FACTORS ASSOCIATED WITH EXCLUSIVE BREASTFEEDING OF GHANAIAN TWINS

BY

JANE APPIADUAH ODEI

(10362831)

THIS THESIS IS SUBMITTED TO THE UNIVERSITY OF GHANA, LEGON IN PARTIAL FULFILMENT OF THE REQUIREMENT FOR THE AWARD OF MPHIL NUTRITION DEGREE

JULY, 2013

DECLARATION

This thesis is the result of research work undertaken by Jane Appiaduah Odei in the Department of Nutrition and Food Science, University of Ghana, under the supervision of Prof Anna Lartey and Dr. Gloria Ethel Otoo.

…………………………… ……………………..……..

Jane Appiaduah Odei Date
(Student)

…………………………… ……………………………

Prof Anna Lartey Date
(Principal Supervisor)

…………………………… …………………………..…

Dr. Gloria Ethel Otoo Date
(Co-Supervisor)

DEDICATION

This work is dedicated to my dear parents, Mr. and Mrs. James and Joana Odei whose unflinching love, support and encouragement have enabled the birthing of my thesis.

ACKNOWLEDGEMENTS

I thank the most High God without whom I could not have started this thesis at all. His strength, grace and guidance have indeed brought me this far and I am most grateful.

Great achievements are never possible without the diverse contributions of great men and women and this thesis is no exception. I sincerely appreciate the guidance and support received from my supervisors: Prof Anna Lartey and Dr. Gloria Otoo. Thank you Prof and the International Development Research Centre (IDRC), Canada. This work was carried out with the aid of a grant from the International Development Research Centre, Ottawa, Canada. Thank you Dr. Otoo for the encouragement to stay focused and complete this project on time.

My gratitude also goes to all the staff of the Nutrition Research Centre of the Radiological and Medical Sciences Research Institute at the Ghana Atomic Energy Commission (GAEC), Kwabenya, particularly Ms. Theodosia Adom, Dr. Rose Boatin and Mr. David Bansa as well as Mr. Dominic Datohe, Kennedy and Aku Sika. Kudos to the entire team for the opportunity to work and learn from you; for supplying equipment for the project and also assisting with sample analysis.

I appreciate Tema General Hospital, Ashaiman Polyclinic and New Crystal Hospital for their cooperation in recruiting the research participants. To the nursing mothers who volunteered their precious babies, time and effort to participate, I sincerely appreciate. Last but not least I thank my lovely family and friends notably Jehoshaphat, Joellen, Alex, Eric, Emmanuel, Esther, Nana Afia, Gifty and Isaac who contributed in diverse ways to the success of this project.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF ABBREVIATIONS

AOR:	Adjusted Odds Ratio
APC:	Ashaiman Polyclinic
BFHI:	Baby-Friendly Hospital Initiative
BSES-SF:	Breastfeeding Self-Efficacy Scale-Short Form
CS:	Caesarean Section
CWCs:	Child Welfare Clinics
EBF:	Exclusive Breastfeeding
FTIR:	Fourier Transform Infrared Spectrophotometry
GDHS:	Ghana Demographic and Health Survey
GNA:	Ghana News Agency
HIV:	Human Immunodeficiency Virus
IRMS:	Isotope Ratio Mass Spectrometry
LBW:	Low Birth Weight
MICS:	Multiple Indicator Cluster Survey
MTCT:	Mother-to-Child Transmission
NICU:	Neonatal Intensive Care Unit
OPD:	Out-Patient Department
SGA:	Small for Gestational Age
SSA:	Sub-Saharan Africa
TGH:	Tema General Hospital
UNICEF:	United Nations Children's Fund
WHO:	World Health Organization

ABSTRACT

Background: Exclusive breastfeeding (EBF) for the first six months after birth has been recommended by the WHO as the best infant feeding strategy. Despite this, studies carried out in Ghana among singletons indicate low EBF rates. Data on EBF rates among twin infants in Ghana remain limited and the EBF rate among twins is hypothesized to be low.

Objectives: The study sought to identify factors associated with EBF among Ghanaian infants particularly, twins. The duration of EBF among both twins and singletons were estimated. The mean daily breast milk volume produced by mothers with singletons and mothers with twins were estimated.

Methods: A cross-sectional survey involving 50 mother-singleton and 50 mother-twin pairs recruited from three health facilities in the Tema metropolis and Ashaiman municipality was done. Infants were between 2 to 6 months. Data on the sociodemographic, biomedical and biocultural characteristics of participants were collected. Information on foods or liquids fed to the infants in the previous 24 hours and past month were used to estimate EBF among the infants. The deuterium oxide stable isotope dilution method was used in estimating the mean daily volume of breast milk produced by a subsample of mothers with singletons (n = 11) and mothers with twins (n = 13). Multivariate binary logistic regression analysis was used to identify the predictors of EBF at six months.

Results: Only 14% of twin infants were exclusively breastfed for six months compared to 44% of singletons ($p < 0.01$). EBF for six months was significantly associated with mother's perceived breast milk production ability ($p < 0.01$) and television (TV) ownership ($p = 0.048$). The median EBF duration for singleton and twin infants was 4 months and 1 month respectively ($p < 0.01$). Mean daily volume of breast milk produced by mothers with singletons was significantly higher than that produced by mothers with twins (900.18 ± 363.68 ml/day vs. 608.65 ± 270.21 ml/day, $p = 0.02$). The predictors of EBF at six months were perceived breast milk production ability (AOR = 4.340; 95% CI, 1.011 – 18.622) and prenatal EBF intention (AOR = 16.075; 95% CI, 1.077 – 239.951).

Conclusions: Encouraging expectant mothers particularly those with twin gestations to decide prenatally to exclusively breastfeed upon delivery could increase EBF rates among Ghanaian women. Mothers must be encouraged and supported to believe in their abilities to produce enough milk to meet the nutritional needs of their infants.

CHAPTER ONE

1.0 INTRODUCTION

1.1 Background Information

All over the world breastfeeding remains the most important method of infant feeding especially for the first six months of life. This is attributed to the many undisputable benefits that breastfeeding confers on the health of both mothers and infants. It is well documented that breastfed infants have a lower incidence of respiratory tract and diarrhoeal infections (Talayero *et al.*, 2006; Dewey *et al.*, 1995). This is because breast milk contains several immunologic factors such as immunoglobulin A which protect the infant from contracting infections. A study by Talayero *et al* (2006) revealed that exclusively breastfed infants are less likely to be hospitalized compared to their non-exclusively breastfed counterparts, with the incidence of hospital visits during the first year of life declining as the duration of breastfeeding increases. Furthermore, breastfed infants have been shown to exhibit higher cognitive function (Lucas *et al.*, 1992). Apart from the benefits enjoyed by the infants, mothers who breastfeed exclusively also benefit immensely in that they experience delayed return of ovulation as well as lower rates of ovarian and breast cancers (American Academy of Paediatrics, 2005; Tung *et al*., 2003). The strong bond that is fostered between mothers and infants during the breastfeeding process cannot be overemphasized (Yokoyama *et al*., 2006).

Based on these and other scientific evidence, the World Health Organization (WHO) in 2002 recommended exclusive breastfeeding of infants for the first six months of life. Exclusive breastfeeding is defined as feeding an infant with breast milk only without giving water, water-based foods or formula except for medications such as oral rehydration salts (ORS) and syrups (WHO, 2002).

The recommendation is, however, silent on exactly what mothers with multiple births should do considering the challenges involved in caring for this group of infants. Again, despite the numerous benefits of exclusive breastfeeding (EBF) for infants, mothers and the society at large, Ghana's EBF rate has lately been on the decline from 63% in 2008 to 46% in 2012 (GNA, 2012). It is worth noting that if EBF rates even among singletons is decreasing then the rate among twins and other multiples could probably be much lower considering the extra effort required in caring for more than one baby at the same time. Globally, sub-Saharan Africa (SSA) has the highest average twin birth rate of 20 per 1000 live births while Europe and Asia have rates of 10 and 5-6 per 1000 deliveries respectively (Olusanya, 2011; Bulmer, 1970). In SSA, the south western parts of Nigeria particularly the Yoruba tribe have been reported to have the highest rate of twins globally with an average incidence of 50 twin births per 1000 deliveries (Akinboro *et al*., 2008; Mosuro *et al*., 2001; Bulmer, 1970). In Ghana, although the twin birth rate is not as high as observed among the Nigerian Yoruba tribe, the rate is still considered among the highest. Mosuro and colleagues (2001) established that the incidence of twin births in Accra over a 12-year period (1988-1999) was 33.4 twin births per 1000 deliveries while the rate in Kumasi over a 15-year period (1985-1999) was 26.6 twin births per 1000 deliveries. Thus for every 33 singleton births in Kumasi in 1999, there was a twin delivery while in Accra there was a twin birth for every 21 singleton births in the same year (Mosuro *et al.*, 2001). Irrespective of the fact that the number of twins in Ghana is not as high as singletons, it is likely the population of twins has increased considering the current population growth and the increase in twinning rates in most developed and developing countries (Smits and Monden, 2011). Twin births have been linked with certain nutritional risks and complications such as a higher likelihood of being born preterm (before 37 weeks of gestation), higher likelihood of having a low birth weight (< 2.5kg) and a higher risk of developing cerebral palsy especially as birth weight falls (Vassilaki *et al*., 2012; Yokoyama *et al*., 2006). Additionally, twins and other multiples even when born at term are about 4-5 times more likely to die before their first birthday compared to singletons (Fierro, 2012). Mothers with multiple pregnancies are also considered to be at high risk of stress, complications and mortality and hence are more likely to be delivered via caesarean section (Boseley, 2009).

It is, therefore, important that research on the factors that enhance or hinder EBF among high risk groups such as twins be carried out. This would help develop strategies which could improve EBF rates among twins as well as markedly reduce perinatal and infant mortality among this group of children.

1.2 Conceptual Framework

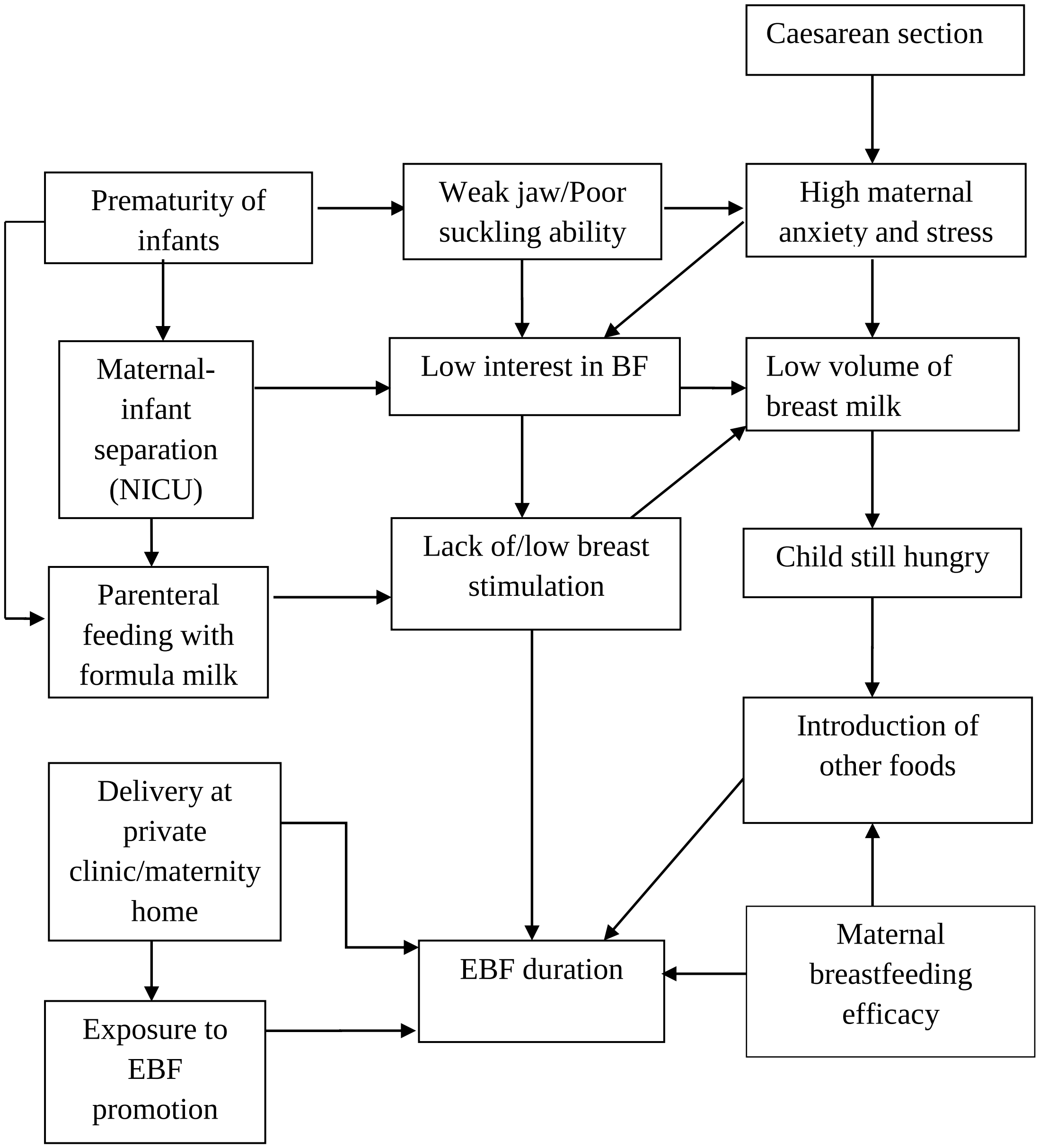

Fig 1.1: Schematic representation of factors that affect exclusive breastfeeding

The framework above indicates some determinants of exclusive breastfeeding. These determinants although could affect mothers with singletons may more likely affect mothers with twins. Details about how these factors influence exclusive breastfeeding can be found in section 2.3 under the literature review.

1.3 Rationale

Considering the importance of EBF to the health of both mothers and infants coupled with the relatively high twin birth rate in Ghana, it is crucial that mothers of twins are encouraged to exclusively breastfeed their infants to ensure optimal health. However, this cannot be done effectively without in-depth understanding of the factors that influence EBF among twins. Additionally, lack of information regarding breastfeeding practices among mothers of twins in Ghana makes it difficult to address any difficulties faced by such mothers. This study was carried out to identify the barriers to EBF among mothers nursing twins.

1.4 Main Objective

This study sought to identify the factors associated with exclusive breastfeeding of twins in Ghana.

1.5 Specific Objectives

1. To identify the factors associated with EBF of twins.

2. To determine the duration of EBF for mothers of twins.

3. To estimate the mean daily volume of breast milk produced by mothers breastfeeding twins versus mothers breastfeeding singletons using stable isotope dilution method.

1.6 Significance of the Study

Information on the factors that either hinder or enhance EBF would help health professionals and lactation counsellors to provide appropriate counselling on exclusive breastfeeding to mothers with twins thereby helping to reduce infant mortality as a result of sub-optimal breastfeeding practices.

CHAPTER TWO

2.0 LITERATURE REVIEW

2.1 Benefits of Exclusive Breastfeeding (EBF)

The WHO (2002) has recommended exclusive breastfeeding for the first six months after delivery as the best infant feeding practice. This is due to the numerous benefits EBF imparts on the health of both mothers and infants. It has been established that exclusively breastfed infants have lower incidence of respiratory tract and diarrhoeal infections. Also such infants have a decreased risk of acute otitis media, asthma, allergies, nutrient deficiencies, cancers and obesity (Ladomenou *et al.*, 2010; Talayero *et al.*, 2006; Dewey *et al.*, 1995).The presence of immunologic factors such as immunoglobulin A in breast milk protects the infant from contracting infections. Talayero and colleagues (2006) have reported that infants who are exclusively breastfed are less likely to be hospitalized compared to their non-exclusively breastfed counterparts. They further suggested that the incidence of hospital visits during the first year of life decreases as the duration of breastfeeding increases. Exclusively breastfed infants have also been shown to exhibit higher cognitive function in contrast to non-exclusively breastfed infants (Lucas *et al.*, 1992). This is due to the presence of docosahexaenoic acid in breast milk which also contribute to the growth and the development of healthy eyes and nervous system (Drover *et al.*, 2011; Jørgensen *et al.*, 2001). In addition to the benefits enjoyed by the infants, exclusively breastfeeding mothers experience delayed return of ovulation as well as lower rates of ovarian and premenopausal breast cancers (American Academy of Paediatrics, 2005; Tung *et al.*, 2003). A strong bond is fostered between mothers and infants during the breastfeeding process (Yokoyama *et al.*, 2006). In addition, exclusive breastfeeding for the first 6 months has been associated with a faster postpartum weight loss in the mother (Dewey *et al.*, 2001). In resource limited countries that also have a high burden of HIV transmission and infection, EBF for the initial 6 months has been found to decrease the likelihood of mother-to-child transmission (MTCT) of HIV compared to mixed feeding (Iliff *et al.*, 2005). The financial gains made by the family from EBF compared to mixed feeding or formula feeding is another advantage worth-mentioning (Ladomenou *et al.*, 2010).This is because money that would have been spent to purchase infant formula in addition to the time involved in preparing it for the baby would both be saved (Bartick, 2011). Also, since EBF infants have lower incidence of morbidity, money that would have been spent on hospital admissions and medications would be saved (Bartick, 2011; Bartick and Reinhold, 2010).

Based on these and other scientific evidence, the World Health Organization (WHO) in 2002 recommended EBF of infants for the first six months of life as a public health policy. The recommendation is, however, silent on exactly what mothers of multiple births (twins) should do considering the challenges involved in caring for this group of infants.

2.2 Prevalence of EBF

2.2.1 Global Prevalence of EBF

The WHO recommends a 90% universal coverage target for EBF in order to prevent 13-15% of 9 million deaths of children under-five in low and middle-income countries annually (Jones *et al.*, 2003). However, the prevalence of EBF up to 6 months is still far from this target in both developing and developed countries.

According to UNICEF, the global EBF rate for infants aged below 6 months between the years 2000 and 2007 was 38% (UNICEF, 2008). Within the same time, only 23% of infants less than 6 months were breastfed exclusively in West and Central Africa while a slightly higher rate (26%) was recorded in the Middle East and North Africa (UNICEF, 2008). Exclusive breastfeeding rates of 39%, 43% and 44% were observed in Eastern and Southern Africa; East Asia and the Pacific; and South Asia respectively (UNICEF, 2008). Similarly, a recent study by Cai and colleagues (2012) which assessed the prevalence of EBF of infants 0-5 months from 1995 to 2010 concluded that the prevalence of EBF in developing countries in 2010 was 39%. This albeit low rate was an increase of 6% over the 1995 EBF rate of 33%.

In the USA, although the national goal of EBF prevalence at 3 months and 6 months were set at 40% and 17% respectively, the national prevalence in 2010 were 33% and 13.3% at 3 and 6 months respectively (CDC, 2010). In 2012, however, the prevalence increased to 36% and 16.3% at 3 months and 6 months respectively (CDC, 2012). Despite the increase, the EBF rate remains low. In Iran, as many as 82% of infants a month old were reported to have been breastfed exclusively in the first month, 44% in the fourth month and only 2% by the sixth month (Koosha *et al.*, 2008). Another study also from Iran suggests a rate of 57% at 4 months and almost 28% at 6 months (Olang *et al.*, 2009). It is obvious from the statistics of the various countries and regions that EBF rate in the immediate postpartum period is often generally higher than the rate observed after 4 months after birth. In some of these settings, factors such as low socioeconomic status, maternal education and inadequate breastfeeding policies and programmes have been cited as contributors to the low EBF rates observed (Olang *et al.*, 2009; Koosha *et al.*, 2008).

