRSPE
Wood	☐ 2	Don't know	☐ 6	
Tiles	☐ 3	Not applicable	☐ 7	
Concrete	☐ 4			

24. Roof Leaking

When it rains, does the roof of your home leak water? *Check only one option.*			✓	RFLEAK
Yes, a lot	☐ 1	Don't know	☐ 4	
Yes, a little	☐ 2	Not applicable	☐ 5	
No	☐ 3			

25. Does your household have the following items? Do you have:
Answer each question ✓

		Yes	No		Yes	No	
ELECT	Working electricity	☐ 1	☐ 2	Radio	☐ 1	☐ 2	RADIO
GENER	Working generator	☐ 1	☐ 2	Refrigerator	☐ 1	☐ 2	FRIDGE
WATER	Running water	☐ 1	☐ 2	Fan	☐ 1	☐ 2	FAN
COUCH	Sofa or couch	☐ 1	☐ 2	Bicycle	☐ 1	☐ 2	BIKE
TV	Television	☐ 1	☐ 2	Car	☐ 1	☐ 2	CAR

26. Method of cooking

Which of the following is used in your household as the main method of cooking each day? *Check one option.*			✓	COOKMET
Electric stove	☐ 1	Firewood	☐ 5	
Gas stove	☐ 2	Other, *specify:* _____	☐ 6	
Paraffin stove	☐ 3	Don't know	☐ 7	
Charcoal stove	☐ 4	Not applicable	☐ 8	

27. Animal Keeping

In this household do you keep any animals? 1=Yes 2 = No 88= does not know ☐
KEEPANMA

If yes:

i. Number of cows? ☐☐ TN COWS

ii. Number of goats? ☐☐ TN GOATS

iii. Number of sheeps? ☐☐ TNSHEEP

iv. Number of chickens? ☐☐
TNCHICKS

v. Number of dogs? ☐☐ TNDOGS

vi. Number of pigs? ☐☐ TNPIGS

vii. Number of cats? ☐☐ TNCATS

viii. Total other other type of animal that is not mentioned? ☐☐ TNOTHER

ix. If yes, mention ☐☐☐☐☐☐☐☐☐☐☐☐ TN OTHER

28. On average, how many people eat in your household every day?	☐☐	EATNO

29. How much money does your family usually spend buying food for the household each day? FODCST

Record amount in Tanzanian shillings: ☐☐☐ , ☐☐ Tsh

☐ Don't know

30. Meat consumption

How often does your household eat meat in the family meal? *Check only one option.*		✓		MEATINT
Never	☐ 1	3 to 4 times per week	☐ 5	
Less than once per month	☐ 2	5 to 6 times per week	☐ 6	
1 to 3 times per month	☐ 3	Every day	☐ 7	
1 to 2 times per week	☐ 4	Don't know	☐ 8	

Partner Instructions: I would like to ask you a few questions about your husband/partner whom you live with.

31. How long have you been living with your *partner*? *Record total # of years:* ***(If less than 1 year, write '00')***	☐☐	PRTTIM

32. Literacy level of partner ✓	**Yes**	**No**	**Don't know**	
Does your ***partner*** know how to read?	☐ 1	☐ 2	☐	PRTREAD
Does your ***partner*** know how to write?	☐ 1	☐ 2	☐	PRTWRIT

33. Partner education level

What is the highest level of formal education of your partner? ✓		
Never to school	☐ 1	EDULEVEL
Drop in primary school	☐ 2	
Primary school	☐ 3	
Secondary School	☐ 4	
High school/Occupational school	☐ 5	

34. Partner employment

How would you describe your ***partner's* employment?** *Allow participant to describe their partner's employment in their own words, then mark the most appropriate response. Do not ask them directly. Check only one option.*	✓	PEMPLOY
government job	☐ 1	
private job	☐ 2	
self employed	☐ 3	
farming only	☐ 4	
daily wage earner	☐ 5	
does not work	☐ 6	
Other, *specify:* _____	☐ 7	

III. BEHAVIORAL INFORMATION

35. Have you ever smoked cigarettes?	✓	SMKEVER
1 = Yes	☐ 1	
2 = No, never smoked ➢ **If *NO:*** *Skip to* ***Question37***	☐ 2	

36. Do you currently smoke cigarettes?	✓	SMKCURR
1 = Yes	☐ 1	
2 = No	☐ 2	

37. On average, how many cigarettes do you smoke each day? ☐☐☐ CIGNO

38. Does anyone in your household currently smoke cigarettes?	✓	PASCIG
1 = Yes	☐ 1	
2 = No	☐ 2	

39. Do you currently sleep under a mosquito treated bed net?	✓	SMKCURR
1 = Yes	☐ 1	
2 = No	☐ 2	

40. Do you drink alcohol?	✓
1 = Yes	☐ 1
2 = No	☐ 2

41. How many days would you drink alcohol on average per week? _____

42. Disposal of faces?	✓	SMKCURR
1 = Toilet	☐ 1	
2 = Open place (No toilets)	☐2	
3 = Open space (Toilet available)	☐ 3	

IV. HEALTH INFORMATION DURING PREGNANCY

43. How many times did you attend the antenatal clinic during this pregnancy? ☐
ANTVISIT

1= Did not attend 2 = one to two visits 3 = Three to four visit 4 = More than four visits

