Breastfeeding practices and health facility births in South Sudan

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Thesis for the degree of Philosophiae Doctor (PhD)
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This thesis is dedicated to my parents

Bruno Lodu Tongun and

Tranquilina Najorong Tongunmafi

Scientific environment

This research is a result of the collaboration between Makerere University, Uganda, the University of Bergen, Norway, Gulu University, Uganda, Busitema University, Mbale, Uganda, and Juba University, South Sudan. The collaboration was under the Survival Pluss project, funded by the Norwegian Programme for Capacity Building Development in Higher Education and Research for Development (NORHED) under the Norwegian Agency for Development Cooperation (Norad), Norway. I have benefited from the support from the Survival Pluss project that granted me a PhD scholarship, and the Norwegian Research School of Global Health, which granted me numerous travel grants to attend courses and scientific conferences.

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Abbreviations

AIDS	Acquired Immunodeficiency Syndrome
CI	Confidence interval
CS	Caesarean section
BFHI	Baby-Friendly Hospital Initiative
EBF	Exclusive breastfeeding
EIBF	Early initiation of breastfeeding
HIV	Human Immunodeficiency Virus
ILO	International Labour Organization
IYCF	Infant and young child feeding
KMC	Kangaroo mother care
LMIC	Low- and middle-income countries
MOH	Ministry of Health
PMTCT	Prevention of mother-to-child transmission of HIV-1
SID	Sudden infant death syndrome
TBA	Traditional birth attendance
UNICEF	United Nations Children's Fund
WHO	World Health Organization

Definitions

Definitions were adapted from the World Health Organization (WHO) and United Nations Children's Fund (UNICEF) guidelines for infant and young child feeding (IYCF).

Early initiation of breastfeeding (EIBF): putting the infant to the breast within one hour of birth.

Exclusive breastfeeding (EBF): feeding the infant on only breast milk, and no other liquids or solids, not even water, except for drops or syrups consisting of vitamins, mineral supplements or medicines. The WHO recommends that EBF starts within an hour of birth up to six months of age.

Predominant breastfeeding (PBF): feeding the infant on breast milk plus some liquid-base foods except formula or animal milk.

Complementary feeding (CF): giving the infant any food (liquid, semi-solid and solid) whether manufactured or locally prepared, while continuing breastfeeding up to two years or beyond.

Pre-lacteal feeding (PLF): giving the infant any food before initiation of breastfeeding.

Replacement feeding (RF): feeding the infant with no breast milk, but a diet that provides the nutrients the infants need until the age at which they can be fully fed on family foods.

Mixed feeding (MF): feeding the infant with both breast milk and other liquids or foods.

Breast milk substitute: any food being marketed or otherwise represented as a partial or total replacement for breast milk.

Wet-nursing: breastfeeding by a woman other than the infant's mother.

Skilled birth attendant: the presence of trained health professional who be a nurse, midwife, doctor, etc.

Abstract

Introduction: Studies on the determinants of breastfeeding practices and health facility utilization have not been conducted in South Sudan. This thesis assesses the prevalence and determinants of suboptimal breastfeeding practices especially delayed initiation of breastfeeding and pre-lacteal feeding. We also assessed the effect of the Baby-Friendly Hospital Initiative training on breastfeeding practices.

Methods: The thesis consists of three surveys. The first is a cross-sectional study among 806 mothers in Juba Teaching Hospital in South Sudan, which assessed using bivariable and multivariable logistic regression analysis the prevalence and factors associated with delayed initiation of breastfeeding.

The second survey of 806 mothers in the same hospital – together with the first survey – became a "before and after study", assessing using a modified Poisson model the effect of the Baby-Friendly Hospital Initiative training on early initiation of breastfeeding.

In the third survey, we interviewed 810 mothers in a rural community in Jubek State in South Sudan. We assessed the prevalence and determinants of pre-lacteal feeding and the level and determinants of health facility utilization at birth.

Results: In the first survey in the hospital, the prevalence of delayed initiation of breastfeeding was 52%; factors associated with delayed initiation of breastfeeding included caesarean section, discarding of colostrum, being a single mother, exposure to advertisement of infant formula, and lack of house ownership.

In the second survey in the hospital after the Baby-Friendly Hospital Initiative training, the prevalence of early initiation of breastfeeding increased from 48% before to 91% after health workers training. Regardless of the mode of birth, training was effective in increasing early initiation of breastfeeding.

In third survey in the community, the prevalence of pre-lacteal feeding was 53% and proportion of mothers giving birth at a health facility was 25.8%. The predictors of health facility birth included antenatal care visits, mother's education, socio-economic status, and first-time mothers.

Conclusion: The findings highlight the need for efforts to increase health facility births, breastfeeding counselling, promote the health benefits of early initiation of breastfeeding, and colostrum, roll out the Baby-Friendly Hospital Initiative training to other hospitals in the country, as well as to discourage discarding of colostrum and pre-lacteal feeds. These will result in improved breastfeeding practices and ultimately improved maternal and infant health.

Original papers

The work in this thesis is based on the following papers which are referred to in the text by Roman numerals:

I. Justin Bruno Tongun, Mohammed Boy Sebit, David Mukunya, Grace Ndeezi, Victoria Nankabirwa, Thorkild Tylleskar and James K. Tumwine. Factors associated with delayed initiation of breastfeeding: a cross-sectional study in South Sudan. International Breastfeeding Journal 2018 13:28. https://doi.org/10.1186/s13006-018-0170-0.

II. Justin Bruno Tongun, James K. Tumwine, Grace Ndeezi, Mohammed Boy Sebit, David Mukunya, Jolly Nankunda, and Thorkild Tylleskar. The effect of health worker training on early initiation of breastfeeding among mothers in South Sudan: a before and after hospital-based study. Int. J. Environ. Res. Public Health 2019, *16*(20), 3917; https://doi.org/10.3390/ijerph16203917.

III. Justin Bruno Tongun, Mohamedi Boy Sebit, Grace Ndeezi, David Mukunya, Thorkild Tylleskar and James K. Tumwine. Prevalence and determinants of pre-lacteal feeding in South Sudan: a community-based survey. Global Health Action 2018, VOL. 11, 1523304. https://doi.org/10.1080/16549716.2018.1523304.

IV. Justin Bruno Tongun, David Mukunya, Thorkild Tylleskar, Mohamedi Boy Sebit, James K Tumwine, Grace Ndeezi. Determinants of health facility utilization at birth in South Sudan. Int. J. Environ. Res. Public Health 2019, 16(13), 2445. https://doi.org/10.3390/ ijerph16132445.

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1. Introduction

The year 2016 marked the start for the Sustainable Development Goals (SDG) (1, 2). The SDG three states: "Ensure healthy lives and promote wellbeing for all at all ages." Target 3.2 states: "By 2030, end preventable deaths of infants and children under 5 years of age, with all countries aiming to reduce neonatal mortality to at least as low as 12 per 1,000 live births and under-5 mortality to at least as low as 25 per 1,000 live births." (2). Although by 2015 under-5 mortality had remarkably declined globally, 15,000 children under-5 years of age died every day in 2017 (3). Nearly 80% of these deaths were concentrated in sub-Saharan Africa and South Asia (4). Sub-Saharan Africa has one of the highest mortalities: a neonatal mortality of 28 per 1000 live births and an under-5 mortality of 83 per 1000 live births (5).

Among the risk factors for under-5 mortality are suboptimal breastfeeding and low level of health facility utilization during birth (6). Optimal breastfeeding includes early initiation (EIBF – within the first hour of birth); exclusive breastfeeding (EBF) from birth to 6 months; and continued breastfeeding to at least 24 months (6). According to the 2016 Lancet Breastfeeding series, optimal breastfeeding is one of the interventions known to improve child survival and reduce under-5 mortality (7). Achieving high optimal breastfeeding rates could prevent 800,000 child deaths globally (7). Findings from studies showed that EIBF decreased the under-5 mortality by 19% in Nepal (8) and by 23% in Ghana (6). A prospective analysis of pooled data from three randomized trials from Ghana, India and Tanzania reaffirmed that both EIBF and EBF independently reduced neonatal and infant morbidity and mortality (9). The benefits of breastfeeding compelled the WHO and UNICEF to launch the BFHI in 1991 and update it in 2018 (10). A systematic review revealed that delayed initiation of breastfeeding doubles the risk of deaths in neonates (11). Similarly, pre-lacteal and mixed feeding has been reported to increase neonatal morbidity and mortality (12).

Findings from a study in sub-Saharan Africa and South East Asia showed that a health facility-based delivery having a skilled birth attendant decreased neonatal mortality (13). Global scale-up of optimal breastfeeding and health facility-based delivery with a skilled

birth attendant could substantially contribute to achieving the Sustainable Development Goal targets 3.1 and 3.2.

1.1 Breastfeeding

The physiology of breast milk

Breast milk synthesis occurs in the alveolar milk-producing cells of the mother's breast. Each alveolus is surrounded by myoepithelial cells responsible for milk ejection (14). The milk from the alveoli drains through lactiferous ducts to the nipple (15).

Milk synthesis occurs in two stages referred to as lactogenesis I and II. In lactogenesis I, the alveolar cells start to produce the first milk (colostrum) in mid-pregnancy (16). This milk is reabsorbed into the mother's bloodstream during pregnancy. Lactogenesis II starts soon after the expulsion of the placenta following birth, regulated by prolactin and oestrogen (17). Prolactin triggers alveolar cells to produce and secrete colostrum (18), whereas oestrogen regulates milk flow. A few days after birth, colostrum is gradually replaced by transitional milk and finally mature milk (16).

Factors influencing milk production

Factors associated with milk production include correct attachment to the breast, stimulation of the nipple, and efficient suckling, (19). Poor infant latch, breast engorgement due to irregular or incomplete removal of milk, placenta retention, diabetes mellitus, and stress at birth; and socio-cultural factors also decrease milk production (20).

Breastfeeding practices

There has been variation in breastfeeding practices globally (21). A secondary analysis of the WHO global survey found that the rate of early initiation of breastfeeding was 50% in low- and middle-income countries (22). A meta-analysis of Demographic and Health Surveys (DHS) from 29 countries in sub-Saharan Africa reported that only 40% of children were exclusively breastfeed for six months (23).

WHO recommends the following practices for infant and young child feeding (IYCF) (24):

- "Early initiation of breastfeeding" (EIBF), defined as putting an infant to the breast within an hour of birth.
- "Exclusive breastfeeding" (EBF), which is feeding the infant only on breast milk and no other liquids or solids, not even water, except for prescribed medicines or supplements.
- "Complementary feeding", defined as giving the infant any food (liquid, semi-solid and solid foods), whether manufactured or locally prepared, while continuing breastfeeding up to two years and beyond.

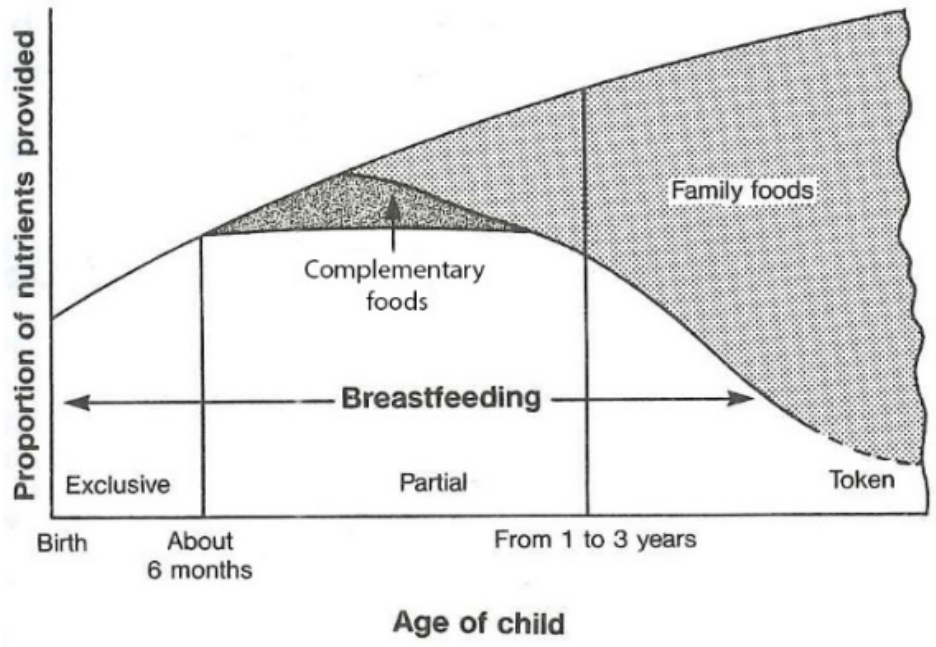

Figure 1. The stages of infant feeding, adapted from (27).

Previous studies on breast volume and milk production during extended lactation in women found that breastfeeding alone beyond six months of life is not enough due to the infant's increased needs (25).

A recent systematic review reaffirmed that a healthy infant should be exclusively breastfed for 6 months, and thereafter receive complementary feeds, while continuing breastfeeding for two years (26).

1.1.2 Factors influencing breastfeeding

Health facility factors

The BFHI 2018 guideline recommends that health facilities providing maternity and newborn services should enable mothers and their infants to remain together, rooming-in throughout the day and night (28). A study in Bangladesh reported that rooming-in was linked to an increase in bonding, attachment, mother's empowerment and optimal breastfeeding (29). Similarly, early skin-to-skin contact between the mother and infant was reported to increase EIBF and EBF (29).

Secondary analysis of DHS data on predictors of early initiation of breastfeeding among Zimbabwean women revealed that the presence of skilled birth attendants during childbirth is vital in increasing the rates of EIBF and EBF (30). A study in Greece showed that support to breastfeeding mothers, by knowledgeable efficient midwives with a positive attitude, is associated with early initiation of breastfeeding (31).

Individual and socio-demographic factors

An Ethiopian study on the timely initiation of breastfeeding and associated factors among mothers showed that mothers' attributes, such as an age of 25-35 years, residing in rural area, antenatal care visits, multiparity, and normal delivery were associated with increase in optimal breastfeeding (32). A study in Taiwan on maternal and hospital factors associated with first-time mothers' breastfeeding practice showed that mother's education status, marriage and unemployment were associated with EBF (33).

Socio-cultural factors

A study in Mozambique on knowledge, beliefs and practices regarding EBF of infants found that, after giving birth, a mother is thought to be "dirty" and must take a bath before contact with her infant (34). This false belief impedes early skin-to skin contact and delays initiation

of breastfeeding. Findings from Lebanon showed that most mothers consider colostrum unclean and bad for their infants (35), which encourages mothers to use pre-lacteal feeds.

1.1.3 Benefits of breastfeeding

Breast milk contains all nutrients the infant needs in the first six months of life, such as proteins, carbohydrates, fats, immunoglobulins and biologically active substances, e.g. hormones (36). Breast milk is also a probiotic diet, containing bacteria originating from the mother's skin or intestine, which translocate and gain access to mother's breast via lymph and blood circulation (37, 38). The bacteria enrich the intestinal flora of the infant, influence microbiota composition and prevent allergic rhinitis and other metabolic syndromes (39-41).

There is evidence indicating that breastfeeding is protective against common childhood illnesses, such as diarrhoea (42, 43), severe respiratory tract infections, especially pneumonia (44-46), middle ear infection and malocclusion (46-48). In Botswana, breastfeeding was reported to be protective against severe pneumonia in HIV-1-exposed uninfected children (49). Another study in Zambia showed that the benefit of breastfeeding extends beyond the first year of life (50). Other studies have demonstrated that breastfeeding is even protective against non-communicable diseases, such as type 1 and type 2 diabetes, cardiovascular disorders (51, 52) and obesity in children (53, 54).

Exclusive breastfeeding prevents 13% of deaths in children under five years of age (55). A study in the Lancet reported that a global scale-up of exclusive breastfeeding could prevent 12% deaths in children under five years, with approximately 800,000 lives being saved in low- and middle-income countries (LMIC) (56). Breastfeeding has also been reported to reduce the risk of sudden infant death syndrome (SID) in high-income countries (57, 58). Furthermore, breastfeeding to any extent and any duration could reduce the risk of SID by 73%.

Breastfeeding improves cognitive function in children. For example, results from a randomized controlled trial in Belarus demonstrated that EBF and prolonged breastfeeding were strongly associated with improved cognitive development (59). A study in Brazil

showed that the breastfeeding benefits extends beyond infancy and are associated with increased intelligence, grades attained in school and better adult earning (60).

Breastfeeding offers several benefits to the mothers. For example, immediately after childbirth, breastfeeding assists the mother's uterus to contract, preventing post-partum bleeding and returning the uterus to its pre-pregnancy size (61). Breastfeeding also promotes child spacing and maternal health facilitated by lactation amenorrhea and delay the return of ovulation (62, 63). In Burkina Faso and Uganda, optimal breastfeeding reduces fertility (64). Furthermore, prolonged breastfeeding reduces the risk of type 2 diabetes and overweight/obesity (51, 65), ovarian cancer and breast cancer (65-67).

Breastfeeding has a direct impact on society and the economy. In sub-Saharan Africa, breast milk has an economic advantage compared to infant formula. Breast milk does not require packaging, energy processing, or fuel to heat the milk or any cleaning equipment. Apart from its nutritional value, breast milk contributes to the gross national product in Mali, Nigeria, Senegal and Zimbabwe (68). A study in the US noted that, if 90% of women practiced exclusive breastfeeding, about 900 children could be saved from deaths resulting from diseases (69). Similarly, 13 billion US dollars would be saved from treating different diseases in children. Furthermore, 18 billion US dollars would be saved from medical cost if policies promoting optimal breastfeeding were implemented in this country (70).

1.1.4 Breastfeeding and HIV-1

In sub-Saharan Africa, the proportion of adults infected with the HIV-1 declined from 2009 to 2018 (71). However, women of reproductive age still account for 59% of new infections. These mothers might expose or transmit the virus to their infants through body fluids, including breast milk (72). The risk of HIV-1 transmission increases with a high maternal viral load and inflammation of the mother's breast (73). A study on postnatal transmission of HIV-1 from mother to infant in Rwanda was one of the first to describe transmission of HIV-1 from mother to child through breastfeeding (74).

Knowledge of HIV-1 transmission through breast milk led to the release of several guidelines by WHO, ranging from not breastfeeding at all to abrupt cessation of breastfeeding. The WHO 2016 guidelines recommend HIV-1-positive mothers to

exclusively breastfeed for six months and continue breastfeeding up to 24 months or beyond, while on anti-retroviral treatment (75). In addition, the guidelines recommend testing all pregnant women and breastfeeding mothers during antenatal and postnatal care and start anti-retroviral therapy (ART) regardless of CD4 count for life in HIV-1 positive mothers. Furthermore, the guidelines emphasize that mothers living with HIV-1 should be supported to adhere to ART treatment (76).

Recent studies have indicated increasing rates of exclusive breastfeeding among HIV-1 infected women in low resource settings (77, 78). In Rwanda, a study on the impact of maternal ART on mother-to-child transmission of HIV six weeks postpartum showed a decline in mother to child transmission of HIV-1 through breastfeeding (79). Furthermore, exclusive breastfeeding was found to decrease transmission of HIV-1 from a mother-to-child through breastfeeding compared to mixed feeding (80-83). A multi-centre study in Burkina-Faso, Kenya and South Africa found that children who were weaned or never breastfed have a higher risk of dying compared with children who were still breastfeeding (84).

1.1.5 Strategies to protect, promote, and support breastfeeding

Global strategies

Thirty years ago, the UN assembly adopted the convention on the rights of the child in 1989 (85). The core principles of the convention were “non-discrimination; devotion to the best interests of the child; the right to life, survival, and development; and respect for the views of the child.” These principles included the right to optimal breastfeeding, which ensures survival and development of the child. Recently, UN experts released a statement stating that: “Breastfeeding is a human rights issue and should be protected and promoted for the benefit of both the mother and the child.” (86). This statement asserts that children have the right to life, survival and development, and to the highest attainable standard of health, as well as to safe and nutritious foods.

A century ago, the International Labour Organization (ILO) adopted the Maternity Protection Conventions 1919 (No.3). Convention No.103 and No.183 followed the first in 1952 and 2000, respectively (87). The primary concern of ILO was that work done by a

woman does not cause risk to her health and that of her child. The conventions cover different aspects, including health protection, maternity leave, leave in case of illness and complications, cash and medical benefits, employment protection, and non-discrimination against breastfeeding mothers.

Health facility strategies

WHO and UNICEF launched the BFHI in 1991, which was updated in 2018 (10). This aims to protect, promote, and support breastfeeding in the health facility and community, based on the ten steps to successful breastfeeding (Table 1). In addition, it has both external and internal evaluation mechanisms for monitoring the performance in implementing hospitals (88). This strategy also urges hospital in-charges to have a written breastfeeding policy and empower health workers with the practical skills needed to assist breastfeeding mothers. Furthermore, BFHI has boosted optimal breastfeeding in several countries (89, 90).

Breastfeeding education is a critical strategy in breastfeeding promotion. Women mainly depend on health workers for correct information about breastfeeding. WHO has developed a training course to bring health workers up-to-date information on optimal breastfeeding practices (91). This training ensures uniformity of messages passed on to breastfeeding mothers, since mixed messages can lead to suboptimal breastfeeding, as evidenced by a report from South Africa (92).

Other strategies known to increase the rate of early initiation of breastfeeding and exclusive breastfeeding include breastfeeding counselling during antenatal care, education of the mothers and family members, and training health professional on breastfeeding (93, 94).

Community strategies

Over the years, mass media-communication programmes have been crucial in improving breastfeeding initiation and exclusive breastfeeding in Uganda (95). Most families have access to a radio. In Bangladesh, media campaigns increased optimal breastfeeding (96). In Zimbabwe, a study on the impact of a breastfeeding intervention delivered by village health workers in a rural community showed that delivering breastfeeding information that are culturally relevant resulted to increase in EIBF and EBF (97). In Vietnam, a community-

based study on father education intervention on breastfeeding practice resulted an increase in optimal breastfeeding (98).

Table 1. The ten steps to successful breastfeeding (10).

Ten steps 1989	Ten steps 2018
1.Have a written breastfeeding policy	1. Have institutional procedures necessary to ensure that care is delivered consistently and ethically
2. Train all healthcare staff in the skills necessary to implement this policy	2. Ensure that staff has sufficient knowledge, competence and skills to support breastfeeding
3. Inform all pregnant women about the benefits and management of breastfeeding	3. Discuss the importance and management of breastfeeding with pregnant women and their families
4. Help mothers initiate breastfeeding within the first hour of birth	4. Facilitate immediate and uninterrupted skin-to-skin contact, and support mothers to initiate breastfeeding as soon as possible after birth
5. Show mothers how to breastfeed and how to maintain lactation, even if they should be separated from their infants	5. Support mothers to initiate and maintain breastfeeding and manage common difficulties
6. Give newborn infants no food or drink other than breast milk, unless medically indicated	6. Not to provide breastfed newborns any food or fluids other than breast milk, unless medically indicated
7. Practice rooming-in (allow mothers and infants to remain together) 24 hours a day	7. Enable mothers and their infants to remain together and practice rooming-in 24 hours a day
8. Encourage breastfeeding on demand	8. Support mothers to recognize and respond to their infants' cues for feeding.
9. Give no artificial teats or pacifiers (also called dummies or soothers) to breastfeeding infants	9. Counsel mothers on the use and risks of feeding bottles, teats and pacifiers
10. Foster the establishment of breastfeeding-support groups and refer mothers to them on discharge from the hospital or clinic	10. Coordinate discharge so that parents and their infants have timely access to ongoing support and care

In Uganda, peer counselling is an important strategy that is widely accepted in breastfeeding promotion (99). Similarly, peer counselling was effective in improving EBF in a randomized control trial in Burkina Faso, South Africa and Uganda (100). A randomised controlled trial in Bangladesh on the effect of community-based peer counsellors on EBF

practices reported that peer counselling was effective in increasing optimal breastfeeding (101).

1.2 Health facility utilization during child birth

In a global study on skilled birth attendance, the lessons learned showed that giving birth in a health facility in the presence of a skilled attendant has been recognized as one of the interventions to avoid maternal mortality and improve the health outcome of newborns (102). Nevertheless, a sizable percentage of childbirths occur outside health facilities in low resource settings (103). Delivery outside health facilities contribute to ~3 million neonatal deaths annually (104) and ~2.7 million stillbirths in the world in 2008 (105).

Determinants of health facility utilization at birth

In sub-Saharan Africa, women face several obstacles in accessing and using health facility during childbirth. This is presented in the video "Why did Mrs. X die, retold" on https://www.youtube.com/watch?v=gS7fCvCIe1k. A recent systematic review on barriers to access and utilization of emergency obstetric care at health facilities in sub-Saharan Africa showed that access to, and utilization of, health facility services during birth was affected by several factors, including younger age, illiteracy, lower income, unemployment, a lower level of assertiveness among women, poor knowledge about obstetric danger signs and cultural beliefs (106). In Ethiopia, cost, distance to health facility and disrespect or abuse of mothers during birth decreased health facility delivery (107). In addition, long waiting times at health facilities, poor staff knowledge and skills, poor interpersonal relationships and abuse of women by health workers, all discourage the use of a health facility during birth (108). Other studies found factors, such as affordability and financial risk, associated with access and usage of health facilities during birth, traditional influences and socio-cultural factors; socio-economic factors were associated with underutilization of health facilities at birth (106, 109). Furthermore, women's concern for the lack of supportive attendance during birth, privacy, stigma-free environment and lack of practices that they experience when they give birth at home were noted (109). On the other hand, a study on social determinants of health facility use at birth in Ghana reported that mothers living in urban residences, maternal education, parity, religion and high socio-economic status were

associated with increased health facility delivery (110). Another study from Ethiopia reported that awareness of birth complication was associated with health facility delivery (111).

In South Sudan, a study of the barriers to institutional childbirth found several factors that hinder women from accessing and using healthcare during birth (112). These include long distances to health facilities, lack of transportation, a poor referral system, flooding, cost in health facilities, insecurity, influence of culture, privacy concerns, fear of Caesarean section, inadequate health facility infrastructure and neglect and/or abuse during admission.

1.3 Justification

This thesis is part of the Survival Pluss project, which project aimed to identify ways of saving mothers and babies in post-conflict Northern Uganda and South Sudan. One research component was to conduct a baseline survey on challenges facing mothers and children in South Sudan. Studies focused on the determinants of breastfeeding practices, health facility utilization during birth with skilled birth attendance, and the effect of health facility-based birth on breastfeeding have not been conducted in South Sudan.

The initial idea was to conduct an extensive baseline survey on maternal and child health indicators. Unfortunately, in 2013 civil unrest gripped the country. The conflict started in Juba, the capital city, and spread to the rest of the country, rendering most parts inaccessible due to insecurity (113). A new strategy was developed to reduce the number of the research sites limited to Jubek, Yei River and the Terekeka States, following a feasibility survey assessing the situation of these areas. As soon as the survey team had returned, civil unrest spread to Yei, Terekeka and Koji Koji. The possibility of conducting an extensive survey in this period of conflict became remote.

Given the lack of data on maternal and child health, particularly on breastfeeding practices and health facilities utilization during birth, we designed a baseline survey in areas that were accessible on which future research could be built once peace had returned. Although the data generated by the survey might not be generalised to the entire population, it can still provide a snapshot of the challenges faced by the mothers and children in South Sudan. Finally, we selected a) a rural area located 10-80 km around Juba in Jubek State, and b)

Juba Teaching Hospital (JTH), the major referral hospital for the baseline surveys to generate data on breastfeeding practices and the determinants of health facility-based birth (especially delayed initiation of breastfeeding and use of pre-lacteal feeds), as also the effect of the Baby Friendly Hospital Initiative training on breastfeeding practices. This was carried out in the context of low health facility utilization for delivery and skilled birth attendance in the newly instituted health system in South Sudan.

South Sudan, a young country, is rapidly introducing policies promoted by the WHO, but it is not always clear to what extent these policies have been implemented. The country has limited published data on breastfeeding practices and health facility utilization during birth**.** We carried out a literature search in consultation with a trained librarian at the University of Bergen library to identify data on breastfeeding practices in both Sudan and South Sudan. We systematically searched electronic databases, including MEDLINE, WEB OF SCIENCE, and EMBASE. Search terms consisted of subject heading, such as MeSH for MEDLINE and other free text words, including keywords "South Sudan", "Sudan", or (Sudan*, South* Sudan* or east Africa*), "Breastfeeding" or "Breast feeding", or ""Breast feed" or "expressed Breast Feeding", or "breastfeeding or breast feeding", or "breast fed", or "mothers milk or human milk", or "infant feeding". The search identified 109 articles; and after removing duplicates, 96 articles remained. We examined their titles and abstracts from which we selected only 13 for a full review. We dropped 11 articles, 3 recent articles from the Sudan and 8 from east African countries. We identified only one study on breastfeeding practices in South Sudan, dating 6 decades back (114). In addition, we searched for estimates from the UNICEF and WHO (115) and grey literature. The results showed low rates of early initiation of breastfeeding (48%) and exclusive breastfeeding (45%).

Apart from a high maternal mortality ratio estimated at 800 per 100,000 live births, suboptimal child health services (116, 117), and breastfeeding practices, the country is grappling with other challenges, such as civil unrest, famine (118), malnutrition (119), and increasing numbers of HIV-1 infections among women and children (120-122). Considering these challenges, it is highly likely that suboptimal breastfeeding and health facility utilization during childbirth might be contributing to the high morbidity and mortality in children<5 years in South Sudan. Therefore, there is an urgent need to understand and

generate up-to-date and context-specific data on the determinants of breastfeeding practices and health facility-based births in South Sudan.