2.2.2 EBF Prevalence in Africa

In Africa, the story is not different due to sub-optimal breastfeeding practices. In Ethiopia for example practices such as discarding the colostrum, serving water and butter to infants after birth, introduction of pre-lacteal feeds as well as improper positioning and attachment have been confirmed to contribute to low EBF rates (Tamiru *et al.*, 2012). According to the 2005 Ethiopian Demographic and Health Survey, 49.0% of infants less than 6 months were exclusively breastfed (Alemayehu *et al.*, 2009). A cross-sectional study in Tanzania that assessed the knowledge and prevalence of EBF in one of the major regions in the country estimated that out of 402 mothers who consented to participate in the study, 86% had good knowledge of EBF but only 58% exclusively breast-fed their babies until 6 months (Nkala and Msuya, 2011). A related study carried out in Nigeria by Ukegbu and colleagues (2011) also supported the observation in that although as high as 91.2% of the participants interviewed had very sound knowledge of breastfeeding only 37.3% practiced EBF by 24 weeks after delivery. Hence, it is clear that just having a good knowledge of EBF does not suggest that mothers would automatically breastfeed exclusively though knowledge is vital in improving EBF rates.

2.2.3 Prevalence of EBF in Ghana

Ghana’s EBF rate has risen steadily from 7% in 1993 to 31% in 1998 and then to 53% in 2003 (GDHS, 2008). The findings of the 2008 Ghana Demographic and Health Survey (GDHS) suggest that the percentage of Ghanaian children ever breast-fed is between

97-98%. Within the same period, the percentage of infants who initiated breastfeeding within one hour after delivery was 52%, a 6% increase over the 2003 value of 46%. Additionally, 82% of infants aged less than two months were reported to have been breast-fed exclusively. Conversely, only 49% of infants were still being breast-fed exclusively by 4 to 5months. Furthermore, a total of 63% of infants below 6 months were breast-fed exclusively in 2008. Though this was an improvement upon the 2003 rate of 53%, it was still below the 90% coverage target recommended by the WHO. The results of the recent Multiple Indicator Cluster Survey (MICS) suggest that the rate of EBF has declined from 63% to 46% (GSS MICS, 2011).

As reported by the 2008 GDHS, sub-optimal feeding practices such as the early introduction of water, juices, infant formula, semi-solid and solid complementary foods are still persistent in many parts of the country. The culture whereby prelacteal feeds are fed to babies is reported to be more common in the Ashanti, Western, Upper East and Central regions with more than one out of four children receiving prelacteal feeds (GDHS, 2008). The survey further established that aside receiving breast milk, 3% of infants below 6 months also received other milk (e.g. formula) while 17% received water. Furthermore, 17% were fed semi-solid or solid complementary food while less than 1% received juice or other non-milk based liquids.

In all the studies cited, EBF was defined as feeding an infant with only breast milk - no other food, drink, or even water although oral rehydration salts (ORS), drops and syrups (vitamins, minerals and medicines) are allowed (Oche *et al.*, 2011). Additionally, the 24-hour dietary recall method was used in the determination of EBF practice. In this method, a dietary recall of all foods and drinks the caregiver has given to the infant in the past 24 hours is done. Caregivers who report not having fed anything apart from breast milk to the child in the past 24 hours are classified as having done exclusive breastfeeding.

2.3 Determinants of EBF

2.3.1 Caesarean Delivery

One type of delivery that has been shown to adversely affect breastfeeding especially in the immediate post-partum hours is caesarean section (CS). CS is commonly done on women carrying multiple babies due to the risks and complications associated with such pregnancies. Although medical technology and scientific advancement has made CS safer than it used to be, the pain and stress associated with nursing the baby while recovering from the surgery makes breastfeeding difficult (Flidel-Rimon and Shinwell, 2002). As a result, babies delivered by CS tend to initiate suckling later than their counterparts who go through vaginal delivery (VD) (Hyde *et al.*, 2012; Zanardo *et al.*, 2010; Perez-Escamilla *et al.*, 1996). Suckling the breast in the immediate postpartum period especially within the first hour after delivery has been proven to contribute to stimulation and subsequently production of breast milk (Hyde *et al.*, 2012). In instances where breastfeeding initiation is delayed due to the mother's inability to breastfeed after a surgery, breastfeeding rates usually decline both at the hospitals and after hospital discharge (Hyde *et al.*, 2012).

Maternal hormone variation following CS has also been suggested to contribute to alteration in breastfeeding patterns. Stimulation of the nipple through suckling causes the release of lactation hormones - prolactin and oxytocin from the pituitary gland of the brain. Prolactin triggers milk production in the lobules of the mammary gland while oxytocin causes the myoepithelial cells of the breasts to release milk into the ducts (let-down reflex). As the infant suckles the breast, milk is transported to the nipples and then into the mouth (Byrd-Bredbenner *et al.*, 2009). Thus, the more the baby sucks, the more milk is produced and released for consumption and vice versa.

Following CS, the concentration of oxytocin declines resulting in decreased milk ejection (Nissen *et al.*, 1996). Dopamine, another hormone whose concentration rises after CS inhibits the secretion of prolactin, a crucial hormone in lactogenesis thereby reducing milk production (Ben-Jonathan and Hnasko, 2001).

Findings from a recent study that examined the effect of elective caesarean delivery on breastfeeding rate suggest lower breastfeeding prevalence postpartum (on the 7^{th} day, 3^{rd} and 6^{th} month) among mothers who underwent caesarean delivery compared with mothers who delivered vaginally (Zanardo *et al.*, 2010). Additionally, both elective and emergency caesarean deliveries were negatively associated with exclusive breastfeeding rates compared with vaginal delivery (Zanardo *et al.*, 2010).

2.3.2 Maternal Stress and Anxiety

Stressed and anxious mothers are less likely to breastfeed frequently compared to relaxed and less anxious mothers. Such mothers have a higher tendency to bottle feed and hence usually record lower EBF rates ((Doulougeri *et al.*, 2013). During periods of stress there is the release and activation of the hormone cortisol which is a known inhibitor of prolactin and oxytocin (Doulougeri *et al.*, 2013). Research carried out among urban Guatemalan mothers has revealed that stress during labour and/or delivery which is characterized by high cortisol levels could lead to delayed onset of lactation (Grajeda and

Pérez-Escamilla, 2002) which could eventually reduce breastfeeding frequency and duration. Mode of delivery typically emergency (unscheduled) caesarean section has also been identified to exacerbate stress levels especially in primiparous mothers compared with vaginal delivery (Grajeda and Pérez-Escamilla, 2002). Additionally stress triggered by the demands of caring for a sick infant could discourage the mother and may lead to early cessation of breastfeeding (Doulougeri *et al.*, 2013).

2.3.3 Perceived Low Volume of Breast Milk

The perception of the inability to produce adequate amounts of breast milk especially in the case of multiple births is a major challenge in the quest to improve EBF rates. Some mothers find it difficult to believe that it is possible for their babies to survive on only breast milk in the first 6 months of life without supplementing with any food or drink including water. Persistent crying of the babies even after they have been breastfed usually suggests to them that the babies are still hungry (Ukegbu *et al.*, 2011). This perception of breast milk insufficiency which could frustrate the mother or caregiver and even other members of the family is likely to contribute to early breastfeeding cessation or shorter EBF duration (Fjeld *et al.*, 2008). A study among periurban women in Ghana to identify perceived incentives and barriers to exclusive breastfeeding reported that perceived milk insufficiency was one of the main hurdles preventing the achievement of optimum EBF rates (Otoo *et al.*, 2009). In a related study in nearby Nigeria, results of focus group discussions among women with infants between one and six months revealed that many of the participants reported inadequate production of breast milk as a justification for introducing other foods (Ukegbu *et al.*, 2011). The study thus suggested that postnatal education in both the communities and hospitals be intensified to encourage mothers to continue EBF.

2.3.4 Delivery Location

Delivery in government health facilities (e.g. polyclinics and general hospitals) have been positively associated with higher breastfeeding initiation and EBF duration compared with delivery in private facilities or at home (Aidam *et al.*, 2005). The main reason for this observation is that a number of government facilities have been designated baby-friendly unlike private facilities. Women who deliver in private health facilities, maternity homes or with traditional birth attendants are also more likely to discontinue EBF before 6 months unlike mothers who deliver in government hospitals or polyclinics (Aidam *et al.*, 2005). This observation has been attributed to the little or no EBF education offered by private health facilities most of which are also not designated baby friendly as compared to most government facilities which have the baby friendly designation and hence tend to promote EBF (Ukegbu *et al.*, 2011; Aidam *et al.*, 2005).

Published data indicate that delivering in a baby friendly health facility is more likely to increase both breastfeeding initiation and duration compared to delivering in a non-baby friendly health facility (Ukegbu *et al.*, 2011; Braun *et al.*, 2003). The Baby-Friendly Hospital Initiative (BFHI) was launched by the WHO and UNICEF in 1991 to promote and support breastfeeding and ultimately ensure good health for infants. It is based on the 10 Steps to Successful Breastfeeding, a program aimed at directing all hospitals with maternity facilities, both public and private to practices that promote and support breastfeeding. Some studies that have assessed the impact of BFHI designation on breastfeeding initiation and duration have concluded that hospitals with the BFHI designation record higher breastfeeding rates than those that are undesignated BFHI (Perez-Escamilla *et al.*, 2007). Also, assessment of breastfeeding initiation and rates in previously non-baby friendly hospitals before and after BFHI designation favour higher breastfeeding initiation and duration (Braun *et al.*, 2003).

These observations are attributed to the fact that health facilities that have the baby-friendly designation tend to promote EBF by educating mothers and health workers on the benefits of EBF to the infant, mother and society at large. In addition, hospital practices that hamper EBF such as delayed breastfeeding initiation, prelacteal feeding and maternal-infant separation after delivery are discouraged as much as possible (Braun *et al.*, 2003).

Maternal exposure to EBF information in the immediate perinatal and postnatal period at government facilities plays a role in encouraging mothers to continue EBF even in the face of challenges (Ukegbu *et al.*, 2011).

2.3.5 Poor Suckling Ability

During pregnancy, the high concentration of progesterone, a pregnancy hormone in the blood inhibits the production and release of breast milk. However, after birth the level of this hormone declines thereby triggering lactogenesis as the levels of prolactin and oxytocin rise.

Both of these lactation hormones are stimulated by birth of the baby and baby’s suckling. Inability of the infant to suck the breast normally due to undeveloped jaws, ill health or poor latch-on techniques could hinder adequate stimulation of the breast which is necessary for the production of human milk and the continuous supply of milk to the baby. When this happens, babies may not receive adequate milk and hence may cry incessantly causing the mothers to become frustrated and sometimes discouraged with breastfeeding. Some mothers may as a result resort to bottle feeding which also has the potential to cause a decline in breastfeeding frequency and duration (Bragelien *et al.*, 2007; Yokoyama *et al.*, 2006).

2.3.6 Preterm Delivery and Low Birth Weight

An infant born before 37 weeks of gestation is considered to be a preterm infant while a baby who weighs less than 2500g (2.5kg) at birth is considered a low birth weight infant (Hodnett *et al.,* 2010). Such infants may not be fully developed at birth and could suffer several neonatal or perinatal complications such as necrotizing enterocolitis and respiratory infections (Henderson *et al.,* 2009). They are also at risk of possessing lower cognitive function unlike term and normal birth weight infants. It is therefore critical that infants born with either one or both conditions be given utmost care and nutrition to ensure optimal growth. The nutritional quality of breast milk makes it the best food for these infants (Arslanoglu *et al.*, 2010). Despite this, such infants may lack well developed suckling reflexes which are essential to their nutrition and subsequent growth (Yokoyama *et al.,* 2006). As a result of the poor suckling reflexes of these infants, they may be separated from their mothers and admitted in the Neonatal Intensive Care Unit (NICU) where they are likely to be fed parenterally. Such separation may interfere with normal breastfeeding practices. Some preterm infants admitted into the NICU may be fed directly from the breast while others may be fed with breast milk using a cup and spoon.

Others may also be fed with breast milk through a nasogastric tube (Akter *et al.*, 2011). Thus, with the exception of mothers who feed their infants directly from the breast, other mothers who express the milk may suffer breast congestion due to the inability to fully empty the breast (Wheeler and Dennis, 2013). This may trigger further stress and frustration in the mother which could eventually inhibit the production and maintenance of milk supply.

It has been established that maternal diseases like diabetes and hypertension more often than not result in the delivery of ill or preterm babies. Such mothers could further experience suboptimal breast milk production unlike mothers of term infants especially if they have been expressing the milk using a breast pump for a long period (Yokoyama *et al.,* 2006; Flidel-Rimon and Shinwell, 2002). This is because mothers with preterm deliveries do not experience the full effects of the hormones necessary to stimulate lactation. The onset of copious milk production known as lactogenesis II which normally occurs between 2 to 5days after delivery is often delayed in mothers who deliver prematurely (Cregan *et al.,* 2002).

2.3.7 Maternal Self-Efficacy

According to Bandura's (1977) social cognitive theory, self-efficacy refers to the conviction a person has in his or her ability to execute a certain task. The application of this theory is found in behaviour change programs like weight loss or fitness programs (Wheeler and Dennis, 2013). Among nursing mothers, the confidence the mother has that she can breastfeed is an important modifiable factor that has been used to predict breastfeeding initiation and duration in some studies (Jackson, 2012; Otsuka *et al.,* 2008 and Sacco *et al*, 2006). Hence, mothers who strongly believe that they can breastfeed are more likely to defy all the odds and breastfeed exclusively and vice versa.

Among mothers with twins, this factor is very crucial considering that they have an extra burden of caring for two infants. Thus, the slightest feeling of inability to satisfactorily breastfeed two or the lack of belief in continuing EBF until 6 months could easily lead to premature breastfeeding cessation. This could be detrimental to the health of both mother and babies and would possibly increase the cost of caring for such infants particularly when formula milk is supplemented. This has been demonstrated in research carried out among multiples and singletons which showed that mothers with multiples were less confident in breastfeeding their babies compared with mothers with singletons (Yokoyama *et al.*, 2006; Flidel-Rimon and Shinwell, 2002).

The idea of breastfeeding self-efficacy was developed by Dennis (1999) using Bandura's social cognitive theory to examine a mother's confidence in her ability to breastfeed (Dennis and Faux, 1999). It has the ability to predict

1. ‘‘whether a mother chooses to breastfeed or not’’
2. ‘‘how much effort she will expend’’
3. “whether she will have self-enhancing or self-defeating thought patterns’’ and
4. “how she would respond emotionally to breastfeeding difficulties’’ (Dennis, 1999)

As reported by Wheeler and Dennis (2013), the breastfeeding self-efficacy scale-short form (BSES-SF) was used to examine self-efficacy of mothers with either ill or preterm infants. The researchers concluded that the BSES-SF could be a valid tool in measuring breastfeeding self-efficacy even among mothers of ill or preterm infants.

Its use among mothers with multiples could help identify mothers who need consistent encouragement and support in breastfeeding self-efficacy.

2.4 Assessment of Breast Milk Intake

Data on the volume of human milk produced and consumed by infants remains limited especially in resource-poor countries. One reason for this phenomenon is the difficulty involved in assessing breast milk intake (IAEA, 2010). Unlike other foods that can be directly weighed and their consumption measured, direct weighing of human milk intake is challenging (IAEA, 2010). Over the years, the infant test weighing method has been employed by many researchers in the estimation of breast milk intake (Otoo *et al.,* 2010; Savenije and Brand 2006). It is easy to use a method which involves weighing the infant before and after every breastfeeding episode (Aryeetey *et al.,* 2009).

This conventional procedure, however, has been found to be time-consuming particularly for the mother and less accurate since it underestimates milk intake by about 1% - 5% (Savenije and Brand 2006; Brown *et al.*, 1982). Further, the method interferes with the mother-infant feeding pattern (Samuel *et al.*, 2012). In instances where mothers feed their babies on demand and even during the night it becomes difficult for the researcher to obtain accurate results of milk fed to the baby (Savenije and Brand 2006).

The use of non-radioactive labelled water is a more practical and precise method compared to the test weighing method (Adom *et al.,* 2011; Moore *et al.,* 2007). Over two decades ago, Coward and his colleagues (1979) introduced the deuterium oxide dilution technique for the estimation of breast milk intake. This method involved dispensing the deuterium oxide dose to the infant. However, it was plagued with some disadvantages such as requiring the baby to fast for long periods before sample collection as well as an overestimation of breast milk intake compared with the test-weighing method (Adom *et al.,* 2011; Butte *et al*., 1988; Coward *et al.,* 1979). Also, the method could not provide information on water intake from other sources apart from breast milk since it assumed that breast milk was the only source of water for the infant (Adom *et al.,* 2011; Butte *et al*., 1988; Coward *et al.,* 1979).

Subsequently, Coward and colleagues (1982) improved on the first technique and developed an enhanced method whereby the deuterium oxide (heavy water) dose is administered to the mother and hence the name dose-to-the-mother deuterium oxide turnover technique (Medoua *et al.,* 2012). A small pre-weighed dose (30g) of heavy water is administered orally to the mother after pre-dose saliva samples have been collected from both mother and baby. The technique in addition to being more precise, accurate and sensitive also allows the researcher to estimate the baby's intake of water from non-human milk sources and the mother's body composition.

Since the oral dose of deuterium oxide mixes with the body water after a few hours, samples of body water in the form of saliva, urine, plasma or human milk can be obtained and the deuterium enrichments measured using either Isotope Ratio Mass Spectrometry (IRMS) or Fourier Transform Infrared (FTIR) Spectrometry (IAEA, 2010). It is worth noting that though the FTIR is appropriate for saliva sample analyses, there are limitations with its use for urine and human milk analyses since it is not as sensitive as the IRMS and higher doses of deuterium oxide are required. Nevertheless, the FTIR is easy to use and maintain, as well as less expensive to purchase. The cost of analysis is also lower and it does not require specialized personnel to operate (IAEA, 2010). In this study, the FTIR spectrometry is employed.

In the deuterium oxide dilution technique, a two-compartment steady state model is assumed in the estimation of breast milk and water intakes from sources other than breast milk (Fig 2.1).

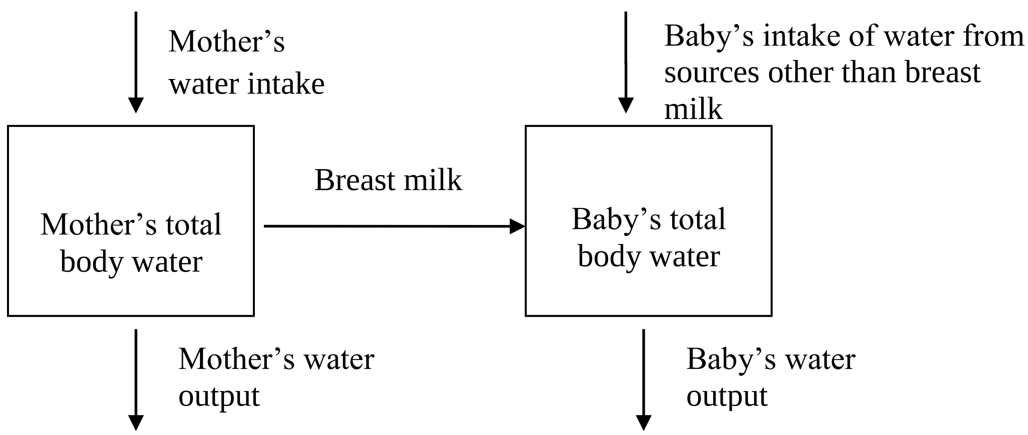

Fig 2.1: Two compartment steady state model of water flow in a mother–baby pair (IAEA, 2010).