44. Did you have any health problems during this pregnancy? ☐ PREGPRO

1 = No 2 = Yes high blood pressure 3 = Yes diabetic 4 = serious mornic sickness

5 = Anaemia 6 = Eclampsia 7 = Other (specify) _____

45. Did you have any medication during this pregnancy? ☐ MEDPREG

1 = Yes 2 = No If yes, it is _____

46. Did you drink tea during pregnancy?

1 = regular drinking 2 = Seldom drinking 3 = Never ☐ TEAPREG

47. What is the average number of cups you drank per day? ☐ AVCPTEA

48. Have you received any breastfeeding education during pregnancy?

1 = During this pregnancy 2 = During previous pregnancy ☐ BFEDU

3 = Never had breastfeeding education (**If never skip QN 53)**

49. Where did you receive the breastfeeding education?

1 = Antenatal Clinic 2 = During hospital stay 3 = Labour ward ☐ WHER EDU

4 = Others (specify) _____

50. During antenatal visits or hospital visit, did you receive? (Possible to have more than one answer) ☐ **RCBFINF**

1 = Pamphlets on breastfeeding baby

2 = Lectures or classes on breastfeeding baby

3 = Demonstrations on how to breastfeed baby

4 = Television show on breastfeeding

5 = Samples of infant formula

6 = Booklets or other information about infant formula

7 = Individual consultation or discussion with any of the staff about breast-feeding baby

8 = Did not receive any materials

9 = Other (please specify)

51. Your main sources of breastfeeding information during pregnancy? (Select one answer)

1 = Booklets
2 = TV
3 = Lectures
4 = Individual consultation (doctor, nurse, community health worker) ☐ SOUCEINF
5 = Others (Specify)_____
99 = Not applicable

52. In general, do you think you have had enough information about feeding your baby from hospital staff?

1 = Yes 2 = No 3 = Don't want to comment ☐ ENOGINF

53. What do you think about the information given by the hospital?

1 = Very useful 2 = A little useful 3 = Not necessary ☐ HOSPINF
4 = Boring 5 = Does not meet the need 6 = Others: _____

54. Did you ever see an infant formula advertisement during pregnancy?

1 = Yes 2 = No 3 = Not sure ☐ SAWADV

55. If yes, where did you see the formula advertisement?

1= Health facility 2 = Shop 3 = Market Center 4 = Other (specify)____ ☐ WHERADV

I am going to read out a few statements which are related to breastfeeding knowledge. Please just answer true, false or don't know. It really doesn't matter if you don't know.

	1 = True	2 = False	3 = Don't know
56. Babies naturally know how to breastfeed	☐ 1	☐ 2	☐ 3
57. Formula-fed babies sleep longer at night	☐ 1	☐ 2	☐ 3
58. Feeding more often increases breastmilk supply	☐ 1	☐ 2	☐ 3
59. Babies need to feed more when they are having a growth spurt	☐ 1	☐ 2	☐ 3
60. There are lots of women who need to give their babies formula because they can't make enough milk	☐ 1	☐ 2	☐ 3
61. Birth control pills can reduce milk supply	☐ 1	☐ 2	☐ 3
62. Getting extra rest and relaxation is necessary to ensure a good milk supply	☐ 1	☐ 2	☐ 3
63. Feeding formula to a one month old baby will not reduce the amount of milk produced by the mother	☐ 1	☐ 2	☐ 3

V. HEALTH INFORMATION DURING DELIVERY

64. Where did you give birth (*to this child*)?

1 = Home 2 = Health facility 3 = Maternity or nursing home ☐ PDELIV
4 = On the way to the health facility 5 = Other (specify)_____

65. Gender of the baby 1 = Male 2 = Female ☐ BGENDER

66. Type of delivery

1= Vaginal 2 = assisted 3 = caesarean **(if caesarean ask QN 67)** ☐ TYPEDEL

67. If caesarean section, what was the reason?

1 = Mother reason 2 = Fetal reason 3 = Social reason _____ ☐ CAESRSN

68. Who conducted the delivery?

1 = Doctor 2 = Nurse or midwife 3 = Auxiliary nurse
4 = TBA trained or untrained 5 = community health worker, ☐ ATTENDT
6 = Relative 7= Neighbour 8 = Myself 9 = Other specify_____

69. Has your baby had any health problems, either since the pregnancy or as a result of the birth?

1 = Yes 2 = No ☐

BABYHP

70. What health problems has your baby had?
_____WHATPRB

71. What was your baby's Apgar score? (Check the child's card) _____ APGSCOR

72. Has your baby spent any time in a Special Care unit?
1 = No 2 = Yes 3 = Home delivery ☐ TSPCARE

73. If yes, how long was your baby in this care room? _____hours ☐ TOTALTM

74. How was your baby fed when he/she was in the care room?
1 = Breastfed only 2 = Expressed breastmilk ☐ FEDCROOM
3 = Cow's milk 4 = Bottle fed formula
5 = I don't know 6 = Others: _____

75. After birth, how long did the baby stay in the room with you each day?
☐ ISTAY
1 = 24 hours 2 = Day time 3 = Night time
4 = No time 5 = Other: _____

76. Did you receive a vitamin A mega-dose after delivery (like this/these)?
☐ PNSUPPL
(Show common types of capsules/syrups/ampoules)
1 = Yes 2 = No 88 = does not know

77. If yes, how many days after delivery ☐☐ DAYSUPPL
1 = 00 to 08 weeks 88 = does not know

VI. INFANT FEEDING INFORMATION

78. When did you first decide how you were going to feed your new baby?
1 = Before I became pregnant
2 = Early in my pregnancy (before 20weeks) ☐ TMDECBF
3 = Late in my pregnancy …(after 20weeks)
4 = After my baby was born
5 = Others: _____

79. Who helped you decide how to feed your baby? HELPDEC
(Please circle any answers that apply. You can have more than one answer)
1 = No one, I decided myself
2 = The baby's father.
3 = My mother or Mother in-law

4 = Other relatives

5 = Friends

6 = Health professionals e.g., nurse, midwife

7 = Other (please specify) _____

80. After delivery, did anyone support/ encourage you to breastfeed?

1 = No, I have no support 2 = Doctors 3 = Nurses ☐ BFSUPORT

4= My mother/mother inlaw 5 Friend/ neighbour 6 = Other specify

_____

81. Did any hospital staff encourage you to put your baby to the breast right after the birth?

1 = Yes 2 = No 3 = Home delivery ☐ ENCBF

82. Who encouraged you to put your baby to the breast right after the birth?

☐ BFABIRTH

1 = No, I have no support 2 = Doctors 3 = Nurses

4= My mother/mother inlaw 5 = Friend/ neighbour 6 = Other specify _____

83. Did any staff member teach you how to position and attach your baby to the breast?

1 = No 2 = Yes 3 = Home delivery 4 = I didn't need to be taught ☐ BFPOSTN

84. Did any staff member check how your baby's mouth was attached to your breast when you first started feeding? 1 = Yes 2 = No 3 = Home delivery ☐ BFMOUTH