1.4 Conceptual framework for factors influencing breastfeeding practices

The focus of this thesis is breastfeeding practices, especially delayed initiation of breastfeeding and pre-lacteal feeding in the context of health facility utilization and skilled birth attendance. The studies also assessed the factors that influence early breastfeeding practices and health facility utilization at birth. These are presented in a conceptual framework (Figure 2), which has 3 groups of factors influencing breastfeeding practices: individual factors, group level, and society level. The understanding of these factors might be useful for future interventions to improve breastfeeding practices in South Sudan.

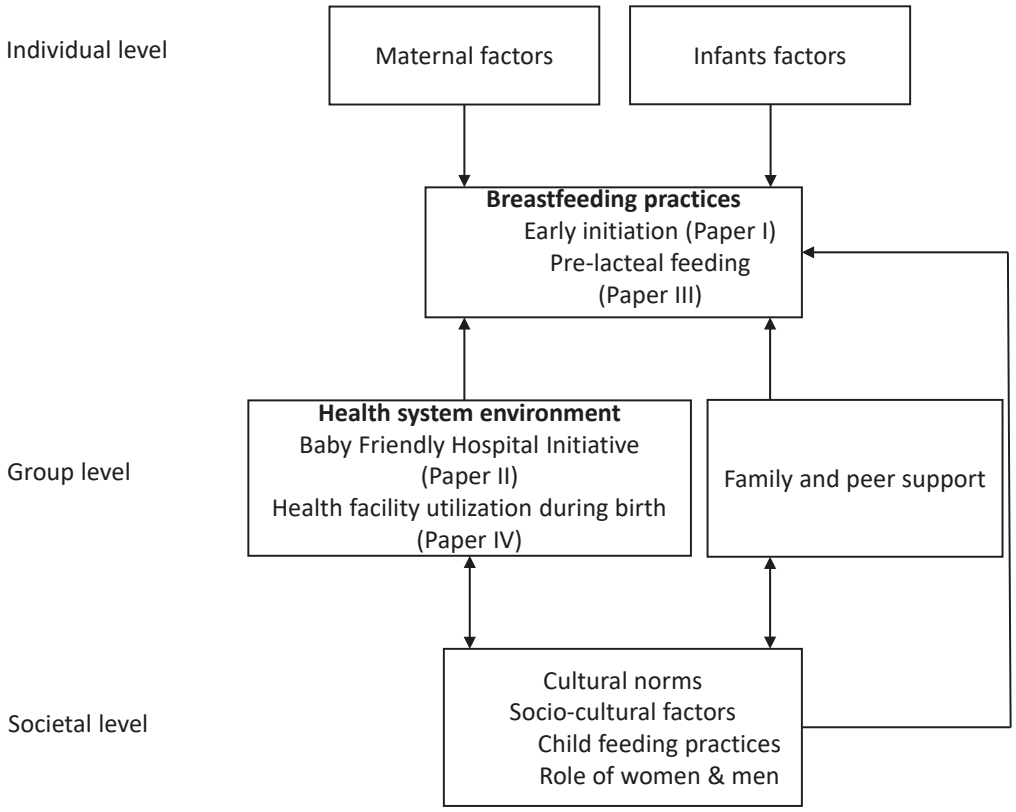

Figure 2. A conceptual framework for factors influencing breastfeeding practices in South Sudan: adapted from Hector et al. (123).

Individual factors include those that are directly related to the mother and the infant which are closely linked with demographic variables, such as mother's age, marital status, mode of birth, parity, mother's intention to breastfeed; knowledge; skills and parenting experience; and the nature of early interaction between mother and infant. Infant factors considered were age and sex, which might directly influence the initiation and duration of breastfeeding.

Group-level factors include characteristics of the setting the mother-infant pairs find themselves in and those that enable mothers to breastfeed. We considered aspects with a direct influence on the mother and infant, such as the hospital and health facility environment, especially health facility utilization during birth and the Baby-Friendly Hospital Initiative. This is a milieu that encourages breastfeeding practices, such as infant rooming-in with the mother that allow feeding on demand, skin-to-skin contact, kangaroo mothers' care (KMC), professional breastfeeding support, follow up care and support. Other factors include home and peer support environment, the mother's work environment, and the community environment, such as breastfeeding norms in public places.

The societal and cultural factors impact on the acceptability and expectations of breastfeeding practices, and the context in which breastfeeding practices occur. These factors include cultural norms regarding breastfeeding, child feeding and parenting, the role of women in society, partner support, practices related to breast milk substitutes, and complementary food.

1.5 Aim and objectives

Aim

The thesis aimed to provide baseline information on breastfeeding practices and health facility utilization during childbirth in South Sudan.

Specific objectives

1. To assess the prevalence and determinants of delayed initiation of breastfeeding at Juba Teaching Hospital in South Sudan, Paper I
2. To assess the effect of the Baby-Friendly Hospital Initiative training on early initiation of breastfeeding at Juba Teaching Hospital in South Sudan, Paper II
3. To describe the prevalence and factors associated with pre-lacteal feeding in Jubek State in South Sudan, Paper III
4. To determine the prevalence and determinants of health facility utilization and skilled birth attendance during childbirth in Jubek State, South Sudan, Paper IV

2. Study subjects and methods

2.1 Study area

South Sudan is a landlocked country located in East-Central Africa. It gained independence on 9th July 2011 from the Republic of Sudan following a referendum (124, 125). South Sudan is bordered by Sudan to the north, Ethiopia to the east, Kenya to the southeast, Uganda to the south, the Democratic Republic of Congo to the southwest, and the Central African Republic to the west, Figure 3.

Figure 3. Map of Africa with South Sudan highlighted (126).

South Sudan has a surface area of 640,000 square kilometres (km^2), almost twice as large as Norway. The estimated population is 12 million (127). South Sudan's Human Development Index in 2018 ranked number 187 out of 189 in the world, only followed by the Central African Republic and Niger. The country has some of the poorest basic health indicators in the world (115) (Table 2).

Table 2. South Sudan health indicators

Health indicators	Rates and percentages	Global ranking
Total population	12.2 million inhabitants	
Life expectancy at birth	58.6 years	
Maternal mortality ratio	789 per 100,000 live births	5st
Under-five mortality rate	96 per 1000 live births	11th
Infant mortality rate	59 per 1000 live births	
Neonatal mortality rate	38 per 1000 live births	7th
Early initiation of breastfeeding	48 %	
Exclusive breastfeeding	45 %	
Fully immunized children	26%	
Wasting in children < 5 years	22.7%	
Stunting in children < 5 years	31.1%	
HIV in children < 5 years	1.25 per 1000 uninfected people	

2.2 Study setting

The surveys were carried out in Juba Teaching Hospital (Figure 4) and a rural community in Jubek State. Jubek State hosts Juba, the capital city and the most populous city in South Sudan. Jubek State is bordered by the following States: Terekeka to the north, Imatong to the east, Yei River to the southwest, and Amadi to the west (Figure 5).

Fig. 4. Juba Teaching Hospital in Juba, South Sudan.

Figure 5. The states of South Sudan (128). The studies were carried out in Jubek state (south on the map).

The different methods used are described in detail in each study. However, a summary of the methodology is presented in this section and in Table 3.

The work consists of 3 surveys: Two hospital-based surveys in Juba Teaching Hospital in October 2016 and April 2018 (Papers I and II) and a community-based survey between October – December 2016 (Papers III and IV).

Table 3. Study designs, participants, objectives, and statistical analyses

Papers	Study designs	Participants	Objectives	Statistical analyses
I	A hospital-based cross-sectional study	806 mothers	To assess the prevalence & factors associated with breastfeeding initiation in Juba Teaching Hospital	Frequencies, Chi square tests, bivariable and multivariable analysis
II	A hospital-based "before & after" study	806 mothers	To evaluate the effect of the Baby-Friendly Hospital Initiative training on early initiation of breastfeeding in JTH	Frequencies, Chi square tests, bivariable and a modified Poisson model
III	A community-based cross-sectional study	810 mothers	To determine the prevalence & predictors of pre-lacteal feeding in Jubek State	Frequencies, Chi square tests, bivariable and multivariable analysis
IV	The same as in Paper III	810 mothers	To assess the level and determinants of health facility utilization at birth in Jubek State	Frequencies, Chi square tests, bivariable and multivariable analysis

Paper I

Setting and design

We carried out a cross-sectional hospital-based survey among 806 mother-infant pairs at Juba Teaching Hospital in South Sudan (Figure 5).

Sampling

From October 2016, we contacted a total of 1723 mothers in the postnatal ward of Juba Teaching Hospital. We excluded 13 mothers who had had stillbirths and 94 mothers enrolled in another study. The team explained the objectives and procedures of the study to 1616 mothers eligible to participate, and randomly selected 808 mothers. Of these, 806 consented to participate in the study, but 2 mothers with sick infants declined. The team conducted face-to-face interview using a paper-based questionnaire to collect data on sociodemographic, birth characteristics, and early breastfeeding practices (Figure 6). The detailed sampling procedure is described in Paper I.

Figure 6. Research assistant interviewing a mother in Juba Teaching Hospital.

Statistical analysis

Statistical analysis was carried out using STATA version 14 (STATA Corp LLC, Texas, USA). We used conventional statistical methods to summarize and describe data in the tables. Multivariable analysis was conducted to identify factors associated with delayed initiation of breastfeeding.

Paper II

Study design

This was a "before and after" study carried out among 806 mother-infant pairs in the maternity unit at Juba Teaching Hospital.

Sample size estimation

We used Open Epi (Fleiss) and a formula for detecting differences between 2 proportions (129). The assumptions made were an alpha of 5%, power of 90%, the ratio of exposed to

unexposed as 1, and 48% prevalence of early initiation of breastfeeding in the baseline "before" study. We assumed that the training of health workers would increase the prevalence of early initiation breastfeeding to 56%. The sample size was again the 806 participants.

Training of health workers in Juba Teaching Hospital

The low prevalence of early initiation of breastfeeding in the "before" study triggered the research team to plan and implement a training intervention for health workers to improve their competence in promoting optimal breastfeeding in the hospital. A breastfeeding expert facilitated a 4-day course based on the WHO/UNICEF Baby-Friendly Hospital Initiative 20 hour course (130). The training consisted of 15.5 hours of theory and 4.5 hours of practical sessions – demonstrations, role-plays, and hands-on practice in the postnatal ward. After the training, a grace period of 4 months was allowed for the health workers to internalize and practice their acquired skills.

Four months after the training, we carried out the "after study" to assess breastfeeding practices in the same hospital. Between the "before" and "after" surveys, there was no change in hospital leadership, nor on the maternity ward. No significant political or policy changes had taken place in the country, nor any interventions, such as a massive breastfeeding awareness campaign.

Sampling

A total of 990 mothers gave birth to live infants in Juba Teaching Hospital during the study period. We consecutively recruited a total of 806 mother-infant pairs. We excluded 116 mothers not contacted by the study team because they had had an early discharge, 31 declined consent, 33 had sick infants, and 4 infants had congenital malformations.

Statistical analysis

The two datasets, "before" and "after" were merged. We used conventional statistical methods to summarize and describe the data in tables. A modified Poisson model was used to assess the effect of the training on early initiation of breastfeeding. We assessed confounding and retained factors that caused a variation between the crude and the adjusted

prevalence ratio of ≥ 10% and known confounders from the literature in the final model. Stata version 15 (Stata Corp, College Station, Texas, USA) was used in the analysis.

Papers III and IV

Setting and design

We carried out a community-based survey among 806 mothers of children aged 0-23 months in Jubek State (Figure 7).

Figure 7. Research team traveling to a village across the River Nile

Sample size estimation

The sample size for this study was calculated using Open-Epi software (129). The following considerations were made when calculating the sample size for assessing prevalence of pre-lacteal feeding: 43% prevalence of pre-lacteal feeding from a study in Uganda (131); a precision of 5%; a design effect of 2 and 7.5% non-response. For the factors associated with pre-lacteal feeding, the place of birth was used to calculate the sample size required to detect differences in the proportion of pre-lacteal feeding between mothers who had given birth at home and those who had hospital births. Using a study in South Sudan where 87% of mothers gave birth at home (132), we assumed that the prevalence of pre-lacteal feeding was 70% among mothers who had given birth at home, and 48% for those who gave birth in hospital. This yielded a total of 349 participants for the objective of factors associated with pre-lacteal feeding. Therefore, we took the larger sample size of 810.

The sample size for the prevalence of health facility utilization was calculated using Open Epi (129). The following were considered in the calculation: a 12% prevalence of health facility birth from South Sudan Household Survey (133); a precision of 5%; and a design effect of 4.9. This gave a minimum sample size of 795 participants. We therefore took the larger sample size of 810 above.

Sampling

We used a 2-stage sampling method, which is basically a modification of the WHO Expanded Programme of Immunization (EPI) method for estimating vaccination coverage (134). We listed all 43 villages and corresponding populations in the 4 counties, from which we selected 30 villages by probability proportionate to size. In each village, a list of households was used to choose an index house randomly. The next house was selected by picking the house nearest to the index household, i.e. the one whose door was closest. Only one mother-infant pair was chosen from each household. This process was repeated until 27 mother-infant pairs had been interviewed in each village, giving a total of 810 participants. The details of the sampling procedure have been published in Papers I and II.

Trained research assistants conversant with the study area and fluent in the local language collected the data. The interviews were done in a private area in the mother's home away

from the other members of the family. We recruited mothers of children aged 0-23 months. The mother-infant pairs were those residing in the village during the survey (Figure 8).

Figure 8. Research assistant conducting interview in rural community in Jubek State.

Statistical analysis

We used STATA version 14 (STATA Corp LLC, Texas, USA) with a survey set command adjusted for multistage sampling in the data analysis. The data were reported as proportions, means and standard deviations. We conducted logistic regression to assess factors associated with pre-lacteal feeding and health facility birth, with further analysis to assess for any association between breastfeeding and health facility utilization at birth.

Ethical approval

Ethical approval was obtained from the Directorate of Planning, Budgeting and Research in the Ministry of Health in South Sudan – reference number SMOH/E/JS/44. K.1; and from the Norwegian Regional Committee for Medical and Health Research Ethics in the West - reference 2018/913/REK Vest. Official letters of permission were presented to the Director General of the hospital, ward in-charge and the community leaders. Written informed consent was obtained from the mothers and a thumb print from those who could not write. Privacy and confidentially measures were maintained throughout the study.

3. Results

Paper I

In total, 806 mother-infant pairs were recruited at the postnatal ward in Juba Teaching Hospital. The mean age of the mother was 26.5 years with a standard deviation (SD) of 5.3. The mean age of the children was 12.4 (SD 6.9) months. The prevalence of early initiation of breastfeeding was [48% (388/806); 95% confidence interval (CI) (43.1-54.3)]. Factors associated with delayed initiation of breastfeeding included caesarean section, discarding of colostrum, advertisement of formula milk, lack of marriage and non-house ownership.

Paper II

In this paper, the prevalence of early initiation of breastfeeding increased from 48% (388/806) before to 91% (732/806) after health workers training. Similarly, early initiation of breastfeeding increased from 3% (3/97) before to 60% (12/20) after health workers training among women who delivered by caesarean section. About 8% (67/806) of mothers discarded colostrum before compared to 3% (24/806) after health workers training. Furthermore, 17% (134/806) of mothers used pre-lacteal feeds before compared to only 2% (15/806) after health workers training. Regardless of the mode of birth, the training intervention was effective in increasing early initiation of breastfeeding [adjusted prevalence ratio (PR) 1.69, 95% confidence interval, CI (1.57-1.82)] in the hospital.

Paper III

For this paper, 810 mother-infant pairs were enrolled. The mean age of the mothers was 26.6 (SD 5.5) years. The mean age of the children was 12.4(SD 6.9) months. Most mothers were married, but over half had no formal education. The prevalence of pre-lacteal feeding was [53% (426/810); 95% CI (48.1-59.0)]. Predictors of pre-lacteal feeding included lack of breastfeeding counselling and discarding of colostrum.

Paper IV

Only a quarter of the mothers gave birth at health facilities [25.8% (209/810); 95% CI (18.2-35.3)] and a similar proportion had skilled attendants [25.6% (207/810); 95% CI

(17.9-35.0)]. Factors associated with health facility births in the multivariable analysis included educational status, antenatal care, socio-economic status and primipara. Further analysis of the data revealed that the mothers giving birth at home were more likely to delay initiation of breastfeeding [AOR 1.72; 95% CI (1.03,2.88)] (Table 4).

Table 4. Bivariate and multivariate logistic regression analysis of delayed initiation of breastfeeding among mothers of children aged <2 years surveyed in South Sudan.

Characteristic	Bivariable N = 810 OR (95%CI)	Multivariable N = 810 AOR (95%CI)
Place of birth		
Health facility	1	1
Home	2.0 (1.32, 2.71)	1.7 (1.03,2.88)
Mother's age		
≤19	1	1
20–24	0.5 (0.24,1.16)	0.7 (0.28, 2.0)
25–29	0.6 (0.29,1.40)	0.8 (0.30,2.17)
30–34	0.9 (0.42,1.91)	1.1 (0.39, 2.95)
≥35	0.8 (0.36,1.78)	0.8 (0.27, 2.39)
Marital status		
Married	1	
Single	0.5 (0.18,1.63)	0.6 (0.19,1.73)
Mother's education		
No formal education	1	1
Primary	0.5 (0.32,0.68)	0.6 (0.38,1.01)
≥Secondary	0.4 (0.22,0.82)	0.7 (0.34,1.59)
Mother's employment		
Employed	1	1
Unemployed	2.5 (1.38,4.42)	2.0 (1.00,4.14)
Antenatal care visits		
None	1	1
1–3	0.2 (0.12,0.48)	0.7 (0.37,1.24)
≥4	0.6 (0.33,1.07)	1.3 (0.62,2.84)
Parity		
1	1	1
>1	0.9 (0.64,1.37)	0.7 (0.40,1.25)
Socio-economic quintiles		
Poorest (Q1)	1	1
Poor (Q2)	0.5 (0.30,0.96)	0.5 (0.30,0.92)
Medium (Q3)	0.5 (0.39,0.73)	0.6 (0.39,0.50)
Less poor (Q4)	0.5 (0.32,0.77)	0.6 (0.40,1.02)
Least poor (Q5)	0.4 (0.25,0.66)	0.7 (0.36,1.27))

4. Discussion

We found more than half the mothers delayed initiation of breastfeeding, the associated factors delaying initiation of breastfeeding were caesarean section, discarding of colostrum, exposure to infant formula advertisement, single mother and lack of house ownership. On the other hand, the introduction of the Baby-Friendly Hospital Initiative training was effective in increasing an early initiation of breastfeeding. We also found more than half the mothers gave pre-lacteal feeds to their infants. Predictors of pre-lacteal feeding included lack of breastfeeding counselling and discarding of colostrum. Furthermore, only a quarter of the mothers gave birth at health facilities and a similar number had been attended by skilled birth attendants. Factors significantly associated with health facility births were antenatal visits, mother's education, socio-economic and primipara. Further analysis of the data showed that the mothers who gave birth at home were more likely to delay initiation of breastfeeding. The details of the main findings are summarized in Table 5.

4.1 Discussion of the main findings

Breastfeeding initiation

Despite the known benefits of breastfeeding, over half the mothers had delayed the initiation of breastfeeding before health workers training. This was an unexpected result, since Juba Teaching Hospital is a major referral health facility and a better outcome had been expected. Our study is not consistent with that of a recent Demographic Health Survey, which found that giving birth in a hospital was associated with early initiation of breastfeeding in sub-Saharan Africa (215). According to WHO, the prevalence of early initiation of breastfeeding reported herein is suboptimal, below the target of 50% by 2025 (147). On the other hand, our findings are comparable to that of an Ethiopian study (217). Furthermore, our findings showed a lower prevalence of early initiation of breastfeeding compared to other studies conducted in Uganda (148), Bangladesh (53) and Malaysia (149). The possible explanation for the delayed initiation of breastfeeding could be due to poor implementation of breastfeeding policies, low ante-natal care attendance, lack of knowledge among mothers and lack of support from health workers. Another plausible explanation for these findings

might be inadequate breastfeeding knowledge among health workers who were observed to encourage the use of formula milk. We also noticed infant formula promoters in the hospital. Infant formula was also found among mothers who had just given birth and claimed not have enough breast milk.

Table 5. Summary of the main findings in comparison with studies in sub-Saharan Africa.

Study variables	Study outcomes	Similar findings
Prevalence of early initiation of breastfeeding (Paper I)	43-48%	Nigeria (135)
Factors associated with delayed initiation of breastfeeding	Caesarean section, Discarding of colostrum, Lack of marriage, breast milk substitute advertisement, and Low socio-economic status	Nigeria (136), Tanzania (137), Uganda (138)
Prevalence early initiation of breastfeeding (after health workers training) (Paper II)	84-91%	Ethiopia (139, 140), Zimbabwe (97)
Prevalence of pre-lacteal feeding (Paper III)	50-53 %	Ethiopia (141, 142)
Pre-lacteal feeds	Common pre-lacteal feeds include glucose solution, infant formula and water	Sub-Saharan Africa (143)
Predictors of pre-lacteal feeding	Discarding of colostrum	Ethiopia (144)
Prevalence of health facility births (Paper IV)	25%	Ethiopia (145)
Factors associated with health facility utilization	Ante-natal care visits, socio-economic status, and primipara	Uganda (146)

As the baseline "before" study showed a large proportion of non-optimal breastfeeding practices, the study team designed a training intervention for health workers in the maternity unit of Juba Teaching Hospital based on the Baby-Friendly Hospital Initiative course.

Effect of health workers' training on breastfeeding initiation

After health workers training nearly all mothers (91%) initiated breastfeeding within one hour of birth. This finding was expected since studies elsewhere showed the same trend of improvement in the rates of early initiation of breastfeeding following training of health workers (150, 151). The increase in early initiation of breastfeeding might be due to

knowledge and skills acquired by the health workers, which enabled them to educate, counsel and support nursing mothers.

Apart from the impact on early initiation of breastfeeding, health workers training mitigated barriers to optimal breastfeeding, such as caesarean section, discarding of colostrum and the use of pre-lacteal feeds. Most mothers who gave birth by caesarean section practised early initiation of breastfeeding after training. There was also a significant decline in the discarding of colostrum and use of pre-lacteal feeds. This finding is consistent with that of a study in India (152). The probable explanation for the improvement might be that the health workers were able to educate, counsel and support the mothers about the benefits of colostrum and negative impact of pre-lacteal feeds.

By implementing the Baby-Friendly Hospital Initiative course, we were able to enhance health workers' knowledge/practice and improve the rate of early initiation of breastfeeding in Juba Teaching Hospital. We considered this a humble contribution to the scientific debate in the field of breastfeeding in a country that had been cut off from the rest of the world by many years of civil strife.

Factors associated with delayed initiation of breastfeeding before the training of health workers

Mothers delivering by caesarean section delayed initiation of breastfeeding compared to those who had a normal birth in the "before" study. This was consistent with recent findings from Ethiopia and Australia (153, 154). A possible explanation for this delay might be the prolonged time of recovery from anaesthesia or surgical procedure, separation of the mother and infant, delay in skin-to-skin contact, and pain or fatigue (155, 156). WHO recommends a caesarean section rate of 10-15% of hospital deliveries (157). However, the caesarean section rate of 22% in our study was high and might have contributed to delayed initiation of breastfeeding.

Aggressive and unethical infant formula marketing and promotion strategies appear to undermine optimal breastfeeding in low- and middle-income countries (158). Here, we found delayed initiation of breastfeeding was high among mothers exposed to infant formula advertisement one month before giving birth. Mothers exposed to advertisement

were twice as likely to delay initiation of breastfeeding. Our finding agrees with that of a recent study in Mexico, which reported suboptimal breastfeeding among mothers exposed to the promotion of infant formula (159). Similarly, a recent study from the Philippines reported that an infant is more likely to have received infant formula if the mother recalls the advertisement, and if a health worker or relatives recommended formula milk (160). Another systematic review revealed that the promotion of infant formula was a significant barrier to optimal breastfeeding (161). In Nepal, it has also been reported that the promotion of breast milk substitutes by health workers was associated with delayed initiation of breastfeeding and non-exclusive breastfeeding in hospitals (162). Furthermore, production and marketing of breast milk substitutes is rapidly expanding, and the sale of infant formula is projected to increase from $40 to 70 billion globally (163). This increase is mainly due to the marketing of infant formula in low- and middle-income countries.

Marital status appears to be associated with delayed initiation of breastfeeding. Unmarried women were 4 times more likely to delay initiation of breastfeeding. A similar finding was reported in Kenya where unmarried women delayed breastfeeding initiation and ceased breastfeeding early (164). The probable explanation might be lack of social, economic and emotional support from the partner or family members. This finding agrees with a recent systematic review illustrating that partner, community and peer support are associated with optimal breastfeeding (165). Women in poor resource settings relied mostly on their partner for financial and social support. Thus, lack of such support may have a far-reaching effect on the mothers, especially during the postpartum period. Our findings also conform with the evidence from a systematic review, which reported a positive influence of social support on optimal breastfeeding (166). The father's role and help in the promotion of optimal breastfeeding have been demonstrated in studies in different settings (167-171). Furthermore, a recent review that investigated interventions involving fathers showed a significant improvement in the initiation of breastfeeding, EBF and duration of breastfeeding when they were involved in breastfeeding (172). Therefore, the role of husbands or fathers is essential in supporting breastfeeding and should be given a priority in breastfeeding promotion interventions and programs.

We have used house ownership as a proxy for the socio-economic status of the mothers. Mothers who did not own a house and therefore considered to have a low socio-economic

status more often delayed initiation of breastfeeding than other women. This is consistent with data from Ethiopia, where ownership of a house was associated with early initiation of breastfeeding (219). Low socio-economic status is associated with a stressful lifestyle and worries that might have contributed to suboptimal breastfeeding. Our result also agrees with findings from India, which showed that improved socio-economic status is vital in promoting optimal breastfeeding practices (173). In contrast to our results, a study in Nigeria reported an increase in early initiation of breastfeeding among mothers who were unemployed, uneducated and those who were poorer than average (174).

Pre-lacteal feeding

The use of pre-lacteal feeds was high among the mothers we surveyed, which is consistent with studies in Cote d'Ivoire and Uganda (175, 176). The similarity might be due to the study design and participants characteristics. Our result is higher than the prevalence of pre-lacteal feeding in Ethiopia (177-181) and Tanzania (182). However, the use of pre-lacteal feeds in our study is much lower compared to the 73% prevalence of pre-lacteal feeding in Vietnam (141).

In the current study most mothers gave sugar solution, infant formula, and water to their infants. The reasons for providing these pre-lacteal feeds vary for each type of feed. For example, mothers who gave sugar solution and infant formula thought their babies were hungry, while those who gave water misconceived that their infants might be thirsty because the outside temperature was high in South Sudan. Our finding is comparable to that of a study in Ghana, where women thought it was a normal practice to give water to infants (184). Similarly, a qualitative study in Tanzania reported that mothers were influenced by family members, especially the mother-in-law, to provide water and other feeds to crying babies to quench thirst and hunger (185). Some mothers also had a belief that giving other feeds could clean the infant's mouth, throat, and prepare the stomach (180).

The practice of discarding colostrum was common in the current study. Mothers who expressed and threw away colostrum were more likely to give pre-lacteal feeds compared to those who gave colostrum to their infants. Mothers had a belief that colostrum is "bad and dirty" and might cause their infants to become sick. This finding is consistent with results from a community study in Ethiopia, which showed that mothers who discarded colostrum

were 10 times more likely to give pre-lacteal feeds (180). It was also comparable to another study in the Raya kobo district in Ethiopia (186), where mothers who gave pre-lacteal feeds thought colostrum causes abdominal pain in the infants; hence they provided them with butter to prepare their bowels. Cultural beliefs are responsible for the practice of discarding of colostrum in most low-income settings (187). This practice is a significant barrier to early initiation and exclusive breastfeeding. Our study did not carry out an in-depth analysis of the effect of cultural beliefs on discarding of colostrum, which is one of its limitations.

In sub-Saharan Africa, postpartum care for the mother and infant after birth is the responsibility of the wider family, including grandmothers, relatives and friends. Cultural beliefs and postnatal care offered to mothers are interconnected. These are directly associated with colostrum discarding and use of pre-lacteal feeds (188). It is not clear if colostrum discarding led to the use of pre-lacteal feeds or vice versa. It might be that mothers discard the first milk since it is considered dirty and bad for the infant. While waiting for the white milk to 'come', the mothers or relatives might have advised the mother to give pre-lacteal feeds. On the other hand, it is the norm in many cultures to offer infants liquids, foods or herbs before breastfeeding is established. However, before the mature milk is produced, the thick yellow milk that appears on the first day is expressed and discarded. Therefore, qualitative understanding of the cultural role linking pre-lacteal feeds and discarding of colostrum is needed in low resource settings, including South Sudan.

Health facility utilization with skilled attendance

This survey found that only a quarter of the women utilized a health facility during childbirth. This result was surprisingly low, given that the area surveyed has the comparative advantage of being close to Juba, the capital, compared to other regions. Thus, health facility births are most likely to be lower in other areas affected by conflict. Therefore, the proportion of mothers who give birth at health facilities remains alarmingly low. Lack of transport infrastructure would also have contributed to low access to health facilities during birth, since most of the communities surveyed live in islands along the river Nile where there is no road infrastructure. These women faced unreliable transport means, except bicycles and small boats; thus, they might have preferred giving birth at home, as reported in a previous systematic review in low- and middle-income countries (109). The

low use of health facilities in this survey could be partly due to the insecurity resulting from on-going civil unrest, which may have hindered improvement in the necessary infrastructure (112). Instability discourages mothers from utilizing health facilities, especially during the night (112, 189, 190). Socio-economic consequences and shocks of war lead to poor health service delivery and utilization (191-193). Furthermore, the low use of health facilities for childbirth could be due to reasons on the supply side, culminating in poor quality of healthcare (194). Another study has demonstrated that low-quality health care discourages women from using health facilities (190). There could also be socio-cultural factors, such as fear of loss of dignity that discourages mothers from seeking healthcare during childbirth (195).