In this model, the mother's body is one compartment while the baby's is another. Both compartments are linked by the flow of milk from the mother to her baby. It is assumed that water intake is equal to water output.

2.5 Special Case of Twins

2.5.1 Twinning Rate in sub-Saharan Africa, Specifically Ghana

Normally, human pregnancy results in the birth of one offspring but a twin occurs when a single pregnancy results in the birth of two infants either of the same or different sex. When the infants are of the same sex they are referred to as monozygotic or identical twins because they originate from the fertilization of a single ovary (Oxford Medical Dictionary, 2007). However, dizygotic or fraternal twins occur as a result of the fertilization of two different ovaries (Oxford Medical Dictionary, 2007). Fraternal twins contribute substantially to the global incidence of twins since the occurrence of identical twins remains constant at 3.5-4 per 1000 live births (Smits and Monden, 2011; Akinboro *et al.*, 2008). It has been documented that out of every 90 pregnancies, there is a twin pregnancy while a triplet pregnancy occurs in every 8,100 pregnancies and one in 729,000 conceptions results in a quadruplet (Llewellyn-Jones, 1998). Similarly, Smits and Monden (2011) in their study on "Twinning across the Developing World" reported that for every 76 deliveries one was a twin birth.

The current twin incidence of 6-9 per 1000 live births in South-East Asia is reported to be low. This is no different from the rates recorded in Latin America (Smits and Monden, 2011). Incidentally, the story in Africa is the reverse with an average twin birth rate of 11-18 per 1000 deliveries. Countries such as Morocco and Tunisia located in northern Africa record rates of about 12 per 1000 while Egypt has a high rate of 17.7 (Smits and Monden, 2011). Namibia, Lesotho, Madagascar and South Africa which are all located in Southern Africa have lower rates of 11-15 twin births per 1000 deliveries. Nations in the Western zone of Africa and along the Atlantic Ocean running from Ghana, Nigeria and

Guinea to Democratic Republic of Congo all the way to Tanzania, Mozambique and the Comoros all have rates above 18 per 1000 births. Smits and Monden (2011) have indicated that Benin, which borders Nigeria on the West, has higher twin birth rates than Nigeria. Prior to this report, however, a number of studies had identified Nigeria to be the country with the highest twin rate worldwide with a rate of over 45 per 1000 births (Iyiola *et al.*, 2013; Akinboro *et al.*, 2008; Mosuro *et al.*, 2001). Therefore, comparing the rate in Benin (27.9) to Nigeria's over 45 per 1000 live births, it appears that Nigeria is still in the lead with regards to twinning rates.

In Ghana, available data indicate that although the twin birth rate is not as high as Nigeria's, the rate is still considered among the highest. Mosuro *et al.,* (2001) concluded that the incidence of twin births in Accra, the capital city of Ghana from 1988-1999 was 33.4 twin births per 1000 deliveries while the rate in Kumasi, the second largest city in Ghana over a 15-year period (1985-1999) was 26.6 twin births per 1000 deliveries. Additionally, there was a twin birth for every 33 singleton births in Kumasi in 1999 while in the same year for every 21 singleton births there was a twin delivery in Accra (Mosuro *et al.*, 2001).

2.5.2 Factors that Influence Twin Births

Many researchers hold the view that twin births could be influenced by both biological and environmental factors. Some biological factors that have been cited are maternal age, parity and heredity (genetics) (Akinboro *et al.*, 2008; Mosuro *et al.*, 2001).

Increasing maternal age has been linked with a higher twin incidence. Some studies have argued that as maternal age increases usually up to age 40, the tendency to deliver twins also increases due to a higher likelihood of hyper ovulation (Bulmer, 1970). Contrasting observations have, however, been made among other populations.

In South-West Nigeria where twining rate has been estimated to be approximately 50 per 1000 deliveries, maternal age range of 25-29 years has been established to record the highest number of twin births followed by ages 30-34 (Iyiola *et al.,* 2013; Akinboro *et al.,* 2008; Mosuro *et al.*, 1996). This is in agreement with another study conducted in North-Central Nigeria where the highest twin rates were recorded by mothers within the 25-29 age group followed by the 30-34 age range (Iyiola *et al.*, 2013). This has been attributed to the fact that persons within these age brackets are within the reproductive age and sexually active unlike mothers below this age bracket who may be unmarried and thus not sexually active (Iyiola *et al.*, 2013). Furthermore in the afore-mentioned studies the lowest twin birth rate was recorded for the mothers between the ages of 15-20 and 45-49 years.

Maternal history of twinning has also been observed to influence twin births. Females who have twin relatives or are themselves twins have a higher tendency to deliver twins (Akinboro *et al.*, 2008). Additionally, females whose mothers or sisters have twins have a two-fold risk of delivering twins compared to women whose mothers or sisters do not have twins. Also, those who have had an earlier set of twins have quadruple risk of having twins compared to women who have not had an earlier set of twins (Akinboro *et al.,* 2008). Multiparous mothers unlike primiparous mothers have been positively associated with twin births (Iyiola *et al.*, 2013).

Another determinant that has been implicated to contribute to twin birth incidence is diet. Some studies carried out among the Yoruba tribe in South-West Nigeria have indicated that the increased consumption of a particular species of Yam (*Dioscorea rotundata*) could explain the high twin births observed in that population. It has been reported that the people from that part of Nigeria consume different foods prepared from the *Dioscorea sp.* of yam (Akinboro *et al.,* 2008). This yam species is known to contain a phytoestrogen which serves as an ovulation inducer and triggers multiple ovulations ((Iyiola *et al.*, 2013; Akinboro *et al.,* 2008) thereby resulting in the high twin births.

The increased use of assisted reproduction technologies (ART) such as in vitro fertilization (IVF) and intrauterine insemination (IUI) to cure infertility has also led to increased twin birth rates. About 25-30% of twins delivered in the developed world result from the use of ART (Ibrahim *et al.*, 2012).

Social class is yet another factor that has been implicated to contribute to high twin birth rates. Akinboro and his team of researchers (2008) commenting on Nylander's (1981) study on the factors that influence twin births maintained that twin births among persons in the lowest social class was more than double the rates among the middle and high social class have. Additionally, the former observed that people living in the rural areas studied tended to be alike "socially", "culturally" and "ethnically" and were involved in polygamous relationships, had large families and hardly used family planning methods. A typical example of such a setting is Igbo-Ora in the Oyo state of Nigeria (Akinboro *et al.*, 2008).

Other determinants of high twin birth incidence include race, increasing maternal height, body mass index, seasonal variations, early conception particularly within three months after marriage and increased use of ovulation inducing medications (Ibrahim *et al.*, 2012; Akinboro *et al.*, 2008).

2.5.3 Health and Nutritional Problems Associated with Twins

Globally, multiple births compared with single births are linked with several maternal and neonatal morbidity and mortality (Olusanya, 2011). Some notable maternal risk factors associated with multiple pregnancies are hypertension, hyperemesis gravidarum, foetal malpresentation, antepartum and postpartum haemorrhage and genital sepsis (Ibrahim *et al.*, 2012). Furthermore, women with multiple gestations have an increased risk of delivering via caesarean section and even when they deliver vaginally it is more complicated than delivering a single baby (Ibrahim *et al.*, 2012; Boseley, 2009). In developed nations such as the United States of America and UK, available data indicate that 60% of twins and other multiples are delivered by caesarean section (Ibrahim *et al.*, 2012). In developing countries especially, this contributes to the mother being exposed to other health challenges such as anaemia and septicaemia (Ibrahim *et al.*, 2012).Thus, improving maternal nutrition among such high risk mothers could go a long way to reduce maternal morbidity and mortality.

Many twin infants are born either preterm or with a low birth weight (Olusanya, 2011). Additionally, infants whose weight for gestational age is less than the 10^{th} percentile are referred to as small for gestational age (SGA). Usually, babies who are born preterm also turn out to be either LBW or SGA obviously because body growth and development are incomplete. In many low-middle income nations, SGA is usually a consequence of inadequate maternal nutrition (Hodnett, 2010). With a worldwide prevalence of 15.5%, LBW accounts for many adverse perinatal outcomes such as neurodevelopmental challenges (e.g. cerebral palsy), infectious morbidities and neonatal mortalities (Ibrahim *et al.*, 2012). Again, about 60-80% of neonatal deaths are attributable to LBW while preterm birth is responsible for the annual over 100,000 global neonatal mortalities (Ibrahim *et al.*, 2012).

Some studies that examined perinatal outcomes among twin infants confirmed that coupled with preterm delivery, LBW and intrauterine growth restriction, multiples have an increased risk of cerebral palsy, hyperbilirubinaemia, sepsis, admission to the NICU congenital abnormalities and even death (Ibrahim *et al.*, 2012; Vassilaki *et al.*, 2012; Olusanya, 2011; Glinianaia *et al.*, 2002).

It is therefore, necessary that such high-risk infants are provided with high quality, nutritionally and immunologically adequate foods like breast milk to boost their growth and development. In spite of this need, many preterm infants lack the ability to suckle well due to weak jaws (Yokoyama *et al.*, 2006) leading to a nutritional compromise. In addition, coordination of the suckling, breathing and swallowing reflexes may be undeveloped further decreasing their likelihood of suckling directly from the breasts particularly in the early postpartum period (Yokoyama *et al.*, 2006). In order to provide the specialized care they require, these infants are often separated from their mothers and accommodated in a NICU where they are kept at the right temperature and often fed parenterally (Kiełbratowska *et al.*, 2010). As a result, the mother's interest in breastfeeding her baby may decline and eventually lead to a decrease in the amount of breast milk produced and consequently a reduction in EBF duration. Feeding the baby with liquids other than breast milk while in the NICU additionally reduces the likelihood of breast stimulation thereby hindering lactogenesis (Flidel-Rimon and Shinwell, 2002).

Providing nutrition education for expectant mothers and their families as well as relevant skills to make them employable could contribute to reducing LBW and preterm deliveries markedly since it has been observed that a higher proportion of LBW and preterm babies are born to people in lower socioeconomic groups (Hodnett *et al.*, 2010). Thus addressing poverty among such families could enhance the nutritional status of expectant mothers. Further, encouraging mothers with preterm or LBW babies who cannot suckle normally to express breast milk either manually or with a pump would improve stimulation of the breasts which could subsequently maintain or even improve lactation (Kiełbratowska *et al.*, 2010).

2.5.4 Breastfeeding Practices among Mothers with Twins

Caring for two babies at the same time is indeed no mean task and for most mothers with multiples, exclusively breastfeeding their babies till they are introduced to complementary foods, though pleasurable and fulfilling, can be very demanding.

The body's demand and supply mechanism allows even quadruplets to be breastfed with sufficient milk. This explains why mothers with singletons can donate extra breast milk to milk banks (Kiełbratowska *et al.,* 2010). Research carried out by Saint and colleagues (1986) in a group of eight Western Australian women breastfeeding twins and one woman breastfeeding triplets concluded that six months postpartum, milk yields for three mothers who fully breastfed and four others who partially breastfed their twins ranged from 840-2160 g/day and 420–1390 g/day respectively. Findings from the same study maintained that approximately 3000g of breast milk was produced per day by the mother who fully breastfed her set of 2.5months old triplets until they were four months. They, therefore, concluded that mothers with twins are capable of producing adequate breast milk to nourish their infants.

Other scientific evidence that seem to support the claim by Saint *et al.,* (1986)indicate that mothers with twins can produce between 1000-2000g of milk per day six months after delivery (Medoua *et al*., 2012) while mothers with triplets can actually produce more than triple the quantity produced by mothers with singletons i.e. over 3000g (Kiełbratowska *et al.*, 2010).

Despite the conclusions by some scientists that mothers with multiples can produce adequate breast milk to nourish their infants, research carried out to estimate breastfeeding rates among singletons, twins and triplets in Japan (Yokoyama *et al.*, 2006) revealed that EBF rates was lower among twins and triplets (4.1%) compared with singletons (44.7%) aged between 3-6 months. Again, the odds of choosing bottle-feeding with formula milk only were higher among mothers with multiples (2.44) than mothers with singletons (1.00) (Yokoyama *et al.*, 2006). In the same study, perceived maternal stress, use of incubator and poor maternal health were also positively associated with an increased likelihood of choosing bottle-feeding with formula only. These results are consistent with other studies that have indicated that because of the extra burden involved in caring for twins and other multiples such mothers are not usually able to exclusively breastfeed their infants up to six months though they are aware of the benefits of this practice (Flidel-Rimon and Shinwell, 2002; Leonard, 2000).

It is in the light of the afore-mentioned breastfeeding practices among twins in other settings that this study was carried out to determine the possible factors influencing exclusive breastfeeding practices in Ghana.

CHAPTER THREE

3.0 METHODOLOGY

3.1 Study Design and Study Sites

The study was a cross-sectional survey of mothers with either twin or singleton infants between 2 – 6 months. It was conducted from November 2012 to March 2013. Participants were selected from the child welfare clinics of three health facilities in the Tema metropolis and Ashaiman municipality all in the Greater Accra region of Ghana namely: Tema General Hospital (TGH), Ashaiman Polyclinic (APC) and New Crystal Hospital. These hospitals were selected based on their proximity to the researcher since the researcher was situated in the Tema Metroplis during the research period. The study required follow-up of participants as well as transporting of equipment and samples to and from the study sites. Hence, the choice of the above-named hospitals. Permission was sought and was granted by all three facilities prior to recruitment of the participants. Tema General Hospital is located in the harbour city of Tema, which is also a metropolitan city and serves as the main referral hospital for patients in and around the metropolis. As such, the facility records a high yearly attendance of out-patient department (OPD) cases totalling over 150, 000 and deliveries of both twins and singletons annually. In 2012, the total deliveries recorded at the hospital were 5,826 (includes still births and macerated births) out of which 3,953 were singletons and 194 were twins. One set of triplet was also delivered in the same year. Ashaiman Polyclinic and New Crystal Hospital are both located in Ashaiman, a town close to Tema and a municipal district that shares a southern border with Tema. While the former is a government health facility, the latter is a private hospital located about three minutes' drive from the former. Ashaiman Polyclinic recorded an annual OPD attendance of over 45,000 with total deliveries for 2012 being 2,952 of which 30 sets were twins. New Crystal Hospital, which is regarded as one of the largest private facilities in the Greater Accra region recorded close to 15,000 out-patient cases monthly (Ocloo, 2013). In 2012, there were a total of 1,281 deliveries in this hospital out of which 10 were twins.

The number of twin births in every1000 deliveries for the three facilities was calculated as: (Twin deliveries/Total deliveries) × 1000.

The number of singleton births (*x*) for each twin delivery(*y)* was also computed as *x/ y*. (Akinboro *et al.*, 2008).

3.2 Sampling and Sample Size Determination

Using the formula by Daniel, 1999 and a twinning rate of 33.4 per 1000 live births which is the twinning rate for Accra (Mosuro *et al.*, 2001), sample size was calculated as:

$$N = \frac{[Z^2 \times P\ (1 - P)]}{d^2}$$

Where N = sample size per group,

Z = the critical probability value for 95% confidence interval (1.96),

P = prevalence/twinning rate (3.34%), and

d = margin of error, (0.05).

Hence, N is approximately 45.

Therefore, a sample size of 50 mother-baby pairs were recruited into two groups – 50 mothers with twin infants in one group and another 50 mothers with singletons in the non-twin (singleton) group. A convenience sampling technique was used to recruit participants for both groups.

About two-thirds the mothers with twins were not directly recruited from the child welfare clinics (CWCs) of the study hospitals because though they delivered at the health facilities

that participated in this study, they were attending other CWCs that were closer. The names and folder numbers of such mothers whose babies were within the age range of the study were obtained from the delivery books at the labour wards of the respective facilities. However, apart from New Crystal Hospital that also recorded the contact phone numbers, the names of mothers obtained from the delivery books of both Tema General Hospital and Ashaiman Polyclinic lacked such vital information. Therefore, a follow-up was made to the Records department of Tema General Hospital to trace the folders of the mothers using their names and folder numbers which were available in the delivery books. Mothers (in some cases close relatives of the mothers) whose phone numbers were obtained from their folders were called and those interested in participating were recruited. They were subsequently followed-up at home, given consent forms to sign and interviewed. A few mothers were also recruited and later interviewed from the lying-in ward of the TGH. A similar follow-up to the Records department of APC proved unfruitful since the names and contacts of the mothers could not be obtained.

For mothers who were recruited from the CWCs an announcement was made at the CWCs on the day of recruitment by the researcher with the assistance of the nurse in-charge about the ongoing project and mothers with infants within the inclusion criteria were invited to participate. Mothers who showed interest in participating and met the inclusion criteria were taken through the details of the study and given the opportunity to ask questions. Those who were willing to participate were asked to give their consent by writing their names and signing or thumb printing the consent form.

3.3 Inclusion Criteria for Study Participants

Inclusion criteria

Biological mothers within the ages of 18 – 49 years with either a singleton or a set of twins [either identical (monozygotic) or fraternal (dizygotic)] who showed interest in participating were recruited. Only mothers with infants between the ages of 2 – 6 months were included.

As indicated in fig 3.1, 93 mothers with twins were contacted but 41 of them declined participation mainly because they were not interested in the study. Hence, 50 mother-twin pairs were finally recruited. Similarly, fig 3.2 shows the enrolment statistics for mother-singleton pairs. Out of the 63 mothers with singletons who were contacted, 54 agreed to participate though 4 were later lost to follow-up.

Exclusion criteria

Mothers who were not breastfeeding at all due to personal choice or medical condition that interferes with breastfeeding such as mastitis were excluded from the study. Again, babies with any condition that made breastfeeding difficult (e.g. cleft palate) were excluded.

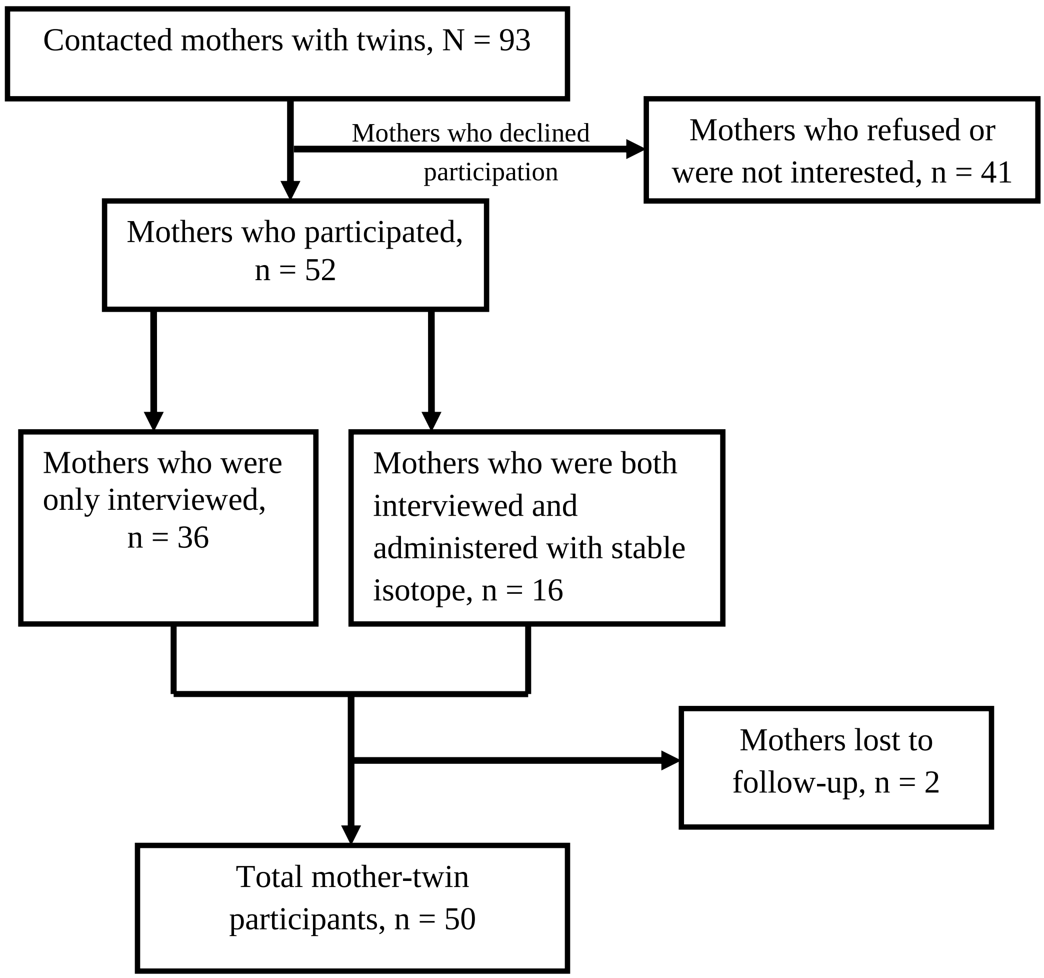

Fig 3.1: Enrolment statistics for recruitment of mother-twin participants.