85. How many hours after birth did you first put the baby to the breast? ☐ BFSTART

1 = 000 to1 hr 2 = after 1 hr 3 = The next day 4 = Other specify_____

86. How long was it before your milk came-in?

1 = Within one hour of the birth 2 = The 1st day of the birth

3 = The second day of the birth 4 = Other (please specify) _____ ☐ MILKCOM

87. What was your baby's 1st feed: 1 = Colostrum 2 = Formula 3 = Cow's milk

☐ FIRFEED

4 = Sugar water 5 = Plain water 6 = Traditional herb 7 = Others (Specify) _____

88. If first feed was not colostrum, ask if she gave colostrum after 1st feed.

☐ COLSTRUM

1= yes, 2 = no

89. Have you experienced any of the following problems since you started breast-feeding?
(Please circle any answers that apply) (You can have more than one answer) BFPROB

1 = Inverted nipples

2 = Cracked or sore nipples

3 = Baby gets too much milk

4 = Baby gets milk too fast

5 = Takes a long time before milk starts flowing at start of feed

6 = Baby too tired to feed

7 = Difficulty expressing milk

8 = Baby not gaining enough weight

9 = Baby has problems sucking

10 = Breasts engorged (too full)

11 = Baby doesn't wake up for feeds

12 = Not enough milk or colostrum for baby

13 = Mastitis (a pink, tender, hot, swollen area of the breast accompanied with fever or chills)

14 = No problem experienced (**if no problem ask QN 91)**

15 = Other (please specify) _____

90. Have any of the following people supported or encouraged you with breast-feeding during the problem? (Please circle any answers that apply) (You can have more than one answer)

1 = Your friends 2 = The baby's father 3 = Other members of your family

4 = Nurse 5 = Your doctor 6 = Your mother ☐ BFSUPP

7 = Your mother-in-law 8 = Other (please specify)_____

91. When do you plan to give your baby solids? (e.g. Rice, stiff porridge, cooked banana)

1 = Before 2 months 2 = Between 2 and 3 months

3 = Between 4 and 5 months 4 = At six months ☐ PLANSOLD

5 = Between 7 and 9 months 6 = Between 10 and 12 months

7 = Over 12 months 8 = Already started 9 = Other (please specify) _____

92. When do you plan to give your baby liquid foods? (e.g. Water, Porridge, Soup, Juice)

1 = Before 2 months 2 = Between 2 and 3 month

3 = Between 4 and 6 months 4 = Between 7 and 9 months ☐ PLANLIQD

5 = Between 10 and 12 months 6 = Over 12 months

7 = Already started 8 = Other (please specify) _____

93. At what age do you plan to stop breastfeeding your baby?

1 = Before 2 months 2 = Between 2 and 3 months ☐ BFSTOP

3 = Between 4 and 6 months 4 = Between 7 and 9 months

5 = Between 10 and 12 months 6 = Over 12 months

7 = Stopped already 8 = Other (please specify)

94. How long did you breastfed the previous younger sibling?

1 = No younger child 2= did not breastfeed 3 = Less than six months

5 = 6-12 months 5 = Over 12 months

☐ BFSBLIG

95. What was the sex of the previous younger sibling?

1 = Male 2 = Female 3 = No other child ☐ SIBSEX

96. Does the baby's father have any preference for how you feed your baby?

☐ DADPREF

1 = Yes, he prefers bottle-feeding 2 = Yes, he prefers breast-feeding
4 = He doesn't mind how I feed my baby 5 = Never really discussed with him

97. Did your mother breastfeed any of her children? ☐ MOTHBF

1 = Yes 2 = No 3 = Don't know

98. Does your mother have any preference for how you feed your baby?

1 = She prefers bottle-feeding

2 = She prefers breast-feeding

3 = She doesn't mind how I feed my baby ☐ MOMFEDPR

4 = Never really discussed the matter with her

5 = Mother died when young

99. How have your friends fed their babies?

1 = Most of them bottle-fed ☐ FRIEFD
2 = Most of them breast-fed
3 = Some breast-fed and some bottle-fed
4 = Friends don't have babies

100. Which person do you think is the most helpful to support you breastfeeding

1 = Husband 2 = Mother 3 Mother in law
4 = Medical/health worker 5 = Others ☐ PSUPPTBF

101. Since delivery of the baby, did any relatives and/or friends visit you and give you some sugar and formula as a gift? 1 = Yes 2 = No ☐ GIFTFOM

VII. MATERNAL EMPLOYMENT

If the mother reported to be employed in QN 17 ask the following question:

102. How long is your maternity leave? _____ (Months) MATLEAVE

103. Do you get payment during maternity leave? 1 = Yes 2 = No ☐ PAYLEAV

104. What do you plan to do in the next six months?

1 = Will be at home with the baby 2 = Work full-time

3 = Work half day 4 = Undecided 5 = others (specify) _____ ☐ WOKPLAN

105. Can you continue to breastfeeding after you go to work? ☐ BFWORK

1 = Yes 2 = No 3 Not sure

106. If no, the reason is:

1 = Too far from home to take the baby to breastfeed 2 = No feeding time

3 = No feeding place 4 = Other reason (specify) _____ ☐ REASON

107. How will you maintain breastfeeding while working?

1 = Express the milk ☐ BFMANTAN

2 = Ask care taker to bring a child to the office

3 = Take time between my work to go home and breastfeed

4 = Will stop breastfeeding

5 = Other (specify)

VIII. CONFIDENCE IN BREASFEEDING

In a scale of 1 to 5 points, rate your confidence to breastfeeding by circling the appropriate answer.