The factors associated with giving birth at a health facility or receiving skilled birth attendance during childbirth include: having attended antenatal care (ANC), mother's education, socio-economic status, and being a first-time mother. These results are consistent with findings of a 2010 analysis of South Sudan Household Survey data on the risk factors for not using skilled birth attendants (196).

Women who attended ANC were more likely to use health facilities at childbirth than those who had not. This finding is consistent with results from other low-income countries (197) and a multi-country report in 2016 (198). Women who attended ANC might have gained appropriate knowledge and were less likely to delay in seeking obstetric care.

Educated women were more likely to utilize a health facility during birth than uneducated women, a result consistent with findings of a recent systematic review (106). A possible explanation is that educated mothers have better knowledge regarding obstetric care and are more likely to engage in health-seeking behaviour. Education status could indirectly influence other factors, such as income enabling the women to access health facility (199, 200).

Women in higher socio-economic status were reported to give birth in a health facility, most probably because they could afford to meet the indirect and direct cost linked to childbirth. In sub-Saharan Africa, health financing is a significant challenge and a unique barrier for users seeking healthcare services. In recent years, several countries (Ghana, Kenya, South Africa and Uganda) have implemented a policy of user fee abolition to encourage equitable

access to healthcare services (201). Removal or reduction of user fees has been reported to increase access and utilization of maternal services (202). On the other hand, a recent systematic review indicates that low household income is a barrier to the usage of health facilities during childbirth in several countries in sub-Saharan Africa (29). These findings are comparable to the result of our survey, which shows that women of low socio-economic status are less likely to use a health facility during childbirth. These results indicate that even in countries like South Sudan where healthcare, including maternal services, are said to have "free" indirect costs, such as transport, that prevent poor women from seeking institutional delivery (112). Further analysis of our data showed that mothers who gave birth at home were more likely to delay initiation of breastfeeding.

4.2 Discussion of methods

Study design

These studies on breastfeeding initiation, pre-lacteal feeding, and health facility utilization used a cross-sectional quantitative design. The major limitation of the cross-sectional design is that it obtains self-reported data at one point-in-time. In addition, a cross-sectional study has in-built weaknesses, such as recall bias compared to a prospective study design. The surveys in this thesis used a short recall duration, which might have led to a lack of representativeness in the data. The second study used a "before and after" study design, with no randomization, with the only comparative group being "before". Lack of randomization is an inbuilt weakness of the "before" and "after" design. This study design is the most useful non-experimental design in determining the immediate effect of a short-term programme, but is less useful in evaluating long-term programmes, since many parallel events can influence the outcome measure over longer time periods. Such circumstances can be threats to the internal validity. In principle, the designs used in this thesis only provide a glimpse into reality, which cannot be used to make any causal inference.

Sample size

The work in this thesis has adequate power, which is vital to answer the research questions and ensure that true relationships are found, while avoiding type II errors. A type II error is

the failure to reject a false null hypothesis (203). The sample size for all 4 studies was calculated in advance and had 90% power. The ranges of the confidence intervals (CI) are good indicators of power; hence, the smaller the CI ranges, the higher the power of the study, as is the case for the studies in this thesis. It could even be argued that the surveys were overpowered for their primary objective or outcome; but when conducting multivariable analysis, this power allows one to include many co-variables without losing too many degrees of freedom.

Internal validity

Threats to the internal validity are possible alternative explanations for the observed results. It is critical to understand whether the studies in this thesis truly measured what they were supposed to. We paid close attention to the main threats of internal validity, such as information bias, selection bias, and confounding (204). Bias is any trend in the collection, analysis, interpretation, publication, or review of data that leads to conclusions that are systematically different from the truth (205). Therefore, internal validity can be assessed by how well the surveys have ruled out alternative explanations for the findings.

Information bias

Data assessment is crucial for the validity of any study relying on self-reported information from study participants, as in our studies. Self-reported data is susceptible to recall bias and social desirability (206, 207); the longer the recall duration, the more challenging it is for the study participant to remember accurately the events and actions (208). Difficulties in remembering the events reduce precision in the information. A recall period of many years seems to increase the tendency to report the desired practice (209).

We used a combination of a short recall of hours within in the postnatal ward of Juba Teaching Hospital, and 24-hour recall in the community survey. However, a 24-hour recall was found inadequate in obtaining information on breastfeeding pattern (210). Evidence has shown that mothers find it difficult to remember the timing of initiation of breastfeeding (211). However, we collected data within 24 hours of delivery, when mothers could vividly remember the circumstances surrounding birth, including breastfeeding in the hospital. Furthermore, we minimized recall bias in the community survey, since most of the mothers

had infants aged 0-6 months. A study on exclusive breastfeeding showed that mothers up to 6 months after birth had a better recall than those with older children (212). Despite the short recall duration in the postnatal ward, there might have been recall bias in estimating timing of breastfeeding initiation, since most mothers had no watch and the ward had no wall-clock. The one hour within which infants were first put to the breast was self-reported by the mothers.

Social desirability is a significant barrier in nutrition studies and other studies of sensitive topics, such as HIV-1 (213, 214). For example, in studies involving adults, foods regarded as unhealthy were less reported than foods considered healthy (215). On the other hand, under-reporting of events have been documented in a study in which adults report on behalf of children (215). In the studies in this thesis, it is likely that the mothers could have under-reported undesired practices, such as birth assisted by traditional birth attendants or relatives, use of pre-lacteal feeds and discarding of colostrum.

Previous studies have stressed the importance of face-to-face interviews compared to self-administered questionnaire and/or telephone interviews, use of appropriate study tools and a conducive environment for interviews (216, 217). To ensure consistency in the studies, we carried out face-to-face interviews at the participant's homestead in a private place away from family members. In addition, the interview time was kept short to avoid fatiguing participants. On average, an interview lasted for about one hour, which was adequate in answering the research question for each paper. However, in some instances it took longer to complete the questionnaire, and this might have caused fatigue among participants.

The tool used in our studies was derived from a validated WHO guideline. The wording in the questionnaire was simplified and we deliberately minimized use of medical jargon and terminologies. The questionnaire was also translated into Bari, the local language, and then back-translated into English to ensure proper understanding of the questions. Trained research assistants conversant in the local language administered the questionnaire. Our studies were consistent with a previous study which reported that it is essential to ensure the wording of the questions and answers in the questionnaire are clear to enhance their understanding, and that the questions should not be intimidating or biased to the study

participants (218). The answers should also cover a range to reflect the experience of the participants.

Selection bias

Selection of research participants is critical; inappropriate choice may distort the results. The selection of participants into the study and loss to follow-up of participants were the primary sources of bias. The study design in our papers allowed one contact with the participants and no follow-up. We minimized bias through a random selection of the participants (Paper I-III). However, we consecutively recruited participants in paper IV. In addition, some participants were not contacted by the study team because they had had an early discharge from the postnatal ward. Thus, it is possible that essential information might have been missed if the discharged participants had different characteristics from those who participated. This probably did not affect the overall results since only a small proportion of participants were discharged early.

Threats to internal validity for the "before-and-after" study

These include historical, instrumental/reporting, maturation, drop-out threats, etc. "Historical threat" arises when one or more events, such as a change of hospital management team or work procedures. These are not part of the intervention but could nevertheless influence the outcome that takes place between the "before" and "after" measurements (219). Historical threat was highly unlikely because there were no changes in the hospital management team, staff or working procedure between the "before" and "after" measurements.

"Instrumentation/reporting threat" occurs when the method of measurement of study outcome change between the "before" and "after" measurements (219). This threat was minimized by using the same questionnaire during data collection before training and after training intervention.

"Maturation threat" arises when the apparent change in breastfeeding initiation might be because of the intervention group naturally changing as it becomes more knowledgeable or experienced rather than to the intervention itself (219). This was highly unlikely in our

survey because the mothers who participated in the “after” study were not the same mothers in the “before” survey.

“Drop-out threat” occurs when many participates drop out of the study to alter the characteristics of the “after” participants (219). This threat was avoided since all the participants who consented took part in the study.

Confounding

Cross-sectional studies are prone to confounding due to non-randomization of exposure variables. We used standard cross-sectional design and a ‘before” and “after” study design after training health workers in the hospital. There was no randomization and only a historical control. In the analysis, comparisons were made between the baseline data and after training. From the designs per se, there is potential for confounding.

To control for confounding in our studies, we included all the factors likely to influence the dependent variable in a multivariable logistic model. The predictors known to be associated with the dependent variable from the literature and variables with a p-value <0.25 from the bivariable logistic regression model were all included in the multivariable logistic model with stepwise selection. The stepwise selection procedure removes the non-significant variables, starting with the least significant and continuing until all the factors left in the model are those significantly associated with the dependent variable. The stepwise multivariable model is robust, which provided highly significant findings. Furthermore, a detailed assessment was carried out to ensure that highly correlated variables, such as “mother’s and father’s educational status”, have not been entered in the model at the same time. Thus, the factors associated with the outcome variable in the final model were found to be coherent with those in the literature and are therefore less likely to be due to chance.

Consistency, reliability and dependability

We paired assistants during the data collection. The supervisor ‘overheard’ a small number of the interviews to check for consistent interviewing, and any deviations were corrected. Furthermore, the principal investigator for these surveys checked the collected data daily for completeness and consistency. Appropriate reporting is also crucial in ensuring the consistency of the data generated in the studies. In this thesis, reporting followed the

recommended guidelines from 'Strengthening the Reporting of Observational Studies in Epidemiology' (STROBE) (220).

Applicability: external validity and transferability

The findings in this thesis may not be generalizable to the whole population because the data was collected from only Jubek State in South Sudan. Nevertheless, our findings give a glimpse of the broader picture in the country. Therefore, the current findings might be used to generate better estimates of health facility utilization at childbirth and breastfeeding practices in rural areas and health facilities in South Sudan. It might also be necessary to relate the specific findings to similar settings within South Sudan. For example, JTH is considered a model health facility, perceived to provide the "best healthcare." Unfortunately, the current results revealed suboptimal breastfeeding practices among the surveyed mothers. We speculate that other health facilities across the country might be far from optimal. Therefore, transferability of the training intervention, which was proved effective in JTH, might apply to other health facilities in South Sudan.

4.3 Strengths and limitations

Strengths

The work in this thesis used the most recent data to assess the determinants of breastfeeding practices, the effect of BFHI training on breastfeeding and examine the social determinants of health facility utilization at birth in the time of civil unrest in South Sudan. The data pertaining to the determinants of breastfeeding in the health facility surveys were collected a few hours after delivery. The results can be used to generate better estimates of breastfeeding practices and health facility use at birth in South Sudan. Furthermore, the results contribute to the body of literature and scientific debate on the determinants of breastfeeding and health facility utilization at birth and highlight the need for targeted maternal and child health interventions in a low resource setting.

Limitations

A major limitation in this thesis was the measurement of the main outcomes with a 2-year recall window. The long recall periods of the time to initiating breastfeeding, use of pre-lacteal feed and health facility utilization might have introduced a misclassification bias. In addition, mothers provided self-reported information on these practices, which might have led to social desirability bias in which the participants report on what was expected and not on actual practices (221).

In the "before" and "after" study, there could be possible historical, instrumental/reporting, maturation threat to internal validity. In addition, data on history of pregnancy, factors such as distance to the health facility, and complications during previous childbirth, were not obtained, which was a major limitation.

Our studies used only a quantitative method. A mixed-methods approach could have given us an in-depth understanding of the factors underlying the breastfeeding practices and health facility utilization. We were unable to carry out an in-depth probe into cultural norms and practices associated with breastfeeding practices and utilization of health facilities due to insecurity caused by the ongoing civil unrest in the country.

In this thesis, the mothers' ability to estimate the exact time of the initiation of breastfeeding was not appropriately assessed. Most mothers had no time-piece in the postnatal ward to accurately assess the timing of early initiation of breastfeeding.

Finally, the outcome of this thesis cannot be generalized to the whole population in the country since the data came from only one community and a single hospital.

4.4 Policy recommendations

Our work supports WHO's breastfeeding recommendations. However, there is a need to target the barriers to optimal breastfeeding practices in South Sudan.

- The Ministry of Health needs to roll out the Baby-Friendly Hospital Initiative training to all health workers and support the accreditation of the Baby-Friendly Hospital Initiative programme in all maternity units.

- There is a need to conduct a countrywide campaign on the importance of utilization of health facility-based delivery, especially in rural communities to increase the use of health facilities during childbirth.
- The donor community and non-governmental organizations need to support the Ministry of Health in implementing the Baby-Friendly Hospital Initiative in hospitals and programmes that promote health facility utilization in South Sudan.

5. Conclusion

The findings in this thesis highlight the need for efforts to increase health facility births, breastfeeding counselling, promote the health benefits of early initiation of breastfeeding, discourage the discarding of colostrum and the use of pre-lacteal feeds. These will result in improved breastfeeding practices and ultimately improved maternal and infant health.

References

1. United Nations. United Nations General Assembly. Transforming our world: the 2030 agenda for sustainable development. New York;2015 [cited 2019 May 2]. Available from: http://www.un.org/ga/search/view_doc.asp?symbol=A/RES/70/1&Lang=E.
2. United Nations. Sustainable development goals. New York: United Nations; 2015 [cited 2019 May 2]. Available from: http://www.un.org/sustainabledevelopment/summit/.
3. United Nations. Levels and Trends in Child Mortality Report. 2018 [cited 2019 May 2]. Available from: https://www.un.org/en/development/desa/.../mortality/child-mortality-report-2018.asp.
4. UNICEF. Committing to child survival: a promise renewed – progress report. 2015 [cited 2019 May 2]. Available from: https://www.unicef.org/publications/index_83078.html.
5. Liu L, Oza S, Hogan D, Chu Y, Perin J, Zhu J, et al. Global, regional, and national causes of under-5 mortality in 2000-15: an updated systematic analysis with implications for the Sustainable Development Goals. Lancet. 2016;388(10063):3027-35.
6. Tawiah-Agyemang C, Kirkwood BR, Edmond K, Bazzano A, Hill Z. Early initiation of breast-feeding in Ghana: barriers and facilitators. Journal of Perinatology. 2008;28 Suppl 2:S46-52.
7. Victora CG, Bahl R, Barros AJ, Franca GV, Horton S, Krasevec J, et al. Breastfeeding in the 21st century: epidemiology, mechanisms, and lifelong effect. Lancet. 2016;387:475-90.
8. Mullany LC, Katz J, Li YM, Khatry SK, LeClerq SC, Darmstadt GL, et al. Breast-feeding patterns, time to initiation, and mortality risk among newborns in southern Nepal. The Journal of Nutrition. 2008;138(3):599-603.
9. Edmond K, Newton S, Hurt L, Shannon CS, Kirkwood BR, Mazumder S. Timing of initiation, patterns of breastfeeding, and infant survival: prospective analysis of pooled data from three randomised trials. Lancet. 2016;4:e266-75.
10. World Health Organization. Implementation guidance: protecting, promoting and supporting breastfeeding in facilities providing maternity and newborn services: the revised Baby-friendly Hospital Initiative. 2018 [cited 2019 May 10]. Available from: https://www.who.int/nutrition/publications/infantfeeding/bfhi-implementation-2018.pdf.
11. Khan J, Vesel L, Bahl R, Martines JC. Timing of breastfeeding initiation and exclusivity of breastfeeding during the first month of life: effects on neonatal mortality and morbidity--a systematic review and meta-analysis. Maternal and Child Health Journal. 2015;19(3):468-79.
12. Benedict RK, Craig HC, Torlesse H, Stoltzfus RJ. Trends and predictors of optimal breastfeeding among children 0-23 months, South Asia: Analysis of national survey data. Maternal & Child Nutrition. 2018;14 Suppl 4:e12698.
13. Adam T, Lim SS, Mehta S, Bhutta ZA, Fogstad H, Mathai M, et al. Cost effectiveness analysis of strategies for maternal and neonatal health in developing countries. BMJ. 2005;331(7525):1107.

14. Iber D, Menshykau D. The control of branching morphogenesis. Open biology. 2013;3(9):130088.
15. Ramsay DT, Kent JC, Owens RA, Hartmann PE. Ultrasound imaging of milk ejection in the breast of lactating women. Pediatrics. 2004;113(2):361-7.
16. Kulski JK, Hartmann PE. Changes in human milk composition during the initiation of lactation. The Australian Journal of Experimental Biology and Medical Science. 1981;59(1):101-14.
17. Kulski JK, Smith M, Hartmann PE. Perinatal concentrations of progesterone, lactose and alpha-lactalbumin in the mammary secretion of women. The Journal of Endocrinology. 1977;74(3):509-10.
18. Neville MC, Morton J, Umemura S. Lactogenesis. The transition from pregnancy to lactation. Pediatric Clinics of North America. 2001;48(1):35-52.
19. The optimal duration of exclusive breastfeeding. Journal of advanced nursing. 2001;35(3):313-5.
20. Truchet S, Honvo-Houeto E. Physiology of milk secretion. Best Practice & Research Clinical Endocrinology & Metabolism. 2017;31(4):367-84.
21. Kent JC, Hepworth AR, Sherriff JL, Cox DB, Mitoulas LR, Hartmann PE. Longitudinal changes in breastfeeding patterns from 1 to 6 months of lactation. Breastfeeding Medicine. 2013;8(4):401-7.
22. Takahashi K, Ganchimeg T, Ota E, Vogel JP, Souza JP, Laopaiboon M, et al. Prevalence of early initiation of breastfeeding and determinants of delayed initiation of breastfeeding: secondary analysis of the WHO Global Survey. Scientific Reports. 2017;7:44868.
23. Issaka AI, Agho KE, Renzaho AM. Prevalence of key breastfeeding indicators in 29 sub-Saharan African countries: a meta-analysis of demographic and health surveys (2010-2015). BMJ. 2017;7(10):e014145.
24. World Health Organization. Indicators for assessing infant and young child feeding practices Geneva;2010 [cited 2019 Aug 18]. Available from: http://www.who.int/nutrition/publications/infantfeeding/9789241599290/en/
25. Kent JC, Mitoulas L, Cox DB, Owens RA, Hartmann PE. Breast volume and milk production during extended lactation in women. Experimental Physiology. 1999;84(2):435-47.
26. Smith HA, Becker GE. Early additional food and fluids for healthy breastfed full-term infants. The Cochrane Database of Systematic Reviews. 2016(8):Cd006462.
27. King FS, Burgess A. Nutrition for developing countries. Second ed. New York : United States: Oxford University Press Inc.; 2000.
28. Bass JL, Gartley T, Kleinman R. World Health Organization Baby-Friendly Hospital Initiative Guideline and 2018 Implementation Guidance. JAMA Pediatrics. 2019;173(1):93-4.
29. Karim F, Billah SM, Chowdhury MAK, Zaka N, Manu A, Arifeen SE, et al. Initiation of breastfeeding within one hour of birth and its determinants among normal vaginal deliveries at primary and secondary health facilities in Bangladesh: A case-observation study. PloS One. 2018;13(8):e0202508.
30. Mukora-Mutseyekwa F, Gunguwo H, Mandigo RG, Mundagowa P. Predictors of early initiation of breastfeeding among Zimbabwean women: secondary analysis of ZDHS 2015. Maternal Health, Neonatology and Perinatology. 2019;5:2.

31. Iliadou M, Lykeridou K, Prezerakos P, Swift EM, Tziaferi SG. Measuring the Effectiveness of a Midwife-led Education Programme in Terms of Breastfeeding Knowledge and Self-efficacy, Attitudes Towards Breastfeeding, and Perceived Barriers of Breastfeeding Among Pregnant Women. Materia Socio-medica. 2018;30(4):240-5.
32. Tewabe T. Timely initiation of breastfeeding and associated factors among mothers in Motta town, East Gojjam zone, Amhara regional state, Ethiopia, 2015: a cross-sectional study. BMC Pregnancy and Childbirth. 2016;16(1):314.
33. Tsai TI, Huang SH, Lee SY. Maternal and Hospital Factors Associated with First-Time Mothers' Breastfeeding Practice: A Prospective Study.Breastfeeding Medicine. 2015;10(6):334-40.
34. Arts M, Geelhoed D, De Schacht C, Prosser W, Alons C, Pedro A. Knowledge, beliefs, and practices regarding exclusive breastfeeding of infants younger than 6 months in Mozambique: a qualitative study. Journal of Human Lactation. 2011;27(1):25-32; quiz 63-5.
35. Osman H, El Zein L, Wick L. Cultural beliefs that may discourage breastfeeding among Lebanese women: a qualitative analysis. International Breastfeeding Journal. 2009;4:12.
36. Bauer J, Gerss J. Longitudinal analysis of macronutrients and minerals in human milk produced by mothers of preterm infants. Clinical Nutrition. 2011;30(2):215-20.
37. Latuga MS, Stuebe A, Seed PC. A review of the source and function of microbiota in breast milk. Seminars in Reproductive Medicine. 2014;32(1):68-73.
38. Le Doare K, Holder B, Bassett A, Pannaraj PS. Mother's Milk: A Purposeful Contribution to the Development of the Infant Microbiota and Immunity. Frontiers in Immunology. 2018;9:361.
39. Han DH, Shin JM, An S, Kim JS, Kim DY, Moon S, et al. Long-term Breastfeeding in the Prevention of Allergic Rhinitis: Allergic Rhinitis Cohort Study for Kids (ARCO-Kids Study). Clinical and experimental otorhinolaryngology. 2019.
40. Gomez-Gallego C, Garcia-Mantrana I, Salminen S, Collado MC. The human milk microbiome and factors influencing its composition and activity. Seminars in Fetal & Neonatal Medicine. 2016;21(6):400-5.
41. McGuire MK, McGuire MA. Got bacteria? The astounding, yet not-so-surprising, microbiome of human milk. Current Opinion in Biotechnology. 2017;44:63-8.
42. Duijts L, Jaddoe VW, Hofman A, Moll HA. Prolonged and exclusive breastfeeding reduces the risk of infectious diseases in infancy. Pediatrics. 2010;126(1):e18-25.
43. Koyanagi A, Humphrey JH, Moulton LH, Ntozini R, Mutasa K, Iliff P, et al. Effect of early exclusive breastfeeding on morbidity among infants born to HIV-negative mothers in Zimbabwe. The American Journal of Clinical Nutrition. 2009;89(5):1375-82.
44. Roth DE, Caulfield LE, Ezzati M, Black RE. Acute lower respiratory infections in childhood: opportunities for reducing the global burden through nutritional interventions. Bulletin of the World Health Organization. 2008;86(5):356-64.
45. Cesar JA, Victora CG, Barros FC, Santos IS, Flores JA. Impact of breast feeding on admission for pneumonia during postneonatal period in Brazil: nested case-control study. BMJ.1999;318(7194):1316-20.

46. Dieterich CM, Felice JP, O'Sullivan E, Rasmussen KM. Breastfeeding and health outcomes for the mother-infant dyad. Pediatric Clinics of North America. 2013;60(1):31-48.
47. Walker WA, Iyengar RS. Breast milk, microbiota, and intestinal immune homeostasis. Pediatric Research. 2015;77(1-2):220-8.
48. Bowatte G, Tham R, Allen KJ, Tan DJ, Lau M, Dai X, et al. Breastfeeding and childhood acute otitis media: a systematic review and meta-analysis. Acta Paediatrica. 2015;104(467):85-95.
49. Kelly MS, Zheng J, Boiditswe S, Steenhoff AP, Feemster KA, Arscott-Mills T, et al. Investigating Mediators of the Poor Pneumonia Outcomes of Human Immunodeficiency Virus-Exposed but Uninfected Children. Journal of the Pediatric Infectious Diseases Society. 2019;8(1):13-20.
50. Kuhn L, Sinkala M, Semrau K, Kankasa C, Kasonde P, Mwiya M, et al. Elevations in mortality associated with weaning persist into the second year of life among uninfected children born to HIV-infected mothers. Clinical infectious diseases. 2010;50(3):437-44.
51. Horta BL, Loret de Mola C, Victora CG. Long-term consequences of breastfeeding on cholesterol, obesity, systolic blood pressure and type 2 diabetes: a systematic review and meta-analysis. Acta Paediatrica (Oslo, Norway : 1992). 2015;104(467):30-7.
52. Rosenbauer J, Herzig P, Giani G. Early infant feeding and risk of type 1 diabetes mellitus-a nationwide population-based case-control study in pre-school children. Diabetes/Metabolism Research and Reviews. 2008;24(3):211-22.
53. Arenz S, Ruckerl R, Koletzko B, von Kries R. Breast-feeding and childhood obesity--a systematic review. International Journal of Obesity and Related Metabolic Disorders. 2004;28(10):1247-56.
54. Chivers P, Hands B, Parker H, Bulsara M, Beilin LJ, Kendall GE, et al. Body mass index, adiposity rebound and early feeding in a longitudinal cohort (Raine Study). International Journal of Obesity (2005). 2010;34(7):1169-76.
55. Jones G, Steketee RW, Black RE, Bhutta ZA, Morris SS. How many child deaths can we prevent this year? Lancet. 2003;362(9377):65-71.
56. Black RE, Victora CG, Walker SP, Bhutta ZA, Christian P, de Onis M, et al. Maternal and child undernutrition and overweight in low-income and middle-income countries. Lancet. 2013;382(9890):427-51.
57. Ip S, Chung M, Raman G, Chew P, Magula N, DeVine D, et al. Breastfeeding and maternal and infant health outcomes in developed countries. Evidence Report/Technology Assessment. 2007(153):1-186.
58. Hauck FR, Thompson JM, Tanabe KO, Moon RY, Vennemann MM. Breastfeeding and reduced risk of sudden infant death syndrome: a meta-analysis. Pediatrics. 2011;128(1):103-10.
59. Kramer MS, Aboud F, Mironova E, Vanilovich I, Platt RW, Matush L, et al. Breastfeeding and child cognitive development: new evidence from a large randomized trial. Archives of General Psychiatry. 2008;65(5):578-84.
60. Horta BL, Bas A, Bhargava SK, Fall CH, Feranil A, de Kadt J, et al. Infant feeding and school attainment in five cohorts from low- and middle-income countries. PloS One. 2013;8(8):e71548.

61. Chowdhury R, Sinha B, Sankar MJ, Taneja S, Bhandari N, Rollins N, et al. Breastfeeding and maternal health outcomes: a systematic review and meta-analysis. Acta Paediatrica. 2015;104(467):96-113.
62. Malarcher S, Spieler J, Fabic MS, Jordan S, Starbird EH, Kenon C. Fertility Awareness Methods: Distinctive Modern Contraceptives. Global Health, Science and Practice. 2016;4(1):13-5.
63. Ramos R, Kennedy KI, Visness CM. Effectiveness of lactational amenorrhoea in prevention of pregnancy in Manila, the Philippines: non-comparative prospective trail. BMJ. 1996;313(7062):909-12.
64. Becker S, Rutstein S, Labbok MH. Estimation of births averted due to breast-feeding and increases in levels of contraception needed to substitute for breast-feeding. Journal of Biosocial Science. 2003;35(4):559-74.
65. Unar-Munguia M, Stern D, Colchero MA, Gonzalez de Cosio T. The burden of suboptimal breastfeeding in Mexico: Maternal health outcomes and costs. Maternal & child nutrition. 2018:e12661.
66. Gaitskell K, Green J, Pirie K, Barnes I, Hermon C, Reeves GK, et al. Histological subtypes of ovarian cancer associated with parity and breastfeeding in the prospective Million Women Study. International Journal of Cancer. 2018;142(2):281-9.
67. Sung HK, Ma SH, Choi JY, Hwang Y, Ahn C, Kim BG, et al. The Effect of Breastfeeding Duration and Parity on the Risk of Epithelial Ovarian Cancer: A Systematic Review and Meta-analysis. Journal of Preventive Medicine and Public Health. 2016;49(6):349-66.
68. Hatloy A, Oshaug A. Human milk: an invisible food resource. Journal of Human Lactation. 1997;13(4):299-305.
69. Bartick M, Reinhold A. The burden of suboptimal breastfeeding in the United States: a pediatric cost analysis. Pediatrics. 2010;125(5):e1048-56.
70. Bartick MC, Schwarz EB, Green BD, Jegier BJ, Reinhold AG, Colaizy TT, et al. Suboptimal breastfeeding in the United States: Maternal and pediatric health outcomes and costs. Maternal & Child Nutrition. 2017;13(1).
71. UNAIDS. State of the epidemic. 2018 [cited 2019 May 7]. Available from: www.unaids.org/sites/default/files/media_asset/unaids-data-2018_en.pdf.
72. World Health Organization. HIV transmission through breastfeeding 2004 [cited 2019 April,28]. Available from: https://www.who.int/nutrition/publications/HIV_IF_Transmission.pdf.
73. Van de Perre P, Rubbo PA, Viljoen J, Nagot N, Tylleskar T, Lepage P, et al. HIV-1 reservoirs in breast milk and challenges to elimination of breast-feeding transmission of HIV-1. Science Translational Medicine. 2012;4(143):143sr3.
74. Van de Perre P, Simonon A, Msellati P, Hitimana DG, Vaira D, Bazubagira A, et al. Postnatal transmission of human immunodeficiency virus type 1 from mother to infant. A prospective cohort study in Kigali, Rwanda. The New England Journal of Medicine. 1991;325(9):593-8.
75. World Health Organization. Guideline updates on HIV and infant feeding: the duration of breastfeeding and support from health services to improve feeding practices among mothers living with HIV. Geneva;: World Health Organization; 2016 [cited 2019 May 3]. Available from: https://www.who.int/maternal_child_adolescent/.../hiv-infant-feeding-2016/en/.