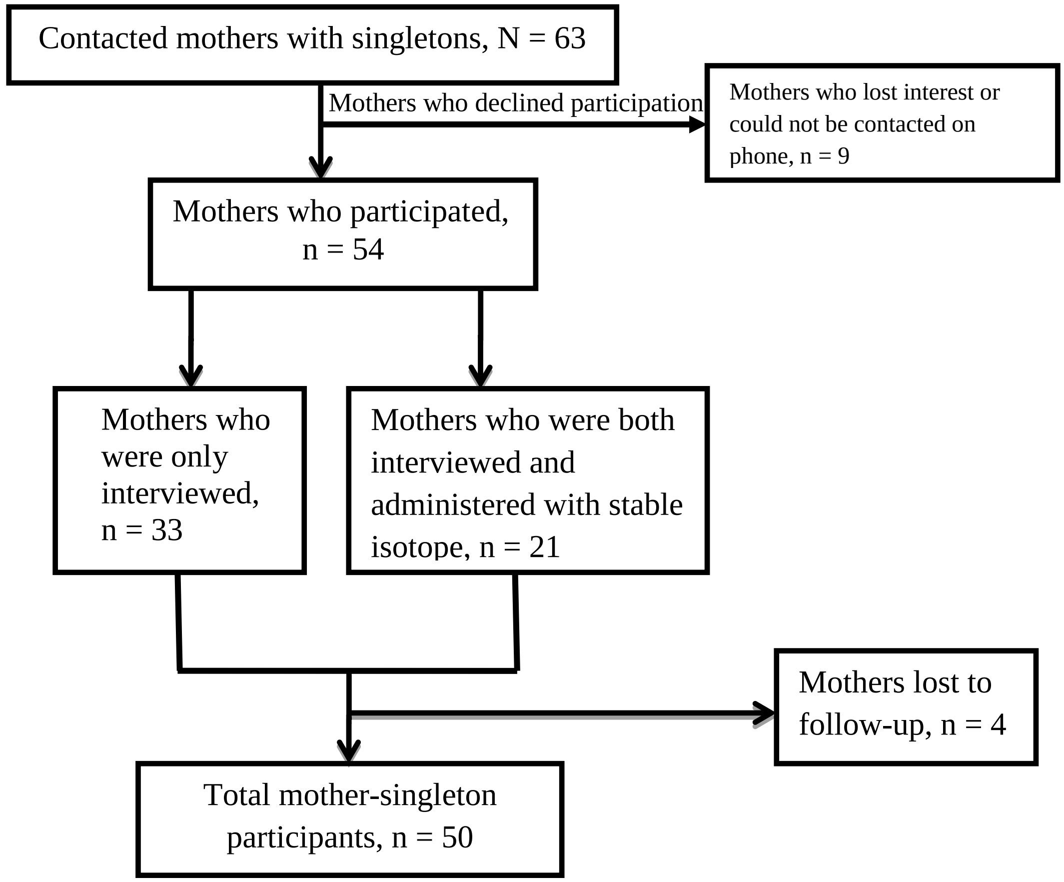

Fig 3.2: Enrolment statistics for recruitment of mother-singleton participants.

3.4 Ethical Considerations

Ethical clearance was sought from and approved by the Institutional Review Board of the Noguchi Memorial Institute of Medical Research, University of Ghana, Legon. Mothers and their infants were only recruited into the study after they had given their written consent by either signing or thumb-printing against their names on an informed consent form.

3.5 Data Collection

The data collection was in two parts – parts A consisted of the questionnaire interview while part B involved the estimation of breast milk intake using deuterium oxide (heavy water). Some of the mothers consented to participating in only the interview and not the breast milk estimation aspect of the study while others consented to participate in both aspects.

3.5.1 Survey Instruments

3.5.1.1 Study Questionnaire

With the aid of a pre-tested semi-structured questionnaire (Appendix II), data on maternal socio-demographics (e.g. age, marital status, occupation, income and highest educational level attained), biomedical (e.g. parity, delivery place, delivery type, time of breastfeeding initiation and infant's dietary intake) and biocultural factors (e.g. family cooperation for current infant feeding, breastfeeding advice) were obtained. Additionally, data on the infants' background characteristics (e.g. age in completed months, gestational age, NICU admission and birth weight) as well as morbidity in the preceding 24 hours and fortnight before the interview were collected. Information was also collected on dietary intakes of the infants in the last 24 hours as well as the preceding month before the interview. Mothers were asked if they had fed any of twelve listed foods or liquids (e.g. breast milk, water, formula and porridge) to their infants in the last 24 hours or past month. Following the WHO (2008) recommendation, infants who had taken only breast milk except for ORS, drops or syrups (vitamins, minerals or medication) in the past 24 hours were grouped into the exclusively breastfeeding category. Those who had taken breast milk plus liquids such as water, water-based drinks and fruit juices were put in the predominant breastfeeding category. Lastly, infants who had consumed other foods or liquids including formula in addition to breast milk were put in the partial breastfeeding group.

3.5.2 Anthropometry

The mothers were weighed in minimal clothing on an electronic scale (Seca Gmbh & Co Kg, Germany) to the nearest 0.1kg. Mothers wearing heavy jewellery, belts or cloth were politely asked to remove them prior to weighing. Babies were weighed naked on a portable paediatric scale to the nearest 0.01kg (Seca, Vogel and Halke, Hamburg, Germany). Maternal and infant weights were taken at baseline (day 0) and on day 14. Maternal height was measured to the nearest 0.1cm using a stadiometer (Seca Gmbh & Co Kg, Germany) while a standardized wooden infantometer was used to measure infants recumbent length (Seca Model 207 CE 0123).

All measurements were carried out following standard procedures (IAEA, 2010) and were done in duplicates.

3.5.3 Estimation of Breast Milk Volume Using Stable Isotope Technique

In order to estimate the volume of breast milk intake by the infants, the deuterium oxide (^2H_2O) stable isotope dilution technique was used in both groups (Adom *et al*., 2011; Coward *et al*., 1982).

A sub-sample of 30 mother-baby pairs were categorized into two groups–the singleton group and the twin group. Below are the steps followed in the estimation of the breast milk intake using the ^2H_2O stable isotope dilution method.

3.5.3.1 Administration of Deuterium Oxide Dose

Pre-dose saliva samples were collected from the mothers after they were served with cotton wool balls (Synergy Health, England) to chew in order to stimulate salivation. Prior to this, it was ensured that mothers had not eaten or drank anything in the preceding 20 minutes. Chewing of the cotton ball was done for about 5 - 7 minutes. Mothers were asked to think about their favourite food in order to enhance salivation (IAEA, 2010). The cotton wool was then put into the barrel of a 20 ml plastic syringe (Euro-Ject V CE0123, Germany) and pressed to obtain about 2 - 5 ml of the saliva sample.

A similar approach was used to obtain saliva samples from the babies except that since they could not chew the cotton, plastic swabs with considerably thick cotton wool firmly wrapped on one end was moved systematically through their mouths in a clockwise motion until it became soaked with saliva (Fig 3.3). Again, it was ensured that the infants had not been breastfed or given any food or drink at least 15 minutes before sampling was done in order to avoid sampling breast milk or other foods or liquids. The sodden cotton wool was removed from the plastic stick with the aid of forceps. This was put into the barrel of a 5 ml syringe which was pressed with the plunger to obtain the desired volume of saliva sample (Fig 3.3). In cases where insufficient volumes of saliva (< 2 ml) were obtained, the process was repeated until the required volume was obtained.

Fig 3.3: **Left**: Sampling saliva from an infant using a swab; **Right**: Pressing sodden cotton wool with a syringe to obtain saliva.

After the pre-dose saliva sampling, mothers were served with 30 g of deuterium labelled water (99.8% purity; Cambridge Isotope Laboratories Inc., Andover, MA., USA) to drink through a straw in order to avoid spillage. The 30 g (± 0.02 g) deuterium dose was weighed into dose bottles in the laboratory using an analytical balance. The dose bottle was rinsed with some drinking water (about 60 ml) twice and given to the mother to drink to ensure that the complete dose had been taken. The time of the dose intake as well as the weight of the heavy water (deuterium) drunk by the participant were recorded on the dosing data sheet (appendix III and IV). The weight of the deuterium was pre-indicated on the dose bottle.

Saliva samples of between 2 - 5 ml were collected from both the mothers and their babies on days 1, 2, 3, 4, 13 and 14 after the mothers had drank the deuterium oxide dose. Gloves, syringes and swabs were discarded between participants. The saliva samples were stored in 4.5 ml volume sterile plastic cryovials (Nunc Cryo Tube Vials, Denmark) that were labelled with the participant's ID and kept on ice packs in labelled zip-lock bags in an ice chest till they were transferred into a freezer for storage at -20°C until analysis. Prior to analysis, the saliva samples were allowed to thaw at room temperature and centrifuged for 5 minutes at 4.4 rpm (Eppendorf Centrifuge5702, Hamburg, Germany).

3.5.3.2 Saliva Sample Analysis

The deuterium enrichment in the saliva samples was measured with the Fourier Transform Infrared (FTIR) Spectrophotometer (FTIR-Schimadzu, IRPrestige-21, Schimadzu Corporation, Japan). The equipment was calibrated with a standard solution of deuterium at least twice a day to ensure accuracy of readings. A calcium chloride cell with a path length of 100µm (Fig 3.4) was carefully filled with the saliva sample using a 1 ml syringe and placed in the path of light beam inside the FTIR (Fig 3.5). Throughout the analysis, the pre-dose saliva sample for each participant was analysed before analysing the post–dose samples since the former served as a background against which the latter were measured. The measurements were done in triplicates and the two closest values selected. The infrared spectra were measured in the absorbance range of 2300-2900 cm^{-1}.

Fig 3.4: FTIR cell with a 1 ml syringe in the filling port (IAEA, 2010).

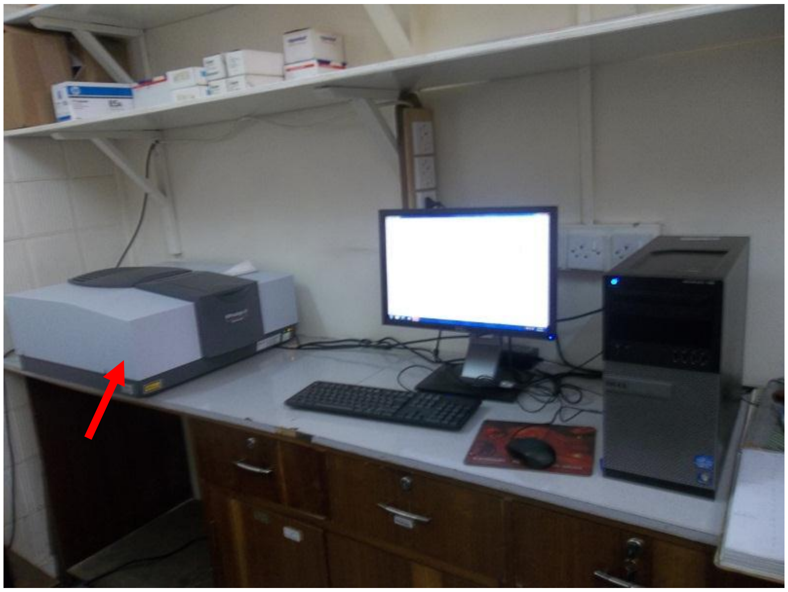

Fig 3.5: Typical FTIR spectrophotometer (arrowed) connected to a desktop.

3.5.3.3 Estimation of breast milk volume

Amount of breast milk and water from non-milk sources ingested by the babies were estimated by entering the deuterium enrichment values or concentrations (in ppm) obtained from the FTIR spectrophotometer into a model for water turnover in the mothers and infants (IAEA, 2010). An algorithm (Microsoft Excel® 2007 spreadsheet) developed by the Medical Research Council [(MRC); Human Nutrition Research, Cambridge, UK] based on the work by Coward and colleagues (1982) was used in the estimation of intakes of breast milk and water from non-milk sources. Using the *Solver* function in the Excel spreadsheet, non-linear regression was employed to generate the line of best fit for the entered data. Consequently, the average human milk and non-milk oral intakes in ml/day were calculated.

With reference to the findings reported by Medoua *et al.*, (2012) and Haisma *et al.*, (2003) infants with non-breast milk water intake < 52 ml/day were categorized into the EBF group. Those with non-breast milk intakes between 52-216 ml/day were put into the predominant breastfeeding group > 216 ml/day were classified as partially breastfeeding. Results of breast milk intake were expressed as means ± SD which give an indication of how much milk is produced by mothers.

3.6 Quality Control

The administered questionnaires were pre-tested using individuals with similar characteristics as the actual participants recruited into the study. This ensured that the questions were well-framed and well-understood. It was then updated and re-tested for further use. All equipment (e.g. the FTIR spectrophotometer, adult weighing scale, stadiometer, paediatric scale and infantometer) were calibrated each time they were used. The field assistant was adequately trained and monitored to ensure proper conduct of the various procedures.

3.7 Data Analyses

Data entry and analyses were done using SPSS version 16.0 software (SPSS Inc., Chicago, IL, USA). Descriptive statistics (frequencies and proportions) were used to summarize the demographic characteristics of participants.

Bivariate analyses were done using chi-square statistics to determine associations between categorical variables with statistical significance set at $p < 0.05$.

Multivariate binary logistic regression models were used to determine the predictors of EBF at six months. The dependent variable for the analyses was EBF status at six months while the independent variables were delivery type, mother's perception of infant suckling ability at birth, perceived breast milk production ability, infant type, prenatal EBF intention, parity, maternal education, ownership of TV (proxy for family's socioeconomic status), breastfeeding initiation, pregnancy intention, prenatal breastfeeding advice received from spouse and postnatal breastfeeding advice received from spouse (Table 3.1). Results of associations were described in terms of odds ratios and significance was set at $p < 0.05$ (2-sided).

Table 3.1: Definition of variables used in the multivariate binary logistic regression model

	Variable	Coding
Dependent variable	EBF status at 6months	1 = Yes (29) 0 = No (71)
Independent variables	Perceived sucking ability at birth	0 = Poor 1 = Normal
	Delivery type	0 = Caesarean section 1 = Vaginal
	Maternal education	0 = None/Primary/JSS 1 = Secondary/Tertiary
	Infant type	0 = Twin 1 = Singleton
	Perceived breast milk production ability	0 = No 1 = Yes
	TV ownership	0 = No 1 = Yes
	Prenatal EBF intention	0 = No 1 = Yes
	Breastfeeding initiation	0 = After a day 1 = Within a day 2 = Within 30 minutes
	Pregnancy Intention	0 = Unplanned 1 = Planned
	Prenatal breastfeeding advice received from spouse	0 = No 1 = Yes
	Postnatal breastfeeding advice received from spouse	0 = No 1 = Yes
	Parity	0 = Primiparous 1 = Multiparous

CHAPTER FOUR

4.0 RESULTS

4.1 Twin Birth Rates in the Participating Hospitals

Tema General Hospital, the main referral hospital in the Tema metropolis recorded a twin birth rate of approximately 47 twin births per 1000 deliveries in 2012 i.e. 1 twin delivery for every 20 singleton birth. Ashaiman Polyclinic and New Crystal hospital which are both located in the Ashaiman municipality recorded twin birth rates of 10 twin births per 1000 deliveries and 8 twin births per 1000 deliveries respectively.

4.1.1 Demographic and Socioeconomic Characteristics of Participants

Almost half the number of mothers with singletons (46%) had attained either senior secondary or tertiary education compared to only 20% of mothers with twins (Table 1). The mean age of mothers with singletons was 28.80 ± 5.08 years (range, 20 to 40 years) while that of mothers with twins ranged between 18 to 38 years with the mean age being 29.10 ± 4.32 years. Majority of the mothers were married (67%), were mainly traders (48%) and worked outside the home (68%). About 41% had monthly incomes less than GH₵150.00 and about 54% of all the women lived in rented facilities. Mothers with singletons did not differ significantly from mothers with twins in any of the demographic characteristics except in educational levels ($p = 0.006$).

From Table 2, the mean age of the singletons was about 3 months. However, birth weight was significantly different among the two groups of infants (3.13 ± 0.51 vs. 2.42 ± 0.39 kg; $p < 0.01$). Whereas the majority of singleton infants had normal birth weights, more than 50% of the twin infants were either low birth weight (LBW) or very low birth weight (VLBW). The two groups of infants also differed significantly in gestational age

($p < 0.01$). While only 6% of singletons were born before 37 weeks of gestation, 28% of twins were born preterm, i.e. before 37 weeks of gestation.

Table 1: Demographic and Socioeconomic Characteristics of Participants (N = 100)

Variable	**Mothers with singletons n (%) n = 50**	**Mothers with twins n (%) n = 50**	***p*-value[a]**
Age (years)			
$\bar{x}$ ± SD	28.80 ± 5.08	29.10 ± 4.32	0.085
18-25	15 (30)	7 (14)	
26-30	16 (32)	26 (52)	
31-35	14 (28)	15 (30)	
36-40	5 (10)	2 (4)	
Educational level			
≤ Junior secondary	27 (54)	40 (80)	**< 0.01***
Senior secondary/Tertiary	23 (46)	10 (20)	
Marital Status			
Married	31 (62)	36 (72)	0.330
Co-habiting	12 (24)	6 (12)	
Single/Widowed	7 (14)	8 (16)	
Main Occupation			
Salaried worker	9 (18)	6 (12)	0.193
Artisan	17 (34)	13 (26)	
Trader	23 (46)	25 (50)	
Unemployed	1 (2)	6 (12)	
Work outside home			
Yes	36 (72)	32 (64)	0.391
No	14 (28)	18 (36)	
Monthly Income			
<GH₵150.00	19 (38)	22 (44)	0.542
≥GH₵150.00	31 (62)	28 (56)	
House Ownership			
Own house	21 (42)	25 (50)	0.547
Rented facility	29 (58)	25 (50)	
Ownership of TV			
Yes	45 (90)	44 (88)	0.749
No	5 (10)	6 (12)	
Ownership of radio			0.160
Yes	41 (82)	35 (70)	
No	9 (18)	15 (30)	
Mode of transport			
Private car	10 (20)	6 (12)	0.275
Public transport	40 (80)	44 (88)	

[a] Chi-square test. * $p < 0.05$.