108. In general, how comfortable would you or do you feel while breastfeeding in front of other people?
1 = not very comfortable…..**2**…….**3**……..**4**…….**5** = very comfortable BFPEOPLE

109. In general, how comfortable would you or do you feel while breastfeeding in front of female friends?
1 = not very comfortable….**2**…….**3**…….**4**……..**5** = very comfortable. BFEMALE

110. In general, how comfortable would you or do you feel while breastfeeding in front of female relatives e.g., mother, sister?
1 = not very comfortable….**2**……..**3**…...**4**……**5** = very comfortable BFFEMREL

111. In general, how comfortable would you or do you feel while breastfeeding in front of male friends?
1 = not very comfortable……**2**……**3**……**4**…….**5** = very comfortable. BFMALEF

112. In general, how comfortable would you or do you feel while breastfeeding in front of male relatives e.g., father, brother?

1 = not very comfortable…..**2**…..**3**…..**4**…..**5** = very comfortable BFMALERL

113. In general, how comfortable would you or do you feel while breastfeeding in <u>someone else's house</u>?
1 = not very comfortable……**2**……**3**……**4**……**5** = very comfortable. BFSOMONE

114. In general, how comfortable would you or do you feel while breastfeeding on <u>public transport</u>?
1 = not very comfortable..**2**..**3**..**4**..**5** = very comfortable BFTRANS

115. In general, how comfortable would you or do you feel while breastfeeding in a <u>public eating place</u>?
1 = not very comfortable……**2**..**3**……**4**……**5** = very comfortable BFEATING

116. In general, how comfortable would you or do you feel while breast-eeding in a public place such as <u>Kibiti or Ikwiriri Market?</u>
1 = not very comfortable....**2**…..**3**…..**4**…..**5** = very comfortable BFMARKT

VIII. NUTRITIONAL STATUS

117. Maternal Height ☐☐☐.☐ **MHT**

118. Maternal weight ☐☐.☐ **MWT**

INFANT FEEDING QUESTIONNAIRE

IFAKARA HEALTH INSTITUTE &CURTIN UNIVERSITY OF TECHNOLOGY. **Infant Feeding Patterns Study**	**Infant Feeding Questionnaire**

This form should be administered at first, third and sixth months when visiting infant

1. Infant ID ☐☐☐☐☐☐ INFANTID

2. Mother DHSS ID ☐☐☐☐☐☐☐☐☐☐ MOTHID

3. Date of visit ☐☐☐☐☐☐☐☐ DATEVST

4. Enumerator Initial ☐☐☐ FW ID

5 .Date of Birth ☐☐☐ DOB

6. Age of infant in completed weeks or months on the day of visit (1 to 26 weeks)

Write age in weeks ☐ ***AGE***WEEK

7. Gender of baby: 1 = Male 2 = Female ☐ GENDER

8. Mother status: 1=present, ☐☐ WSTATUS

2 = currently in hospital, 3 = temporarily away,

4 = died, 15 = permanently moved, 6 = refused,

7 = withdrawn, 8 = Other (mention) _____

9. Informant: ☐☐ INFORMANT

1=mother or primary caregiver (if mother died), 2=father,

3= other family member 4=other guardian/caretaker

10. Infant's status: ☐ ISTATUS

1=present, 2 = currently in hospital,
3 = temporarily away, 4 = died,
5 = permanently moved, 6 = refused temporary,
7 = withdrawn, 8 = Other (mention)_____

11. Date of death **if infant died** ☐☐☐☐☐☐☐☐ DATEDIED

(Example: 09/09/2012)

12. Time of death, **if infant died** ☐☐☐☐ TIMEDIED
(0000 to 23:59, 8888, 9999) ***If the child died, end the discussion after Qn. 12 but if temporarily unavailable, make another appointment.***

INFANT FEEDING PACTICES
Now I would like to ask you about how you feed you baby.

13. Are you breastfeeding your baby? 1 = Yes 2 = No ☐ BFBABY

14. If no, ask how long did the you breastfeed in weeks_____ HOWLONG

15. How are you feeding your baby now? ***(Select one correct answer)***

1 = Breastfeeding only
2 = Mainly breastfeeding but topping up with bottle feeding of formula.
3 = Mixed feeding (breastfeeding, water, animal milk, formula, solid foods, porridge and other foods)
4 = Cow's milk or other animal milk only.
5 = Mainly breastfeeding, and with some water ☐ FEEDPRA
6 = Formula feeding only
7= Breastfeeding and animal milk
8 = Family foods only
9 = Other (specify) _____

If the answer is breastfeeding only go to QN 25

16. Did (Name of a child) eat/drink the following foods yesterday? ***(Do not prompt, but probe for more than one answer)***
(FEEDYEST)

Food Given Yesterday		**Yes**	**No**	**Don't Know**	**How often per day**
CODE		**1**	**2**	**3**	
PWATER	Plain water				
HONEY	Honey				
TMED	Traditional Medicine				
CBABYF	Commercial baby d foods such as Cerelac				
CPFOOD	Commercially produced infant formula				
MILK	Goat or soya milk				
COWML	Cow milk				
PORICAS	Cassava porridge				
MAIZAPO	Maize porridge				
RICEPOR	Rice porridge				
POXPOR	Porridge from mixed cereals and legumes *(Uji wa lishe)*				
OTHERCE	Porridge from other cereal (sorghum, millet)				
TEACOF	Tea or coffee				
OTHELIQ	Any other liquids (ORS, medication, supplements)				
JUICE	Juice (homemade or commercial)				
COKFOD	Bread				
COKMAIZ	Cooked maize mixed with Legumes *(makande)*				
COKBAN	Cooked Banana				
UGALI	Ugali (stiff porridge)				
RICE	Rice				
FYELLO	Pumpkin, carrots, yellow/orange sweet potato				
IRPOTATO	Cooked Irish potatoes				
SWETPOT	Cooked sweet potatoes				
YAMS	Cooked yams				
CASCOOK	Cooked cassava				
VEG	Any dark green, leafy vegetables such as amaranth, cassava, pumpkin or sweet potato leaves, greens spinach or other dark green leafy vegetables				
FRUIT	Ripe mangoes bananas or papayas, orange, *Mabungo* and any other fruits				
ORGAN	Liver, kidney, heart or other organ meats				
MEAT	Red meat (beef, goat) or duck				
EGG	Eggs				
FISH	Fresh or dried fish or shellfish				
CHIKEN	Chicken , duck any other bird				
LEGUME	Any foods made from beans, peas, lentils, or nuts				
MILKPR	Cheese, yogurt or other milk products				
OIL/FAT	Any oil, fats, ghee or butter, or foods made with any of these				
SUGAR	Any sugary foods such as chocolates, sweets, candies				
CAKBIS	Pastries, cakes, or biscuits				
OTHEFO	Any other solid or semi-solid food				