76. World Health Organization. Guidelines for managing advanced HIV disease and rapid initiation of antiretroviral therapy 2017, [cited 2019 April,29]. Available from: https://www.who.int/hiv/pub/guidelines/advanced-HIV-disease/en/.
77. Gejo NG, Weldearegay HG, KT WT, Mekango DE, Woldemichael ES, Buda AS, et al. Exclusive breastfeeding and associated factors among HIV positive mothers in Northern Ethiopia. PloS One. 2019;14(1):e0210782.
78. Okanda J, Otieno G, Kinuthia J, Kohler P, John-Stewart G. Higher likelihood of 6-months exclusive breastfeeding among HIV infected than uninfected mothers: a household survey in Kenya. International Breastfeeding Journal. 2018;13:51.
79. Mugwaneza P, Lyambabaje A, Umubyeyi A, Humuza J, Tsague L, Mwanyumba F, et al. Impact of maternal ART on mother-to-child transmission (MTCT) of HIV at six weeks postpartum in Rwanda. BMC Public Health. 2018;18(1):1248.
80. Coovadia HM, Rollins NC, Bland RM, Little K, Coutsoudis A, Bennish ML, et al. Mother-to-child transmission of HIV-1 infection during exclusive breastfeeding in the first 6 months of life: an intervention cohort study. Lancet. 2007;369(9567):1107-16.
81. Becquet R, Marston M, Dabis F, Moulton LH, Gray G, Coovadia HM, et al. Children who acquire HIV infection perinatally are at higher risk of early death than those acquiring infection through breastmilk: a meta-analysis. PloS One. 2012;7(2):e28510.
82. Coutsoudis A, Kuhn L, Pillay K, Coovadia HM. Exclusive breast-feeding and HIV transmission. AIDS (London, England). 2002;16(3):498-9.
83. Iliff PJ, Piwoz EG, Tavengwa NV, Zunguza CD, Marinda ET, Nathoo KJ, et al. Early exclusive breastfeeding reduces the risk of postnatal HIV-1 transmission and increases HIV-free survival. AIDS. 2005;19(7):699-708.
84. Cournil A, De Vincenzi I, Gaillard P, Cames C, Fao P, Luchters S, et al. Relationship between mortality and feeding modality among children born to HIV-infected mothers in a research setting: the Kesho Bora study. AIDS. 2013;27(10):1621-30.
85. United Nations Children's Fund. Convention on the Rights of the Child [cited 2019 May 15]. Available from: https://www.unicef.org/child-rights-convention.
86. United Nations Office of the High Commissioner for Human Rights. Breastfeeding a matter of human rights, say UN experts, urging action on formula milk. New York;: United Nations; 2016 [cited 2019 May 3]. Available from: http://www.ohchr.org/EN/NewsEvents/Pages/DisplayNews.aspx?NewsID=20904&LangID=E%28.
87. ILO. Maternity and paternity at work – Law and practice across the world 2016 [Available from: i2.cdn.turner.com/cnn/2016/images/01/28/wcms_242615.pdf.
88. Araujo RG, Fonseca VM, de Oliveira MIC, Ramos EG. External evaluation and self-monitoring of the Baby-friendly Hospital Initiative's maternity hospitals in Brazil. International breastfeeding journal. 2019;14:1.
89. Kavle JA, Ahoya B, Kiige L, Mwando R, Olwenyi F, Straubinger S, et al. Baby-Friendly Community Initiative-From national guidelines to implementation: A multisectoral platform for improving infant and young child feeding practices and integrated health services. Maternal & Child Nutrition. 2019;15 Suppl 1:e12747.
90. Kavle JA, Welch PR, Bwanali F, Nyambo K, Guta J, Mapongo N, et al. The revitalization and scale-up of the Baby-Friendly Hospital Initiative in Malawi. Maternal & Child Nutrition. 2019;15 Suppl 1:e12724.

91. WHO U. Breastfeeding Counselling: a training course. 1993 [cited 2019 April,22]. Available from: https://www.who.int/maternal_child_adolescent/.../pdfs/bc_participants_manual.pdf.
92. West NS, Schwartz SR, Yende N, Schwartz SJ, Parmley L, Gadarowski MB, et al. Infant feeding by South African mothers living with HIV: implications for future training of health care workers and the need for consistent counseling. International Breastfeeding Journal. 2019;14:11.
93. Sinha B, Chowdhury R, Sankar MJ, Martines J, Taneja S, Mazumder S, et al. Interventions to improve breastfeeding outcomes: a systematic review and meta-analysis. Acta Paediatrica. 2015;104(467):114-34.
94. Sinha B, Chowdhury R, Upadhyay RP, Taneja S, Martines J, Bahl R, et al. Integrated interventions delivered in health systems, home, and community have the highest impact on breastfeeding outcomes in Low-and Middle-Income countries. The Journal of Nutrition. 2017;147(11):2179s-87s.
95. Gupta N, Katende C, Bessinger R. An evaluation of post-campaign knowledge and practices of exclusive breastfeeding in Uganda. Journal of Health, Population, and Nutrition. 2004;22(4):429-39.
96. Sanghvi T, Haque R, Roy S, Afsana K, Seidel R, Islam S, et al. Achieving behaviour change at scale: Alive & Thrive's infant and young child feeding programme in Bangladesh. Maternal & Child Nutrition. 2016;12 Suppl 1:141-54.
97. Mbuya MNN, Matare CR, Tavengwa NV, Chasekwa B, Ntozini R, Majo FD, et al. Early Initiation and Exclusivity of Breastfeeding in Rural Zimbabwe: Impact of a Breastfeeding Intervention Delivered by Village Health Workers. Current Developments in Nutrition. 2019;3(4):nzy092.
98. Bich TH, Long TK, Hoa DP. Community-based father education intervention on breastfeeding practice-Results of a quasi-experimental study. Maternal & Child Nutrition. 2019;15 Suppl 1:e12705.
99. Nankunda J, Tumwine JK, Nankabirwa V, Tylleskar T. "She would sit with me": mothers' experiences of individual peer support for exclusive breastfeeding in Uganda. International Breastfeeding Journal. 2010;5:16.
100. Tylleskar T, Jackson D, Meda N, Engebretsen IM, Chopra M, Diallo AH, et al. Exclusive breastfeeding promotion by peer counsellors in sub-Saharan Africa (PROMISE-EBF): a cluster-randomised trial. Lancet. 2011;378:420-7.
101. Haider R, Ashworth A, Kabir I, Huttly SR. Effect of community-based peer counsellors on exclusive breastfeeding practices in Dhaka, Bangladesh: a randomised controlled trial [see commments]. Lancet. 2000;356(9242):1643-7.
102. Adegoke AA, van den Broek N. Skilled birth attendance-lessons learnt. BJOG. 2009;116 Suppl 1:33-40.
103. Montagu D, Yamey G, Visconti A, Harding A, Yoong J. Where do poor women in developing countries give birth? A multi-country analysis of demographic and health survey data. PloS One. 2011;6(2):e17155.
104. WHO. Neonatal and perinatal mortality: country, regional and global estimates 2006 [Available from: https://apps.who.int/iris/handle/10665/43444.
105. Lawn JE, Blencowe H, Pattinson R, Cousens S, Kumar R, Ibiebele I, et al. Stillbirths: Where? When? Why? How to make the data count? Lancet. 2011;377(9775):1448-63.

106. Geleto A, Chojenta C, Musa A, Loxton D. Barriers to access and utilization of emergency obstetric care at health facilities in sub-Saharan Africa: a systematic review of literature. Systematic Reviews. 2018;7(1):183.
107. Siraj A, Teka W, Hebo H. Prevalence of disrespect and abuse during facility based child birth and associated factors, Jimma University Medical Center, Southwest Ethiopia. BMC Pregnancy and Childbirth. 2019;19(1):185.
108. Mrisho M, Schellenberg JA, Mushi AK, Obrist B, Mshinda H, Tanner M, et al. Factors affecting home delivery in rural Tanzania. Tropical Medicine & International Health. 2007;12(7):862-72.
109. Bohren MA, Hunter EC, Munthe-Kaas HM, Souza JP, Vogel JP, Gulmezoglu AM. Facilitators and barriers to facility-based delivery in low- and middle-income countries: a qualitative evidence synthesis. Reproductive Health. 2014;11(1):71.
110. Dankwah E, Zeng W, Feng C, Kirychuk S, Farag M. The social determinants of health facility delivery in Ghana. Reproductive Health. 2019;16(1):101.
111. Kahsay ZH, Hiluf MK, Shamie R, Tadesse Y, Bazzano AN. Pregnant Women's Intentions to Deliver at a Health Facility in the Pastoralist Communities of Afar, Ethiopia: An Application of the Health Belief Model. International Journal of Environmental Research and Public Health. 2019;16(5).
112. Wilunda C, Scanagatta C, Putoto G, Takahashi R, Montalbetti F, Segafredo G, et al. Barriers to Institutional Childbirth in Rumbek North County, South Sudan: A Qualitative Study. PloS One. 2016;11(12):e0168083.
113. ROBERT GERENGE. South Sudan's December 2013 conflict 2016 [cited 2019 May 22]. Available from: https://www.accord.org.za/ajcr-issues/ south-sudans-december-2013-conflict/.
114. Housden L. Infant-feeding in north-east Africa. Br Med J. 1950;2(4676):456-7.
115. United Nations Children's Fund. The state of the world's children. New York; 2017 [cited 2019 May 3]. Available from: https://www.unicef.org/sowc2017/.
116. Alkema L, Chou D, Hogan D, Zhang S, Moller AB, Gemmill A, et al. Global, regional, and national levels and trends in maternal mortality between 1990 and 2015, with scenario-based projections to 2030: a systematic analysis by the UN Maternal Mortality Estimation Inter-Agency Group. Lancet. 2016;387(10017):462-74.
117. Sami S, Kerber K, Kenyi S, Amsalu R, Tomczyk B, Jackson D, et al. State of newborn care in South Sudan's displacement camps: a descriptive study of facility-based deliveries. Reproductive Health. 2017;14(1):161.
118. Devi S. Famine in South Sudan. Lancet (London, England). 2017;389(10083):1967-70.
119. Charchuk R, Houston S, Hawkes MT. Elevated prevalence of malnutrition and malaria among school-aged children and adolescents in war-ravaged South Sudan. Pathogens and Global Health. 2015;109(8):395-400.
120. UNAIDS. South Sudan's HIV prevalence may lead to an epidemic [cited 2019 April,18]. Available from: https://www.africanews.com/.../south-sudan-s-hiv-prevalence-may-lead-to-an-epidemic-...
121. UNAIDS. South Sudan 2016 [cited 2019 April,18]. Available from: www.unaids.org/en/regionscountries/countries/southsudan.
122. WHO. South Sudan - HIV country profile 2016 [cited 2019 April,18]. Available from: https://www.who.int/hiv/data/Country_profile_South_Sudan.pdf.

123. Hector D, King L, Webb K, Heywood P. Factors affecting breastfeeding practices: applying a conceptual framework. New South Wales public health bulletin. 2005;16(3-4):52-5.
124. Sudan referendum: what's being voted on and what will happen? The Telegraph. 2011.
125. BBC. South Sudan backs independence - results. 2011.
126. Advocate. SS. Map of South Sudan 2017 [cited 2019 August, 3]. Available from: southsudanadvocate.org/wp-content/upload/2017/07/map-south-sudan-alt.png.
127. Government of Southern Sudan. Southern Sudan counts. South Sudan Bureau of Statistics; 2008.
128. Wikipedia. States of South Sudan 2015 [cited 2019 August,3]. Available from: https://en.wikipedia.org/wiki/States_of_South_Sudan.
129. Dean AG, Sullivan KM, Soe MM. Open epi: open source epidemiologic statistics for public health. 2013 [cited 2019 May 3]. Available from: https://www.openepi.com/.
130. United Nations Children's Fund/World Health Organization. Baby-friendly hospital initiative. 2017 [cited 2019 May 3]. Available from: https://www.unicef.org/nutrition/files/BFHI_Case_Studies_FINAL.pdf.
131. Wamani H, Astrom AN, Peterson S, Tylleskar T, Tumwine JK. Infant and young child feeding in western Uganda: knowledge, practices and socio-economic correlates. Journal of Tropical Pediatrics. 2005;51:356-61.
132. Groppi L, Somigliana E, Pisani V, Ika M, Mabor JL, Akec HN, et al. A hospital-centered approach to improve emergency obstetric care in South Sudan. International journal of gynaecology and obstetrics: the official organ of the International Federation of Gynaecology and Obstetrics. 2015;128:58-61.
133. The Govenment of the Republic of Sudan. The Republic of South Sudan: The Sudan Household Health Survey 2010 [cited 2019 May 22]. Available from: https://www.google.com/url?sa=t&rct=j&q=&esrc=s&source=web&cd=3&cad=rja&uact=8&ved=2ahUKEwjv1bvp4q7iAhXnsaQKHd5-DQYQFjACegQIAhAB&url=https%3A%2F%2Freliefweb.int%2Freport%2Fsouth-sudan-republic%2Frepublic-south-sudan-sudan-household-health-survey-2010&usg=AOvVaw0RS2TYlvkSGkfxFXCOvxft.
134. Bennett S, Woods T, Liyanage WM, Smith DL. A simplified general method for cluster-sample surveys of health in developing countries. World Health Statistics. 1991;44(3):98-106.
135. Osubor KM, Fatusi AO, Chiwuzie JC. Maternal health-seeking behavior and associated factors in a rural Nigerian community. Maternal and Child Health Journal. 2006;10(2):159-69.
136. Berde AS, Yalcin SS, Ozcebe H, Uner S, Caman OK. Determinants of pre-lacteal feeding practices in urban and rural Nigeria; a population-based cross-sectional study using the 2013 Nigeria demographic and health survey data. African Health Sciences. 2017;17:690-9.
137. Exavery A, Kante AM, Hingora A, Phillips JF. Determinants of early initiation of breastfeeding in rural Tanzania. International Breastfeeding Journal. 2015;10:27.
138. Mukunya D, Tumwine JK, Nankabirwa V, Ndeezi G, Odongo I, Tumuhamye J, et al. Factors associated with delayed initiation of breastfeeding: a survey in Northern Uganda. Global Health Action. 2017;10(1):1410975.

139. Abie BM, Goshu YA. Early initiation of breastfeeding and colostrum feeding among mothers of children aged less than 24 months in Debre Tabor, northwest Ethiopia: a cross-sectional study. BMC Research Notes. 2019;12(1):65.
140. Beyene MG, Geda NR, Habtewold TD, Assen ZM. Early initiation of breastfeeding among mothers of children under the age of 24 months in southern Ethiopia. International Breastfeeding Journal. 2016;12:1.
141. Nguyen PH, Keithly SC, Nguyen NT, Nguyen TT, Tran LM, Hajeebhoy N. Prelacteal feeding practices in Vietnam: challenges and associated factors. BMC Public Health. 2013;13:932.
142. Legesse M, Demena M, Mesfin F, Haile D. Prelacteal feeding practices and associated factors among mothers of children aged less than 24 months in Raya Kobo district, North Eastern Ethiopia: a cross-sectional study. International Breastfeeding Journal. 2014;9(1):189.
143. Bergamaschi N, Oakley L, Benova L. Is childbirth location associated with higher rates of favourable early breastfeeding practices in Sub-Saharan Africa? Journal of Global Health. 2019;9(1):010417.
144. Rogers NL, Abdi J, Moore D, Nd'iangui S, Smith LJ, Carlson AJ, et al. Colostrum avoidance, prelacteal feeding and late breast-feeding initiation in rural Northern Ethiopia. Public health nutrition. 2011;14:2029-36.
145. Liben ML, Yesuf EM. Determinants of early initiation of breastfeeding in Amibara district, northeastern Ethiopia: a community based cross-sectional study. International Breastfeeding Journal. 2016;11:7.
146. Atusiimire LB, Waiswa P, Atuyambe L, Nankabirwa V, Okuga M. Determinants of facility based-deliveries among urban slum dwellers of Kampala, Uganda. PloS One. 2019;14(4):e0214995.
147. WHO. Global nutrition targets 2025. [cited 2019 May 10]. Available from: https://www.who.int/nutrition/global-target-2025/en/.
148. Kalisa R, Malande O, Nankunda J, Tumwine JK. Magnitude and factors associated with delayed initiation of breastfeeding among mothers who deliver in Mulago hospital, Uganda. African Health Sciences. 2015;15(4):1130-5.
149. Muda CMC, Ismail TAT, Jalil RA, Hairon SM, Sulaiman Z, Johar N. Maternal Factors Associated with the Initiation of Exclusive Breastfeeding among Mothers at One Week after Delivery in Two Selected Hospitals in Kelantan, Malaysia. The Malaysian Journal of Medical Sciences. 2018;25(4):112-21.
150. Prasad B, Costello AM. Impact and sustainability of a "baby friendly" health education intervention at a district hospital in Bihar, India. BMJ. 1995;310(6980):621-3.
151. Shinwell ES, Churgin Y, Shlomo M, Shani M, Flidel-Rimon O. The effect of training nursery staff in breastfeeding guidance on the duration of breastfeeding in healthy term infants. Breastfeeding Medicine. 2006;1(4):247-52.
152. Sethi V, Kashyap S, Seth V. Effect of nutrition education of mothers on infant feeding practices. Indian Journal of Pediatrics. 2003;70(6):463-6.
153. John JR, Mistry SK, Kebede G, Manohar N, Arora A. Determinants of early initiation of breastfeeding in Ethiopia: a population-based study using the 2016 demographic and health survey data. BMC Pregnancy and Childbirth. 2019;19(1):69.

154. Arora A, Manohar N, Hayen A, Bhole S, Eastwood J, Levy S, et al. Determinants of breastfeeding initiation among mothers in Sydney, Australia: findings from a birth cohort study. International breastfeeding Journal. 2017;12:39.
155. Berde AS, Yalcin SS. Determinants of early initiation of breastfeeding in Nigeria: a population-based study using the 2013 demograhic and health survey data. BMC Pregnancy and Childbirth. 2016;16:32.
156. Perez-Escamilla R, Maulen-Radovan I, Dewey KG. The association between cesarean delivery and breast-feeding outcomes among Mexican women. American Journal of Public Health. 1996;86(6):832-6.
157. World Health Organization. Statement on Caesarean Section Rates. 2015 [cited 2019 May 14]. Available from: https://apps.who.int/iris/bitstream/10665/161442/1/WHO_RHR_15.02_eng.pdf.
158. Piwoz EG, Huffman SL. The Impact of Marketing of Breast-Milk Substitutes on WHO-Recommended Breastfeeding Practices. Food and Nutrition Bulletin. 2015;36(4):373-86.
159. Hernandez-Cordero S, Lozada-Tequeanes AL, Shamah-Levy T, Lutter C, Gonzalez de Cosio T, Saturno-Hernandez P, et al. Violations of the International Code of Marketing of Breast-milk Substitutes in Mexico. Maternal & Child Nutrition. 2018:e12682.
160. Sobel HL, Iellamo A, Raya RR, Padilla AA, Olive JM, Nyunt US. Is unimpeded marketing for breast milk substitutes responsible for the decline in breastfeeding in the Philippines? An exploratory survey and focus group analysis. Social Science & Medicine (1982). 2011;73(10):1445-8.
161. Rollins NC, Bhandari N, Hajeebhoy N, Horton S, Lutter CK, Martines JC, et al. Why invest, and what it will take to improve breastfeeding practices? Lancet. 2016;387:491-504.
162. Pries AM, Huffman SL, Adhikary I, Upreti SR, Dhungel S, Champeny M, et al. Promotion and prelacteal feeding of breastmilk substitutes among mothers in Kathmandu Valley, Nepal. Maternal & Child Nutrition. 2016;12 Suppl 2:8-21.
163. Kent G. Global infant formula: monitoring and regulating the impacts to protect human health. International Breastfeeding Journal. 2015;10:6.
164. Kimani-Murage EW, Madise NJ, Fotso JC, Kyobutungi C, Mutua MK, Gitau TM, et al. Patterns and determinants of breastfeeding and complementary feeding practices in urban informal settlements, Nairobi Kenya. BMC Public Health. 2011;11:396.
165. Shakya P, Kunieda MK, Koyama M, Rai SS, Miyaguchi M, Dhakal S, et al. Effectiveness of community-based peer support for mothers to improve their breastfeeding practices: A systematic review and meta-analysis. PloS One. 2017;12(5):e0177434.
166. Meedya S, Fahy K, Kable A. Factors that positively influence breastfeeding duration to 6 months: a literature review. Women and Birth. 2010;23(4):135-45.
167. Abbass-Dick J, Dennis CL. Maternal and paternal experiences and satisfaction with a co-parenting breastfeeding support intervention in Canada. Midwifery. 2018;56:135-41.
168. deMontigny F, Gervais C, Lariviere-Bastien D, St-Arneault K. The role of fathers during breastfeeding. Midwifery. 2018;58:6-12.

169. Leng RNW, Shorey S, Yin SLK, Chan CPP, He HG. Fathers' Involvement in Their Wives'/Partners' Breastfeeding: A Descriptive Correlational Study. Journal of Human Lactation. 2019:890334419830988.
170. Pontes CM, Osorio MM, Alexandrino AC. Building a place for the father as an ally for breast feeding. Midwifery. 2009;25(2):195-202.
171. Tadesse K, Zelenko O, Mulugeta A, Gallegos D. Effectiveness of breastfeeding interventions delivered to fathers in low- and middle-income countries: A systematic review. Maternal & Child Nutrition. 2018;14(4):e12612.
172. Abbass-Dick J, Brown HK, Jackson KT, Rempel L, Dennis CL. Perinatal breastfeeding interventions including fathers/partners: A systematic review of the literature. Midwifery. 2019;75:41-51.
173. Nguyen PH, Avula R, Headey D, Tran LM, Ruel MT, Menon P. Progress and inequalities in infant and young child feeding practices in India between 2006 and 2016. Maternal & Child Nutrition. 2018;14 Suppl 4:e12663.
174. Ogbo FA, Page A, Agho KE, Claudio F. Determinants of trends in breast-feeding indicators in Nigeria, 1999-2013. Public Health Nutrition. 2015;18(18):3287-99.
175. Engebretsen IM, Wamani H, Karamagi C, Semiyaga N, Tumwine J, Tylleskar T. Low adherence to exclusive breastfeeding in Eastern Uganda: a community-based cross-sectional study comparing dietary recall since birth with 24-hour recall. BMC Pediatrics. 2007;7:10.
176. Berde AS, Ozcebe H. Risk factors for prelacteal feeding in sub-Saharan Africa: a multilevel analysis of population data from twenty-two countries. Public Health Nutrition. 2017;20(11):1953-62.
177. Bimerew A, Teshome M, Kassa GM. Prevalence of timely breastfeeding initiation and associated factors in Dembecha district, North West Ethiopia: a cross-sectional study. International Breastfeeding Journal. 2016;11:28.
178. Tewabe T. Prelacteal Feeding Practices among Mothers in Motta Town, Northwest Ethiopia: A Cross-sectional Study. Ethiopian Journal of Health Sciences. 2018;28(4):393-402.
179. Tekaly G, Kassa M, Belete T, Tasew H, Mariye T, Teshale T. Pre-lacteal feeding practice and associated factors among mothers having children less than two years of age in Aksum town, Tigray, Ethiopia, 2017: a cross-sectional study. BMC Pediatrics. 2018;18(1):310.
180. Amele EA, Demissie BW, Desta KW, Woldemariam EB. Prelacteal feeding practice and its associated factors among mothers of children age less than 24 months old in Southern Ethiopia. Italian Journal of Pediatrics. 2019;45(1):15.
181. Temesgen H, Negesse A, Woyraw W, Getaneh T, Yigizaw M. Prelacteal feeding and associated factors in Ethiopia: systematic review and meta-analysis. International Breastfeeding Journal. 2018;13:49.
182. Nkala TE, Msuya SE. Prevalence and predictors of exclusive breastfeeding among women in Kigoma region, Western Tanzania: a community based cross-sectional study. International Breastfeeding Journal. 2011;6(1):17.
183. Chea N, Asefa A. Prelacteal feeding and associated factors among newborns in rural Sidama, south Ethiopia: a community based cross-sectional survey. International Breastfeeding Journal. 2018;13:7.

184. Otoo GE, Lartey AA, Perez-Escamilla R. Perceived incentives and barriers to exclusive breastfeeding among periurban Ghanaian women. Journal of Human Lactation. 2009;25(1):34-41.
185. Mgongo M, Hussein TH, Stray-Pedersen B, Vangen S, Msuya SE, Wandel M. "We give water or porridge, but we don't really know what the child wants:" a qualitative study on women's perceptions and practises regarding exclusive breastfeeding in Kilimanjaro region, Tanzania. BMC Pregnancy and Childbirth. 2018;18(1):323.
186. Legesse M, Demena M, Mesfin F, Haile D. Prelacteal feeding practices and associated factors among mothers of children aged less than 24 months in Raya Kobo district, North Eastern Ethiopia: a cross-sectional study. International Breastfeeding Journal. 2014;9:189.
187. Hailemariam TW, Adeba E, Sufa A. Predictors of early breastfeeding initiation among mothers of children under 24 months of age in rural part of West Ethiopia. BMC Public Health. 2015;15:1076.
188. Alemu SM, Alemu YM, Habtewold TD. Association of age and colostrum discarding with breast-feeding practice in Ethiopia: systematic review and meta-analyses. Public Health Nutrition. 2019:1-20.
189. Mugo NS, Dibley MJ, Damundu EY, Alam A. Barriers Faced by the Health Workers to Deliver Maternal Care Services and Their Perceptions of the Factors Preventing Their Clients from Receiving the Services: A Qualitative Study in South Sudan. Maternal and Child Health Journal. 2018.
190. Mugo NS, Dibley MJ, Damundu EY, Alam A. "The system here isn't on patients' side"- perspectives of women and men on the barriers to accessing and utilizing maternal healthcare services in South Sudan. BMC Health Services Research. 2018;18(1):10.
191. Salama P, Spiegel P, Talley L, Waldman R. Lessons learned from complex emergencies over past decade. Lancet. 2004;364(9447):1801-13.
192. Casey SE, Chynoweth SK, Cornier N, Gallagher MC, Wheeler EE. Progress and gaps in reproductive health services in three humanitarian settings: mixed-methods case studies. Conflict and Health. 2015;9(Suppl 1 Taking Stock of Reproductive Health in Humanitarian):S3.
193. Kruk ME, Kujawski S, Moyer CA, Adanu RM, Afsana K, Cohen J, et al. Next generation maternal health: external shocks and health-system innovations. Lancet. 2016;388(10057):2296-306.
194. Berendes S, Lako RL, Whitson D, Gould S, Valadez JJ. Assessing the quality of care in a new nation: South Sudan's first national health facility assessment. Tropical Medicine & International Health. 2014;19(10):1237-48.
195. Kane S, Rial M, Kok M, Matere A, Dieleman M, Broerse JEW. Too afraid to go: fears of dignity violations as reasons for non-use of maternal health services in South Sudan. Reproductive Health. 2018;15(1):51.
196. Mugo NS, Agho KE, Dibley MJ. Risk Factors for Non-use of Skilled Birth Attendants: Analysis of South Sudan Household Survey, 2010. Maternal and Child Health Journal. 2016;20(6):1266-79.
197. Bishanga DR, Drake M, Kim YM, Mwanamsangu AH, Makuwani AM, Zoungrana J, et al. Factors associated with institutional delivery: Findings from a cross-sectional study in Mara and Kagera regions in Tanzania. PloS One. 2018;13(12):e0209672.

198. Campbell OM, Calvert C, Testa A, Strehlow M, Benova L, Keyes E, et al. The scale, scope, coverage, and capability of childbirth care. Lancet. 2016;388(10056):2193-208.
199. Margolis R. Educational differences in healthy behavior changes and adherence among middle-aged Americans. Journal of Health and Social Behavior. 2013;54(3):353-68.
200. Cutler DM, Lleras-Muney A. Understanding differences in health behaviors by education. Journal of Health Economics. 2010;29(1):1-28.
201. Ridde V, Morestin F. A scoping review of the literature on the abolition of user fees in health care services in Africa. Health Policy and Planning. 2011;26(1):1-11.
202. De Allegri M, Ridde V, Louis VR, Sarker M, Tiendrebeogo J, Ye M, et al. Determinants of utilisation of maternal care services after the reduction of user fees: a case study from rural Burkina Faso. Health Policy. 2011;99(3):210-8.
203. Martin Bland. An introduction to medical statistics 4th ed. Oxford; New York: Oxford University Press; 2015.
204. Rothman KJ. Epidemiology: an introduction. 2nd ed: Oxford University Press,USA; 2012.
205. Last JM AJ. International Epidemiological Association: A Dictionary of epidemiology 3rd ed. New York: Oxford University Press; 1995.
206. Fadnes LT TA, Tylleskar T. How to identify information bias due to selfreporting in epidemiological research. The Internet Journal of Epidemiology. 2009;7(2).
207. Bland RM, Rollins NC, Solarsh G, Van den Broeck J, Coovadia HM. Maternal recall of exclusive breast feeding duration. Archives of Disease in Childhood. 2003;88(9):778-83.
208. Gillespie B, d'Arcy H, Schwartz K, Bobo JK, Foxman B. Recall of age of weaning and other breastfeeding variables. International Breastfeeding Journal. 2006;1:4.
209. Promislow JH, Gladen BC, Sandler DP. Maternal recall of breastfeeding duration by elderly women. American Journal of Epidemiology. 2005;161(3):289-96.
210. Aarts C, Kylberg E, Hornell A, Hofvander Y, Gebre-Medhin M, Greiner T. How exclusive is exclusive breastfeeding? A comparison of data since birth with current status data. International Journal of Epidemiology. 2000;29(6):1041-6.
211. Huttly SR, Barros FC, Victora CG, Beria JU, Vaughan JP. Do mothers overestimate breast feeding duration? An example of recall bias from a study in southern Brazil. American journal of Epidemiology. 1990;132(3):572-5.
212. Greiner T. Exclusive breastfeeding: measurement and indicators. International Breastfeeding Journal. 2014;9:18.
213. Guest G, Bunce A, Johnson L, Akumatey B, Adeokun L. Fear, hope and social desirability bias among women at high risk for HIV in West Africa. The Journal of Family Flanning and Reproductive Health Care. 2005;31(4):285-7.
214. Miller TM, Abdel-Maksoud MF, Crane LA, Marcus AC, Byers TE. Effects of social approval bias on self-reported fruit and vegetable consumption: a randomized controlled trial. Nutrition Journal. 2008;7:18.
215. Westerterp KR, Goris AH. Validity of the assessment of dietary intake: problems of misreporting. Current Opinion in Clinical Nutrition and Metabolic Care. 2002;5(5):489-93.