Table 2: Biomedical Characteristics of Infants

Variable	**Singletons n = 50**	**Twins n = 50 pairs**	***p*-value[a]**
Infant's sex			
Male	28 (56)	52 (52)	0.643
Female	22 (44)	48 (48)	
Age (months)			
$\bar{x} \pm$ SD	3.14 ± 1.37	3.02 ± 1.12	0.470
2	25 (50)	22 (44)	
3	7 (14)	12 (24)	
4	8 (16)	10 (20)	
5	6 (12)	5 (10)	
6	4 (8)	1 (2)	
Birth weight (kg)			
$\bar{x} \pm$ SD	3.13 ± 0.51	2.42 ± 0.39	**<0.01***
[b]VLBW	2(4)	10 (10)	
[c]LBW	2(4)	43 (43)	
Normal	46 (92)	47 (47)	
Gestational age			
Pre-term (<37weeks)	3 (6)	14 (28)	**<0.01***
Term (37-42 weeks)	47 (94)	36 (72)	
NICU admission			
Yes	3 (6)	21 (21)	**0.018**
No	47 (94)	79 (79)	

[a]Chi-square test. [b]VLBW: Very Low Birth Weight (<1.5-1.999 kg); [c]LBW=Low Birth Weight (2.0-2.499 kg); Normal (2.5-4.0 kg). *p < 0.05.

4.2 Biomedical and Biocultural Characteristics of Mothers

There were significant differences in pregnancy intention (p < 0.01) among mothers of both groups (Table 3). For about 68% of mothers with twins compared to 42% of mothers with singletons the pregnancy was unplanned. Significantly more mothers with twins than mothers with singletons perceived that they could not produce enough breast milk to satisfy their infants (66% vs. 14%, p < 0.01). Breastfeeding initiation was also significantly different among the two groups of mothers (p < 0.01); while 62% of the mothers with singleton babies initiated breastfeeding within the first hour of birth, only 32% of mothers with twins did same. Additionally, 48% of mothers with twins compared with 22% of mothers with singletons initiated breastfeeding after a day. Majority of the mothers were multiparous (n = 69), attended antenatal clinic (n =96) and had vaginal delivery (n = 71). More than half of the women (n = 53) breastfed their infants between 11-20 times per day.

Table 3: Biomedical and Biocultural Characteristics of Mother-Infant Pairs (N = 100)

Characteristic	**Mothers with singletons n (%) n = 50**	**Mothers with twins n (%) n = 50**	***p*-value[a]**
Parity			
Primiparous	17 (34)	14 (28)	0.517
Multiparous	33 (66)	36 (72)	
Pregnancy Intention			
Planned	29 (58)	16 (32)	**< 0.01***
Unplanned	21 (42)	34 (68)	
Perceived breast milk production ability			
Yes	43 (86)	17 (34)	**< 0.01***
No	7 (14)	33 (66)	
Antenatal Clinic Attendance			
Yes	47 (94)	49 (98)	0.617
No	3 (6)	1 (2)	
Facility for Antenatal			
Hospital/Polyclinic	47 (94)	45 (91.8)	0.715
Private Clinic/Maternity home	3 (6)	4 (8.2)	
Delivery Type			
Vaginal	38 (76)	33 (66)	0.271
Caesarean section	12 (24)	17 (34)	
Breastfeeding Initiation			
Within 30 minutes	22 (44)	8 (16)	
Within 1 hour	9 (18)	8 (16)	**< 0.01***
Within a day	8 (16)	10 (20)	
After a day	11 (22)	24 (48)	
Perceived onset of lactation			
Within a day	21 (42)	15 (30)	0.323
Within 2 days	10 (20)	8 (16)	
Within 3 days	10 (20)	18 (36)	
≥ 4 days	9 (18)	9 (18)	
Daily Breastfeeding Frequency			
1-10x	21 (42)	24 (48)	0.455
11-20x	27 (54)	26 (52)	
>20x	2 (4)	0	

[a]Chi-square test. * $p < 0.05$.

4.3 Factors Associated with EBF

A significantly higher percentage of singleton infants than twin infants (44% vs. 14%; $p < 0.01$) were exclusively breastfed for six months (Table 4). Suckling ability at birth, birth weight, gestational age and infant's sex were not significantly associated with EBF at six months. Furthermore, admission of infants at the neonatal intensive care unit (NICU) was not significantly associated with EBF at six months ($p < 0.518$).

Table 4: Infant Factors Associated with EBF at 6 months

	EBF for 6months n (%)	**EBF for <6months n (%)**	***p*-value[a]**
Infant type			
Singleton	22 (44)	28 (56)	**< 0.01***
Twin	7 (14)	43 (86)	
Suckling ability at birth			
Poor	12 (18.2)	54 (81.8)	0.139
Normal	24 (28.6)	60 (71.4)	
Birth weight			
LBW (< 2.5 kg)	10 (17.5)	47 (82.5)	0.147
Normal (2.5 - 4.0 kg)	26 (28)	67 (72)	
Gestational age			
Preterm (< 37 weeks)	3 (17.6)	14 (82.4)	0.258
Term (37 - 42 weeks)	26 (31.3)	57 (68.7)	
Sex			
Male	19 (23.8)	61 (76.2)	0.939
Female	17 (24.3)	53 (75.7)	
NICU admission			
Yes	7 (19.4)	17 (14.9)	0.518
No	29 (80.6)	97 (85.1)	

[a]Chi-square test. * $p < 0.05$.

About 90% of all mothers who did not do EBF for six months perceived that they could not produce enough breast milk to satisfy their infants until they were six months old. A significant number of mothers who owned TV sets compared to mothers who did not own TV sets (74.2% vs. 45.5%, $p = 0.048$) exclusively breastfed for less than six months

(Table 5). None of the other maternal factors tested showed any significant relationship with EBF at six months.

Table 5: Maternal Factors Associated with EBF at Six Months

	EBF for 6months n (%)	EBF for <6months n (%)	*p*-value[a]
Perceived breast milk production ability			
Yes	25 (41.7)	35 (58.3)	**< 0.01***
No	4 (10)	36 (90)	
TV ownership			
Yes	23 (25.8)	66 (74.2)	**0.048***
No	6 (54.5)	5 (45.5)	
Pregnancy intention			
Planned	17 (37.8)	28 (62.2)	0.080
Unplanned	12 (21.8)	43 (78.2)	
Perceived onset of lactation	11 (30.6)	25 (69.4)	0.797
Within a day	18 (28.1)	46 (71.9)	
After a day			
Parity			
Primiparous	9 (29)	22 (71)	0.996
Multiparous	20 (29)	49 (71)	
Maternal age			
18-30	17 (26.2)	48 (73.8)	0.393
31-40	12 (34.3)	23 (65.7)	
Educational level			
None/Primary/JSS	18 (26.9)	49 (73.1)	0.503
Secondary/Tertiary	11 (33.3)	22 (66.7)	
Delivery type			
Caesarean section	7 (24.1)	22 (75.9)	0.493
Vaginal	22 (31)	49 (69)	
Breastfeeding initiation			
Within 30minutes	9 (30)	21 (70)	0.107
Within a day	14 (40)	21 (60)	
After a day	6 (17.1)	29 (82.9)	
Prenatal EBF plan			
Yes	28 (31.5)	61 (68.5)	0.123
No	1 (9.1)	10 (90.9)	

[a]Chi-square test. * $p < 0.05$.

4.4 Sources of Breastfeeding Advice and Support Received By Participants

Participants in this study received breastfeeding advice from various sources at different times. There was a significant difference among mothers with twins and those with singleton babies in terms of the source of prenatal breastfeeding advice received (Table 6). A significant higher proportion of singleton mothers than twin mothers received prenatal breastfeeding advice from their spouses and relatives ($p < 0.01$). With respect to the prenatal advice received from friends, 84% of mothers with twins did not obtain any breastfeeding advice from their friends just as 56% of mothers who delivered singletons did not ($p < 0.01$). However, there was no significant difference in the advice received by both groups of mothers from the health facility.

During the perinatal period, 70% of mothers with singletons received advice from their spouses compared to 30% of mothers with twins ($p < 0.01$). Furthermore, more than half the mothers delivered of singletons (n = 52%) received breastfeeding advice from their friends during the perinatal period while 30% of women with multiple births obtained breastfeeding advice from their friends during the same period ($p = 0.041$).

Postnatally, less than half of mothers with twins (48%) received breastfeeding advice from their spouses as compared to 72% of women with singletons who did ($p = 0.024$). On the contrary, breastfeeding advice received from relatives, friends and the health facilities postnatally did not differ significantly among the two groups of women.

Table 6: Sources of breastfeeding advice received by mothers

Time of receiving advice	Source of advice	Mothers with singletons n (%) n=50	Mothers with twins n (%) n=50	*p*-value[a]
Prenatal	**Spouse**			
	Yes	34 (68)	9 (18)	**< 0.01**
	No	16 (32)	41 (82)	
	Relatives			
	Yes	33 (66)	11 (22)	**< 0.01**
	No	17 (34)	39 (78)	
	Friends			
	Yes	22 (44)	8 (16)	**< 0.01**
	No	28 (56)	42 (84)	
	Health Facility			
	Yes	47 (94)	43 (86)	0.318
	No	3 (6)	7 (14)	
Perinatal	**Spouse**			
	Yes	35 (70)	15 (30)	**< 0.01**
	No	15 (30)	35 (70)	
	Relatives			
	Yes	36 (72)	29 (58)	0.208
	No	14 (28)	21 (42)	
	Friends			
	Yes	26 (52)	15 (30)	**0.041**
	No	24 (48)	35 (70)	
	Health Facility			
	Yes	47 (94)	46 (92)	1.000
	No	3 (6)	4 (8)	
Postnatal	**Spouse**			
	Yes	36 (72)	24 (48)	**0.024**
	No	14 (28)	26 (52)	
	Relatives			
	Yes	37 (74)	29 (58)	0.139
	No	13 (26)	21 (42)	
	Friends			
	Yes	25 (50)	17 (34)	0.156
	No	25 (50)	33 (66)	
	Health Facility			
	Yes	46 (92)	46 (92)	1.000
	No	4 (8)	4 (8)	

[a]Chi-square test. * $p < 0.05$.

4.5 Duration of EBF among Infants

The median EBF duration for singletons and twins were four months and one month respectively. At any time point, more singletons were exclusively breastfed than twins ($p < 0.01$). As many as 60% of twin pairs were exclusively breastfed for less than two months contrary to 16% of singletons who were exclusively breastfed for less than two months. At six months, only 14% of twin babies were exclusively breastfed (Table 7). On the other hand, 44% of singleton infants were exclusively breastfed at six months. There were statistical differences ($p < 0.01$) in the percentages of singleton and twin infants EBF at the different time points.

Table 7: Percentage of infants exclusively breastfed at different time points

Time points	**Percentage exclusively breastfed**	
	Singletons n (%)	Twins n (%)
At 2 months (Singletons, n = 15) (Twins, n = 36)	7 (14)	6 (12)
At 4 months (Singletons, n = 26) (Twins, n = 43)	6 (12)	2 (4)
At 6 months (Singletons, n = 50) (Twins, n = 50)	22 (44)	7 (14)

4.6 Estimation of Breast Milk Intake among Singleton Infants Using Stable Isotope Dilution Method

The breast milk intakes of the singleton children were estimated using the stable isotope dilution method. Table 8 shows the breast milk and non-milk intakes of 11 singletons (5 males, 6 females). The least breast milk intake for the infants was 504 ml/day while the highest intake recorded was 1,574 ml/day. The mean breast milk intake was 900.18 ± 363.68 ml/day.

Based on the breastfeeding categorization by Medoua *et al.*, (2012), the infants breastfeeding status were classified as EBF (if non-milk oral intake was < 52 ml/day), predominantly breastfed (if non-milk oral intake was 52 - 216 ml/day) and partially breastfed (if non-milk oral intake was > 216ml/day). From this classification, only two infants were considered to exclusively breastfed. However, based on the 24 hour dietary recall, 7 infants were considered to be exclusively breastfed since the recall indicated only breast milk consumption in the preceding 24 hours.

Although some babies were categorized as exclusively breastfed based on the 24 hour recall, more than half of those babies were actually partially or predominantly breastfed based on the more accurate isotope dilution method. Generally, it was observed that the higher the breast milk intake of the infants the lower their non-milk intakes.

Table 8: Biomedical Characteristics, Breast Milk Intakes and Breastfeeding Status of Singleton Infants

No.	**Sex**	**Age of infant (months)**	**Weight (kg)**	**Breast milk intake (ml/day) Mean ± SD**	**Non-milk intake (ml/day)**	**Breastfeeding status based on stable isotope technique**	**Breastfeeding status based on 24hour recall**
1.	M	3.4	6.96	644 ± 80.95	495	Partial	Predominant
2.	M	4.5	6.56	1434 ± 168.86	508	Partial	Exclusive
3.	F	4.7	6.27	1155 ± 80.64	554	Partial	Partial
4.	F	2.9	4.58	547 ± 111.63	177	Predominant	Predominant
5.	M	3.0	6.71	919 ± 6.01	256	Partial	Exclusive
6.	F	4.5	6.35	504 ± 125.23	50	Exclusive	Exclusive
7.	M	2.8	5.59	585 ± 99.61	88	Predominant	Exclusive
8.	F	5.7	5.86	888 ± 3.79	643	Partial	Exclusive
9.	F	4.3	6.57	1000 ± 31.62	505	Partial	Exclusive
10.	F	5.1	7.59	1574 ± 213.14	14	Exclusive	Exclusive
11.	M	3.7	5.67	652 ± 78.42	1659	Partial	Predominant

Mean breast milk intake: **900.18 ± 363.68 ml/day**.
M = Male, F = Female; Exclusive = Exclusive breastfeeding (non-milk intake < 52 ml/day),
Predominant = Predominant breastfeeding (non-milk intake of 52 - 216 ml/day) &
Partial = Partial breastfeeding (non-milk intake > 216 ml/day).

4.7 Estimation of Breast Milk Intake among Twin Infants Using Stable Isotope Dilution Method

There were 12 females and 14 males out of the 13 sets of twins whose results have been presented in Table 9. The mean daily breast milk intake among these infants was 609.00 ± 270.21 ml/day. The breast milk intake of the twin infants ranged between 531-2,072 ml/day. From the responses of the 24 hour dietary recall, three mothers were classified into the EBF group while the remaining 10 mothers were classified as having partially breastfed. However, none of the mothers was classified as EBF using the isotope dilution technique. The more precise isotope dilution method found 12 mothers to be doing partial breastfeeding (non-milk intake > 216 ml/day) with the remainder being classified into the predominant breastfeeding group (non-milk intake 52-216 ml/day). The mean daily volume of breast milk produced by mothers with singletons was significantly higher than that produced by mothers with twins (900.18 ± 363.68 vs. 608.65 ± 270.21, $p = 0.02$).

Table 9: Biomedical Characteristics, Breast Milk Intakes and Breastfeeding Status of Twin Infants

No	Sex of infant	Age of infant (mo)	Weight of infants (kg)	Breast milk intake (ml/day)	TOTAL Breast milk intake (ml/day)	Mean BM intake (ml/day) per twin pair	Non-milk oral intake (ml/day)	Breastfeeding status based on stable isotope technique	Breastfeeding status based on 24 hour recall/stable isotope technique
1	F	4.6	6.0	715	1,138	569 ± 11.45	509	Partial	Partial
	F		6.2	423			386		
2	M	3.7	5.6	260	906	453 ± 286.65	546	Partial	Partial
	F		4.6	646			153		
3	M	4.0	6.0	646	1,369	685 ± 197.60	800	Partial	Exclusive
	M		6.0	723			106		
4	M	5.6	6.7	707	1,305	653 ± 188.36	789	Partial	Partial
	M		7.4	598			612		
5	M	4.6	6.0	864	1,722	861 ± 248.55	134	Predominant	Partial
	M		5.9	858			121		
6	F	3.7	4.7	1,446	2,072	1036 ± 299.07	1434	Partial	Partial
	F		5.4	626			172		
7	M	4.0	5.4	365	717	359 ± 103.49	122	Partial	Partial
	F		5.3	352			816		
8	F	2.3	4.9	397	807	404 ± 116.48	473	Partial	Partial
	F		4.6	410			316		
9	M	3.1	6.1	869	1,575	788 ± 227.33	314	Partial	Partial
	M		6.1	706			324		

Table 9 cont'd: Biomedical Characteristics, Breast Milk Intakes and Breastfeeding Status of Twin Infants

No	Sex of infant	Age of infant (mo)	Weight of infants (kg)	Breast milk intake (ml/day)	TOTAL Breast milk intake (ml/day)	Mean BM intake (ml/day) per twin pair	Non-milk oral intake (ml/day)	Breastfeeding status based on stable isotope technique	Breastfeeding status based on 24 hour recall/stable isotope technique
10	M	3.5	5.9	441	1,172	586 ±	242	Partial	Exclusive
	M		5.6	731		169.16	409		
11	M	2.3	4.6	519	935	468 ±	468	Partial	Partial
	F		4.8	416		134.96	357		
12	M	2.6	6.0	1005	1,576	788 ±	243	Partial	Exclusive
	F		4.6	571		227.48	340		
13	F	3.0	4.2	134	531	265.5 ±	287	Partial	Partial
	F		5.4	397		76.64	773		

Mean breast milk intake: **608.65 ± 270.21 ml/day**. Exclusive = Exclusive breastfeeding (non-milk intake < 52 ml/day),
Predominant = Predominant breastfeeding (non-milk intake of 52-216 ml/day) and
Partial = Partial breastfeeding (non-milk intake > 216 ml/day).

Figure 4.1 illustrates the deuterium oxide decay curve in a mother-singleton dyad over a 14-day period. The concentration of the isotope increased gradually in the infant from days 1 to 4 after which its concentration began to decline steadily. The disappearance of the isotope in the mothers' body corresponded with its appearance in the body of the infant. Comparing the slope of the mother's decay curve in Figure 4.1 to that of the mother-twin dyad in Figure 4.2a and 4.2b, it was observed that the slope of the curve of the mother with the singleton was less steep compared to the decay curves of the mother with twins. This indicates that the decay of the isotope in the body of the mother with twins was faster than the decay in the body of the mother with the singleton since the mother with twins was feeding two infants concurrently. Also, the peak of the curve for singletons was about 450 mg/kg compared to about 200 to 250 mg/kg for twin infants.