17. What was the first solid food that you gave your baby?_____BABYSOLD

18. What was the 1st liquid given to your baby_____BABYLIQD

19. What was the 1st Vegetable _____BABYVEG

20. What was the 1st Fruit _____BABYFRUT

21. When cooking baby food, what do you add?

1 = Milk 2 = Oil 3 = Sugar 4 = Salt 5 = Butter 6 = Vegetables ☐ ADDTOF

5 = Fruit juice 7 = Nuts paste 8 = Nothing 9 = Others (Specify) _____

22. How old was your baby when you introduced foods/fluids other than breastmilk?

Write age in weeks ☐ AGEINTRO

23. Main reason for giving other foods/ fluids

(Please circle any answers that apply. You can have more than one answer)

1 = I don't have enough milk

2 = Formula is better for the baby

3 = Bottle-feeding is easier

4 = I don't like breastfeeding

5 = I will go back to work soon after the birth

6 = Breastfeeding will make my breasts sag

7 = Mother had health problems

8 = The baby's father prefers other foods

9 = Formula is just as good as breastmilk

10 = The baby's father can help with bottle-feeding/other feeds

11 = I want to know how much milk baby has at each feed

12 = My mother suggested other feeds

13 = Friend or relative suggested other feeds

14 = Health worker (e.g , doctor, nurse) suggested other feeds

15 = Baby was not gaining enough weight

16 = Baby is crying too much

17 = Baby sick

18 = Another pregnancy

19 = Other (specify) _____

24. What is the time interval you normally feed your baby family foods?

1= < 30 minutes ☐ TIMEFEED

2 = > 30 minutes but < 1 hour

3 = > 1 hour but < 2 hours

4 = > 2 hours but < 3 hours

5 = > 3 hours but < 4 hours

6 = > 4 hours

25. How long does your baby spend at the breast for a feed? ☐ TSPFEED

1 = Baby is not breastfeeding 2 = Less than 15 minutes 3 = 15 to 30 minutes

4 = 30 minutes – one hour. 5 = Continue over an hour 6 = Other (specify)_____

26. About how many times per day do you breastfeed your baby? _____ (Times) FDTIMES

27. How many times do you breastfeed your baby during night? _____ (Times) FDNIGHT

28. Are you feeding by clock or by demand?

1 = Demand 2 = Every two hours 3 = Every three hours ☐ BFDEMAD

4 = Every four hours 5 = (Other specify) ----------

29. How about your baby's appetite ☐ BABYAPP

1 = Very good 2= Good 3 = General 4 = Bad

30. Did you experience any problems with baby feeding or breastfeeding*?* ***(Possible to have more than one answer)***

1 = No problems experienced ☐ ANYPRO

2= Baby has difficulties in sucking ☐

3 = Baby refuses to breastfeed ☐

4 = Not enough milk for the baby ☐

5 = Baby gets too much milk or too fast ☐

6 = Baby too tired to feed i.e. falls asleep on breast

7 = Other _____

If no problem experienced skip Qn. 31 and go to QN 32

31. How did you overcome the problem?

1 = Stopped breastfeeding

2 = Breastfeeding more frequently ☐ OVERCOMP

3 = Breastfeeding less

4 = Give other foods and continue breastfeeding

5. Other (specify) _____

MEDICAL HISTORY

32. Has your child experienced the following condition for the past 2 weeks?

Cough 1 = Ye 2 = No	☐ COUGH
Refusal to eat, drink, or breastfeed 1 = Yes 2 = No	☐ REFUSAL
Fever 1 = Yes 2 = No	☐ FEVER
Difficulty in breathing 1 = Yes 2 = No	☐ DIFBREATH
Chest in-drawing 1 = Yes 2 = No	☐ CHESTIND
Convulsions 1 = Yes 2 = No	☐ CONVUNS
Vomiting 1 = Yes 2 = No	☐ VOMITING
Noise during breathing 1 = Yes 2 = No	☐ NOISEBRE
Rapid Breathing 1 = Yes 2 = No	☐ RAPBRETH
Diarrhoea *(loose watery stool three or more times a day)* 1 = Yes 2 = No	☐ DIARRHEA
Eye Infection 1 = Yes 2 = No	☐ EYEINF
Ear infection 1 = Yes 2 = No	☐ EARINF

(If no any condition reported go to Qn 48)

33. How many days has the child had the following symptom in the past 2 weeks (Write 66 if no symptom)

SYMPTOMS

Cough	☐☐ COUGH
Refusal to eat, drink, or breastfeed	☐☐ REFUSAL
Fever	☐☐ FEVER
Difficulty in breathing	☐☐ DIFBREATH
Chest in-drawing	☐☐ CHESTPETR
Convulsions	☐☐ CONVUNS
Vomiting	☐☐ VOMITING