216. Kesmodel U, Frydenberg M. Binge drinking during pregnancy--is it possible to obtain valid information on a weekly basis? American Journal of Epidemiology. 2004;159(8):803-8.
217. van Ooijen M, Ivens UI, Johansen C, Skov T. Comparison of a self-administered questionnaire and a telephone interview of 146 Danish waste collectors. American Journal of Industrial Medicine. 1997;31(5):653-8.
218. Artino AR, Jr., Phillips AW, Utrankar A, Ta AQ, Durning SJ. "The Questions Shape the Answers": Assessing the Quality of Published Survey Instruments in Health Professions Education Research. Academic Medicine. 2018;93(3):456-63.
219. Ho AMH, Phelan R, Mizubuti GB, Murdoch JAC, Wickett S, Ho AK, et al. Bias in Before-After Studies: Narrative Overview for Anesthesiologists. Anesthesia and Analgesia. 2018;126(5):1755-62.
220. The EQUATOR Network. STROBE - Statement 2015 [cited 2019 May 21]. Available from: www.equator-network.org › Library › Reporting Guideline.
221. Leurent B, Reyburn H, Muro F, Mbakilwa H, Schellenberg D. Monitoring patient care through health facility exit interviews: an assessment of the Hawthorne effect in a trial of adherence to malaria treatment guidelines in Tanzania. BMC Infectious Diseases. 2016;16:59.

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Factors associated with delayed initiation of breastfeeding: a cross-sectional study in South Sudan

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Abstract

Background: The global breastfeeding recommendation states that all infants should be put to the breast within one hour of birth, which is defined as timely initiation or early initiation of breastfeeding. Early initiation of breastfeeding is associated with reduced risk in infant illness and death. Understanding the determinants of delay in initiation of breastfeeding might spur health staff and policy makers to foster timely breastfeeding. We assessed the prevalence and determinants of delay in initiation of breastfeeding among mothers in Juba Teaching Hospital.

Methods: The present study enrolled 806 mother-infant pairs within 24 hrs of birth in Juba Teaching Hospital in 2017. The mothers were interviewed about the time of initiation of breastfeeding, sociodemographic and birth characteristics. The independent variables associated with delay in initiation of breastfeeding were identified using multivariable logistic regression analysis.

Results: In the current study, 52% (418/806) of the mothers initiated breastfeeding later than one hour after birth. Birth by Caesarean section (Adjusted Odds Ratio [AOR] 41; 95% Confidence Interval [CI] 12.21, 138), discarding of colostrum (AOR 9.89; 95% CI 4.14, 23.62), unmarried mothers (AOR 3.76; 95% CI 1.53, 9.24), exposure to infant formula advertisement (AOR 1.82; 95% CI 1.09, 3.02) and no house ownership (AOR 1.52; 95% CI 1.11, 2.09) were independent factors associated with delay in initiation of breastfeeding.

Conclusion: We found that more than half of the mothers delayed the initiation of breastfeeding. Therefore, we recommend training on best breastfeeding practices and counselling skills for health staff in Juba Teaching Hospital. Policy dialogue, with the relevant ministries and departments on the promotion and protection of early initiation of breastfeeding is crucial.

Keywords: Breastfeeding, Early initiation, Infant, Associated factors, South Sudan

Background

The universally accepted breastfeeding recommendations state that all newborn babies should be placed in skin-to-skin contact with their mothers immediately after birth and initiate breastfeeding within one hour of birth [1]. It also states that all infants should be exclusively breastfed (EBF) for six months. From six months of age introduce the child to timely, adequate, safe and appropriate complementary foods while continuing breastfeeding up to two years or beyond [2, 3].

In a recent study, 58% of infants were put to the breast within one hour of birth [4]. Early initiation of breastfeeding (EIBF) promotes the release of oxytocin that enables contraction of the uterus and decreases postpartum haemorrhage [5]. Early breast suckling facilitates production of the first breastmilk, called colostrum which has nutrients and immunity substances that protect infants from infections [5]. Evidence from studies found that EIBF was associated with a lower risk of diarrhoea in infants in Nigeria [6], reduced infant morbidity in Nepal, Vietnam and India [7–9] and reduced infant mortality in Ghana [10, 11].

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However, suboptimal breastfeeding was one of the three leading causes of infant diseases in sub-Saharan Africa [12]. Delay in the initiation of breastfeeding was responsible for increased risk in infant morbidity and mortality in Ghana, India and Tanzania [13]. This practice was associated with antenatal care visits [14], birth place [15], home area, household income [16, 17], prelacteal feeding [18], birth by Caesarian section (CS) and colostrum discarding [19].

The present study was carried out in South Sudan, a country plagued by wars since the 1950s and only punctuated by peace, in 2005 to 2013. These conflicts traumatized women and children, consequently influencing health seeking behaviour and infant feeding. In 2016, the United Nations Children's Fund (UNICEF) estimated that 48% of infants were breastfed early; while 45% were exclusively breastfed for six months [20]. There is little known about the determinants of early breastfeeding practices in South Sudan. This, Africa's youngest nation is fast introducing a number of WHO/UNICEF promoted policies and practices. However, it is not clear to what extent these policies have been implemented. For example, there is a draft policy on infant and young child feeding which apparently, incorporated the Baby Friendly Hospital Initiative (BFHI). To date, however no hospital in the country has yet started implementing the BFHI policy. Therefore, identifying predictors of delay in initiation of breastfeeding is critical in designing strategies to improve early initiation of breastfeeding. This study sought to establish factors associated with delay in initiation of breastfeeding in South Sudan.

Methods

Study setting

This study was conducted at the maternity ward in Juba Teaching Hospital (JTH) in South Sudan. This is a national referral and teaching hospital for the College of Medicine, University of Juba. The hospital has a capacity of 500 beds and conducts, on average, 20 births daily.

Study design and sample

This was a cross-sectional study among 806 mother-infant pairs conducted from October 2016 to January 2017. Mothers who gave informed written consent, had a term birth and live infant were included. We excluded mothers who had ill infants; and those unable to communicate independently.

Sample size estimation

This study considered a 50% prevalence of early initiation of breastfeeding in sub-Saharan Africa from a recent descriptive analysis in 57 low-and middle-income counties [21], with a precision of 5%, 95% confidence intervals and non-response of 20%. This gave us sample size of 461 participants. This sample size was determined using Open Epi [22].

We also calculated a sample size for factors associated with delay in initiation of breastfeeding. Initially, the sample sizes of various exposures were computed using Open-Epi [22] epidemiological calculator for detecting differences between proportions of two groups (Kelsey formula). Finally, discarding of colostrum was used to calculate the sample size needed for detecting variations between proportions of delay in initiation of breastfeeding between mothers who discarded colostrum and those who did not. Using a study from the Somali region of Ethiopia where 46.3% of the mothers discarded colostrum, while 53.7% did not [23], we assumed the proportion of delay in initiation of breastfeeding of 59% for mothers who discarded colostrum and 49% for those who have not discarded. This gave a sample size of 806; which was enough to detect differences in the proportions of the exposures of interest with 80% power.

Sampling procedure

A total of 1723 mothers gave birth in JTH, of these 13 had stillbirths; and 94 mothers were enrolled in another study. The study objectives and procedures were explained to the 1616 mothers eligible to participate in the study. In the design of the study, we planned to recruit 10 of the 20 mothers who gave birth daily. However, consecutive sampling would have favored those mothers who gave birth in the day and left out those who gave birth at night; who may have different characteristics. It was also not practical to randomly sample 10 mothers after all births had occurred in a day, because most mothers leave the hospital few hours after birth. Therefore, we decided to randomly sample one of every two mothers who gave birth. This process spread the data collection throughout the day. So, for every two births, the mothers were requested to pick a concealed piece of paper from a box. Those who picked a "yes" were assigned to "participate" and those picking the "no" option to "not to participate" in the study (Fig. 1). Of the 808 mothers who picked to participate in the study, 806 consented to participate in the study; while two mothers with ill infants declined consent.

Data collection and instruments

We used a questionnaire generated from the World Health Organization (WHO) indicators for assessing infant and young child feeding practices [24] and a study in Uganda [25]. The questionnaire was translated to *Bari* (the local language) and back translated into English by a different translator for validation. Next, it was piloted and pretested in Al Sabbah Children Hospital in Juba. After the pilot test, irrelevant questions were removed, vague questions made clearer and errors corrected. The

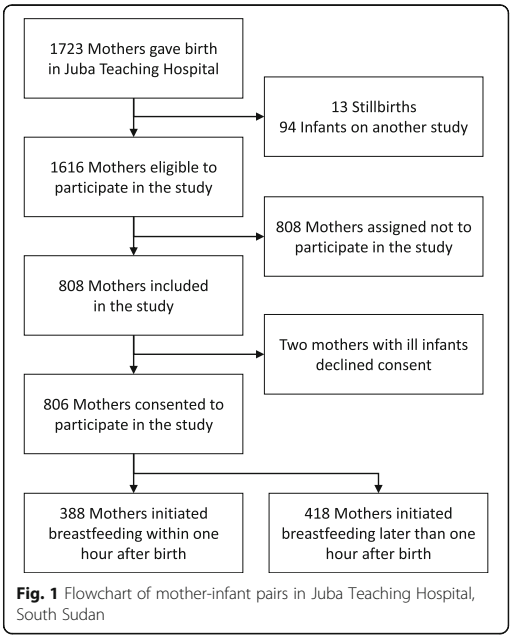

Fig. 1 Flowchart of mother-infant pairs in Juba Teaching Hospital, South Sudan

questionnaire had three sections: sociodemographic characteristics, birth characteristics, and breastfeeding practices. The data were collected by a pair of trained research assistants in a face to face interview. The collected data were checked daily for completeness, consistency and errors by the principal investigator (PI). The data were cleaned, coded, double entered into Epi Info version 6 and stored safely in a password-protected computer to which the PI had sole access.

Study variables

The outcome variable was timely or early initiation of breastfeeding. The mothers were asked how long after birth their babies were first put to the breast. Initiating breastfeeding within one hour was categorized as "early", whereas later than one hour was categorized as "late /delayed". The independent variables have three sections:

1: *Sociodemographic characteristics* including maternal age, marital status, parity, place of residence, educational status, employment status, religion, household assets, house ownership, age of infant, and infant sex.
2: *Maternal health services* including antenatal care, place of birth, assistance during birth, mode of delivery, type of birth, birth order, breastfeeding counseling, breastfeeding support; and exposure to infant formula advertisement through radio, TV or newspapers one month before birth.
3: *Breastfeeding practices* including prelacteal feeding and colostrum discarding.

Data processing and analysis

In the present study, we reported the descriptive variables as means and standard deviations. The categorical variables were reported as proportions. Chi square tests were performed to identify the independent variables that were associated with outcome variable of interest and recorded their p - values. Factors from the literature known to predict our outcome variable and those with a p - value ≤0.25 at binary analysis, not in the causal pathway and not strongly collinear with other independent variables were entered into the initial multivariable logistic regression model. We evaluated for collinearity and any factor with variance inflation factor (VIF) > 10 was regarded as strongly collinear. In instances where there was collinearity, the factor with a stronger measure of association with the outcome variable was retained in the model and the other dropped. The variables with a p - value ≤0.25 from bivariate analysis were then entered into a backward stepwise multivariate model. Next interaction terms were formed between the variables retained in the multivariate model. The reduced model was then compared with the model with the interaction terms using chunk test to assess for interaction. We evaluated the confounding effect for the variables dropped from the model on the variables that remained in the multivariate model. Any variable that caused a variation ≥10% between the crude and adjusted degrees of association of any of the variables that remained in the multivariate model was kept in the model as a confounder. In the final model, independent variables with a p - value < 0.05 were regarded key associated factors. Finally, we carried out the multivariable logistic regression analysis without discarding of colostrum. Since this variable could be a consequence and not a cause of the delay in initiation of breastfeeding. For example, discarding of colostrum could result from delay in initiation of breastfeeding due to mother's engorged breast or infant illness. To control for this situation, we repeated the analysis without this variable. Data analysis for the current study was conducted using STATA version 14 (Stata Corp LLC, Texas, USA).

Results

Baseline and birth characteristics

The mean age of the mothers was 24.9 years (SD 5.3) (Tables 1 and 2). Of all the mothers, more than half 51% lived in urban area, 46% owned houses, 96% were married, 17% were uneducated, and 76% were unemployed. The majority, 91% of the mothers attended antenatal

Table 1 Baseline characteristics of mother-infant pairs and delayed initiation of breastfeeding in Juba Teaching Hospital, South Sudan

	All participants $n = 806$	Delayed initiation[a] of breastfeeding $n = 418$
Variables	*n* (%)	*n* (%)
Infant sex		
Male	386 (47.9)	209 (50.0)
Female	420 (52.1)	209 (50.0)
Mother age		
≤ 19	139 (17.2)	73 (17.5)
20–24	252 (31.3)	126 (30.1)
25–29	246 (30.5)	135 (32.3)
30–34	123 (15.3)	57 (13.6)
≥ 35	46 (5.7)	27 (6.5)
Place of residence		
Urban	410 (50.9)	204 (48.8)
Rural	396 (49.1)	214 (51.2)
House ownership		
Yes	373 (46.3)	167 (40.0)
No	433 (53.7)	251 (60.0)
Mother marital status		
Married	775 (96.2)	394 (94.3)
Single	31 (3.8)	24 (5.7)
Mother education status		
None	136 (16.9)	65 (15.6)
Primary	377 (46.8)	194 (46.4)
Secondary	239 (29.7)	128 (30.6)
Tertiary	54 (6.7)	31 (7.4)
Mother employment status		
Employed	197 (24.4)	101 (24.2)
Not employed	609 (75.6)	317 (75.8)

[a]Delayed initiation refers to putting an infant to the breast later than 1 hr after birth

Table 2 Birth characteristics of mother-infant pairs and delayed initiation of breastfeeding in Juba Teaching Hospital, South Sudan

	All participants $n = 806$	Delayed initiation[a] of breastfeeding $n = 418$
Variables	*n* (%)	*n* (%)
Antenatal care visit		
2 or more	731 (90.7)	368 (88.0)
0–1	75 (9.3)	50 (12.0)
Skilled birth attendant		
Yes	788 (97.8)	406 (97.1)
No	18 (2.2)	12 (2.9)
Mode of birth		
Normal vaginal	709 (88.0)	324 (77.5)
Caesarean section	97 (12.0)	94 (22.5)
Birth type		
Single	790 (98.0)	407 (97.4)
Multiple	16 (2.0)	11 (2.6)
Birth order		
Primipara	523 (64.9)	263 (62.9)
Multipara	283 (35.1)	155 (37.1)
Exposure to infant formula advertisement one month before birth		
No	711 (88.2)	354 (84.7)
Yes	95 (11.8)	64 (15.3)
Breastfeeding counseling		
Yes	445 (55.2)	241 (57.7)
No	361 (44.8)	177 (42.3)
Breastfeeding support		
Yes	459 (56.9)	232 (55.5)
No	347 (43.1)	186 (44.5)
Discarding of colostrum		
No	739 (91.7)	357 (85.4)
Yes	67 (8.3)	61 (14.6)

[a]Delayed initiation refers to putting an infant to the breast later than 1 h after birth

care (ANC), 88% gave birth normally, 55% received breastfeeding counseling, and 88% were not exposed to infant formula advertisement a month before birth.

Bivariate analysis

More than half 52% (418/806) of the mothers delayed initiation of breastfeeding. Place of residence, marital status, no house ownership, ANC, mode of birth, birth order, type of birth, discarding of colostrum, and exposure to infant formula advertisement were associated with delay in initiation of breastfeeding (Table 3). The variables which were not associated at this level were excluded in final multivariable analysis.

Multivariable analysis

In this analysis, birth by Caesarean section (Adjusted odd ratio [AOR] 41; 95% confidence interval [CI] 12.21, 138), discarding of colostrum (AOR 9.89; 95% CI 4.14, 23.62), unmarried mothers (AOR 3.76; 95% CI 1.53, 9.24), exposure to infant formula advertisement (AOR 1.82; 95% CI 1.09, 3.02), and no house ownership (AOR 1.52; 95% CI 1.11, 2.09) were associated with delay in initiation of breastfeeding (Table 3). The repeated model without discarding of colostrum found the same results with similar measure of association.

Discussion

In this study, more than half of the mothers initiated breastfeeding later than one hour after birth. Factors

Table 3 Bivariate and multivariable analysis for delayed in initiation of breastfeeding in Juba Teaching Hospital, South Sudan

	Bivariate $n = 806$	Multivariable $n = 806$
Variables	OR (95% CI)	AOR[a] (95% CI)
Infant's sex		
Male	1	
Female	0.84 (0.64, 1.11)	–
Mother's age		
≤ 19	1	
20–24	0.90 (0.60, 1.37)	–
25–29	1.10 (0.72, 1.67)	–
30–34	0.78 (0.48, 1.27)	–
≥ 35	1.28 (0.65, 2.52)	–
Place of residence		
Urban	1	
Rural	1.19 (0.90, 1.57)	–
House ownership		
Yes	1	1
No	1.70 (1.29, 2.45)	1.52 (1.11, 2.09)
Mother marital status		
Married	1	1
Unmarried	3.32 (1.41, 7.79)	3.76 (1.53, 9.24)
Mother education status		
None	1	
Primary	1.56 (0.78, 1.71)	–
Secondary	1.26 (0.83, 1.92)	–
Tertiary	1.47 (0.36, 1.28)	–
Mother employment status		
Employed	1	
Not employed	1.03 (0.75, 1.42)	–
Antenatal care visits		
2 or more	1	
0–1	1.97 (1.19, 3.26)	1.53(0.87, 2.71)
Skilled birth attendant		
Yes	1	
No	1.88 (0.70, 5.06)	–
Mode of birth		
Normal vaginal	1	
Caesarean section	37.23 (11.68, 119)	41 (12.21, 138)
Birth type		
Single	1	
Multiple	2.07 (0.71, 6.01)	–
Birth order		
Multipara	1	
Primipara	1.20 (0.90, 1.60)	1.22 (0.88, 1.68)
Exposure to infant formula advertisement one month before birth		
No	1	1
Yes	2.08 (1.32, 3.28)	1.82 (1.09, 3.02)
Breastfeeding counseling		
Yes	1	
No	0.81(0.62, 1.08)	–
Breastfeeding support		
Yes	1	
No	1.13 (0.85, 1.49)	–
Discarding of colostrum		
No		
Yes	10.88(4.65, 25.47)	9.89 (4.14, 23.62)

[a]*AOR* adjusted odds ratio

associated with this practice were birth by Caesarean section, discarding of colostrum, unmarried mothers, no house ownership and exposure to infant formula advertisement.

According to the WHO rating on early initiation of breastfeeding; 0–29% is considered poor, 30–49% as fair, 50–89% as good and 90–100% as very good [26]. The prevalence of early initiation of breastfeeding in the present study is fair. This was similar to that of a study in Ethiopia [27]. This was however, lower than that of other studies in Mulago hospital (69%) [16], rural Uganda (57%) [28], and Ethiopia (84%) [29].

There was strong evidence that birth by Caesarean section (CS) was associated with delay in initiation of breastfeeding. This was similar to findings from Uganda [30], Tanzania [31], Ethiopia [27], and Nigeria [32]. This could be explained by the hospital practice of separating infants from their mothers after CS as reported in studies in Nigeria [33] and Vietnam [34]. This also could be due to fatigue and pain experienced by the mother after birth [16].

Mothers who were exposed to infant formula advertisement were two times more likely to delay initiation of breastfeeding. This was similar to that of a study in Cambodia [35]. A recent systematic review found that infant formula promotion undermined breastfeeding, urged mothers to stop breastfeeding and gave prelacteal feeding [36]. A study in Nepal found that promotion of infant formula by health staff contributed to suboptimal breastfeeding [37].

Discarding of colostrum was strongly associated with delay in initiation of breastfeeding. However, discarding colostrum could be a consequence and not a cause of delay in initiation of breastfeeding. To counter this situation, the multivariable analysis was repeated without

discarding of colostrum, but the findings were similar. In this study, mothers thought colostrum was dirty and bad. This finding was similar to studies in Guinea-Bissau [38], Ethiopia [39] and Guatemala [40]. Negative cultural beliefs were responsible for discarding of colostrum. However, our study did not explore the effect of cultural beliefs on discarding of colostrum.

Unmarried mothers were four times more likely to practice delay in initiation of breastfeeding compared to married mothers. This was similar to recent findings in the Democratic Republic of Congo [41] and Tanzania [31]. Another study in the USA reported delayed initiation of breastfeeding among unmarried mothers who gave birth to preterm infants [42]. The present study however, did not investigate the reasons underlying delay in initiation of breastfeeding among the unmarried mothers.

Lastly, mothers who did not own houses were two times more likely to breastfeed later than one hour after birth compared to those who own houses. This was similar to that of a study in Ethiopia [29]. The mothers who breastfed later than one hour after birth may most likely be women living in poverty and were given less opportunity to initiate breastfeeding early.

Strengths and limitations

This study was the first to assess early initiation of breastfeeding in a unique conflict setting in South Sudan. The data were gathered within 24 hrs after birth which minimized recall bias. This study had several limitations; the result of this study cannot be generalized since one hospital was studied. This study omitted other methods of infant formula advertisement such as points of sale, social media promotion, internet, health staff role and public display. In addition, the information on infant formula advertisement could be subject to recall bias. Finally, the mothers' ability to estimate exact time on initiation of breastfeeding was not assessed.

Conclusion

In this study, delay in initiation of breastfeeding was prevalent in Juba Teaching Hospital. Birth by Caesarean section, discarding of colostrum, exposure to infant formula advertisement, unmarried mothers and no house ownership were associated with delay in initiation of breastfeeding. We recommend health staff training on best breastfeeding practices and counselling skills, especially the staff responsible for birth by Caesarean section. In-depth study on cultural beliefs and socioeconomic determinants with special focus on discarding of colostrum and house ownership is urgent. Policy dialogue is crucial with the Ministry of Health to review compliance with WHO policies, especially the Code of Marketing Breast Milk Substitutes. Initiation of the BFHI might go a long way in mitigating the challenge of delay in initiation of breastfeeding in the hospital. Lastly, a qualitative study is recommended to investigate the rational for delay in initiation of breastfeeding among unmarried mothers.

Abbreviations

ANC: Antenatal care; CS: Caesarean section; EBF: Exclusive breastfeeding; JTH: Juba Teaching Hospital; VIF: Variance inflation factor; WHO: World Health Organization

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Availability of data and materials

The dataset for this study is available from the corresponding author on request.

Authors' contributions

JBT conceptualized, designed, and supervised the study, analyzed the data, wrote the first draft of the manuscript. JKT, TT, GN, VN and DM conceptualized, designed the study and writing of the manuscript. JKT, TT, GN, VN, MBS and DM participated in the data analysis and interpretation of results. All authors have read and approved the final version of the manuscript.

Ethics approval and consent to participate

Ethical approval was obtained from the Directorate of Planning, Budgeting and Research in the Ministry of Health and the Jubek State Ministry of Health, South Sudan – reference number SMOH/E/JS/44.K.1. To participate in the study, participants gave written informed consent or a thumbprint for those who were unable to write.

Consent for publication

Not applicable. Our manuscript does not contain individual person's data in any form such as individual details, images or videos.

Competing interests

The authors declare that they have no competing interests.

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References

1. World Health Organization. Guideline: protecting, promoting and supporting breastfeeding in facilities providing maternity and newborn services. Geneva: World Health Organization; 2017. Available from: http://apps.who.int/iris/handle/10665/259386. Accessed 18 May 2018.
2. World Health Organization. Global strategy for infant and young child feeding. Geneva: World Health Organization; 2003. Available from: http://www.who.int/nutrition/publications/infantfeeding/9241562218/en/. Accessed 18 May 2018.