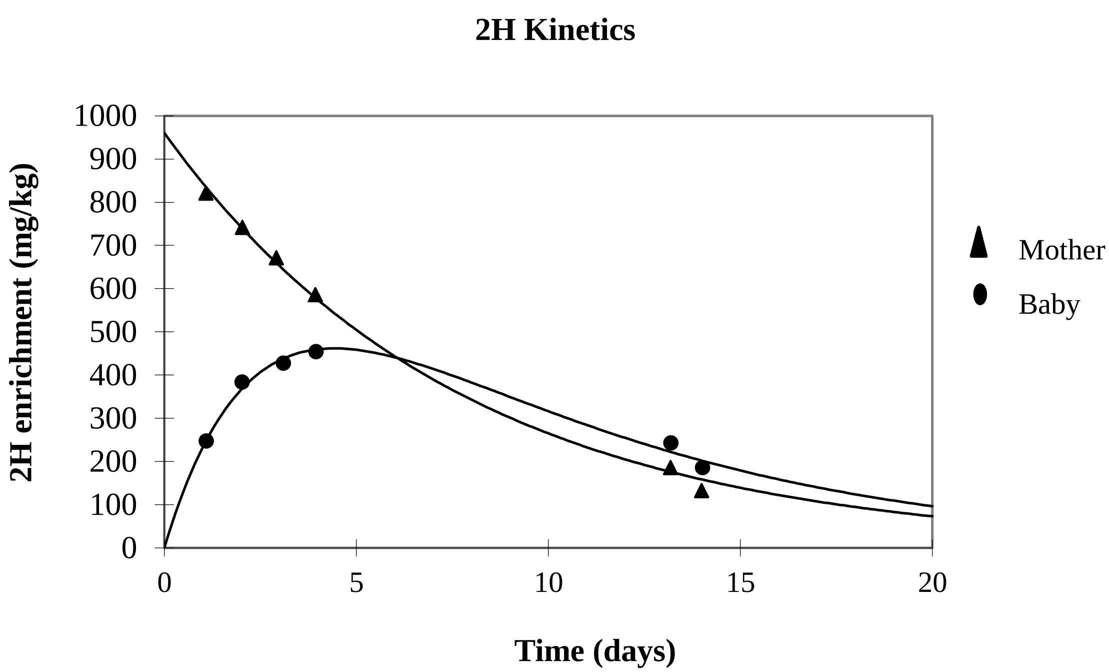

Fig 4.1: ^{2}H enrichment decay curve for a mother with a singleton

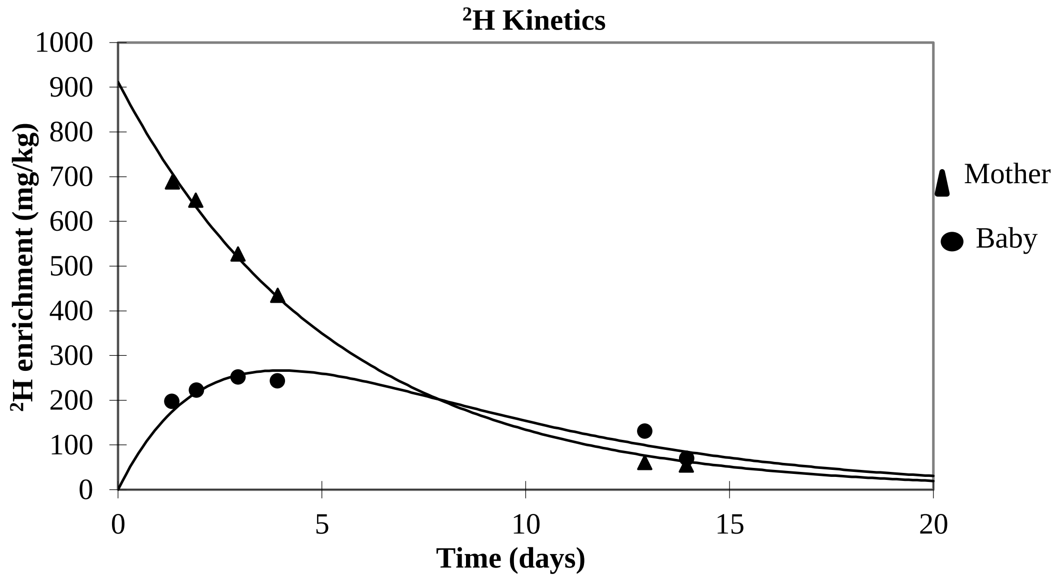

Fig 4.2a: ^{2}H enrichment decay curve for a mother-twin dyad
(1st twin)

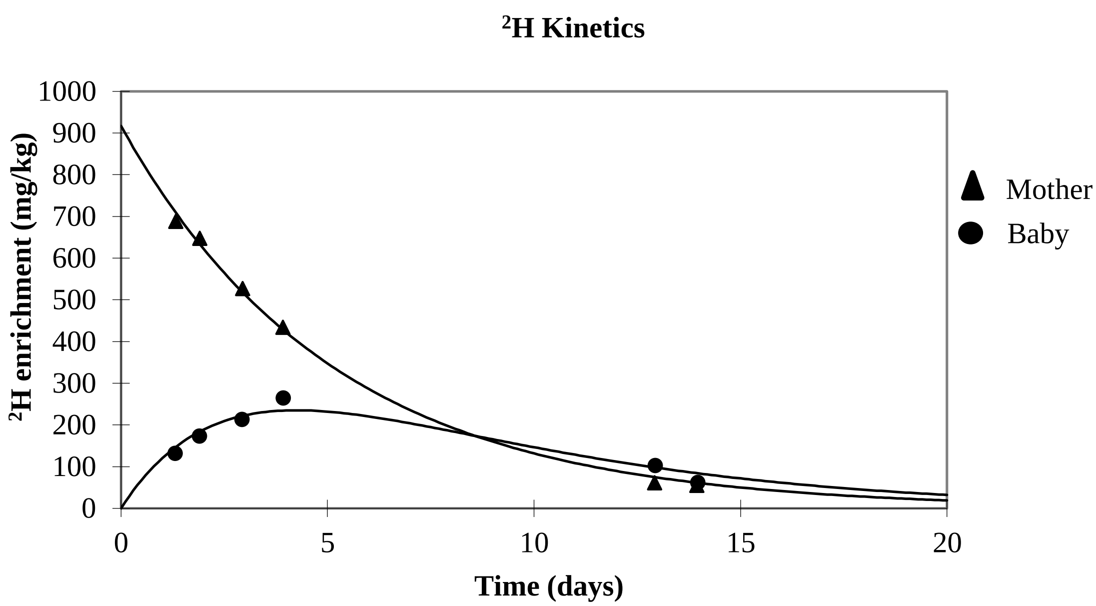

Fig 4.2b: ^{2}H enrichment decay curve for a mother-twin dyad
(2nd twin)

4.8 Predictors of EBF at 6 Months

In all, twelve variables were included in the multivariate binary logistic regression model to determine the possible predictors of EBF at six months (Table 10). The variables that came out significantly associated with EBF at six months were perceived breast milk production ability and prenatal EBF intention. Mothers who perceived they could produce adequate breast milk to satisfy their babies were about four times more likely to breastfeed exclusively at six months (AOR = 4.340; 95% CI, 1.011-18.622) than mothers who perceived they could not. Additionally, women who during pregnancy planned to exclusively breastfeed their babies were about 16 times more likely to exclusively breastfeed their infants at six months (AOR = 16.075; 95% CI, 1.077-239.951) compared with mothers who did not plan to do so.

Table 10: Determinants of EBF status at 6 months (N = 100)

Variable	Sample size (n)	AOR[c]	95% CI	*p*-value
Perceived sucking ability at birth				
Poor	41	0.331	0.091-1.203	0.093
Normal (Ref)	59	1.000		
Delivery type				
Caesarean section	29	2.055	0.283-14.938	0.477
Vaginal (Ref)	71	1.000		
Maternal education				
None[a]/Primary/JSS[b]	67	1.703	0.514-5.642	0.384
Secondary/Tertiary (Ref)	33	1.000		
Infant type				
Singleton	50	3.111	0.717-13.506	0.130
Twin (Ref)	50	1.000		
Perceived breast milk production ability				
Yes	60	4.340	1.011-18.622	**0.048***
No (Ref)	40	1.000		
TV ownership				
No	11	3.566	0.641-19.841	0.147
Yes (Ref)	89	1.000		
Prenatal EBF intention				
Yes	89	16.075	1.077-239.951	**0.044***
No (Ref)	11	1.000		
Breastfeeding initiation				
After a day	35	1.002	0.123-8.189	0.999
Within a day	35	4.097	0.939-17.883	0.061
Within 30 minutes (Ref)	30	1.000		
Pregnancy Intention				
Unplanned	55	0.621	0.189-2.038	0.432
Planned (Ref)	45	1.000		
Prenatal breastfeeding advice received from spouse				
No	57	1.799	0.321-10.099	0.134
Yes (Ref)	43	1.000		
Postnatal breastfeeding advice received from spouse				
No	40	0.296	0.060-1.455	0.134
Yes (Ref)	60	1.000		
Parity				
Primiparous	31	0.878	0.247-3.124	0.841
Multiparous (Ref)	69	1.000		

[a]None in maternal education rankings refers to no formal education ; [b]JSS: Junior Secondary School; [c]AOR: Adjusted Odds Ratio; Ref, Reference category; CI: Confidence Interval;*$p < 0.05$.Hosmer-Lemeshow goodness of fit parameters: $\chi 2_8 = 9.605$, $p = 0.294$.

CHAPTER FIVE

5.0 DISCUSSION

EBF rates among twins and singletons in this study compared well with rates reported by other studies (Yokoyama *et al.,* 2006; Aidam *et al.,* 2005; Yokoyama and Ooki, 2004). More singletons than twin infants were exclusively breastfed up to the recommended six months.

5.1 Factors Associated with EBF at six months

This study identified three factors that were significantly associated with EBF at six months i.e. infant type (singleton vs. twins), perceived breast milk production ability and TV ownership.

5.1.1 Infant Type (singletons vs. twins)

Exactly 44% of singleton infants were EBF at six months compared to 14% of twins who were EBF at six months. This finding is in agreement with other studies that have reported that twins and other higher order multiple births are less likely to be EBF at six months compared to their singleton counterparts (Yokoyama *et al.*, 2006; Yokoyama and Ooki, 2004). These studies also indicated that, mothers with twins and other higher order multiple births were more likely to bottle-feed their infants compared to mothers with singletons. Evaluation of the effectiveness of a Polish breastfeeding programme carried out to promote EBF rates to six months among infants in that country concluded that EBF among twins and triplets was very low, 4.9% (n = 122) while that of the singletons was 73.2% (Yokoyama *et al.*, 2006; Czeszyñska and Kowalik, 1998). Some reasons that have been cited for this observation among twin infants include poor suckling ability, low gestational age (< 37 weeks), low birth weight (< 2.5 kg) and late breastfeeding initiation

(3-4 days after delivery). In this study, however, these factors were not significantly associated with EBF at six months. The significant association between infant type and EBF at six months may be attributed to stress as a result of the extra work mothers with twins have to do in feeding and caring for their infants. It is possible that the stress involved in caring for two babies compels such mothers to resort to bottle-feeding since with bottle-feeding mothers can rely on other members of the family or even close friends to assist (Doulougeri *et al.,* 2013; Moore, 2007). Furthermore, stress is a known inhibitor of prolactin and oxytocin; two hormones that are crucial in the production and ejection of breast milk respectively (Byrd-Bredbenner *et al.,* 2009). It is worth-mentioning that caring for two infants concurrently places a high demand on the mother's time. Hence, such mothers compared to mother-singleton pairs may lack adequate time to rest and stay nourished which are also very important factors in maintaining lactation (Flidel-Rimon and Shinwell 2002). This finding calls for additional support from relatives, friends and the health system for mothers with twins in order to encourage them to EBF as long as possible in the first six months (Kiełbratowska *et al.,* 2010; Östlund *et al.,* 2010).

5.1.2 Perceived Breast Milk Production Ability

Perceived breast milk production ability was another maternal factor significantly associated with EBF at six months in this study. Majority of mothers (90%) who perceived that they could not produce adequate breast milk to satisfy their infants till they turned six months introduced other foods and liquids particularly formula and porridge before six months. Interestingly, a greater proportion of mothers with twins perceived that they could not produce sufficient breast milk to satisfy their infants till they were six months old. Hence, it is likely this factor compelled mothers with twins to EBF for less than six months. The perception of breast milk insufficiency has been reported by other researchers to be a major barrier to EBF even among singletons (Ukegbu *et al.*, 2011; Otoo *et al.,* 2009; Fjeld *et al.,* 2008). Mothers interpreted the persistent crying of infants after they have been breastfed to mean that the breast milk is inadequate and hence should be supplemented with other liquids or foods such as water, formula or porridge. Among twins and other higher order multiple births, this perception seems to be strongly related to EBF for less than six months especially in instances where grandmothers and other relatives impress on the nursing mothers to feed other foods. Observations made during interviews with mother-twin pairs suggested that grandmothers of twin infants, though aware of the benefits of EBF, seemed convinced that breast milk alone was not enough to satisfy the babies up to six months. In other scenarios, some mothers reported that physicians, nurses and midwives encouraged them (mother-twin dyads) to supplement the breast milk with formula and other liquids not because the mothers were ill or could not lactate but because they had two babies. Thus, instead of healthcare professionals encouraging exclusive breastfeeding among this high risk group, some rather engage in deterring nursing mothers from doing so (Flidel-Rimon and Shinwell 2002). Coupled with the fact that nearly half of mother-twin pairs earned monthly incomes of less than GH₵ 150.00, the early introduction of other foods and liquids could increase the family's cost of caring for these infants. This is because early introduction of other foods or liquids could result in diarrhoea, otitis media and other infections (Bartick and Reinhold, 2010; Dewey *et al.,* 1995) which may compromise the nutritional and general health status of the infants. Additionally, the high cost of formula milk may be unbearable for some mothers (Bartick, 2011; Bartick and Reinhold, 2010) especially mother-twin pairs who would generally need to purchase more formula to feed two infants. Hence, it is important to correct the perception of breast milk insufficiency among nursing mothers through intensified EBF promotion programmes. Furthermore, formation of community support groups consisting of mothers who have successfully EBF twins for six months should be encouraged in order to provide the needed psychosocial support for new mothers.

5.1.3 TV Ownership

Contrary to other studies (Ukegbu *et al.*, 2011; Haider *et al.*, 2010), a significant number of mothers who owned a TV set in this study exclusively breastfed for less than six months. Haider *et al* (2010) reported that 81% of Bangladeshi nursing mothers obtained infant feeding messages from the mass media. Out of this percentage, 97% of mothers recalled hearing messages on EBF for the first six months and appropriate complementary feeding after six months from TV. They, therefore, indicated that continued efforts in airing EBF promotion programmes on TV could result in appreciable EBF rates. It could be that if mothers in this study were exposed to EBF programmes aired on TV, they may have been more likely to exclusively breastfeed to six months. Currently in Ghana, no EBF promotion programmes are aired on TV. The only current national child nutrition campaign on TV in Ghana is the United States Agency for International Development (USAID) sponsored advert "*Aduane Pa Ma Asetena Pa*'' (Good Food for Good Life) (www.goodlifeghana.com). The advert which was launched in 2013 by the Ministry of Health and the Ghana Health Service airs on Ghanaian TV channels and mainly focuses on appropriate and timely complementary feeding after six months. It does not provide much information on EBF for the first six months (www.goodlifeghana.com). Modification of the "*Aduane Pa Ma Asetena Pa*'' advert to include more information on the benefits of EBF for the first six months may increase EBF rates. Also, educating caregivers and other family members such as fathers and grandmothers through TV to understand that well-nourished mothers can produce adequate amounts of breast milk to feed their infants until six months could contribute to higher rates in future.

Findings from studies in Lao People's Democratic Republic (PDR) and Vietnam suggest that TV advertisement strongly influence EBF rates at six months (Putthakeo *et al.*, 2009; Duong *et al.*, 2005). In Lao PDR for instance, out of 75% of nursing mothers who watched adverts that promoted infant formula on TV, 48.4% indicated that they wanted to purchase infant formula after watching the adverts (Putthakeo *et al.*, 2009; Duong *et al.*, 2005). Fortunately in Ghana, the Ghana Code of Marketing of Breast Milk Substitutes (Ghana Breastfeeding Promotion Regulations (LI, 1667), 2000) does not permit the advertising of infant formula, therefore, introducing adverts that promote EBF to six months could encourage mothers to continue the practice of EBF for the recommended six months.

5.2 Duration of EBF among Infants

The median duration of EBF among singletons was significantly longer than the median duration among twin infants. This is consistent with findings from previous studies in which a higher percentage of twins than singletons were EBF for less than two months (Östlund *et al.*, 2010; Moore 2007). About half the number of twins (n = 15 pairs) in this study who were EBF for less than two months were introduced to formula soon after delivery. The rest of the mothers reported introducing other foods or liquids apart from breast milk about 3 to 7 days after delivery. Common reasons given by these mother-twin pairs for introducing other foods include perceived delayed onset of lactation, persistent crying of babies after breastfeeding and ill health after caesarean section though these determinants were not significantly associated with EBF at six months. On the other hand, these factors have been indicated to decrease EBF rates among singletons and especially twins (Vassilaki *et al.*, 2012; Zanardo *et al.*, 2010; Otoo *et al*., 2009).

The EBF rate at six months among twins (14%) though low appears to be higher than rates reported by other studies. In Japan and Poland, the EBF rates recorded among twins and triplets were 4.1% and 4.9% respectively (Yokoyama *et al.*, 2006; Czeszyñska and Kowalik, 1998). The EBF rate among singletons in this study (44%) was comparable to that recorded among the Japanese singletons (44.7%). However, it was far lower than the rate of 52% reported in Accra, Ghana by Aidam *et al* (2005) and the 46% recently reported by the UNICEF Multi Indicator Cluster Survey (GNA, 2012). This indicates a decline in the EBF rate among singletons which is surprising since most of these mothers reported to have received breastfeeding advice from the health facilities prenatally, perinatally and postnatally. The short EBF duration observed among both groups of mothers may be attributed to a lack of commitment on the part of mothers to persevere in the face of challenges. Challenges such as ill health, perceived delayed onset of lactation, and persistent crying of babies after breastfeeding were commonly cited by mothers as reasons why they introduced other foods or liquids before six months. The public health nurses and other health professionals responsible for educating mothers on the benefits of breastfeeding should be encouraged to address these concerns among nursing mothers. In future, EBF promotion should also target other members of the family and society such as fathers, grandmothers and close friends since they could also influence the decision mothers make with respect to EBF.

5.3 Estimation of Breast Milk Intake among Singleton and Twin Infants

Singletons in this study consumed an average of 900ml of breast milk in a day. This is consistent with the findings by Wells *et al.,* (2012) who reported a mean of 901 ml of breast milk among EBF singleton infants using the stable isotope dilution method in Iceland. The mean volume of breast milk intake for singletons from this study agrees with the range of breast milk produced by a healthy, well- nourished mother (699–854 ml/day) (Kent *et al.,* 2006; Butte *et al.,* 2002). This finding suggests that mothers with singletons in this study can exclusively breastfeed their infants for the recommended six months. The conventional test weighing method which has been used over the years to estimate breast milk intake is known to underestimate volumes of breast milk by about 1-5% (Savenije and Brand, 2006; Brown *et al.,* 1982) unlike the stable isotope dilution technique which is more accurate and precise. Other researchers who employed the stable isotope dilution method in assessing breast milk intake among singletons recorded averages lower than was observed in this study but within the established range of 669-854ml/day (Medoua *et al.,* 2012; Adom *et al.,* 2011; Moore *et al.,* 2007). The non-breast milk intake among singleton infants averaged about 450 ml/day despite the high volume of breast milk produced by the mothers. It has been reported by previous studies that the early introduction of other foods or liquids has the potential of reducing EBF duration in addition to exposing the infants to diarrhoea and other illnesses (Medoua *et al.,* 2012; Wells *et al.,* 2012; Dewey *et al.,* 1995). Based on the 24 hour recall, 63% of singleton infants (n = 11) were exclusively breastfed while only 18% were exclusively breastfed based on the stable isotope dilution technique. This finding was expected since the 24 hour recall of assessing breastfeeding status has been shown to overestimate EBF rates (Medoua *et al.,* 2012; Adom *et al.,* 2011) sometimes due to recall bias or the tendency to report what mothers perceive researchers want to hear (Otoo *et al.,* 2009). The use of the deuterium oxide stable isotope, however, is able to accurately decipher between respondents who genuinely EBF and those who do not. Another advantage of the stable isotope dilution technique over the 24 hour recall in estimating EBF rates is that the former provides additional information on the volume of non-breast milk intake consumed. This information serves as a guide in classifying infants' breastfeeding status.

Average breast milk intake of twin infants was significantly lower than the intake in singletons (608.65 ± 270.21 vs. 900.18 ± 363.68, p = 0.02). Kiełbratowska *et al* (2010) and Saint *et al* (1986) used the less precise test weighing method to estimate breast milk produced by mothers nursing twins and reported yields between 840 – 2,160 g. To the best of our knowledge, this is the first study that has used the stable isotope dilution method to estimate milk intake of twins. More studies in other settings using this method would be needed to confirm our findings for twin mothers.