Noise during breathing ☐☐ NOISEBRE

Rapid Breathing ☐☐ RAPBRETH

Diarrhoeal *(loose watery stool three or more times a day)* ☐☐ DIARRHEA

Eye Infection ☐☐ EYEINF

Ear infection ☐☐ EARINF

34. Has your baby had to see a health worker as a result of this health problem?

1 = Yes 2 = No ☐ SEEHW

35. How many times has your baby seen the Health Worker?

1 = One Visit 2 = Two to Four Visits 3 = More than four visits ☐ HOSPVIST

HOSPITALISATION

36. Was the baby admitted to the hospital in the last 2 weeks?

1 = Yes, 2 = No ***(If no, skip to 43 if sick but not admitted)*** ☐ ADMITTED

37. Date of admission

(***(Example 09/09/1909)*** ☐☐☐☐☐☐☐☐ ADMDATE

38. Time of admission ☐☐☐☐ ADMTM

(0000 to 2359, 9999)

39. Main reason for admission:

a) Acute lower respiratory tract infection/ pneumonia, ☐ ALRI

b) Diarrhoea ☐ DIARR

c) Fever/malaria ☐ FEVER

d) Others ☐ OTHERS

(If other is not selected, skip to 43)

40. If reason is "others", specify

☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐ HOSOTHER

41. Date of discharge ☐☐☐☐☐☐☐☐ DISDATE

(Example 09/09/1909)

42. Has your child been admitted again after the reported admission? ☐ ADMAGAIN

1 = Yes, 2 = No

FEEDING SICK CHILD *(consider both situations, when child was sick and not sent to hospital and when child was sent to hospital)*

43. Did you change feeding practice when your baby was sick? ☐ FEEDSICK
1 = Yes 2 = No

44. If yes, what did you change? ***(Circle all possible answers)***

1 = continue breastfeeding frequent and on demand
2 = Give more fluid
3 = Give traditional medicine CHANGE
5 = Offer soft, favorite foods
6 = Increase the number of times the child is fed
7 = Use fortified complementary foods or vitamins
8 = Give solid foods
9 = Give mixed feed.
10 = Stop Breastfeeding
11 = Stop feeding the baby
12 = Others (Specify) _____

45. About how long does your baby spend at the breast for a feed when they are sick?

1= Baby is formula fed only
2 = Baby receives other family foods only
3 = Less than 15 minutes
4 = 15 minutes to half an hour
5 = Half an hour to an hour
6 = Continuous, over an hour
7 = Other (please specify) _____ ☐ TSICKFED

46. Did anyone advise you how to feed your sick child?
1 = Yes 2 = No ☐ ADVFED

47 If yes, who advised you? 1 = Nurse 2 = Doctor 3= Mothers or mother- in-law
4= friend/ neighbour 5. Husband 6 = Other specify ---------- ☐ WHOADV

IMMUNISATION RECORD

48. BCG: 1= Yes 2=No 3 = yes, confirmed from vaccine card, ☐ BCG

4= yes, by caregiver's report only, 88 =does not know

(Example 09/09/1909) | | | | | | | | | DATEBCG

49. BCG Scar: 1=Yes, 2 = No, 88 =does not know, | | BCGS

50. Polio 0 at birth: 1 = Yes 2 = No 3 = yes, confirmed from vaccine card, | | POLB

4 = yes, by caregiver's report only,
88 =does not know 99 = not applicable

51. Polio1:1 = Yes 2 = No 3 = yes, confirmed from vaccine card, | | POL1

4= yes, by caregiver's report only, 88 =does not know,

52. Date Polio 1 received (if known) | | | | | | | | | DATEPOLIO1

(Example 09/09/1909)

53. Polio2: 1= Yes 2=No, 3= yes, confirmed from vaccine card, | | POL2

4= yes, by caregiver's report only, 88 =does not know 99 = not applicable

54. Date Polio 2 received (if known) | | | | | | | | | DATEPOL2

(Example 09/09/1909)

55. Polio3: 1= Yes 2 = No 3 = yes, confirmed from vaccine card | | POL3
4= yes, by caregiver's report only, 88 = Does not know 99 = not applicable

56. Date Polio 3 received (if known) | | | | | | | | | DATEPOL3

(Example 09/09/1909)

57. DTP1: 1= Yes 2=No, 3= yes, confirmed from vaccine card, | | DPT1
4 = yes, by caregiver's report only, 88 =does not know __ = not applicable

58. Date DPT1 | | | | | | | | | DATEDPT1

(*Example 09/09/1909)*

59. DTP2 ☐ DPT2

1= Yes 2=No, 3= yes, confirmed from vaccine card,
4 = yes, by caregiver's report only, 88 =does not know 99 = not applicable

60. Date DPT2 ☐☐☐☐☐☐☐☐ DATEDPT2

(*Example 09/09/1909)*

61. DTP3 1=Yes, 2=No, 88 = does not know 99 = not applicable ☐ DPT3

62. Date DPT3 ☐☐☐☐☐☐☐☐ DATEDPT3

(***Example 09/09/1909)***

63. HepB1 ☐ HEPB1

1 = Yes 2 = No, 3 = yes, confirmed from vaccine card,
4 = yes, by caregiver's report only, 88 = does not know, 99 = not applicable

64. Date HepB1 ☐☐☐☐☐☐☐☐ DATHEPB1

(***Example 09/09/1909)***

65. HepB2 1 = Yes 2 = No, 3 = yes, confirmed from vaccine card ☐ HEPB2

4 = yes, by caregiver's report only, 88 = does not know 99 = not applicable

66. Date HepB2 ☐☐☐☐☐☐☐☐ DATHEPB2

(***Example 09/09/1909)***

67. HepB3 ☐ HEPB3

1 = Yes 2 = No, 3= yes, confirmed from vaccine card

4 = yes, by caregiver's report only, 88 = does not know 99 = not applicable

68. Date HepB3 ☐☐☐☐☐☐☐☐ DATHEPB3

(***Example 09/09/1909)***

69. DTP1-HepB-Hib (pentavalent) ☐ PENT1

1 = Yes 2 = No, 3= yes, confirmed from vaccine card
4 = yes, by caregiver's report only, 88 = does not know 99 = not applicable