3. Victora CG, Bahl R, Barros AJ, Franca GV, Horton S, Krasevec J, et al. Breastfeeding in the 21st century: epidemiology, mechanisms, and lifelong effect. Lancet. 2016;387(10017):475–90.
4. Takahashi K, Ganchimeg T, Ota E, Vogel JP, Souza JP, Laopaiboon M, et al. Prevalence of early initiation of breastfeeding and determinants of delayed initiation of breastfeeding: secondary analysis of the WHO global survey. Sci Rep. 2017;7:44868.
5. Palmeira P, Carneiro-Sampaio M. Immunology of breast milk. Rev Assoc Med Bras. 2016;62(6):584–93.
6. Ogbo FA, Page A, Idoko J, Claudio F, Agho KE. Diarrhoea and suboptimal feeding practices in Nigeria: evidence from the national household surveys. Paediatr Perinat Epidemiol. 2016;30(4):346–55.
7. Mullany LC, Katz J, Li YM, Khatry SK, LeClerq SC, Tielsch JM, et al. Breast-feeding patterns, time to initiation, and mortality risk among newborns in southern Nepal. J Nutr. 2008;138(3):599–603.
8. Hajeebhoy N, Nguyen PH, Mannava P, Nguyen TT, Mai LT. Suboptimal breastfeeding practices are associated with infant illness in Vietnam. Int Breastfeed J. 2014;9:12.
9. Garcia CR, Mullany LC, Rahmathullah L, Katz J, Thulasiraj RD, Tielsch JM, et al. Breastfeeding initiation time and neonatal mortality risk among newborns in South India. J Perinatol. 2011;31(6):397–403.
10. Edmond KM, Kirkwood BR, Amenga-Etego S, Owusu-Agyei S, Hurt LS. Effect of early infant feeding practices on infection-specific neonatal mortality: an investigation of the causal links with observational data from rural Ghana. Am J Clin Nutr. 2007;86(4):1126–31.
11. Edmond KM, Kirkwood BR, Tawiah CA, Owusu-Agyei S. Impact of early infant feeding practices on mortality in low birth weight infants from rural Ghana. J Perinatol. 2008;28(6):438–44.
12. Lim SS, Vos T, Flaxman AD, Danaei G, Shibuya K, Memish ZA, et al. A comparative risk assessment of burden of disease and injury attributable to 67 risk factors and risk factor clusters in 21 regions, 1990-2010: a systematic analysis for the global burden of disease study 2010. The Lancet. 2012; 380(9859):2224–60.
13. Edmon K, Newton S, Hurt L, Shannon SG, Mazumder S, Taneja S, et al. Timing of initiation, patterns of breastfeeding, and infant survival: prospective analysis of pooled data from three randomised trials. Lancet. 2016;4(4):e266–75.
14. Ekubay M, Berhe A, Yisma E. Initiation of breastfeeding within one hour of birth among mothers with infants younger than or equal to 6 months of age attending public health institutions in Addis Ababa, Ethiopia. Int Breastfeed J. 2018;13:4.
15. Yimer NB, Liben ML. Effects of home delivery on colostrum avoidance practices in north Wollo zone, an urban setting, Ethiopia: a cross sectional study. Matern Child Nutr. 2018;37(1):4.
16. Kalisa R, Malande O, Nankunda J, Tumwine JK. Magnitude and factors associated with delayed initiation of breastfeeding among mothers who deliver in Mulago hospital. Uganda African Health Sciences. 2015;15(4): 1130–5.
17. Engebretsen IM, Nankabirwa V, Doherty T, Diallo AH, Nankunda J, Fadnes LT, et al. Early infant feeding practices in three African countries: the PROMISE-EBF trial promoting exclusive breastfeeding by peer counsellors. Int Breastfeed J. 2014;9:19.
18. Legesse M, Demena M, Mesfin F, Haile D. Prelacteal feeding practices and associated factors among mothers of children aged less than 24 months in Raya kobo district, north eastern Ethiopia: a cross-sectional study. Int Breastfeed J. 2014;9:189.
19. Tilahun G, Degu G, Azale T, Tigabu A. Prevalence and associated factors of timely initiation of breastfeeding among mothers at Debre Berhan town, Ethiopia: a cross-sectional study. Int Breastfeed J. 2016;11:27.
20. UNICEF. The state of the world's children. New York: UNICEF; 2016. Available from: http://www.unicef.org/sowc2014/numbers. Accessed 4 January 2018.
21. Oakley L, Benova L, Macleod D, Lynch CA, Campbell OMR. Early breastfeeding practices: descriptive analysis of recent demographic and health surveys. Maternal & Child Nutrition. 2018;14(2):e12535.
22. Dean AG, Sullivan KM, Soe MM. Open epi: open source epidemiologic statistics for Public Health; 2013. Available from: www.OpenEpi.com. Accessed 4 September 2017
23. Rogers NL, Abdi J, Moore D, Nd'iangui S, Smith LJ, Carlson D, et al. Colostrum avoidance, prelacteal feeding and late breast-feeding initiation in rural northern Ethiopia. Public Health Nutr. 2011;14(11):2029–36.
24. World Health Organization. Indicators for assessing infant and young child feeding practices. Geneva: World Health Organization; 2010. Available from: http://www.who.int/nutrition/publications/infantfeeding/9789241599290/en/. Accessed 19 May 2018.
25. Tylleskar T, Jackson D, Meda N, Engebretsen IM, Chopra M, Diallo AH, et al. Exclusive breastfeeding promotion by peer counsellors in sub-Saharan Africa (PROMISE-EBF): a cluster-randomised trial. Lancet. 2011;378(9789):420–7.
26. World Health Organization. Infant and young child feeding: a tool for assessing national practices, policies and programmes. Geneva: World Health Organization; 2003. Available from: http://www.who.int/iris/handle/10665/42794. Accessed 10 May 2018.
27. Liben ML, Yesuf EM. Determinants of early initiation of breastfeeding in Amibara district, northeastern Ethiopia: a community based cross-sectional study. Int Breastfeed J. 2016;11:7.
28. Waiswa P, Peterson S, Tomson G, Pariyo GW. Poor newborn care practices - a population based survey in eastern Uganda. BMC Pregnancy and Childbirth. 2010;10:9.
29. Beyene MG, Geda NR, Habtewold TD, Assen ZM. Early initiation of breastfeeding among mothers of children under the age of 24 months in southern Ethiopia. Int Breastfeed J. 2017;12:1.
30. Mukunya D, Tumwine JK, Nankabirwa V, Ndeezi G, Odongo I, Tylleskar T, et al. Factors associated with delayed initiation of breastfeeding: a survey in northern Uganda. Glob Health Action. 2017;10(1):1410975.
31. Exavery A, Kante AM, Hingora A, Phillips JF. Determinants of early initiation of breastfeeding in rural Tanzania. Int Breastfeed J. 2015;10:27.
32. Berde AS, Yalcin SS. Determinants of early initiation of breastfeeding in Nigeria: a population-based study using the 2013 demographic and health survey data. BMC Pregnancy Childbirth. 2016;16:32.
33. Awi DD, Alikor EA. Barriers to timely initiation of breastfeeding among mothers of healthy full-term babies who deliver at the University of Port Harcourt Teaching Hospital. Niger J Clin Pract. 2006;9(1):57–64.
34. Bui QT, Lee HY, Le AT, Van Dung D, Vu LT. Trends and determinants for early initiation of and exclusive breastfeeding under six months in Vietnam: results from the multiple indicator cluster surveys, 2000-2011. Glob Health Action. 2016;9:29433.
35. Pries AM, Huffman SL, Mengkheang K, Kroeun H, Champeny M, Roberts M, et al. Pervasive promotion of breastmilk substitutes in Phnom Penh, Cambodia, and high usage by mothers for infant and young child feeding. Maternal & Child Nutrition. 2016;12(Suppl 2):38–51.
36. Rollins NC, Bhandari N, Hajeebhoy N, Horton S, Lutter CK, Martines JC, et al. Why invest, and what it will take to improve breastfeeding practices? Lancet. 2016;387(10017):491–504.
37. Pries AM, Huffman SL, Adhikary I, Upreti SR, Dhungel S, Champeny M, et al. Promotion and prelacteal feeding of breastmilk substitutes among mothers in Kathmandu valley. Nepal Maternal & Child Nutrition. 2016;12(Suppl 2):8–21.
38. Gunnlaugsson G, da Silva MC, Smedman L. Determinants of delayed initiation of breastfeeding: a community and hospital study from Guinea-Bissau. Int J Epidemiol. 1992;21(5):935–40.
39. Hailemariam TW, Adeba E, Sufa A. Predictors of early breastfeeding initiation among mothers of children under 24 months of age in rural part of West Ethiopia. BMC Public Health. 2015;15:1076.
40. Atyeo NN, Frank TD, Vail EF, Sperduto WAL, Boyd DL. Early initiation of breastfeeding among maya mothers in the western highlands of Guatemala: practices and beliefs. J Hum Lact. 2017;33(4):781–9.
41. Kambale RM, Buliga JB, Isia NF, Muhimuzi AN, Battisti O, Mungo BM. Delayed initiation of breastfeeding in Bukavu, south Kivu, eastern Democratic Republic of the Congo: a cross-sectional study. Int Breastfeed J. 2018;13:6.
42. Kair LR, Colaizy TT. Breastfeeding continuation among late preterm infants: barriers, facilitators, and any association with neonatal intensive care unit admission? Hospital Pediatrics. 2016;6(5):261–8.

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Article

The Effect of Health Worker Training on Early Initiation of Breastfeeding in South Sudan: A Hospital-based before and after Study

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Abstract: Globally, suboptimal breastfeeding contributes to more than 800,000 child deaths annually. In South Sudan, few women breastfeed early. We assessed the effect of a Baby-Friendly Hospital Initiative training on early initiation of breastfeeding at Juba Teaching Hospital in South Sudan. We carried out the training for health workers after a baseline survey. We recruited 806 mothers both before and four to six months after training. We used a modified Poisson model to assess the effect of training. The prevalence of early initiation of breastfeeding increased from 48% (388/806) before to 91% (732/806) after training. Similarly, early initiation of breastfeeding increased from 3% (3/97) before to 60% (12/20) after training among women who delivered by caesarean section. About 8% (67/806) of mothers discarded colostrum before compared to 3% (24/806) after training. Further, 17% (134/806) of mothers used pre-lacteal feeds before compared to only 2% (15/806) after training. Regardless of the mode of birth, the intervention was effective in increasing early initiation of breastfeeding [adjusted prevalence ratio (APR) 1.69, 95% confidence interval CI (1.57-1.82)]. These findings suggest an urgent need to roll out the training to other hospitals in South Sudan. This will result in improved breastfeeding practices, maternal, and infant health.

Keywords: Baby-Friendly Hospital Initiative; training; breastfeeding initiation; South Sudan

1. Introduction

Optimal breastfeeding includes early initiation of breastfeeding (within one hour of birth), exclusive breastfeeding (EBF) from birth up to six months and continued breastfeeding for at least two years [1]. According to the 2016 Lancet Breastfeeding Series, attaining high rates of EBF could prevent as much as 800,000 child deaths per year globally [2,3]. Results from the Neovita study in Ghana, India and Tanzania reported that early initiation of breastfeeding independently reduces neonatal mortality and facilitates EBF [4].

A meta-analysis of Demographic and Health Surveys (DHS) from 29 sub-Saharan African countries showed that 50% of women practiced early initiation of breastfeeding [5]. Findings from South Sudan showed that the prevalence of early initiation of breastfeeding ranged between 35% and 48% in both

the hospital and community [6,7]. South Sudan is a young nation emerging from civil strife and has not implemented interventions such as the Baby-Friendly Hospital Initiative (BFHI) known to promote optimal breastfeeding [8–10].

The BFHI is a programme of the World Health Organization (WHO) and the United Nations Children's Fund (UNICEF) which aims to protect, promote and support breastfeeding [11]. An analysis of systematic reviews on interventions to improve breastfeeding outcomes demonstrated that adhering to "the Ten Steps to Successful Breastfeeding" increased breastfeeding rates [8,12].

Given the low prevalence of early initiation of breastfeeding in our previous survey in Juba Teaching Hospital (JTH) [6], we carried out the BFHI training course for health workers to improve their competence to foster optimal breastfeeding. We hypothesized that the training would improve the knowledge, skills and attitude of staff and early breastfeeding practices of mothers. This survey assessed the effect of the BFHI training intervention on early initiation of breastfeeding at Juba Teaching Hospital in South Sudan.

2. Subjects and Methods

2.1. Design

This was a "before and after" study carried out among mothers at JTH in South Sudan. This study consisted of two parts, a baseline survey which forms the "before" part of this paper and the post-training intervention survey which forms the "after" part of this paper. The "before" survey was carried out in 2016 and has been published [6]. The rest of this section explains the details after the "before" part. The "after" survey was carried out between April–July 2018 after the training of health staff in December 2017.

Setting

This survey was carried out in the postnatal ward of JTH in South Sudan. This hospital conducts approximately 7000 deliveries annually. The average hospital stays are one day for normal births and three days for mothers who have had a caesarean section (CS).

2.2. Training of Health Workers in Juba Teaching Hospital

A paediatrician with specific training and practice in supporting lactation and breastfeeding conducted a 4-day training for 30 health workers including gynaecologists, doctors, midwives and nurses at the maternity unit of JTH in December 2017. All the health workers were enthusiastic and completed the 4-day training. The training was based on the UNICEF/WHO BFHI—a 20 hour course for maternity staff [13]. The training course consisted of 15.5 hours of theory and 4.5 hours of demonstrations, role-plays and hands-on practice.

Four to six months after the training, we carried out the "after" survey to assess breastfeeding practices in the same hospital. Between the "before" and "after" surveys, there was no change either in hospital leadership or in the maternity ward. No significant political or policy changes had taken place in the country in this field, nor had any interventions, such as breastfeeding awareness campaigns.

2.3. Inclusion and Exclusion Criteria

We included mothers who gave birth to live, healthy infants and excluded mothers who were discharged early, those who declined consent and those who had sick infants and infants with congenital malformations.

2.4. Sampling

A total of 990 mothers gave birth during both day and night to live infants in JTH during the survey. We excluded 116 mothers who were not contacted by the survey team because they had had an

early discharge, 31 who declined consent and 33 who had sick infants and four infants with congenital malformations (Figure 1). We consecutively recruited 806 mother–infant pairs.

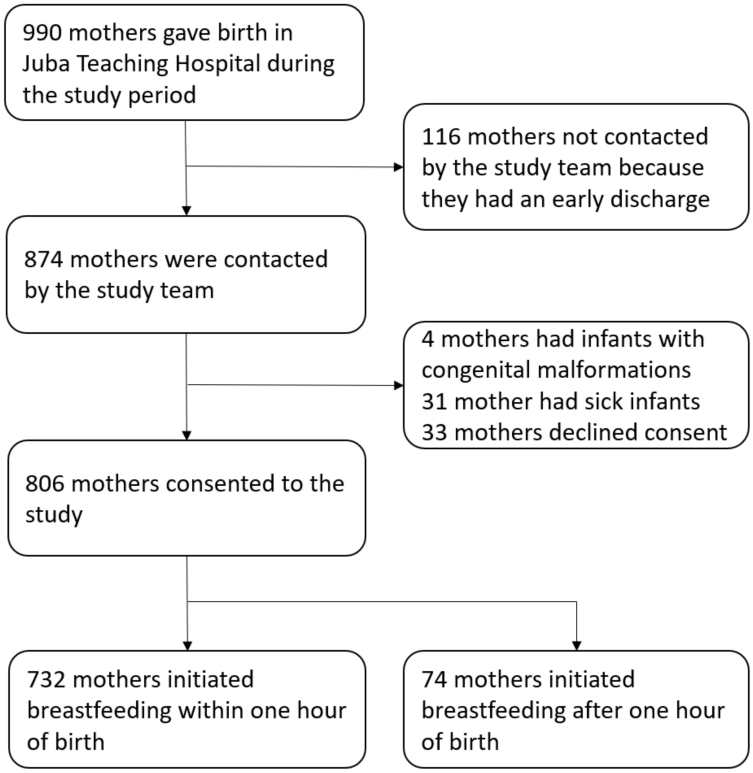

Figure 1. Profile of survey participants in April–July 2018 in Juba Teaching Hospital, South Sudan.

2.5. Variables

The dependent variable was early initiation of breastfeeding. Mothers were asked when they first put their babies on the breast after birth. Breastfeeding within one hour of birth was categorized as "early" and breastfeeding later than one hour after birth as "delayed". The independent variables included the place of residence, marital status, mother's age, education, employment, socioeconomic status, antenatal care, mode of birth, parity, infant sex, breastfeeding counselling during antenatal care, pre-lacteal feeding and discarding of colostrum.

2.6. Sample Size Estimation

We used the Open Epi calculator [14] and a formula for detecting differences between two proportions (Fleiss with continuity correction). The following considerations were made: an alpha of 5%, a power of 90%, a ratio of exposed to unexposed one and 48% prevalence of early initiation of breastfeeding from the baseline survey in JTH [6]. We assumed that the training would increase the prevalence of early initiation of breastfeeding to 56%. The calculated sample size was 803. We recruited 806 mother–infant pairs to make it comparable to the "before" survey.

2.7. Survey Instrument and Data Quality

We used the same questionnaire for the "after" survey as for the "before" survey. It was derived from the WHO guidelines [15] and an EBF survey in Eastern Uganda [16]. The study tool was initially pilot tested and amended accordingly. The principal investigator checked the collected data daily for completeness and consistency. The data were cleaned, coded, entered in an excel sheet and exported to STATA (Stata Corp, College Station, Texas, USA) version 15 for analysis.

2.8. Data Analysis

The two datasets, "before" and "after" survey datasets, were merged. We used conventional statistical methods to summarize and describe the data. We used a modified Poisson model to measure the effect of training on early initiation of breastfeeding and included, as confounders, variables that caused a variation of ≥10% between the crude and the adjusted prevalence ratio of effect of the training on early initiation of breastfeeding and known confounders from the literature. We used STATA version 15 (Stata Corp, College Station, Texas, USA) in the analysis of the data.

2.9. Ethical Approval and Consent to Participate

We obtained ethical approval to conduct this research from the Directorate of Planning, Budgeting, and Research in the Ministry of Health in South Sudan (reference number: SMOH/E/JS/44. K.1) and the Norwegian Regional Committee for Medical and Health Research Ethics in the West (reference number: 2018/913/REK Vest). Official letters of permission were presented to the Director General of the hospital and ward in-charge. We obtained written informed consent from the mothers and a thumbprint from those who could not write. Privacy and confidential measures were maintained throughout the survey.

3. Results

3.1. Sociodemographic Characteristics

A total of 806 mothers participated in the "after" survey. There were no differences in the sociodemographic characteristics of the participants before and after the training, as shown in Table 1. In the "after" survey, the mean age of the mothers was 24.8, with a standard deviation (SD) of 5.4. Less than half the mothers lived in rural areas, the majority were married, less than half had attended primary schools, most were not formally employed, and half had low socioeconomic status. Most mothers had attended antenatal care, less than half had had breastfeeding counselling during antenatal care, and majority had a normal and singleton birth.

Table 1. Sociodemographic characteristics of mother–infant pairs before and after the Baby-Friendly Hospital Initiative (BFHI) training in Juba Teaching Hospital, South Sudan.

Characteristics	Before BFHI training in 2016	After BFHI training in 2018
	N = 806 n (%)	N = 806 n (%)
Place of residence		
Urban	410 (50.9)	351 (43.6)
Rural	396 (49.1)	455 (56.4)
Mother's age		
15–19	139 (17.3)	153 (19.0)
20–24	252 (31.3)	256 (31.8)
25–29	246 (30.5)	227 (28.2)
30–34	123 (15.3)	120 (14.9)
≥35	46 (5.7)	50 (6.2)

Table 1. *Cont.*

Characteristics	Before BFHI training in 2016	After BFHI training in 2018
	N = 806 n (%)	N = 806 n (%)
Marital status		
Married	775 (96.2)	773 (95.9)
Single	31 (3.9)	33 (4.1)
Mother's education		
None	132 (16.9)	166 (20.6)
Primary	377 (46.8)	322 (40.0)
Secondary	239 (29.7)	221 (27.4)
Tertiary	54 (6.7)	97 (12.0)
Mother's employment		
Employed	179 (24.4)	139 (17.3)
Unemployed	609 (75.6)	667 (82.8)
Mother's socioeconomic status		
Poorest	165 (20.5)	168 (20.8)
Poor	157 (19.5)	160 (19.9)
Medium	167 (20.8)	159 (19.3)
Richer	235 (29.2)	160 (19.9)
Richest	80 (10.0)	159 (19.7)
Infant sex		
Male	386 (47.9)	448 (55.6)
Female	420 (52.1)	358 (44.4)
Antenatal care		
0 visit	75 (9.3)	7 (0.9)
1–3 visits	311 (38.6)	326 (40.5)
≥4 visits	420 (52.1)	473 (58.7)
Mode of birth		
Normal	709 (88.0)	786 (97.5)
Caesarean section (CS)	97 (12.0)	20 (2.5)
Parity		
Single	790 (98.0)	793 (98.4)
Multiple	16 (2.0)	13 (1.6)
Breastfeeding counselling at antenatal care		
Yes	445 (55.2)	287 (35.6)
No	361 (44.8)	519 (64.4)

3.2. Breastfeeding Practices

As shown in Table 2, 48.1% (calculated by 388/806) of mothers practiced early initiation of breastfeeding before the training, compared to 90.8% (calculated by 732/806) of mothers after the training of health workers. The proportion of mothers discarding colostrum and/or giving pre-lacteal feeds after the training was significantly lower. The proportion of mothers who delivered babies by CS and adopted early initiation increased from 3% (calculated by 3/97) before the training of health workers to 60% (calculated by 12/20) after the training of health workers, as shown in Table 2.

Table 2. Breastfeeding practices among mother–infant pairs before and after the BFHI training in Juba Teaching Hospital, South Sudan.

Breastfeeding Practices	Before BFHI Training in 2016	After BFHI Trainingin 2018	*p*-Value
	N = 806 n (%)	N = 806 n (%)	
Initiation of breastfeeding			
Early initiation	388 (48.1)	732 (90.8)	<0.001
Delayed initiation	418 (51.9)	74 (9.2)	
Colostrum discarded			
No	739 (91.7)	782 (97.0)	<0.001
Yes	67 (8.3)	24 (3.0)	
Pre-lacteal feeding			
No	672 (83.4)	791 (98.1)	<0.001
Yes	134 (16.6)	15 (1.9)	
Caesarean section			
No	709 (88.0)	786 (97.5)	<0.001
Yes	97 (12.0)	20 (2.3)	

3.3. The Effect of Training on Breastfeeding

In the bivariable analysis, the prevalence of early initiation of breastfeeding increased from 48.1% to 90.8% with a prevalence ratio of 1.89 (95% confidence interval CI: 1.75–2.03). In the multivariable analysis adjusting for marital status, mother's residence, mother's education, employment, socioeconomic status, antenatal care visits, mode of birth, parity and any breastfeeding counselling, the prevalence ratio was to some degree lower, which was 1.69 (95% CI: 1.57–1.82), as shown in Table 3. Regardless of the mode of birth, the training was effective on early initiation of breastfeeding at the bivariable and multivariable analysis.

Table 3. Bivariable and multivariable analysis among mother–infant pairs before and after the BFHI training in Juba Teaching Hospital in South Sudan.

Characteristics	Bivariable Prevalence Ratio (PR) (95% Confidence Interval, CI) N = 806	Multivariable PR (95% CI) N = 806
Training intervention		
Before	1	1
After	1.89 (1.75–2.03)	1.69 (1.57–1.82)
Place of residence		
Urban	1	
Rural	1.00 (0.94–1.07)	
Mother's age		
15–19	1	
20–24	0.99 (0.90–1.08)	
25–29	0.92 (0.83–1.01)	
30–34	0.99 (0.89–1.10)	
≥35	0.94 (0.81–1.10)	
Marital status		
Married	1.32 (1.05–1.67)	1.28 (1.06–1.54)
Single	1	1

Table 3. *Cont.*

Characteristics	Bivariable Prevalence Ratio (PR) (95% Confidence Interval, CI) N = 806	Multivariable PR (95% CI) N = 806
Mother's education		
None	1	1
Primary	0.88 (0.81–0.96)	0.93 (0.87–1.00)
Secondary	0.89 (0.81–0.97)	0.92 (0.85–0.99)
Tertiary	0.99 (0.88–1.10)	0.94 (0.86–1.03)
Mother's employment		
Employed	1	1
Unemployed	1.10 (1.00–1.20)	0.99 (0.92–1.07)
Child sex		
Male	1	
Female	1.00 (0.94–1.07)	-
Antenatal care		
0 visit	1	1
1–3 visits	2.10 (1.55–2.84)	1.48 (1.10–2.00)
≥4 visits	2.09 (1.54–2.83)	1.48 (1.10–1.99)
Mode of birth		
Normal	1	1
CS	0.17 (0.11–0.28)	0.22 (0.14–0.35)
Parity		
Single	1	1
Multiple	0.59 (0.38–0.91)	0.73 (0.48–1.11)
Breastfeeding counselling at antenatal care		
Yes	1	1
No	1.16 (1.08–1.24)	1.04 (0.98–1.10)

4. Discussion

This survey assessed the effect of the BFHI training on early initiation of breastfeeding in JTH. In this paper, the prevalent of early initiation of breastfeeding increased from 48% before to 91% after health workers training. The mothers were 70% more likely to initiate breastfeeding early after health workers training. The increase in early initiation of breastfeeding could be due to the training of health workers since there were no other significant events in the country between 2016 and 2018 in this field. The training of the health workers might have mitigated barriers associated with delayed initiation of breastfeeding reported in previous study [6]. Further, this result showed that BFHI is still, even if it has been 25 years since its launch, an important programme to be implemented in places where it has not yet been implemented. Our findings are in accord with findings from a systematic review that revealed that health worker training programmes positively influence early initiation of breastfeeding [17]. Another study showed that training hospital nursery staff resulted in increased rates of early initiation of breast breastfeeding [18]. Regardless of the mode of birth, we found the BFHI training is effective in increasing the prevalence of early initiation of breastfeeding. This agrees with a report in Vietnam which showed that an intervention that improved health workers' knowledge and skills increased the proportion of mothers who practiced early initiation of breastfeeding [19].

We found that more than half the mothers who gave birth by CS practiced early initiation of breastfeeding after the BFHI training. A study in Australia showed higher proportions of early initiation of breastfeeding among mothers who delivered babies by CS in BFHI hospitals [20]. However, targeted context-specific intervention is needed to further improve initiation of breastfeeding among mothers who give birth by CS in South Sudan [21].

In the current survey, the use of pre-lacteal feeds was lower after the training. This is possibly because of the training. This result is consistent with findings from a survey in India, which showed a decline in pre-lacteal feeding after breastfeeding education was offered by trained health staff [22]. Similarly, fewer mothers discarded colostrum after the training. This result is similar to findings from a survey in India, which showed an increase in mothers feeding colostrum to their infants after being educated and supported by trained health staff [22].

The strengths of this survey are as following: (1) it is the first to evaluate the effect of the BFHI training on early initiation of breastfeeding in South Sudan; (2) we used a large sample of mothers and carried out the survey 4–6 months after the training. However, the findings from this survey are difficult to generalize since the survey was carried out in one hospital. We did not ask the mothers' views on early initiation and colostrum. We also did not assess health worker's knowledge, attitude and skills after the training. The "before and after" survey design has its inherent internal validity limitations, such as historical records, reporting, testing and dropout threats. Furthermore, the mothers who were excluded from the study, including those who were not contacted due to early discharge, declined consent, sick infants and infants with congenital malformations, could have had different characteristics from those who participated in the survey.

5. Conclusions

Our findings suggest an urgent need to roll out the BFHI training to other hospitals in South Sudan. This will result in improved breastfeeding practices and ultimately improved maternal and infant health.

Author Contributions: J.B.T., J.K.T., T.T., G.N. and M.S. conceived and designed the survey. J.B.T. supervised the survey, analysed the data, and wrote the first draft of the manuscript. J.K.T., T.T., G.N., M.S., N.J. and D.M. participated in the interpretation of results and critically reviewed the manuscript. All authors have read and approved the final version of the manuscript.

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Conflicts of Interest: No potential conflict of interest was reported by the authors.

References

1. World Health Organization. Global Strategy for Infant and Young Child Feeding: The Optimal Duration of Exclusive Breastfeeding. 2001. Available online: http://www.who.int/iris/handle/10665/78801 (accessed on 10 October 2019).
2. Victora, C.G.; Bahl, R.; Barros, A.J.; Franca, G.V.; Horton, S.; Krasevec, J.; Murch, S.; Sankar, M.J.; Walker, N.; Rollins, N.C.; et al. Breastfeeding in the 21st century: Epidemiology, mechanisms, and lifelong effect. *Lancet* **2016**, *387*, 475–490. [CrossRef]
3. Rollins, N.C.; Bhandari, N.; Hajeebhoy, N.; Horton, S.; Lutter, C.K.; Martines, J.C.; Piwoz, E.G.; Richter, L.M.; Victora, C.G.; Lancet Breastfeeding Series Group. Why invest, and what it will take to improve breastfeeding practices? *Lancet* **2016**, *387*, 491–504. [CrossRef]
4. NEOVITA Study Group. Timing of initiation, patterns of breastfeeding, and infant survival: Prospective analysis of pooled data from three randomised trials. *Lancet Glob. Health* **2016**, *4*, e266–e275. [CrossRef]
5. Issaka, A.I.; Agho, K.E.; Renzaho, A.M. Prevalence of key breastfeeding indicators in 29 sub-Saharan African countries: A meta-analysis of demographic and health surveys (2010–2015). *BMJ Open* **2017**, *7*, e014145. [CrossRef] [PubMed]
6. Tongun, J.B.; Sebit, M.B.; Mukunya, D.; Ndeezi, G.; Nankabirwa, V.; Tylleskar, T.; Tumwine, J.K. Factors associated with delayed initiation of breastfeeding: A cross-sectional study in South Sudan. *Int. Breastfeed. J.* **2018**, *13*, 28. [CrossRef] [PubMed]

7. Tongun, J.B.; Sebit, M.B.; Ndeezi, G.; Mukunya, D.; Tylleskar, T.; Tumwine, J.K. Prevalence and determinants of pre-lacteal feeding in South Sudan: A community-based survey. *Glob. Health Action* **2018**, *11*, 1523304. [CrossRef] [PubMed]
8. Perez-Escamilla, R.; Martinez, J.L.; Segura-Perez, S. Impact of the Baby-friendly Hospital Initiative on breastfeeding and child health outcomes: A systematic review. *Matern. Child Nutr.* **2016**, *12*, 402–417. [CrossRef] [PubMed]
9. Bass, J.L.; Gartley, T.; Kleinman, R. World Health Organization Baby-Friendly Hospital Initiative Guideline and 2018 Implementation Guidance. *JAMA Pediatrics* **2019**, *173*, 93–94. [CrossRef] [PubMed]
10. Kavle, J.A.; LaCroix, E.; Dau, H.; Engmann, C. Addressing barriers to exclusive breast-feeding in low- and middle-income countries: A systematic review and programmatic implications. *Public Health Nutr.* **2017**, *20*, 3120–3134. [CrossRef] [PubMed]
11. United Nations Children's Fund/World Health Organization. Baby-Friendly Hospital Initiative. 2017. Available online: https://www.unicef.org/nutrition/files/BFHI_Case_Studies_FINAL.pdf (accessed on 3 May 2019).
12. Sinha, B.; Chowdhury, R.; Sankar, M.J.; Martines, J.; Taneja, S.; Mazumder, S.; Rollins, N.; Bahl, R.; Bhandari, N. Interventions to improve breastfeeding outcomes: A systematic review and meta-analysis. *Acta Paediatr.* **2015**, *104*, 114–134. [CrossRef] [PubMed]
13. UNICEF/WHO. Baby-Friendly Hospital Initiative: A 20-Hour Course for Maternity Staff. 2009. Available online: http://www.unicef.org/nutrition/index_24850.html (accessed on 6 October 2019).
14. Dean, A.G.; Sullivan, K.M.; Soe, M.M. Open epi: Open Source Epidemiologic Statistics for Public Health. 2013. Available online: https://www.openepi.com/ (accessed on 3 May 2019).
15. World Health Organization. Indicators for Assessing Infant and Young Child Feeding Practices Geneva. 2010. Available online: http://www.who.int/nutrition/publications/infantfeeding/9789241599290/en/ (accessed on 8 October 2019).
16. Tylleskar, T.; Jackson, D.; Meda, N.; Engebretsen, I.M.; Chopra, M.; Diallo, A.H.; Doherty, T.; Ekström, E.C.; Fadnes, L.T.; Goga, A.; et al. Exclusive breastfeeding promotion by peer counsellors in sub-Saharan Africa (PROMISE-EBF): A cluster-randomised trial. *Lancet* **2011**, *378*, 420–427. [CrossRef]
17. de Jesus, P.C.; de Oliveira, M.I.; Fonseca, S.C. Impact of health professional training in breastfeeding on their knowledge, skills, and hospital practices: A systematic review. *J. Pediatr.* **2016**, *92*, 436–450. [CrossRef] [PubMed]
18. Shinwell, E.S.; Churgin, Y.; Shlomo, M.; Shani, M.; Flidel-Rimon, O. The effect of training nursery staff in breastfeeding guidance on the duration of breastfeeding in healthy term infants. *Breastfeed. Med.* **2006**, *1*, 247–252. [CrossRef] [PubMed]
19. Luong, D.H.; Khue, L.N.; Phuong, D.H.; Mai, D.L.; Aisling, N.D.; Thuy, D.T. The Status of Baby Friendly Hospital Initiative under Hospital Quality Assessment Criteria Implementation: A report in Vietnam. *Divers. Equal. Health Care* **2018**, *15*, 129–136.
20. Rowe-Murray, H.J.; Fisher, J.R. Baby friendly hospital practices: Cesarean section is a persistent barrier to early initiation of breastfeeding. *Birth* **2002**, *29*, 124–131. [CrossRef] [PubMed]
21. Dudeja, S.; Sikka, P.; Jain, K.; Suri, V.; Kumar, P. Improving First-hour Breastfeeding Initiation Rate After Cesarean Deliveries: A Quality Improvement Study. *Indian Pediatrics* **2018**, *55*, 761–764. [CrossRef] [PubMed]
22. Sethi, V.; Kashyap, S.; Seth, V. Effect of nutrition education of mothers on infant feeding practices. *Indian J. Pediatrics* **2003**, *70*, 463–466. [CrossRef] [PubMed]

Appendix 1

Bivariable and multivariable analysis among mother-infant pairs before and after the Baby Friendly Hospital Initiative (BFHI) training in Juba Teaching Hospital in South Sudan

Characteristics	Bivariable prevalence ratio (PR) (95% CI) N= 806	Multivariable PR (95% CI) N= 806
Training intervention		
Before	1	1
After	1.89 (1.75-2.03)	1.69 (1.57-1.82)
Place of residence		
Urban	1	
Rural	1.00 (0.94-1.07)	-
Mother's age		
15-19	1	
20 - 24	0.99 (0.90-1.08)	-
25 - 29	0.92 (0.83-1.01)	
30 - 34	0.99 (0.89-1.10)	
≥ 35	0.94 (0.81-1.10)	
Marital status		
Married	1.32 (1.05-1.67)	1.28 (1.06-1.54)
Single	1	1
Mother's education		
None	1	1
Primary	0.88 (0.81-0.96)	0.93 (0.87-1.00)
Secondary	0.89 (0.81-0.97)	0.92 (0.85-0.99)
Tertiary	0.99 (0.88-1.10)	0.94 (0.86-1.03)
Mother's employment		
Employed	1	1
Unemployed	1.10 (1.00-1.20)	0.99 (0.92-1.07)
Child sex		
Male	1	
Female	1.00 (0.94-1.07)	-
Antenatal care		
0 Visit	1	1
1 - 3 Visits	2.10 (1.55-2.84)	1.48 (1.10-2.00)
≥ 4 Visits	2.09 (1.54-2.83)	1.48 (1.10-1.99)
Mode of birth		
Normal	1	1
CS	0.17 (0.11-0.28)	0.22 (0.14-0.35)
Parity		
Single	1	1
Multiple	0.59 (0.38-0.91)	0.73 (0.48-1.11)
Breastfeeding counseling before birth		
Yes	1	1
No	1.16 (1.08-1.24)	1.04 (0.98-1.10)

III

GLOBAL HEALTH ACTION
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ORIGINAL ARTICLE

Prevalence and determinants of pre-lacteal feeding in South Sudan: a community-based survey

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ABSTRACT

Background: Pre-lacteal feeding (PLF) is a barrier to optimal breastfeeding and increases the risk of diarrhoea and acute respiratory tract infections in infants.The prevalence and predictors of PLF are not well studied in South Sudan. Understanding the predictors of PLF is crucial in designing interventions to increase exclusive breastfeeding (EBF) rates.