Findings of a study by da Costa and co-workers (2010) to assess the mean human milk intake among 1,115 singleton infants (across 12 countries in 5 continents, Africa inclusive) revealed an overall breast milk mean of 780 g/day. The researchers used the stable isotope dilution technique and concluded that infants less than six months required at least 780 g/day of breast milk to grow well. It, therefore, appears that the mean daily volume of breast milk consumed by twin infants in this study may not be adequate to meet the nutritional needs of twin pairs. EBF among mother-twin pairs is not as simple as observed among mother-singleton pairs. This is because several factors such as perceived ability to produce adequate breast milk, early breastfeeding initiation, maternal health and support are necessary to ensure that lactation is maintained and EBF is continued up to six months (Moore, 2007). It is note-worthy that eight out of the 13 mother-twin pairs had milk output of over 1,100 ml/day. Indeed, one of such mothers with twins produced a total of about 2,100 ml of breast milk/day. Based on the stable isotope dilution technique, however, none of the infants could be classified as exclusively breastfed since they all had non-breast milk intakes higher than 52 ml/day. It is important to understand the factors influencing EBF among twin mothers to be able to support them better.

The dose-to-the-mother deuterium oxide stable isotope dilution method used in this study was designed to estimate breast milk intakes among breastfed singleton infants. To the best of our knowledge, no study has used this method in estimating breast milk intakes among twins though it has been used many times to estimate milk intakes among singleton infants. Further studies would, therefore, be needed to validate the accuracy of the method for mothers with twin infants.

5.4 Determinants of EBF at six months

Two factors significantly predicted EBF at six months; perceived breast milk production ability and prenatal EBF intention. The respondents who perceived that they were capable of producing sufficient breast milk to satisfy their infants had a higher likelihood of breastfeeding exclusively up to six months and vice versa. Such mothers were more likely to persist in EBF and not easily give up even when faced with challenges such as stress or consistent crying by the infant (Otsuka *et al.*, 2008; Sacco, 2006). Perceived breast milk production ability is closely linked with self-efficacy, which is defined as the conviction an individual has in his/her ability to successfully perform a certain task (Bandura, 1977). A mother's confidence that she can successfully breastfeed despite all odds has been identified as an important factor in predicting breastfeeding initiation and duration (Wheeler and Dennis, 2013; Jackson, 2012). It is, therefore, not surprising that in this study mothers who were confident in their ability to produce adequate breast milk to satisfy their babies were four times more likely to EBF at six months compared to their counterparts who were not confident.

Prenatal EBF intention also positively predicted EBF at six months. This is in agreement with the findings of similar studies that found positive associations between mothers' prenatal plan to EBF upon delivery and actual breastfeeding practice (Bai *et al.,* 2010; Aidam *et al.,* 2005). Anderson *et al* (2007) observed that respondents who during pregnancy intended to EBF were more likely to EBF upon hospital discharge. Considering that a mother's intention to EBF could actually influence her infant feeding choice after delivery suggests that EBF promotion programmes should be targeted at mothers before delivery. This could contribute to higher EBF rates at six months.

A limitation of this study is that the sample size within each study group may not have been large enough to identify additional statistical associations. Therefore, absence of associations in this study should be interpreted with caution.

CHAPTER SIX

6.0 CONCLUSIONS AND RECOMMENDATIONS

6.1 CONCLUSIONS

The overall aim of this study was to advance understanding of the drivers of exclusive breastfeeding among Ghanaian mothers, especially those nursing twins. The specific objectives were to:

(i) Identify the factors associated with EBF of twins; (ii) Determine the duration of EBF for mothers of twins and (iii) Estimate the mean daily volume of breast milk produced by mothers breastfeeding twins compared to mothers breastfeeding singletons using the stable isotope dilution method.

As a result of the literature review and empirical research conducted, three factors were identified to be positively associated with EBF: the type of infant (i.e. being a twin compared to a singleton), mothers' perceived ability to produce enough breast milk up to six months and ownership of a TV set.

The median duration of EBF was shorter for mothers with twins (one month) than for mothers with singletons (four months). Overall, mothers with twins produced a lower daily breast milk average of about 609ml/day ± 270.21 compared to the average volume of 900.18 ± 363.68 ml/day produced by the mothers with singletons. The predictors of EBF at six months identified were perceived breast milk production ability and prenatal EBF intention.

6.2 RECOMMENDATIONS

Mothers with twin infants need to be encouraged during the prenatal period to breastfeed exclusively upon delivery. Constant encouragement from health staff and community mother support groups for expectant mothers to make this crucial decision even before delivery could contribute to higher EBF rates among this high risk group.

Health workers such as doctors, nurses and midwives who are normally in close contact with expectant mothers should be given regular refresher courses to sharpen their skills and knowledge in caring for infants particularly multiple births. This would ensure that health workers stay abreast with issues that pertain to infant and young child feeding practices. They should also be monitored and assessed periodically by the appropriate authorities to ensure that they pass on accurate information on maternal and infant nutrition to nursing mothers. This is because some participants especially those with twins admitted during the study that some of the health staff advised them to feed their infants with formula, mashed kenkey, water among others since they had two infants and could not feed them adequately with only breast milk for six months.

Last, but not least prospective studies that would follow twin infants for the first six months of life to monitor breast milk intake and growth are needed in order to accurately establish the duration of EBF for twins.

REFERENCES

Adom, T., Bansa, D., Boatin, R., Timpo, S., Asamoa-Tutu, P., Vuore, T., and Datohe, D. (2011).Measurement of breast milk intake using deuterium oxide and fourier transformed infrared spectrophotometer - a pilot study. *Journal of the Ghana Science Association 13*(1).

Aidam, B. A., Perez-Escamilla, R., Lartey, A., and Aidam, J. (2005). Factors associated with exclusive breastfeeding in Accra, Ghana. *European Journal of Clinical Nutrition 59*, 789-796.

Akinboro, A., Azeez, M. A., and Bakare, A. A. (2008). Frequency of twinning in southwest Nigeria. *Indian Journal of Human Genetics 14*(2), 41-47.

Akter, S., Hossain, K., Moniruzzaman, S. M., and Jahan, I. (2011).Exclusive breastfeeding among preterm low birth weight infants at one month follow-up after hospital discharge. *Journal of Enam Medical College 1*(1), 24-30.

Alemayehu, T., Haidar, J., and Habte, D. (2009). Determinants of exclusive breastfeeding practices in Ethiopia. *Ethiopian Journal of Health Development 23*(1), 12-18.

American Academy of Paediatrics, (2005).Breastfeeding and the use of human milk. *Paediatrics 115*(2), 496-506.

Anderson, K. A., Damio, G., Chapman, J. D., and Pérez-Escamilla, R. (2007). Differential response to an exclusive breastfeeding peer counseling intervention: the role of ethnicity. *Journal of Human Lactation 23*(1), 16-23.

Arslanoglu, S., Ziegler, E. E., Moro, G. E., and the WAPM Working Group on Nutrition. (2010). Donor human milk in preterm infant feeding: evidence and recommendations. *Journal of Perinatal Medicine 38*(4), 347-351.

Aryeetey, R. N. O., Marquis, G. S., Brakohiapa, L., Timms, L., and Lartey, A. (2009). Subclinical mastitis may not reduce breastmilk intake during established lactation. *Breastfeeding Medicine*, *4*(3), 161-166.

Baby Friendly Hospital Initiative (BFHI). Retrieved from http://www.unicef.org/programme/breastfeeding/baby.htm on February 20th, 2014.

Bai, Y., Middlestadt, E. S., Peng, J. C-Y., and Fly, D. A. (2010). Predictors of continuation of exclusive breastfeeding for the first six months of life. *Journal of Human Lactation 26*(1), 26-34.

Bandura, A. (1977). Self-efficacy: Toward a unifying theory of behavioural change. *Psychological Review 84*(2), 191-215.

Bartick, M. (2011). Breastfeeding and the U.S. economy. *Breastfeeding Medicine 6*(5), 313-317.

Bartick, M., and Reinhold, A. (2010). The Burden of Suboptimal Breastfeeding in the United States: A Pediatric Cost Analysis. *Pediatrics 125*(5), e1048-e1056.

Ben-Jonathan, N., and Hnasko, R. (2001). Dopamine as a prolactin (PRL) inhibitor. *Endocrine Reviews 22*(6), 724.

Bragelien, R., Røkke, W., and Markestad, T. (2007). Stimulation of sucking and swallowing to promote oral feeding in premature infants. *Acta Paediatrica 96*(10), 1430-1432.

Braun, M. L. G., Giugliani, E. R. J., Soares, M. E. M., Giugliani, C., de Oliveira, A. P., and Danelon, C. M. M. (2003). Evaluation of the impact of the baby-friendly hospital initiative on rates of breastfeeding. *American Journal of Public Health 93*(8), 1277-1279.

Boseley, S. (2009). *The health risks of multiple pregnancies.* Retrieved from http://www.Guardian.Co.Uk/Uk/2009/Jan/27/Multiple-Pregnancy-Health-Dangers on 20th September, 2012.

Brown, K. H., Black, R. E., Robertson, A. D., Akhtar, N. A., Ahmed, G., and Becker, S. (1982). Clinical and field studies of human lactation methodological considerations. *American Journal of Clinical Nutrition 35*, 745-756.

Byrd-Bredbenner, C., Moe, G., Beshgetoor, D., and Berning, J. (2009). *Nutritional aspects of pregnancy and breastfeeding* In: Wardlaw's Perspectives in Nutrition, 8th ed., pp573-603. McGraw Hill Companies Inc. New York, USA.

Butte, N. F., Lopez-Alarcon, G. M., and Garza, C. (2002). *Human-milk intake during exclusive breastfeeding in the first year of life* in Nutrient adequacy of exclusive breastfeeding for the term infant during the first six months of life. World Health Organization, Geneva, pp8-15.

Butte, N. F., Wong, W. W., Patterson, B. W., Garza, C., and Klein, P. D. (1988). Human milk intake measured by administration of deuterium oxide to the mom: a comparison with the test-weighing technique. *American Journal of Clinical Nutrition 47*, 815-821.

Bulmer, M. G. (1970). *The biology of twinning in man*. Clarendon Press, Oxford, UK.

Cai, X., Wardlaw, T., and Brown, D. W. (2012). Global trends in exclusive breastfeeding. *International Breastfeeding Journal 7*(12), 1-5.

Central Statistical Agency [Ethiopia] and ORC Macro. 2006. *Ethiopia Demographic and Health Survey 2005.* Addis Ababa, Ethiopia and Calverton, Maryland, USA: Central Statistical Agency and ORC Macro.

Centres for Disease Control and Prevention (CDC).Breastfeeding report card-United States 2010 (2010). Retrieved from http://www.cdc.gov/breastfeeding/data/reportcard.htm on March 25, 2013.

Centres for Disease Control and Prevention (CDC).Breastfeeding report card-United States 2012 (2012). Retrieved from http://www.cdc.gov/breastfeeding/data/reportcard.htm on March 25, 2013.

Cregan, M. D., De Mello, T. R., Kershaw, D., Mcdougall, K., and Hartmann, P. E.(2002). Initiation of lactation in women after preterm delivery. *Acta Obstetricia et Gynecologica Scandinavica 81*, 870-877.

Coward, W. A., and Whitehead, R. G. (1972). Changes in serum β-lipoprotein concentration during the development of Kwashiorkor and recovery. *British Journal of Nutrition 27*, 383-393.

Coward, W. A., Sawyer, M. B., Whitehead, R. G., Prentice, A. M., and Evans, J. (1979). New method for measuring milk intakes in breast-fed babies. *Lancet 7*, 13-14.

Coward, W. A., Cole, T. J., Sawyer, M. B., and Prentice, A. M. (1982). Breast milk intake measurement in mixed-fed infants by administration of deuterium oxide to their mothers. *Human Nutrition: Clinical Nutrition 36C*, 141-148.

Czeszyñska, M. B. and Kowalik, K. (1998). Multiple pregnancy: Factors contributing to early infant's breastfeeding — Own experience. *Acta Geneticae Medicae et Gemellologiae, 47,* 191-196.

da Costa, M. H. T., Haisma, H., Wells, K. C. J., Mander, P. A., Whitehead, G. R., and Bluck, J. C. L.(2010). How much human milk do infants consume? Data from 12 countries using a standardized stable isotope methodology. *The Journal of Nutrition 140*, 2227-2232.

Daniel, W. W. (1999). Biostatistics: A foundation for analysis in the health sciences, 7th Ed, John Wiley and Sons, New York, United States of America.

Dennis, C-L. (1999). Theoretical underpinnings of breastfeeding confidence: A self-efficacy framework. *Journal of Human Lactation 15*(3), 195-201.

Dennis, C-L., and Faux, S. (1999) Development and Psychometric Testing of the Breastfeeding Self-Efficacy Scale. *Research in Nursing & Health 22*(5), 399-409.

Dewey, K, G., Cohen, R. J., Brown, K. H., and Rivera, L. L. (2001). Effects of exclusive breastfeeding for four versus six months on maternal nutritional status and infant motor development: results of two randomized trials in Honduras. *The Journal of Nutrition 131*, 262-267.

Dewey, K. G., Heinig, M. J., and Nommsen-Rivers, L. A. (1995). Differences in morbidity between breast-fed and formula-fed infants. *Journal of Pediatrics 126*(1), 696-701.

Doulougeri, K., Panagopoulou, E., and Montgomery, A. (2013). The impact of maternal stress on initiation and establishment of breastfeeding. *Journal of Neonatal Nursing* (article in print).

Drover, J. R., Hoffman, D. R., Castneda, Y. S., Morale, S. E., Garfield, S., Wheaton, D. H., and Birch, E. E. (2011). Cognitive function in 18-month-old term infants of the DIAMOND study: A randomized, controlled clinical trial with multiple dietary levels of docosahexaenoic acid. *Early Human Development 87*(3), 223-230.

Duong, V. D., Lee, H. A., and Binns, C. W. (2005). Determinants of breast-feeding within the first 6 months post-partum in rural Vietnam. *Journal of Paediatrics and Child Health 41*, 338 -343.

Edmond, K., and Bahl, R. (2006). Optimal feeding of low birth weight infants. WHO Technical Review.

Fjeld,E., Siziya, S., Katepa-Bwalya, M., Kankasa, C., Moland, K. M., and Tylleskär, T. for the PROMISE-EBF Study Group. (2008). 'No sister, the breast alone is not enough for my baby' a qualitative assessment of potentials and barriers in the promotion of exclusive breastfeeding in southern Zambia. *International Breastfeeding Journal 3*(26).

Fierro, P. P., *Twin and multiple birth rates*. Retrieved from http://multiples.about.com/od/funfacts/a/twinbirthrate.htm on 20th September, 2012.

Flidel-Rimon, O., and Shinwell, E. S. (2002). Breast-feeding multiples. *Seminars in Neonatology 7*, 231-239.

GHS launches "*Aduane Pa Ma Asetena Pa*" campaign. Retrieved from www.goodlifeghana.com/ghs-launches-aduane-pa-campaign on 16th July, 2013.

Ghana Breastfeeding Promotion Regulations (LI, 1667). (2000). Developed by Family Health Division, Ghana Health Service, Accra in collaboration with other development partners.

Ghana Statistical Service (GSS), Ghana Health Service (GHS), and ICF Macro. 2009. Ghana Demographic and Health Survey 2008. Accra, Ghana: GSS, GHS, and ICF Macro.

Ghana Statistical Service (2011). Ghana MICS with an Enhanced Malaria Module and Biomarker, 2011. Summary Report of Key Findings. Accra, Ghana.

Glinianaia, S. V., Pharoah, P. O. D., Wright, C., and Rankin, J. M., on behalf of the Northern Region Perinatal Mortality Survey Steering Group. (2002). Foetal or infant death in twin pregnancy: neurodevelopmental consequence for the survivor. *Archives of Disease in Childhood. Foetal and Neonatal Edition 86*(1), F9-F15.

Ghana News Agency (GNA), (2012). Pay more attention to breastfeeding. *Daily Graphic*, 16th August, 2012, p11.

Grajeda, R., and Perez-Escamilla, R. (2002).Stress during labour and delivery is associated with delayed onset of lactation among urban Guatemalan women. *Journal of Nutrition 132*, 3055-3060.

Gregory, A., Penrose, K., Morrison, C., Dennis, C-L., and MacArthur, C. (2008). Psychometric properties of the breastfeeding self-efficacy scale-short form in an ethnically diverse U.K. sample. *Public Health Nursing 25*(3), 278-284.

Haider,R., Rasheed, S., Sanghvi, G. T., Hassan, N., Pachon, H.,Islam, S., and Jalal, S. B. C. (2010). Breastfeeding in infancy: identifying the program-relevant issues in Bangladesh. *International Breastfeeding Journal 5*(21), 1-12.

Haisma, H., Coward, W. A., Albernaz, E., Visser, G. H., Wells, J. C. K., Wright, A., and Victora, C. G. (2003). Breast milk and energy intake in exclusively, predominantly and partially breastfed infants. *European Journal of Clinical Nutrition 57*, 1633-1642.

Henderson, G., Craig, S., Brocklehurst, P., and McGuire W. (2009). Enteral feeding regimens and necrotising enterocolitis in preterm infants: a multicentre case–control study. *Archives of Disease in Childhood. Foetal and Neonatal Edition 94,* F120-F123.

Hodnett, E. D., Fredericks, S., and Weston, J. (2010). Support during pregnancy for women at increased risk of low birth weight babies (Review). *Cochrane Database of Systematic Reviews 6*, 3-5.

Hyde, M. J., Mostyn, A., Modi, N., and Kemp, P. R. (2012).The health implications of birth by caesarean section. *Biological Reviews 87*, 229-243.

Ibrahim, I., Oyeyemi, A., and Obilahi, A. (2012). Twin pregnancies in the Niger Delta of Nigeria: a four-year review. *International Journal of Women's Health 4*, 245-249.

International Atomic Energy Agency [IAEA]. (2010). Stable isotope technique to assess intake of human milk in breastfed infants. *IAEA Human Health Series*, 7, 2075-3772.

Iliff, P. J., Piwoz, E. G., Tavengwa, N. V., Zunguza, C. D., Marinda, E. T., Nathoo, K. J., Moulton, L. H., Ward, B. J., The ZVITAMBO study group and Humphrey, J. H. (2005). Early exclusive breastfeeding reduces the risk of postnatal HIV-1 transmission and increases HIV-free survival. *AIDS 19*(7), 699-708.

Iyiola, O. A., Oyeyemi, F. B., Raheem, U. A., and Mark, F.O. (2013). Frequency of twinning in Kwara State, North-Central Nigeria. *The Egyptian Journal of Medical Human Genetics 14*(1), 29-35.

Jackson, S. C. (2012). Factors associated with breastfeeding self-efficacy: maternal depression, infant weight gain, and milk-intake. PhD Dissertation, Texas Tech University, Texas, USA.

Jones, G., Steketee, R. W., Black, R. E., Bhutta, Z. A., Morris, S. S., and The Bellagio Child Survival Study Group. (2003). How many child deaths can we prevent this year? *Lancet 362*, 65-71.

Jørgensen, M. H., Hernell, O., Hughes, E. L., and Michaelsen, K. F. (2001). Is There a Relation between Docosahexaenoic Acid Concentration in Mothers' Milk and Visual Development in Term Infants? *Journal of Paediatric Gastroenterology and Nutrition 32*, 293–296.

Kent C. J.,Mitoulas, R. L., Cregan, D. M., Ramsay, T. D., Doherty, A. D., and. Hartmann, E. P. (2006). Volume and frequency of breastfeedings and fat content of breast milk throughout the day. *Pediatrics 117*(3), e387–e395.