70. Date Penta1 received (if known) ☐☐☐☐☐☐☐☐
DATPENT1

(***Example 09/09/1909)***

71. DTP2HepB-Hib (pentavalent) ☐ PENT2

1 = Yes 2 =No, 3= yes, confirmed from vaccine card
4 = yes, by caregiver's report only, 88 = does not know 99 = not applicable

72. Date Penta2 received (if known)

(***Example 09/09/1909)*** ☐☐☐☐☐☐☐☐ DATPENT2

73. DTP3HepB-Hib (pentavalent): ☐ PENT3

1 = Yes 2 =No, 3= yes, confirmed from vaccine card

4 = yes, by caregiver's report only, 88 = does not know 99 = not applicable

74. Date Penta3 received (if known) ☐☐☐☐☐☐☐☐ DATPENT3

(***Example 09/09/1909)***

75. Infant weight kg ☐☐.☐ **INFWEIGT**

76. Infant height cm ☐☐.☐ **INFHEIGT**

77. Weight of the mother ☐☐.☐ **MWT**

THANK YOU FOR PARTICIPATION

Appendix 2: Consent forms

School of Public Health
GPO Box U1987 Perth
Western Australia 6845

Information Sheet

A cohort study of feeding patterns and health outcomes of infants in the Rufiji district of Tanzania

Introduction and rationale

Curtin University of Technology in Australia in collaboration with Ifakara Health Institute intend to conduct a mother child pair cohort study to assess the impact of infant feeding patterns on infant health status. This study will explore the relationship between infant feeding and growth and morbidity. It will investigate factors which prompt the early introduction of family foods and sources of information or advice about infant feeding. Maternal health, mother's dietary patterns and socio- economic status (SES) have also been shown to contribute to infant health. This kind of study has never been conducted in Tanzania or other African countries; therefore this study is unique in that it will also explore the maternal attributes contributing to infant health. Information generated from this study will facilitate the promotion of appropriate infant feeding recommendations and strengthen the ongoing efforts to advocate for integrated maternal and child interventions in our communities, Tanzania rural and other developing countries

Issues related to participation

This study will require visiting you and your infant at home within 4 weeks after delivery, and at 3 and 6 months postpartum.

During the 1st visit, we will obtain the weight and height of the child and your weight. We will also ask questions regarding your food intake and any infant foods consumed, child morbidity and hospitalisation, immunisation, maternal occupation, education level, household size and property ownership.

During the second visit, your weight and infant height and weight will be obtained and we will ask for more information about infant feeding and health of the infant.

The last visit will involve taking your weight, and the weight and height of the infant, morbidity, hospitalisation and vaccination information of the infant. We will again ask questions about the food you consumed as well as your infant.

The first visit will take approximately one hour and the follow-up visits will take up to 25 minutes each.

Confidentiality

All the information collected will be entered into a computer using your study number and your name will not be used. All information regarding your anthropometric measurements, food intake, and other socio-economic and demographic information will be stored in a locked room and it is only the people working in this study who will access this information. Data analysis will be done using code numbers and aggregate data will be used for writing publications.

Risks and Inconveniences

There are no expected adverse effects from your participation in this research. There are no risks in taking body measurements except for the discomfort associated with the removal of some heavy clothes and shoes which may inflate our weight and height readings.

Rights of withdraw

Participation in this study is voluntary. If you decide not to take part in this research or if you decide to withdraw from the study, you will receive all the services which other women and infants receive at the health facility and community. You may decide to stop participating in this research at any time even when you have already consented to participate. However we would be grateful if you participate fully in this study or notify us when you wish to withdraw.

Benefits of participation

If you decide to participate in this research you and your infant will have the opportunity to have your nutritional status assessed over a period of six months. If any serious health problems are identified you or your infant will be referred to receive further assistance.

Contact persons

If you have any question regarding this study later, please call Principal Investigator through telephone number ……

This cohort study of feeding patterns and health outcomes of infants in the Rufiji district of Tanzania has been approved by the Curtin University Human Research Ethics Committee (approval number:……..). The Human Research Ethics Committee at Curtin University requires that all participants are informed that, if they have any

complaint regarding the manner, in which a research project is conducted, it may be given to the Secretary, Human Research Ethics Committee, Curtin University, by telephone 08 9266 2784, or email hrec@curtin.edu.au or in writing C/- Office of Research and Development, Curtin University of Technology, GPO Box U1987, Perth WA 6845. All study participants will be provided with a copy of the Information Sheet and Consent Form for their personal records on request.

Your participation and involvement will be greatly appreciated and I thank you in anticipation of your assistance.

Yours sincerely
Ester Elisaria
PhD student in Public Health
Curtin University of Technology
GPO Box U1987
Perth WA 6845
Tel: 0411244283

CC
Prof Colin Binns

Location:400.328

Phone:+618 9266 2952

Fax:+618 9266 2958

Email:C.Binns@curtin.edu.au

Roslyn Giglia (PhD)
Healthway Health Promotion Research Fellow
Curtin University of Technology
Tel: +61 8 9266 9592
Fax: +61 8 9266 2958
Email: R.Giglia@exchange.curtin.edu.au

School of Public Health
GPO Box U1987 Perth
Western Australia 6845

CONSENT FORM FOR MATERNAL PARTICIPATION

A cohort study of feeding patterns and health outcomes of infants in the Rufiji district of Tanzania

I have read the Information Sheet and have had the details and purpose of the study explained to me. My questions have been answered to my satisfaction, and I understand that I may ask further questions at any time.

I understand that my participation is voluntary and I have the right to withdraw from the study at any time and to decline to answer any particular questions.

I agree to provide information to the researcher and participate in the infant feeding patterns study on the understanding that my name will not be used without my permission and that the information I provide will be used only for this study and publications arising from it.

I understand that the researcher will regularly visit my house to ask questions about feeding patterns, morbidity, hospitalisation and to take anthropometric measurements. I also understand that I have the right to request a copy of this information.