Objective: To assess the prevalence and factors associated with PLF in Jubek State, South Sudan.

Method: This was a community based cross-sectional study of 810 mothers of children under two years of age in Jubek State, South Sudan. Mothers were interviewed in their homes using a semi-structured questionnaire to collect data on PLF, socio-demographic and birth characteristics. Multivariable analysis was used to identify factors independently associated with PLF.

Results: A total of 426/810 (53 %), 95% confidence interval (CI) [48 %, 59 %] mothers had given pre-lacteal feeds to their infants. The commonest pre-lacteal feeds included glucose solution (54%), water (26%), and infant formula (14%). Having received antenatal breastfeeding counselling decreased the odds of PLF [adjusted odds ratio (AOR) 0.60; 95% CI (0.43, 0.82)]; while discarding of colostrum increased the use of pre-lacteal feeds [AOR 1.57; 95% CI (1.17, 2.11)].

Conclusion: The prevalence of PLF in South Sudan is high. Predictors of PLF included lack of breastfeeding counselling and discarding of colostrum. Infant feeding counselling should be given to all pregnant women in the health facilities and communities. The counselling should emphasize the health benefits of colostrum and discourage the practice of discarding it.

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Background

The United Nations Sustainable Development Goals recommended a further reduction of neonatal and under-fives' mortality by 2030 [1]. Optimal breastfeeding is one of the interventions that improve child survival [2]. It has three elements according to the World Health Organization (WHO) namely: early initiation of breastfeeding (within one hour of birth); exclusive breastfeeding (EBF) – breastmilk with no other foods or liquids – in the first six months of life; and continued breastfeeding up to two years of age and beyond, while receiving appropriate complementary foods [3].

The Lancet series on breastfeeding estimated that, globally, optimal breastfeeding may save the lives of 823,000 children aged less than five-years-old annually, equivalent to 14% of the child deaths [4]. A multi-country study with close to 100 000 mother–infant pairs found that both early initiation and EBF were independently associated with a lower risk of child death [5]. Pre-lacteal feeding (PLF) is defined as giving newborns liquids or foods other than breastmilk before breastfeeding is established. It is one of the practices jeopardizing optimal breastfeeding in low and middle-income countries (LMIC) [6,7]. The Baby Friendly Hospital Initiative (BFHI), in its 10 steps to successful breastfeeding, discourages this practice [8]. The rationale behind discouraging PLF is that the feeds are easily contaminated. This might introduce harmful micro-organisms that increase the risk of diarrhoea and disrupt establishment of normal flora in the infant's gastrointestinal tract [9]. PLF has, also, been associated with a fourfold increased risk in infant deaths from infectious diseases [10]. Several studies have found that socio-economic conditions, lack of knowledge and cultural beliefs may contribute to PLF [11–13].

South Sudan, the world's youngest country, gained independence in 2011 [14]. It has been plagued by conflict and widespread population displacement with nearly 5 million people in need of humanitarian aid [15]. The civil unrest resulted in displacement that negatively influences infant feeding practices [16]. UNICEF and non-government organizations (NGOs) estimates that 45% of children below six-months-old are exclusively breastfed [17] and pre-lacteal feeds such as water and cows' milk are

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commonly used [18]. However, published information on predictors of PLF in South Sudan is lacking. Understanding the predictors of PLF is critical in developing strategies to mitigate this practice. This study describes the prevalence and factors associated with PLF in South Sudan.

Methods

Study design, setting and participants

This was a community based cross-sectional study conducted among mothers of children aged less than two years.

The study was carried out in Jubek State, South Sudan, from October to December 2016. Jubek State has an estimated population of 530,000 most of whom live in rural areas [19]. It has 12 counties and one city council (Juba). The study was done in the four counties of Ladu (N = 24,000), Luri (30,744), Mangala (9,631) and Rajaf (21,000) [19].

All consenting mothers who had a child aged less than two years were included in the study. This included mother–infant pairs who had been present in the village at least 24 hours before the survey. For mothers with more than one eligible child, the youngest was selected.

Sample size estimation

The sample size estimation was based on the two objectives. For the prevalence of PLF, the calculated sample size was 810 mother–infant pairs. This sample size was obtained using Open-Epi software [20]. The following considerations were made during the calculation: 43% prevalence of PLF from a study in Uganda [21]; precision of 5%; design effect of 2 and 7.5% non-response.

We also calculated the sample size for factors associated with PLF using Open-Epi for detecting variations between proportions of two groups (Kelsey formula) [20]. In this calculation, the place of birth was used to calculate the sample size required to detect differences in the proportion of PLF between mothers who had given birth at home and those who had hospital births. Using a study in South Sudan where 87% of mothers gave birth at home [22], we assumed that the prevalence of PLF was 70% among mothers who had given birth at home, and 48% for those delivering in hospital. This generated a sample size of 349 for the objective on factors associated with PLF. Therefore, we took the larger sample size of 810 since this would give adequate sample size for each objective.

Sampling procedure

We utilized a modified two stage cluster design survey method developed by the Expanded Program of Immunization of the WHO [23]. In the first stage, all the clusters (43 villages) in the four counties were recorded with their populations. Using probability proportional to size, we selected 30 villages. In the second stage, we asked the village leaders to enumerate and make a list of all households, since there was no list of households available in South Sudan. In each village, we used the generated household list to select an index house by simple random sampling. After choosing the first house, the next house was the one with the door facing and closest to the preceding house. One mother who had an infant aged 0–23 months was interviewed in each house. This procedure was repeated until 27 mother–infant pairs had been recruited in each village.

Eight trained research assistants conversant with the study area and fluent in *Bari* (the local language) collected the data. The interviews were done in a private area in the mother's home, away from the other members of the family.

Study variables

The outcome variable was PLF. Mothers were asked: 'Did you give [NAME] anything else in the first three days of life apart from breast milk?' If yes, they were asked: 'what was [NAME] given to drink?' (The pre-coded options were: water; glucose solution, non-human milk; formula milk; juice; gripe water; solid food and others). The independent variables were maternal age at the last birth, place of residence categorized as 'rural' or 'urban', marital status categorized as 'married' or 'single' (single, separated, divorced, widowed), maternal education was categorized as 'none' (no formal education), 'primary', and '≥ secondary', maternal employment (any job outside the home) was categorized as 'employed' and 'unemployed', child's sex was categorized as 'male' or 'female', antenatal care visit was categorized as '0–3′, '≥ 4′, place of birth was categorized as 'health facility' or 'home', mode of birth was categorized as 'normal birth' or 'caesarean section', type of birth was categorized as 'single' or 'multiple', birth order was categorized as 'primipara' or 'multipara', discarding of colostrum (expressing and throwing away of the first milk) was categorized as 'yes' and 'no', exposure to infant formula advertisement a month before birth was categorized as 'yes' and 'no', antenatal breastfeeding counselling was categorized as 'yes' and 'no', supported/assisted to breastfeed was categorized as 'yes' and 'no', and house ownership categorized as 'yes' and 'no'.

Data quality and analysis

We used a study tool developed from the WHO guidelines on infant and young child feeding (IYCF) [24] and a study on early initiation of breastfeeding and EBF in Uganda [25]. The questionnaire was translated into the local language *Bari*, and translated

back into English, by a different expert. Pilot testing was conducted to test the feasibility of study questionnaire. The principal investigator (JBT) checked the data daily, for completeness and consistency. Data was cleaned, coded and double entered into Epi Info version 6 and stored in a secure password-protected computer.

Continuous descriptive variables were reported as means and standard deviations and the categorical variables as proportions. Chi square tests were performed to identify independent variables at bivariable analysis that were associated with outcome variables. Predictors of PLF from the literature and those with a p-value ≤0.25, not in the causal pathway and not strongly collinear with other independent variables were entered into the initial multivariable logistic regression model. We evaluated for collinearity and predictors with variance inflation factor >10 were considered strongly collinear. In case of collinearity, the predictor with a stronger measure of association with the outcome variable was retained and the other dropped from the model. We formed interaction terms for variables that were significantly associated with pre lacteal feeding, after running a backward stepwise model. We assessed for interaction by comparing the original model with the model with interaction terms using a chunk test. In the final model building we included statistically significant variables in the original model ($p < 0.05$), significant variables from the literature, and confounders in the model. Any variable that caused a difference of ≥10% between the crude and adjusted measures of association of any of the variables in the model was maintained in the model as a confounder. Independent variables with a p-value of less than 0.05 were considered significant. Discarding of colostrum could be a consequence and not a cause of the PLF. To control this situation, we repeated the analysis without this variable.This study used STATA version 14 (STATA Corp LLC, Texas, USA) for data analysis.

Results

A total of 810 mother–infant pairs were included in the study, as shown in Tables 1 and 2. The mean age of the mothers was 26.6 years, with a standard deviation (SD) of 5.5. The mean (SD) age of the children was 12.4 (6.9) months. Most mothers were married, over half had no formal education, and only a quarter gave birth at a health facility.

Fifty-three per cent (426/810), 95% CI [48 %, 59 %] of the mothers had given pre-lacteal feeds, as shown in Tables 1 and 2. The common pre-lacteal feeds included glucose solution, plain water, infant formula, gripe water, and fruit juice, as shown in Figure 1.

Table 1. Baseline characteristics and PLF among mothers of children aged less than two years surveyed in South Sudan.

Characteristics	All participants N = 810 n (%)	Pre-lacteal feeding N = 426 n (%)
Mother's age		
≤19	59 (7.3)	33 (7.7)
20–24	205 (25.3)	100 (23.5)
25–29	289 (35.7)	161 (37.8)
30–34	178 (22.0)	93 (21.8)
≥35	79 (9.7)	39 (9.2)
Marital status		
Married	793 (97.9)	415 (97.4)
Single	17 (2.1)	11 (2.6)
Mother's education		
None	516 (63.7)	280 (65.7)
Primary	228 (28.2)	120 (28.2)
≥Secondary	66 (8.1)	26 (6.1)
Mother's employment		
Employed	120 (14.8)	57 (13.4)
Unemployed	690 (85.2)	369 (86.6)
House ownership		
Yes	790 (97.5)	417 (9.0)
No	20 (2.5)	251 (2.1)
Child's sex		
Male	390 (48.2)	230 (54.0)
Female	420 (51.9)	196 (46.0)

Table 2. Birth characteristics and PLF among mothers of children aged less than twoyears surveyed in South Sudan.

Characteristics	All participants N = 810 n (%)	Pre-lacteal feeding N = 426 n (%)
Antenatal care visits		
Four or more	591 (73.0)	299 (70.2)
0–3	219 (27.0)	127 (29.8)
Place of birth		
Health facility	209 (25.8)	103 (24.2)
Home	601 (74.2)	323 (75.8)
Mode of child birth		
Normal birth	793 (97.9)	414 (97.2)
Caesarean section	17 (2.1)	12 (2.8)
Type of birth		
Single	789 (97.4)	416 (97.7)
Multiple	21 (2.6)	10 (2.4)
Birth order		
Primipara	138 (17.0)	74 (17.4)
Multipara	672 (83.0)	352 (82.6)
Breastfeeding counselling		
No	508 (62.7)	251 (58.9)
Yes	302 (37.3)	175 (41.1)
Breastfeeding support		
No	641 (79.1)	344 (80.8)
Yes	169 (20.9)	82 (19.3)
Discarding of colostrum		
No	496 (61.2)	239 (56.1)
Yes	314 (38.8)	187 (43.9)
Exposed to infant formula advertisement		
No	563 (69.5)	350 (82.2)
Yes	247 (30.5)	76 (17.8)

In the bivariable analysis, the factors associated with PLF were maternal education, caesarean section, having received antenatal breastfeeding counselling and discarding of colostrum, as shown in Table 3. In the multivariable analysis, having received antenatal breastfeeding counselling decreased PLF [AOR 0.60; 95% CI (0.43, 0.82)]; while discarding of colostrum increased it [AOR 1.57; 95% CI (1.17, 2.11)], as shown in Table 3.

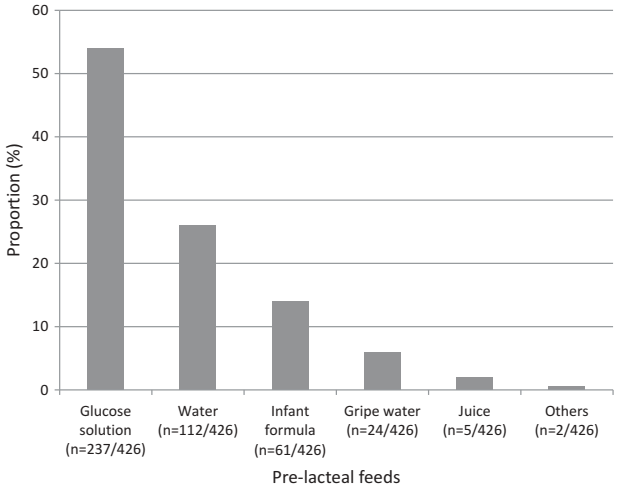

Figure 1. Types of pre-lacteal feeds used among mothers of children aged less than two years surveyed in South Sudan.

Discussion

In this study, more than half (53%) the mothers practised PLF. This finding is not surprising, since it is consistent with studies in the East African region. For example, a report from Eastern Uganda by Engebretsen et.al [26], found that 57% of mothers had given pre-lacteal feeds. Nevertheless, a lower prevalence of PLF was reported from the Kilimanjaro region in northern Tanzania (1%) [27], and from northwest (26.8%) [28] and south Ethiopia (25.5%) [7]. Whereas some low income countries have extension community health workers who move among the villages promoting recommended maternal and newborn care practices [7], such programs are non-existent in South Sudan. The lack of organized programs that specifically focus on promotion of breastfeeding might explain the high prevalence of PLF in our study. A much higher prevalence of PLF was reported in North West Nigeria (85%) [29]. The differences in PLF rates might be partly attributed to variations in study participants and cultural beliefs associated with the practice.

The commonest pre-lacteal feeds in this study were sugar solution (56%), plain water (26%) and infant formula (14%). This agrees with previous studies in Egypt and Kenya [30,31] where similar pre-lacteal feeds were used. Another study in northwest Nigeria reported cows' milk as the most preferred pre-lacteal feed [29]. Participants in the current study were largely peasant farmers with less access to cows' milk and were more likely to give sugar solution, because sugar was readily available. In addition, the use of sugar solution and infant formula was partly due to maternal misconception that the infant might be hungry or hypoglycaemic, especially before lactation is fully established. On the other hand, mothers who gave plain water thought that the infant might be thirsty because of the hot climate in South Sudan.

Mothers who discarded colostrum were two times more likely to practise PLF compared to those who did not. Most probably, the mothers who discarded colostrum were left with no alternative but to give pre-lacteal feeds. Studies from Egypt, Ethiopia and Nepal have also reported that discarding of colostrum was associated with PLF [30,32–34]. A report from Raya Kobo district, Ethiopia [35] found that untrained traditional birth attendants and family members encouraged mothers to discard colostrum and practise PLF [35]. Our study did not qualitatively probe the reasons for discarding colostrum and the role of cultural beliefs on PLF.

We found mothers who received breastfeeding counselling during antenatal care were less likely to give pre-lacteal feeds compared to those who were not counselled on breastfeeding. Similar findings were reported from Ethiopia [36], Burkina Faso and Uganda [37]. In addition, evidence from Bangladesh and Tanzania revealed that breastfeeding counselling increases maternal knowledge on optimal infant feeding [38,39]. Mothers who are knowledgeable on IYCF are more likely to follow the WHO recommendations on practices such as early initiation of breastfeeding, EBF and avoidance of pre-lacteal feeds [40].

Maternal education was not associated with PLF. This was not surprising since most mothers we studied had no formal education. Mothers with no formal education might have had limited access to information on appropriate infant

Table 3. Bivariable and multivariable analysis of the use of PLF among mothers of children aged less than two years surveyed in South Sudan.

Characteristic	Bivariable N = 810 OR (95%CI)	Multivariable model 1 N = 810 Adjusted odd ratio AOR (95%CI)	Multivariable model 2 N = 810 Adjusted odd ratio AOR (95%CI)
Mother's age			
≤19	1.5 (0.79, 2.82)	-	-
20–24	1		
25–29	1.2 (0.86, 1.76)		-
30–34	1.1 (0.66, 1.75)	-	-
≥35	1.1 (0.60, 1.88)	-	-
Marital status			
Married	1		
Single	1.67 (0.46,6.03)	-	-
Mother education			
No formal education	1	1	1
Primary	0.94 (0.62,1.42)	0.63 (0.33, 1.19)	0.60 (0.31,1.09)
≥Secondary	0.55 (0.31,0.97)	0.76 (0.24, 1.26)	0.66 (0.21,2.04)
Mother employment			
Employed	1	1	1
Unemployed	0.79 (0.49,1.26)	0.84 (0.56, 1.26)	0.85 (0.57,1.28)
House ownership			
Yes	1		
No	0.73 (0.24,2.20)	-	-
Child sex			
Male	1		
Female	1.20 (0.89,1.61)	-	-
Antenatal care visits			
Four or more	1		
0–3	0.85 (0.65,1.13)	-	-
Place of birth			
Health facility	1	1	1
Home	1.20 (0.81,1.77)	1.23 (0.84,1.81)	1.36 (0.92,2.01)
Mode of birth			
Normal birth	1		
Caesarean section	2.20 (0.87,5.58)	-	-
Type of birth			
Single	1		
Multiple	0.82 (0.27,2.48)	-	-
Birth order			
Primipara	1		
Multipara	0.95 (0.70,1.29)	-	-
Breastfeeding counselling			
No	1	1	1
Yes	0.71(0.50,1.08)	0.60 (0.43,0.82)	0.63 (0.46,0.87)
Breastfeeding support			
Yes	1		
No	1.22 (0.81,1.86)		
Discarding of colostrum			
No	1	1	
Yes	1.58 (1.11,2.26)	1.57 (1.17, 2.11)	-
Exposure to infant formula advertisement			
No	1		
Yes	1.05 (0.72,1.51)	-	-

Multivariable model 1 including all the predefined variables.
Multivariable model 2 as in number 1 but excluding the discarding of colostrum.

feeding especially through the media, and newspapers. A high level of formal education was reported to be protective against PLF in Eastern Uganda [26].

The findings of this study may have a wide range of implications regarding maternal and infant health, practice and policy on early infant feeding in South Sudan. The high rate of PLF may reduce suckling and production of breastmilk leading to a decrease in EBF [41]. In addition, discarding of colostrum might deny the infant the health benefits leading to an increase in infections and subsequent death. Furthermore, PLF practice disrupts maternal infant bonding which may affect maternal and infant psychology. PLF may also lead to early discontinuation of breastfeeding.

Strengths and limitations

This was a community-based survey that gave us a glimpse of PLF practice in South Sudan. One limitation of this study was that we interviewed mothers of children aged 0–23 months, regarding infant feeding in the first three days of birth. The responses are likely to be influenced by recall bias, especially among the older infants.We should have over sampled mothers with children aged 0–6 months to shorten the recall period and reduce on recall errors [42]. Secondly, mothers in this study self-reported on PLF practices

and this might have led to desirability bias; that is the mothers may have reported the desired answer but not the real practice. Lastly, this study used only a quantitative method. A mixed-methods analysis of PLF practices could have given us in-depth understanding of the factors underlying the practices.

Conclusion

The prevalence of PLF in South Sudan is high. Predictors of PLF included lack of breastfeeding counselling and discarding of colostrum. Infant feeding counselling should be given to all pregnant women in the health facilities and communities. The counselling should emphasize the health benefits of colostrum and discourage the practice of discarding it.

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Author contributions

JBT, JKT, TT, GN and MS conceived and designed the study. JBT supervised the study, analysed the data and wrote the first draft of the manuscript. JKT, TT, GN, MS and DM participated in the interpretation of results and critically reviewed the manuscript. All authors have read and approved the final version of the manuscript.

Disclosure statement

No potential conflict of interest was reported by the authors.

Ethics and consent

We obtained ethical approval from the Directorate of Planning, Budgeting and Research in the Ministry of Health – Reference number SMOH/E/JS/44. K. 1. Official letters of permission were presented to the county commissioners and chiefs. Written consent was obtained from the study participants after providing information about the purpose and procedures of the study. For the participants who could not write, a thumbprint was obtained. Strict privacy and confidentially measures were maintained throughout the study. There was no compensation given to the study participants. Participants' questions regarding the study were addressed accordingly.

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Paper context

PLF is an important barrier to EBF. This study was conducted in Jubek State, South Sudan, a country experiencing low intensity conflict. More than half the mothers had given pre-lacteal feeds. Antenatal breastfeeding counselling was associated with a lower risk of PLF, while discarding of colostrum was associated with a higher risk. PLF may further worsen the situation increasing morbidity and mortality. Interventions to mitigate this practice are needed.

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References

[1] United Nations. Sustainable development goals. New York: United Nations; 2015 cited 2018 Aug 30. Available from: http://www.un.org/sustainabledevelopment/summit/
[2] Rollins NC, Bhandari N, Hajeebhoy N, et al. Why invest, and what it will take to improve breastfeeding practices? Lancet. 2016;387:491–504.
[3] World Health Organization. Global strategy for infant and young child feeding: the optimal duration of exclusive breastfeeding. 2001 [cited 2018 Aug 30]. Available from: http://www.who.int/iris/handle/10665/78801.
[4] Victora CG, Bahl R, Barros AJ, et al. Breastfeeding in the 21st century: epidemiology, mechanisms, and lifelong effect. Lancet. 2016;387:475–490.
[5] Neovita Study Group. Timing of initiation, patterns of breastfeeding, and infant survival: prospective analysis of pooled data from three randomised trials. Lancet Glob Health. 2016;4:e266–e275.
[6] Agho KE, Ogeleka P, Ogbo FA, et al. Trends and Predictors of prelacteal feeding practices in Nigeria (2003-2013). Nutrients. 2016;8:462.
[7] Chea N, Asefa A. Prelacteal feeding and associated factors among newborns in rural Sidama, south Ethiopia: a community based cross-sectional survey. Int Breastfeed J. 2018;13:7.
[8] United Nations Children's Fund/World Health Organization. Baby-friendly hospital initiative. 2017 [cited 2018 May 23]. Available from: https://www.unicef.org/nutrition/files/BFHI_Case_Studies_FINAL.pdf.
[9] Hajeebhoy N, Nguyen PH, Mannava P, et al. Suboptimal breastfeeding practices are associated with infant illness in Vietnam. Int Breastfeed J. 2014;9:12.

[10] Edmond KM, Zandoh C, Quigley MA, et al. Delayed breastfeeding initiation increases risk of neonatal mortality. Pediatrics. 2006;117:e380–e386.
[11] Legesse M, Demena M, Mesfin F, et al. Prelacteal feeding practices and associated factors among mothers of children aged less than 24 months in Raya Kobo district, North Eastern Ethiopia: a cross-sectional study. Int Breastfeed J. 2014;9:189.
[12] Nguyen PH, Keithly SC, Nguyen NT, et al. Prelacteal feeding practices in Vietnam: challenges and associated factors. BMC Public Health. 2013;13:932.
[13] Berde AS, Yalcin SS, Ozcebe H, et al. Determinants of pre-lacteal feeding practices in urban and rural Nigeria; a population-based cross-sectional study using the 2013 Nigeria demographic and health survey data. Afr Health Sci. 2017;17:690–699.
[14] BBC. South Sudan becomes an independent nation. 2011 [cited 2018 Aug 30]. Available from: https://www.bbc.com/news/world-africa-14089843.
[15] Global conflict tracker. Civil war in South Sudan - council on foreign relations. 2018 [cited 2018 May 29]. Available from: https://www.cfr.org/interactives/global-conflict-tracker#!/conflict/civil-war-in-south-sudan.
[16] Gezahegn Y, Kassahun W, Dube L. Factors associated with acute malnutrition among South Sudanese children in Tierkidi Refugee Camp: a case-control study. Quality in Primary Care. 2017;25:253–258.
[17] United Nations Children's Fund. The state of the world's children. New York, 2017 [cited 2018 May 28]. Available from: https://www.unicef.org/sowc2017/.
[18] Trish D, Karen O Improving maternal and child health through media in South Sudan 2017 [cited 2018 June 5]. Available from: http://globalhealthstories.com/wp-content/uploads/2017/12/South-Sudan-report-web2.pdf.
[19] South Sudan National Bureau of Statistics. Population projections for South Sudan by payam 2015 [cited 2018 Jun 5]. Available from: http://www.ssnbss.org/sites/default/files/2016-08/population_projections_for_south_sudan_by_payam_2015_2020.pdf.
[20] Dean AG, Sullivan KM, Soe MM Open epi: open source epidemiologic statistics for public health. 2013 [cited 2018 May 20]. Available from: www.OpenEpi.com.
[21] Wamani H, Astrom AN, Peterson S, et al. Infant and young child feeding in western Uganda: knowledge, practices and socio-economic correlates. J Trop Pediatr. 2005;51:356–361.
[22] Groppi L, Somigliana E, Pisani V, et al. A hospital-centered approach to improve emergency obstetric care in South Sudan. Int J Gynaecol Obstet. 2015;128:58–61.
[23] Bennett S, Woods T, Winitha MS, et al. A simplified general method for cluster-sample surveys of health in developing countries. 1991 [cited 2018 May 23]. Available from: http://www.who.int/iris/handle/10665/47585.
[24] World Health Organization. Indicators for assessing infant and young child feeding practices. Geneva, 2010 [cited 2018 May 23]. Available from: http://www.who.int/nutrition/publications/infantfeeding/9789241599290/en/.
[25] Tylleskar T, Jackson D, Meda N, et al. Exclusive breastfeeding promotion by peer counsellors in sub-Saharan Africa (PROMISE-EBF): a cluster-randomised trial. Lancet. 2011;378:420–427.
[26] Engebretsen IM, Wamani H, Karamagi C, et al. Low adherence to exclusive breastfeeding in Eastern Uganda: a community-based cross-sectional study comparing dietary recall since birth with 24-hour recall. BMC Pediatr. 2007;7:10.
[27] Mgongo M, Mosha MV, Uriyo JG, et al. Prevalence and predictors of exclusive breastfeeding among women in Kilimanjaro region, Northern Tanzania: a population based cross-sectional study. Int Breastfeed J. 2013;8:12.
[28] Tariku A, Biks GA, Wassie MM, et al. Factors associated with prelacteal feeding in the rural population of northwest Ethiopia: a community cross-sectional study. Int Breastfeed J. 2016;11:14.
[29] Jimoh AO, Adaji SE, Adelaiye HA, et al. Factors associated with prelacteal feeding practices in a rural northern Nigerian setting. South African Journal of Clinical Nutrition. 2018;31:37–42.
[30] El-Gilany AH, Abdel-Hady DM. Newborn first feed and prelacteal feeds in Mansoura, Egypt. Biomed Res Int. 2014;2014:258470.
[31] Lakati AS, Makokha OA, Binns CW, et al. The effect of pre-lacteal feeding on full breastfeeding in Nairobi, Kenya. East African Journal of Public Health. 2010;7:258–262.
[32] Yimer NB, Liben ML. Effects of home delivery on colostrum avoidance practices in North Wollo zone, an urban setting, Ethiopia: a cross sectional study. J Health Popul Nutr. 2018;37:4.
[33] Bililign N, Kumsa H, Mulugeta M, et al. Factors associated with prelacteal feeding in North Eastern Ethiopia: A community based cross-sectional study. Int Breastfeed J. 2016;11:13.
[34] Sreeramareddy CT, Joshi HS, Sreekumaran BV, et al. Home delivery and newborn care practices among urban women in western Nepal: a questionnaire survey. BMC Pregnancy Childbirth. 2006;6:27.
[35] Legesse M, Demena M, Mesfin F, et al. Factors Associated with Colostrum Avoidance Among Mothers of Children Aged less than 24 Months in Raya Kobo district, North-eastern Ethiopia: community-based Cross-sectional Study. J Trop Pediatr. 2015;61:357–363.
[36] Yenit MK, Genetu H, Tariku A. Infant feeding counseling and knowledge are the key determinants of prelacteal feeding among HIV exposed infants attending public hospitals in Ethiopia. Arch Public Health. 2017;75:23.
[37] Engebretsen IM, Nankabirwa V, Doherty T, et al. Early infant feeding practices in three African countries: the PROMISE-EBF trial promoting exclusive breastfeeding by peer counsellors. Int Breastfeed J. 2014;9:19.
[38] Ara G, Khanam M, Papri N, et al. Peer counselling improves breastfeeding practices: A cluster randomized controlled trial in urban Bangladesh. Matern Child Nutr. 2018;14:e12605.
[39] Hashim TH, Mgongo M, Katanga J, et al. Predictors of appropriate breastfeeding knowledge among pregnant women in Moshi Urban, Tanzania: a cross-sectional study. Int Breastfeed J. 2016;12:11.
[40] Bica OC, Giugliani ER. Influence of counseling sessions on the prevalence of breastfeeding in the first year of life: a randomized clinical trial with adolescent mothers and grandmothers. Birth. 2014;41:39–45.
[41] Rogers NL, Abdi J, Moore D, et al. Colostrum avoidance, prelacteal feeding and late breast-feeding initiation in rural Northern Ethiopia. Public Health Nutr. 2011;14:2029–2036.
[42] Greiner T. Exclusive breastfeeding: measurement and indicators. Int Breastfeed J. 2014;9:18.