I agree to participate in this study under the conditions set out in the Information Sheet.

Name: .....

Signed: .....

School of Public Health
GPO Box U1987 Perth
Western Australia 6845

CONSENT FORM FOR INFANT PARTICIPATION

A cohort study of feeding patterns and health outcomes of infants in the Rufiji district of Tanzania

I have read the Information Sheet and have had the details and purpose of the study explained to me. My questions have been answered to my satisfaction, and I understand that I may ask further questions at any time.

I understand that my participation is voluntary and I have the right to withdraw my infant from the study at any time and to decline to answer any particular questions.

I agree to provide information to the researcher and participate in the infant feeding patterns study on the understanding that my name or my infant's name will not be used without my permission and that the information I provide will be used only for this study and publications arising from it.

I understand that the researcher will regularly visit my house to ask questions about feeding patterns, morbidity, hospitalisation and to take anthropometric measurements.

I also understand that I have the right to request a copy of this information

I agree for my infant _____ (please write child's name in here) to participate in this study under the conditions set out in the Information Sheet.

Signed by parents or guardian….. ……
……

Date: …….

Appendix 3: Ethics

Curtin University ethical approval

Office of Research and Development

Human Research Ethics Committee

TELEPHONE 92662784

FACSIMILE 9266 3793

EMAIL hrec@curtin.edu.au

To	Professor Colin Binns, Public Health
From	A/Professor Stephan Millett, Chair, Human Research Ethics Committee
Subject	Protocol Approval **HR 155/2011**
Date	15 December 2011

Thank you for providing the additional information for the project titled "*A cohort study of feeding patterns and health outcomes of infants in the Rufiji district of Tanzania"*. The information you have provided has satisfactorily addressed the queries raised by the Committee. Your application is now **approved**.

- You have ethics clearance to undertake the research as stated in your proposal.
- The approval number for your project is **HR 155/2011.** *Please quote this number in any future correspondence*.
- Approval of this project is for a period of twelve months **13-12-2011** to **13-12-2012**. To renew this approval a completed Form B (attached) must be submitted before the expiry date **13-12-2012**.
- If you are a Higher Degree by Research student, data collection must not begin before your Application for Candidacy is approved by your Faculty Graduate Studies Committee.
- The following standard statement **must be** included in the information sheet to participants:

  This study has been approved by the Curtin University Human Research Ethics Committee (Approval Number HR 155/2011). The Committee is comprised of members of the public, academics, lawyers, doctors and pastoral carers. Its main role is to protect participants. If needed, verification of approval can be obtained either by writing to the Curtin University Human Research

Ethics Committee, c/- Office of Research and Development, Curtin University, GPO Box U1987, Perth, 6845 or by telephoning 9266 2784 or by emailing hrec@curtin.edu.au.

Applicants should note the following:

It is the policy of the HREC to conduct random audits on a percentage of approved projects. These audits may be conducted at any time after the project starts. In cases where the HREC considers that there may be a risk of adverse events, or where participants may be especially vulnerable, the HREC may request the chief investigator to provide an outcomes report, including information on follow-up of participants.

The attached **FORM B** should be completed and returned to the Secretary, HREC, C/- Office of Research & Development:
When the project has finished, or

- If at any time during the twelve months changes/amendments occur, or
- If a serious or unexpected adverse event occurs, or
- 14 days prior to the expiry date if renewal is required.
- An application for renewal may be made with a Form B three years running, after which a new application form (Form A), providing comprehensive details, must be submitted.

Regards,

A/Professor Stephan Millett
Chair Human Research Ethics Committee

Ethical approval from Ifakara Health Institute

IFAKARA HEALTH INSTITUTE
research | training | services

INSTITUTIONAL REVIEW BOARD
P O BOX 78373 DAR ES SALAAM, TANZANIA
Tel +255 (0) 22 2774714, Fax: + 255 (0) 22 2771714 Email: irb@ihi.or.tz

National Institute for Medical Research
P O Box 9653
Dar Es Salaam
Email: headquarters@nimr.or.tz

8th December, 2011

Ester Elisaria
Ifakara Health Institute
P O Box 78373
Dar Es Salaam

IHI/IRB/No:43

INSTITUTIONAL CLEARANCE CERTIFICATE FOR CONDUCTING HEALTH RESEARCH

On 8th December 2011, the Ifakara Health Institute Review Board (IHI IRB) reviewed from study titled: *"A cohort study of feeding patterns and health outcomes of infants in the Rufiji District of Tanzania"* submitted by the Principal Investigator Ester Elisaria.

The following documents were reviewed:

1. Protocol
2. Informed Consent Forms
3. Budget
4. Tools
5. CVs

The study has been approved for implementation after IRB consensus. This certificate thus indicates that; the above- mentioned study has been granted an Institutional Ethics Clearance to conduct the above named study in Rufiji district.

The Principal Investigator of the study must ensure that, the following conditions are fulfilled during or after the implementation of the study:

1. PI should submit a six month progress report and the final report at the end of the project
2. Any amendment, which will be done after the approval of the protocol, must be communicated as soon as possible to the IRB for another approval
3. All research must stop after the project expiration date, unless there is prior information and justification to the IRB.
4. There should be plans to give feedback to the community on the findings.
5. Any publication needs to pass through the IRB
6. The approval is valid until 8th December 2012

The IRB reserves the right to undertake field inspections to check on the protocol compliance

Chairperson
JOYCE K. IKINGURA

15th December 2011
IRB Assistant Secretary
Dr MWIFADHI MRISHO

Dar es Salaam PO Box 78373 Tel: 022 2774756 Fax: 022 2771714
Ifakara PO Box 53 Tel: 0232 625164 Fax: 0232 625312
Bagamoyo PO Box 74 Tel: 0232 440065 Fax: 0232 440064
Rufiji PO Box 40 Ikwiriri Tel: 0787 384521 Fax: 0232 010001
Mtwara PO Box 1048 Tel: 0232 333487
Kigoma PO Box 1077 Tel: 0282 803655