IV

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Article

Determinants of Health Facility Utilization at Birth in South Sudan

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Abstract: South Sudan has a high maternal mortality ratio estimated at 800 deaths per 100,000 live births. Birth in health facilities with skilled attendants can lower this mortality. In this cross-sectional study, we determined the level and determinants of health facility utilization and skilled birth attendance in Jubek State, South Sudan. Mothers of children aged less than two years were interviewed in their homes. Multivariable regression analysis was performed to determine factors associated with health facility births. Only a quarter of the mothers had given birth at health facilities, 209/810 (25.8%; 95% CI 18.2–35.3) and 207/810 had a skilled birth attendant (defined as either nurse, midwife, clinical officer, or doctor). Factors positively associated with health facility births were four or more antenatal visits (adjusted odds ratio (AOR) 19; 95% CI 6.2, 61), secondary or higher education (AOR 7.9; 95% CI 3, 21), high socio-economic status (AOR 4.5; 95% CI 2.2, 9.4), and being primipara (AOR 2.9; 95% CI 1.5, 5.4). These findings highlight the need for efforts to increase health facility births in South Sudan.

Keywords: childbirth; health-facility-births; skilled birth attendant; reproductive health; South-Sudan

1. Introduction

The global maternal mortality ratio (MMR) has dropped by 44% in the last 25 years [1]. This decline varies widely between low- and high-income countries. Low-income countries contribute 99% of the maternal deaths in the world, and sub-Saharan Africa accounts for 66% of these deaths [1].

Often, maternal deaths are due to direct obstetric causes such as postpartum haemorrhage, obstructed labour, sepsis, unsafe abortion, and hypertension [2]. These complications can be mitigated by encouraging mothers to give birth at health facilities with the help of skilled birth attendants [3]. Mothers who give birth at health facilities are also less likely to die or lose their new-borns [4–6]. Reduction of mortality in health facility births is, largely, due to skilled health workers' ability to prevent, treat, or control fatal obstetric and neonatal complications.

South Sudan has one of the highest MMR and neonatal mortality rates (NMR) in the world. The MMR was estimated to be 800 per 100,000 live births in 2015, while the NMR was about 39 per 1000 live births in the same year [7,8]. These figures are probably higher in rural areas and those involved in the civil war [9]. The South Sudan Demographic Household survey in 2010 report showed that only 12% of mothers used health facilities during childbirth with skilled birth attendants [10]. For South Sudan to meet the targets of the third Sustainable Development Goal (SDG) of reducing the MMR to less than 70 per 100,000 live births, and the neonatal mortality rate to less than 12/1000

live births [11] interventions that reduce both maternal and neonatal mortality and morbidity must be implemented [12,13]. One such intervention is scaling up health facility births and skilled birth attendance. To design interventions that promote health facility births in South Sudan, up to date context-specific data are needed [14].

We report the level and determinants of health facility utilization and skilled birth attendance during childbirth in Jubek State, South Sudan.

2. Subjects and Methods

2.1. Study Design

This was a cross-sectional study carried out among mothers of children aged 0–23 months.

2.1.1. Setting

This study was carried out from October 2016–December 2016 in four counties in Jubek State, South Sudan. Jubek State has 12 Counties and one city council (Juba) with a population of about 500,000 [15]. Most of the inhabitants are ethnic *Bari* who speaks the *Bari* language. Farming is the main economic activity. The survey was carried out in four rural counties of Lodu, Luri, Mangala, and Rajaf [15].

2.1.2. Sampling

We used a two-stage sampling method, which is; basically, a modification of the World Health Organization (WHO) expanded programme on immunization (EPI) method for estimating vaccination coverage [16]. We listed all 43 villages and corresponding populations in the four counties and selected 30 out of 43 the villages by probability proportionate to size [16]. In each village, we selected an index house randomly and proceeded to the nearest house. The next house was selected by picking the house nearest to the index household; the one whose door was closest. From each household, we recruited one mother-infant pair. This process was repeated until a total of 27 mother-infant pairs had been interviewed from each of the 30 villages, giving us a total of 810 participants. The details of the sampling procedure have been published in the Global Health Action Journal [17].

Eight trained research assistants conversant with the study area and fluent in *Bari* (the local language) collected the data. The interviews were done in a private area in the mother's home, away from the other members of the family.

2.2. Study Participants

We included mothers of children aged 0–23 months; if a mother had two children born in the last two years, only the youngest was selected. We excluded mother-infant pairs who were not residents in the village, children with no mothers, and those whose mothers were not mentally sound to complete the interview.

2.3. Variables

The outcome variables included: the place of birth and skilled birth attendance. Place of birth categorized as a healthcare facility or other (home, on the way to a health facility, traditional birth attendant's house, etc.). Mothers were also asked about the person who assisted them during childbirth, and this was categorized as skilled birth attendance if they reported a healthcare worker (defined as either nurse, midwife, clinical officer, or doctor) or unskilled birth attendance. Other variables included the mothers' age categorised as ≤19, 20–24, 25–29, and ≥30 years; marital status classified as single or married; mothers' education categorized as no formal education, primary, ≥secondary; antenatal care visits categorised as none, 1 to 3, ≥4; parity classified as 1 or >1 and socio-economic status categorized as quintiles Q1 (poorest), Q2 (poor), Q3 (medium), Q4 (less poor) and Q5 (least poor). The socioeconomic status was calculated using multiple correspondence analysis [18] base on:

(a) ownership of assets such as car, phone, radio, television, fridge, cupboard, bicycle, motorcycle, house, land, (b) fuel use for cooking, and (c) assessment of household dwelling characteristics like material of the floor, roof, and house type.

2.4. Data Analysis

We present continuous variables as means and standard deviations; and categorical variables as proportions. We used logistic regression to assess factors associated with health facility birth and skilled birth attendance.

Factors associated with health facility births from the literature and those with a p-value ≤ 0.25, and not strongly collinear with other independent variables were entered in the initial multivariate logistic regression model. We assessed for collinearity and considered factors with a variance inflation factor more than ten strongly collinear. In case of collinearity, the factor with a stronger measure of association with the dependent variable was retained, and the other dropped from the model. We used STATA version 14 (STATA Corp LLC, Texas, TX, USA) with survey set command adjusting for the multistage sampling in the data analysis.

2.5. Ethics

We obtained ethical approval from the Directorate of Planning, Budgeting, and Research in the Ministry of Health in South Sudan—reference number SMOH/E/JS/44.K.1. Official letters of permission were presented to the county commissioners and village chiefs. Written informed consent was obtained from the study participants after providing information about the purpose and procedures of the study. We obtained a thumbprint from participants who were unable to write. Privacy and confidentially measures were maintained throughout the study. No compensation was given to the study participants. We addressed the participants' questions regarding the survey accordingly.

3. Results

3.1. Socio-Demographic and Birth Characteristics

A total of 810 mothers were included in this survey, Table 1. The mean and standard deviation (SD) of the age of mothers was 26.6 (5.5) years. Most of the mothers were married; over half had no formal education. Only a quarter of the mothers gave birth at a health facility, 209/810 (25.8%; 95% CI 18.2–35.3). Of the 810 mothers, 204 had had a skilled birth attendant, and five did not. Another three mothers who did not give birth at a health centre said they had a skilled birth attendant.

3.2. Factor Associated with Health Facility Birth and Skilled Birth Attendance at Birth

Factors linked to health facility births at bivariable level included mother's age, mother's education, one or more antenatal care visits, high socio-economic status, and maternal parity greater than one, Table 2.

Factors positively associated with health facility births in the multivariable analysis included, mother's education status, antenatal care visits, socio-economic status, and parity, Table 2.

Factors associated with skilled birth attendance in the multivariable analysis included mothers' education status, antenatal care visits, and socio-economic status, Table 3.

Table 1. Baseline characteristics of mothers in a community survey in Jubek State, South Sudan.

Characteristics	All Participants N = 810	Health Facility Births N = 209 (25.8%)
	n (%)	*n* (%)
Age of the mother		
≤19	89 (11.0)	35 (16.8)
20–24	195 (24.1)	67 (32.1)
25–29	279 (34.4)	59 (28.2)
30–34	173 (21.4)	40 (19.1)
≥35	74 (9.1)	8 (3.8)
Marital status		
Single	17 (2.1)	6 (2.9)
Married	793 (97.9)	203 (97.1)
Mother's education		
None	516 (63.7)	63 (30.1)
Primary	228 (28.2)	96 (45.9)
≥Secondary	66 (8.2)	50 (23.9)
Mother's employment		
Unemployed	690 (85.2)	166 (79.4)
Employed	120 (14.8)	43 (20.6)
Antenatal care visits		
None	165 (20.4)	4 (1.9)
1–3	444 (54.8)	98 (46.9)
≥4	201 (24.8)	107 (51.2)
Parity		
1	138 (17.0)	61 (29.2)
>1	672 (83.0)	148 (70.8)
Socio-economic quintiles		
Poorest (Q1)	286 (35.3)	28 (13.4)
Poor (Q2)	95 (11.7)	20 (9.6)
Medium (Q3)	114 (14.1)	17 (8.1)
Less poor (Q4)	154 (19.0)	51 (24.4)
Least Poor (Q5)	161 (19.9)	93 (44.4)

Table 2. Bivariate and multivariate logistic regression analysis of health facility birth in a community survey in Jubek State, South Sudan

Characteristic	Bi-Variable N = 810	Multivariable Model l N = 810
	OR (95%CI)	AOR (95%CI)
Mother's age		
≤19	1	1
20–24	0.8 (0.46, 1.4)	0.9 (0.44, 1.9)
25–29	0.4 (0.24, 0.7)	0.8 (0.31, 2.02)
30–34	0.5 (0.2, 1.1)	0.9 (0.32, 2.7)
≥35	0.2 (0.06, 0.6)	0.5 (0.14, 1.9)
Marital status		
Married	1	
Single	1.6 (0.46, 5.4)	-
Mother's education		
No formal education	1	1
Primary	5.2 (3.2, 8.5)	3.1 (1.9, 5.2)
≥Secondary	22 (11, 46)	7.9 (3, 21)

Table 2. *Cont.*

Characteristic	Bi-Variable N = 810	Multivariable Model l N = 810
	OR (95%CI)	AOR (95%CI)
Mother's employment		
Unemployed	1	1
Employed	1.8 (0.94, 3.3)	1.2 (0.6, 2.4)
Antenatal care visits		
None	1	1
1–3	11 (4.2, 31)	5.2 (1.7, 16)
≥4	46 (15, 140)	19 (6.2, 61)
Parity		
1	2.9 (1.8, 4.5)	2.9 (1.5, 5.4)
>1	1	1
Socio-economic quintiles		
Poorest (Q1)	1	1
Poor (Q2)	2.5 (1.2, 4.9)	1.7 (0.8, 3.6)
Medium (Q3)	1.6 (0.64, 4.1)	1.3 (0.5, 3.0)
Less poor (Q4)	4.6 (2.3, 9.3)	2.4 (1.1, 5.0)
Least poor (Q5)	12 (7.0, 24)	4.5 (2.2, 9.4)

Table 3. Bi-variable and multivariable logistic regression analysis of skilled birth attendance in a community survey in Jubek State, South Sudan

Characteristic	Bi-Variable N = 810	Multivariable Model 2 N = 810
	OR (95%CI)	AOR (95%CI)
Mother's age		
≤19	1	1
20–24	0.93 (0.54, 1.60)	1.18 (0.55, 2.52)
25–29	0.44 (0.25, 0.75)	0.88 (0.37, 2.12)
30–34	0.51 (0.22, 1.18)	1.10 (0.40, 3.08)
≥35	0.21 (0.07, 0.61)	0.61 (0.17, 2.14)
Marital status		
Single	1	
Married	0.48 (0.18, 1.3)	-
Mother education		
No formal education	1	1
Primary	5.2 (3.1, 8.7)	3.1 (1.79, 5.37)
≥Secondary	22.9 (11.4, 45.9)	8.2 (3.18, 21.27)
Mother employment		
Unemployed	1	1
Employed	1.6 (0.89, 3.1)	1.05 (0.53, 2.08)
Antenatal care visits		
None	1	1
1–3	8.7 (3.5, 21.9)	3.93 (1.52, 10.15)
≥4	36.4 (11.9, 111.7)	15.17 (5.53, 41.58)
Parity		
>1	1	1
1	2.7 (1.8, 4.3)	2.9 (1.65, 5.16)
Wealth Quintiles		
Poorest (Q1)	1	1
Poor (Q2)	2.5 (1.3, 4.8)	0.61 (0.80, 3.54)
Medium (Q3)	1.6 (0.67, 3.9)	1.26 (0.55, 2.85)
Less poor (Q4)	4.3 (2.2, 8.3)	2.20 (1.123, 4.30)
Wealthiest (Q5)	12.6 (6.8, 23.2)	4.64 (2.38, 9.03)

4. Discussion

This survey found low levels of utilization of health facilities and skilled birth attendance during childbirth; only a quarter of mothers utilized health facilities or received skilled birth attendance during childbirth.

The proportion of mothers who gave birth in a health facility was higher than that observed in the nation-wide South Sudan Household Survey (SSHS) conducted in 2010, which showed that only 12% of mothers gave birth in a health facility [10]. These proportions cannot be compared as the geographical coverage was different. In fact, the study area surveyed is close to Juba. In the rest of the country, health facility utilization is likely to be lower than what we observed. Therefore, the proportion of mothers who give birth at health facilities is still alarmingly deficient. This could be partly due to the insecurity [19] resulting from the on-going civil unrest in South Sudan, which has hindered improvement in the necessary infrastructure. Instability also discourages mothers from utilizing services, especially during the night [19–21]. Furthermore, socioeconomic consequences and shocks of war lead to poor health service delivery and utilization [9,22,23]. Also, the low use of health facilities for childbirth could be due to supply-side reasons such as poor quality of health care [24]. Low-quality health care is known to discourage women from using health facilities [21]. There could also be socio-cultural factors such as fear of dignity violation [25] that discourage mothers from seeking health care during childbirth.

The factors associated with giving birth at a health facility or receiving skilled birth attendance during childbirth included: having attended more antenatal care (ANC) visits, mother's education status, higher socio-economic status, and being a first-time mother. These factors were comparable to the results of a recent study on the risk factors for not using health facility at birth in South Sudan [26].

Antenatal care visit was associated with health facility births. Mothers who had attended at least four ANC visits were 19 times more likely to deliver in health facilities, compared to others who did not attend any antenatal care. This was similar to findings from Tanzania [27]. Women who attended ANC several times could have gained knowledge and understanding of the advantages of a facility birth. Further, women could also have become familiar with the health workers during the ANC visits and were inspired to give birth in health facilities [28].

We also found that the higher the mothers' education, the more likely she was to give birth in a health facility. These mothers were more likely to engage in health seeking behaviours due to higher knowledge levels, and indirectly through education's influence on other factors such as income [29,30].

In our study, mothers of higher socioeconomic status were more likely to give birth at a health facility or receive skilled assistance when giving birth. Women of lower economic status might have had difficulties in finding transport or meeting indirect costs related to childbirth, and hence barred from seeking institutional delivery [19].

A recent qualitative study by Wilunda and colleagues found political instability/ inter-communal conflict, lack of health facility infrastructure, shortage of medical supplies, socio-cultural practices, perception of childbirth, quality of obstetric care as potential factors influencing health facility-based birth in South Sudan [19]. In sub-Sahara Africa, a body of evidence found several factors that directly influenced health facility utilization during childbirth [31–33]. These factors include poor transport infrastructure, lack of finance for transport, indirect cost of obstetric care, distant to health facility, shortage of skilled health workers, suboptimal training of health workers, poor quality of obstetric care characterised by long waiting time, weak referral system and poor staff interpersonal skills, and attitude.

The findings in this study highlight the need to promote health facility births, antenatal care, the general economic situation of the population, and girl child education. The government in South Sudan could emulate evidence-based integrated multi-level practices that have worked in other settings such as: introduction of policies and programmes that support health facility-based birth, training of health workers, building more health facilities, improving referral systems, and addressing issues related to affordability and financial risk associated with access to obstetric services [13,31]. Furthermore,

the stakeholders should pay close attention to traditional, socio-cultural and socio-economic factors that are critical in delayed decision making in seeking obstetric services, and address women's concerns regarding supportive attendance during birth [34].

One strength of this study is that we conducted a community-based survey, in a period of insecurity, where most studies on the subject are either hospital-based or qualitative. To the best of our knowledge, this study provides the first community-based estimate of health facility births in South Sudan since 2010. These data can be used to generate better estimates of health facility births and skilled childbirth in rural South Sudan. However, we did not ask for a history of pregnancy, measure some factors such as distance to the health facility, and complications during previous childbirth, which are essential determinants of place of birth. Lastly, this study was conducted in one state and is unlikely to be generalizable to the whole country.

5. Conclusions

We found that only a quarter of the women gave birth in a health facility in an area close to the capital Juba in South Sudan. Other areas of the country are likely to have even lower attendance. Factors positively associated with health facility births were antenatal care visits, secondary or higher maternal education, high socio-economic status, and primiparity. These findings highlight the need for efforts to increase health facility births and skilled attendance in South Sudan. There is also an urgent need to conduct a broader community-based mixed methods study to provide an in-depth understanding of barriers and facilitators of health facility utilization during childbirth in South Sudan.

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References

1. Trends in Maternal Mortality. 1990 to 2015: Estimates by WHO, UNICEF, UNFPA, World Bank Group and the United Nations Population Division. ISBN 978 92 4 1565141. Available online: https://openknowledge.worldbank.org/bitstream/handle/10986/23550/report.pdf;sequence=1 (accessed on 5 July 2019).
2. Ronsmans, C.; Graham, W.J. Maternal mortality: Who, when, where, and why. *Lancet* **2006**, *368*, 1189–1200. [CrossRef]
3. Kohi, T.W.; Mselle, L.T.; Dol, J.; Aston, M. When, where and who? Accessing health facility delivery care from the perspective of women and men in Tanzania: A qualitative study. *BMC Health Serv. Res.* **2018**, *18*, 564. [CrossRef]
4. Kinney, M.V.; Kerber, K.J.; Black, R.E.; Cohen, B.; Nkrumah, F.; Coovadia, H.; Nampala, P.M.; Lawn, J.E.; Axelson, H.; Bergh, A.M.; et al. Sub-Saharan Africa's mothers, newborns, and children: Where and why do they die? *PLoS Med.* **2010**, *7*, e1000294. [CrossRef] [PubMed]
5. Kibria, G.M.A.; Burrowes, V.; Choudhury, A.; Sharmeen, A.; Ghosh, S.; Mahmud, A.; Kc, A. Determinants of early neonatal mortality in Afghanistan: An analysis of the Demographic and Health Survey 2015. *Glob. Health* **2018**, *14*, 47. [CrossRef] [PubMed]
6. Lawn, J.E.; Blencowe, H.; Oza, S.; You, D.; Lee, A.C.; Waiswa, P.; Lalli, M.; Bhutta, Z.; Barros, A.J.; Christian, P.; et al. Every Newborn: Progress, priorities, and potential beyond survival. *Lancet* **2014**, *384*, 189–205. [CrossRef]

7. Sami, S.; Kerber, K.; Kenyi, S.; Amsalu, R.; Tomczyk, B.; Jackson, D.; Dimiti, A.; Scudder, E.; Meyers, J.; Umurungi, J.P.C.; et al. State of newborn care in South Sudan's displacement camps: A descriptive study of facility-based deliveries. *Reprod. Health* **2017**, *14*, 161. [CrossRef] [PubMed]
8. Alkema, L.; Chou, D.; Hogan, D.; Zhang, S.; Moller, A.B.; Gemmill, A.; Fat, D.M.; Boerma, T.; Temmerman, M.; Mathers, C.; et al. Global, regional, and national levels and trends in maternal mortality between 1990 and 2015, with scenario-based projections to 2030: A systematic analysis by the UN Maternal Mortality Estimation Inter-Agency Group. *Lancet* **2016**, *387*, 462–474. [CrossRef]
9. Salama, P.; Spiegel, P.; Talley, L.; Waldman, R. Lessons learned from complex emergencies over past decade. *Lancet* **2004**, *364*, 1801–1813. [CrossRef]
10. The Republic of South Sudan: The Sudan Household Health Survey 2010. Available online: https://www.google.com/url?sa=t&rct=j&q=&esrc=s&source=web&cd=3&cad=rja&uact=8&ved=2ahUKEwjv1bvp4q7iAhXnsaQKHd5-DQYQFjACegQIAhAB&url=https%3A%2F%2Freliefweb.int%2Freport%2Fsouth-sudan-republic%2Frepublic-south-sudan-sudan-household-health-survey-2010&usg=AOvVaw0RS2TYlvkSGkfxFXCOvxft (accessed on 5 July 2019).
11. Sustainable Development Goals. Available online: http://www.un.org/sustainabledevelopment/summit/ (accessed on 5 July 2019).
12. De Bernis, L.; Kinney, M.V.; Stones, W.; Ten Hoope-Bender, P.; Vivio, D.; Leisher, S.H.; Bhutta, Z.A.; Gulmezoglu, M.; Mathai, M.; Belizan, J.M.; et al. Stillbirths: Ending preventable deaths by 2030. *Lancet* **2016**, *387*, 703–716. [CrossRef]
13. Campbell, O.M.; Calvert, C.; Testa, A.; Strehlow, M.; Benova, L.; Keyes, E.; Donnay, F.; Macleod, D.; Gabrysch, S.; Rong, L.; et al. The scale, scope, coverage, and capability of childbirth care. *Lancet* **2016**, *388*, 2193–2208. [CrossRef]
14. Koblinsky, M.; Moyer, C.A.; Calvert, C.; Campbell, J.; Campbell, O.M.; Feigl, A.B.; Graham, W.J.; Hatt, L.; Hodgins, S.; Matthews, Z.; et al. Quality maternity care for every woman, everywhere: A call to action. *Lancet* **2016**, *388*, 5–11. [CrossRef]
15. Jubek State. Available online: https://en.wikipedia.org/wiki/Jubek_State (accessed on 5 July 2019).
16. A Simplified General Method for Cluster-Sample Surveys of Health in Developing Countries. Available online: http://www.who.int/iris/handle/10665/47585 (accessed on 5 July 2019).
17. Tongun, J.B.; Sebit, M.B.; Ndeezi, G.; Mukunya, D.; Tylleskar, T.; Tumwine, J.K. Prevalence and determinants of pre-lacteal feeding in South Sudan: A community-based survey. *Glob. Health Action* **2018**, *11*, 1523304. [CrossRef] [PubMed]
18. Howe, L.D.; Hargreaves, J.R.; Huttly, S.R. Issues in the construction of wealth indices for the measurement of socio-economic position in low-income countries. *Emerg. Themes Epidemiol.* **2008**, *5*. [CrossRef] [PubMed]
19. Wilunda, C.; Scanagatta, C.; Putoto, G.; Takahashi, R.; Montalbetti, F.; Segafredo, G.; Betran, A.P. Barriers to institutional childbirth in Rumbek North County, South Sudan: A qualitative study. *PLoS ONE* **2016**, *11*, e0168083. [CrossRef] [PubMed]
20. Mugo, N.S.; Dibley, M.J.; Damundu, E.Y.; Alam, A. Barriers faced by the health workers to deliver maternal care services and their perceptions of the factors preventing their clients from receiving the services: A qualitative study in South Sudan. *Matern. Child Health J.* **2018**, *22*, 1598–1606. [CrossRef] [PubMed]
21. Mugo, N.S.; Dibley, M.J.; Damundu, E.Y.; Alam, A. "The system here isn't on patients' side"—Perspectives of women and men on the barriers to accessing and utilizing maternal healthcare services in South Sudan. *BMC Health Serv. Res.* **2018**, *18*, 10. [CrossRef]
22. Casey, S.E.; Chynoweth, S.K.; Cornier, N.; Gallagher, M.C.; Wheeler, E.E. Progress and gaps in reproductive health services in three humanitarian settings: Mixed-methods case studies. *Conflict Health* **2015**, *9*, S3. [CrossRef] [PubMed]
23. Kruk, M.E.; Kujawski, S.; Moyer, C.A.; Adanu, R.M.; Afsana, K.; Cohen, J.; Glassman, A.; Labrique, A.; Reddy, K.S.; Yamey, G. Next generation maternal health: External shocks and health-system innovations. *Lancet* **2016**, *388*, 2296–2306. [CrossRef]
24. Berendes, S.; Lako, R.L.; Whitson, D.; Gould, S.; Valadez, J.J. Assessing the quality of care in a new nation: South Sudan's first national health facility assessment. *Trop. Med. Int. Health* **2014**, *19*, 1237–1248. [CrossRef]
25. Kane, S.; Rial, M.; Kok, M.; Matere, A.; Dieleman, M.; Broerse, J.E.W. Too afraid to go: Fears of dignity violations as reasons for non-use of maternal health services in South Sudan. *Reprod. Health* **2018**, *15*, 51. [CrossRef]

26. Mugo, N.S.; Agho, K.E.; Dibley, M.J. Risk factors for non-use of skilled birth attendants: Analysis of South Sudan household survey, 2010. *Matern. Child Health J.* **2016**, *20*, 1266–1279. [CrossRef] [PubMed]
27. Bishanga, D.R.; Drake, M.; Kim, Y.M.; Mwanamsangu, A.H.; Makuwani, A.M.; Zoungrana, J.; Lemwayi, R.; Rijken, M.J.; Stekelenburg, J. Factors associated with institutional delivery: Findings from a cross-sectional study in Mara and Kagera regions in Tanzania. *PLoS ONE* **2018**, *13*, e0209672. [CrossRef] [PubMed]
28. Jennings, L.; Yebadokpo, A.S.; Affo, J.; Agbogbe, M. Antenatal counseling in maternal and newborn care: Use of job aids to improve health worker performance and maternal understanding in Benin. *BMC Pregnancy Childbirth* **2010**, *10*. [CrossRef] [PubMed]
29. Margolis, R. Educational differences in healthy behavior changes and adherence among middle-aged Americans. *J. Health Soc. Behav.* **2013**, *54*, 353–368. [CrossRef] [PubMed]
30. Cutler, D.M.; Lleras-Muney, A. Understanding differences in health behaviors by education. *J. Health Econ.* **2010**, *29*, 1–28. [CrossRef] [PubMed]
31. Geleto, A.; Chojenta, C.; Musa, A.; Loxton, D. Barriers to access and utilization of emergency obstetric care at health facilities in sub-Saharan Africa: A systematic review of literature. *Syst. Rev.* **2018**, *7*, 183. [CrossRef]
32. Kyei-Nimakoh, M.; Carolan-Olah, M.; McCann, T.V. Barriers to obstetric care at health facilities in sub-Saharan Africa—A systematic review protocol. *Syst. Rev.* **2015**, *4*. [CrossRef] [PubMed]
33. Kyei-Nimakoh, M.; Carolan-Olah, M.; McCann, T.V. Access barriers to obstetric care at health facilities in sub-Saharan Africa—A systematic review. *Syst. Rev.* **2017**, *6*, 110. [CrossRef]
34. Bohren, M.A.; Hunter, E.C.; Munthe-Kaas, H.M.; Souza, J.P.; Vogel, J.P.; Gulmezoglu, A.M. Facilitators and barriers to facility-based delivery in low- and middle-income countries: A qualitative evidence synthesis. *Reprod. Health* **2014**, *11*, 71. [CrossRef]

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