Kiełbratowska, B., Ćwiek, D., Preis, K., Malinowski, W., and Hofman, A. (2010). Breastfeeding of twins. *Archives of Perinatal Medicine 16*(4), 201-205.

Koosha, A., Hashemifesharaki, R., and Mousavinasab, N. (2008).Breastfeeding patterns and factors determining exclusive breastfeeding. *Singapore Medical Journal 49*(12), 1002-1006.

Ladomenou, F., Moschandreas, J., Kafatos, A., Tselentis, Y., and Galanakis, E. (2010). Protective effect of exclusive breastfeeding against infections during infancy: a prospective study. *Archives of Disease in Childhood 95*, 1004-1008.

Leonard, L. G. (2000). Breastfeeding Triplets: The At-Home Experience. *Public Health Nursing 17*(3), 211-221.

Llewellyn-Jones D. (1998). *The baby in pregnancy* In: Every Woman, 9th ed., pp321-322. Safari Books Export Limited, Chanel Islands, UK, in association with Spectrum Books limited, Ibadan, Nigeria.

Lucas, A., Morley, R., Cole, T. J., Lister, G., and Leeson-Payne, C. (1992). Breast milk and subsequent intelligence quotient in children born preterm. *Lancet 39(*8788), 261-264 (abs).

Medoua, G. N., Nana, E. C. S., Ndzana, A. C. A., Makamto, C. S., Etame, L. S., Rikong, H. A., and Oyono, J. L. E.(2012). Breastfeeding practices of Cameroonian mothers determined by dietary recall since birth and the dose-to-the-mother deuterium-oxide turnover technique. *Maternal and Child Nutrition 8*(3), 330-339.

Moore, J. E. (2007). Multiple Births: The art and science of caring for twins, triplets, and more. *Pediatrics in Review 28(3),* e9-e15.

Moore, S. E., Prentice, A. M., Coward, W. A., Wright, A., Frongillo, E. A., Fulford, A. J. C., Mander, A. P, Persson, L-A., Arifeen, S. E., and Kabir, I. (2007). Use of stable-isotope techniques to validate infant feeding practices reported by Bangladeshi women receiving breastfeeding counselling. *American Journal of Clinical Nutrition 85(4),* 1075-1082.

Mosuro, A. A., Agyapong, A. N., Opoku-Fofie, M., and Deen, S. (2001). Twinning rates in Ghana. *Twin Research 4*(4), 238-241.

Nissen, E., Uvnas-Moberg, K., Svensson, K., Stock, S., Widstrom, A-M., and Winberg, J. (1996). Different patterns of oxytocin, prolactin but not cortisol release during breastfeeding in women delivered by caesarean section or by the vaginal route. *Early Human development 45*, 103-118.

Nkala, T. E., and Msuya, S. E. (2011).Prevalence and predictors of exclusive breastfeeding among women in Kigoma region, Western Tanzania: a community based cross-sectional study. *International Breastfeeding Journal 6*(17), 2-7.

Nylander, P. P. (1981). The factors that influence twinning rates. *Acta Genet Med Gamellol 30*(3), 189-202 (abs).

Oche, M. O., Umar, A. S., and Ahmed, H. (2011).Knowledge and practice of exclusive breastfeeding in Kware, Nigeria. *African Health Sciences 11*(3), 518-523.

Ocloo, D. R. (2013). Providing the health needs of rural communities and urban poor: New Crystal Group makes impact in Ashaiman community. *Daily Graphic*, 13th April, 2013, pp26-27.

Olang,B., Farivar, K., Heidarzadeh, A., Strandvik, B., and Yngve, A. (2009). Breastfeeding in Iran: prevalence, duration and current recommendations. *International Breastfeeding Journal 4*(8), 1-10.

Olusanya, B. O. (2011). Perinatal outcomes of multiple births in southwest Nigeria. *Journal of Health, Population and Nutrition 29*(6), 639-647.

Ooki, S., and Yokoyama, Y., (2004). Breastfeeding and bottle-feeding of twins, triplets and higher order multiple births. *Japanese Journal of Public Health 51,* 969 (abs).

Östlund,Å., Nordström, M., Dykes, F., and Flacking, R. (2010). Breastfeeding in Preterm and Term Twins - Maternal Factors Associated With Early Cessation: A - Population-Based Study. *Journal of Human lactation 26*(3), 235-240.

Otoo, G. E., Lartey, A. A., and Pérez-Escamilla, R. (2009).Perceived incentives and barriers to exclusive breastfeeding among periurban Ghanaian women. *Journal of Human Lactation 25*(1), 34-41.

Otoo, G. E., Marquis, G. S., Sellen, D. W., Chapman, D. J., and Pérez-Escamilla, R. (2010). HIV-negative status is associated with very early onset of lactation among Ghanaian women. *Journal of Human Lactation 26*(2), 107-117.

Otsuka, K., Dennis, C-L., Tatsuoka, H., and Jimba, M. (2008).The relationship between breastfeeding self-efficacy and perceived insufficient milk among Japanese mothers. *Journal of Obstetric, Gynaecologic, and Neonatal Nursing 37*(5), 546-555.

Oxford University Press. (2007).Oxford Concise Colour Medical Dictionary, 4th ed., pp 738. Oxford University Press Inc, New York, USA.

Perez-Escamilla, R., Maulen-Radovan, I., and Dewey, K. G. (1996).The association between cesarean delivery and breast-feeding outcomes among Mexican women. *American Journal of Public Health 86*(6), 832-836.

Perez-Escamilla, R. (2007). Evidence Based Breast-Feeding Promotion: The Baby-Friendly Hospital Initiative. *The Journal of Nutrition 137*(2), 484-487.

Putthakeo, P., Ali, M., Ito, C., Vilayhong, P., and Chushi Kuroiwa C. (2009). Factors influencing breastfeeding in children less than 2 years of age in Lao PDR. *Journal of Paediatrics and Child Health 45*, 487-492.

Saint, L., Maggiore, P., and Hartmann, P. E. (1986). Yield and nutrient content of milk in eight women breastfeeding twins and one woman breastfeeding triplets. *British Journal of Nutrition 56*, 49-58.

Sacco, L. M., Caulfield, L. E., Gittelsohn, J., and Martínez, H. (2006). The conceptualization of perceived insufficient milk among Mexican mothers. *Journal of Human Lactation 22*(3), 277-286.

Samuel, T. M., Thomas, T., Bhat, S., and Kurpad, A. V. (2012).Are infants born in baby-friendly hospitals being exclusively breastfed until 6 months of age? *European Journal of Clinical Nutrition 66*(4), 459-465.

Savenije, O. E. M., and Brand, P. L. P. (2006). Accuracy and precision of test weighing to assess milk intake in new born infants. *Archives of Disease in Childhood Foetal and Neonatal Edition 91*(5), F330-F332.

Smits, J., and Monden, C. (2011).Twinning across the developing world. *PLOS ONE 6*(9), e25239. Retrieved from http://www.plosone.org/article/info:doi/10.1371/journal.pone.0025239on 8th May, 2013.

Talayero, J. M. P, n-Garcia, M. L., Puime, A. O., Muncharaz, M. J. B., Soto, B. B., Sanchez-Palomares, M., Serrano, L. S., and Rivera, L. L. (2006). Full breastfeeding and hospitalization as a result of infections in the first year of life. *Pediatrics 118*, e92-e97.

Tamiru, D., Belachew, T., Loha, E., and Mohammed, S. (2012). Sub-optimal breastfeeding of infants during the first six months and associated factors in rural communities of JimmaArjo Woreda, Southwest Ethiopia. *Biomed Central Public Health 12*(363), 1-9.

Tung, K-H., Goodman, M. T., Wu, A. H., McDuffie, K., Wilkens, L. R., Kolonel, L. N., Nomura, A. M. Y., Terada, K. Y., Carney, M. E., and Sobin, L. H. (2003). Reproductive factors and epithelial ovarian cancer risk by histologic type: a multi-ethnic case-control study. *American Journal of Epidemiology 158*(7), 629-638.

Ukegbu, A. U., Ukegbu, P. O.,Okpara, M., Onyeonoro, U. U., and Ubajaka, C. F. (2011).Determinants of breastfeeding patterns among mothers in Anambra State, Nigeria. *South Africa Journal of Child Health 5*(4), 112-116.

UNICEF (2008). Overview of breastfeeding patterns. Retrieved from http://www.childinfo.org/breastfeeding_ghana.html on 7th May, 2013.

Vassilaki, M., Chatzi, L., Bagkeris, E., Papadopoulou, E., Karachaliou, M., Koutis, A., Philalithis, A., and Kogevinas, M. (2012). Smoking and caesarean deliveries: major negative predictors for breastfeeding in the mother–child cohort in Crete, Greece (Rhea study). *Maternal and Child Nutrition*, 1-12.

Wells, C. K. J., Jonsdottir, H. O., Hibberd, L. P., Fewtrell, S. M., Thorsdottir, I., Eaton, S., Lucas, A., Gunnlaugsson, G., and Kleinman, E. R.(2012). Randomized controlled trial of 4 compared with 6 mo of exclusive breastfeeding in Iceland: differences in breast-milk intake by stable-isotope probe. *American Journal of Clinical Nutrition 96*, 73-79.

Wheeler, B. J., and Dennis, C-L. (2013). Psychometric testing of the modified breastfeeding self-efficacy scale (short form) among mothers of ill or preterm infants. *Journal of Obstetric, Gynaecologic, and Neonatal Nursing 42*(1), 70-80.

World Health Organization (2002): *The optimal duration of exclusive breastfeeding: A Systematic Review*. Geneva: World Health Organization.

World Health Organization (2008): *Indicators for assessing infant and young child feeding practices - Part 1: Definitions.* pp4–5.

Yokoyama, Y., Wada, S., Sugimoto, M., Katayama, M., and Sono, J. (2006). Breastfeeding rates among singletons, twins and triplets in Japan: a population-based study. *Twin Research and Human Genetics 9*(2), 298-302.

Yokoyama, Y., and Ooki, S. (2004). Breastfeeding and bottle-feeding of twins, triplets and higher order multiple births. *Japanese Journal of Public Health 51*, 969-974.

Zanardo, V., Svegliado, G., Cavallin, F., Giustardi, A., Cosmi, E., Litta, P., and Trevisanuto, D. (2010). Elective cesarean delivery: does it have a negative effect on breastfeeding? *Birth 37*(4), 275-279.

APPENDICES

APPENDIX I

DEPARTMENT OF NUTRITION AND FOOD SCIENCE
UNIVERSITY OF GHANA

FACTORS ASSOCIATED WITH EXCLUSIVE BREASTFEEDING OF GHANAIAN TWINS

INFORMED CONSENT FORM

Title: Factors associated with exclusive breastfeeding of Ghanaian twins.

Principal Investigator: Jane Appiaduah Odei

Address: University of Ghana, Department of Nutrition and Food Science, Legon, Accra.

General Information about Research

You and your child (children) are being invited to participate in a study that seeks to determine the various factors that influence the exclusive breastfeeding patterns of mothers of twins as well as mothers of singletons. This is important to know because the information from this study could be used to better advice breastfeeding mothers especially those with twins.

If you agree to take part in this study, you will be asked some personal questions such as your age, level of education, where you live, the number of children you have; your baby's birth information, such as birth weight, age at birth (gestational age), suckling ability at birth, feeding type and incubator use; your biomedical history such as delivery type, antenatal and breastfeeding advice received. This would take about 45minutes – 1hour. You will be weighed in minimal clothing (no heavy jewellery, belts or cloth) on an electronic scale while your child (children) would be weighed naked in a baby scale. Your height as well as your infant's(s) length would also be measured. In order to estimate the volume of breast milk you produce in a day, members of the research team would visit you and your child (children) at home or a suitable location. During the visit you would be served with a small cotton wool ball to chew so that you can produce enough saliva. About 2-5ml of the saliva you produce would be taken to the lab for analysis. A small plastic stick with one side covered with cotton wool would instead be used to obtain a similar volume of saliva from your infant(s). After the initial amount of saliva has been taken, you will be given a small volume (30ml) of water mixed with a stable compound called deuterium (heavy water) to drink through a straw. On days 1, 2, 3, 4, 13 and 14 after you have taken the given water, also called heavy water, saliva samples would again be taken from both you and your infant(s) in a similar way as explained earlier. The heavy water you would drink is not going to harm you or your child (children) in any way and has a taste similar to normal water.

Possible Risks and Discomforts

There would be no physical hurt/pain to you and your baby. However, the time to be spent answering the questions and producing the saliva samples may pose some inconvenience to you. It is possible that some of the questions to be asked may pose some discomfort or intrude on your privacy.

You are free to choose not to answer any question(s) that you are not comfortable with or do not wish to discuss and you may stop the interview at any time. You may also refuse to allow the research team into your home.

Possible Benefits

You and your child (children) may not personally benefit from participating in this study, however, knowledge gained from this research will be useful to society as a whole.

Confidentiality

Information obtained from your participation will be kept strictly confidential. The results from this research may be used in presentations and/or research papers. However, your name and that of your child (children) will never be used in any presentation, paper or report. You should also know that the Institutional Review Board (IRB) of the Noguchi Memorial Institute of Medical Research may inspect study records as part of its auditing program but these reviews will only focus on the researcher and not on your responses or involvement. The IRB is a group of people that review research studies to make sure they are safe for participants.

Compensation

You and your child (children) will not pay anything for participating in the study. You will receive a thank you gift of 3 cakes of soap for your participation at the end of the study.

Voluntary Participation and Right to Leave the Research

Participation in this research is voluntary. You are free to decide whether to be in this study or not. If you decide to participate but later change your mind, you may withdraw your participation without any penalty.

Contacts for Additional Information

If you have further questions or concerns relating to your participation in this study you may contact Jane Odei on telephone number 020-8444288 or 0303- 402173 or by e-mail at jane_odei@yahoo.com. Prof Anna Lartey, the main supervisor for the research, may also be contacted on telephone number 0244237188.

Your rights as a Participant

This research has been reviewed and approved by the Institutional Review Board of Noguchi Memorial Institute for Medical Research (NMIMR-IRB). If you have any questions about your rights as a research participant you can contact the IRB office between the hours of 8am-5pm through the landline number 0302916438 or email addresses: nirb@noguchi.mimcom.org or HBaidoo@noguchi.mimcom.org.

VOLUNTEER AGREEMENT

The above document describing the benefits, risks and procedures for the research title, **Factors associated with exclusive breastfeeding of Ghanaian twins** has been read and explained to me. I have been given an opportunity to have questions about the study answered to my satisfaction. I agree to participate as a volunteer.

……………..…… ……….……………………

Date Name and signature or mark of Volunteer

If volunteers cannot read the form themselves, a witness must sign here:

I was present while the benefits, risks and procedures were read to the volunteer. All questions were answered to the volunteer's satisfaction and the volunteer has agreed to take part in the research.

…………………… …………………………

Date Name and signature of Witness

I certify that the nature and purpose, the potential benefits, and possible risks associated with participating in this study have been explained to the above individual.

_____________________ _________________________

Date Name/ Signature of Person Who Obtained Consent

APPENDIX II

DEPARTMENT OF NUTRITION AND FOOD SCIENCE
UNIVERSITY OF GHANA

FACTORS ASSOCIATED WITH EXCLUSIVE BREASTFEEDING OF GHANAIAN TWINS

STUDY QUESTIONNAIRE

BACKGROUND INFORMATION

Mother-baby pair ID Number: …………………….
Name of Interviewer: ……………………………………………………
Language of Interviewer: ……………………………..
Date of Interview (DD/MM/YY): ……………………….
Mother-Singleton pair ☐ Mother-Twin pair ☐

MATERNAL INFORMATION

A. Demographics

1. Name: ……………………………………………………………
2. Telephone number: ……………………………………………………………...
3. Where do you stay? ………………………………………………………….
4. Which religion do you belong to? **1** = Christian **2** = Islamic **3** = Traditional
   4 = Others (specify)……………..

5. What is your age in completed years? ……………………….
   MAGE

6. What is your marital status? **1** = Single **2** = Married **3** = Divorced
   4 = Co-habiting **5** = Widowed
7. What is your highest level of education?
   LEDUC
   1 = None **2** = Primary school **3** = Junior secondary/Middle school
   4 = Vocational/Senior Secondary **5** = University/polytechnic
8. a. What is your main occupation? **1** = Farming **2** = Fish monger **3** = Artisan (seamstress, hair dresser) **4** = Trader **5** = Salaried worker
   b. Do you work outside your home? **1** = NO **2** = YES
9. How much on the average is your monthly income?
   1 = GH¢5 - 149 **2** = GH¢150 - 300 **3** =GH¢310- 500 **4** = GH¢510 - 1000
   5 = GH¢1100 - 1500 **6** = ≥ GH¢1,500 **7** = Other (specify)………………

8 = Don't know

10. What type of house do you stay in?**1** = Own house **2** = Rented apartment = Government estate **4** = Other (specify)……………………………
11. How many rooms are available to you in the house? ………………………
12. How many people are in your household? ……………………………..
13. Do you have any of the following items in your home? (Answer **1** = NO or **2** = YES)

ITEM	**YES/NO** **1** = NO **2** = YES	**QUANTITY**
Radio		
Television		
Fridge/Freezer		
Telephone		
Air conditioner/ Fan		
Internet facility		
Computer (Desktop/Laptop)		

14. What is your mode of transport when going out?**1**= Private Car**2** = Motor bike **3** = Public transport **4** = Bicycle

B. Biomedical/Biocultural

1. How many children do you have? ………..
2. Do you have twins? **1** = No **2** = Yes
3. Did you plan to become pregnant? **1** = Planned **2** = Unplanned
4. Did you attend antenatal clinic when you were pregnant? **1** = No **2** = Yes
5. Where? **1** = Hospital/Polyclinic **2** = Private clinic/Maternity home **3** = Traditional birth attendant (TBA)
6. Where did you deliver your child/children-(twins)? **1** = Hospital/Polyclinic **2** = Private clinic/Maternity home **3** = TBA **4** = Other (specify)…………
7. What type of delivery did you have? **1** = Vaginal delivery **2** = Elective caesarean section**3** = Emergency caesarean section

   Q8 & Q9 For women who delivered by caesarean section only
8. Did you receive anesthesia during delivery? **1** = No **2** = Yes
9. What type of anesthesia did you receive **1** = General anesthesia **2** = Local anesthesia (Epidural)

10. How long after birth did you **first** put your baby (or babies) to the breast?
    1 = Within 30 minutes **2** = Within 1 hour **3** = Within a day **4** = After 1 day

11. How long after birth did your milk come in or start flowing?
    1 =Within a day **2** =Within 2 days **3** =Within 3 days **4** =After 4 days

12. In the **past 24 hours** have you given any of these to your child/children?
    1 = NO **2** = YES

	SING	Twin 1	Twin 2
a. Breast milk			
b. Water			
c. Fruit juice			
d. ORS solution			
e. Glucose solution			
f. Porridge (koko)			
g. Formula			
h. Mpotompoto			
i. Ice kenkey (mashed kenkey)			
j. Rice			
k. Yam			

13. In the past**1 month** have you given any of these to your child/children?
    1 = NO **2** = YES

	SING	Twin 1	Twin 2
a. Breast milk			
b. Water			
c. Fruit juice			
d. ORS solution			
e. Glucose solution			
f. Porridge (koko)			
g. Formula			
h. Mpotompoto			
i. Ice kenkey (mashed kenkey)			
j. Rice			
k. Yam			

14. Did you receive support from the following for your current infant feeding?

   a. Spouse **1** = No **2** = Yes
   b. Family **1** = No **2** = Yes
   c. Friends **1** = No **2** = Yes

15. Did you receive any breastfeeding advice from the following anytime during pregnancy and birth? (**1** = No; **2** = Yes)

Time/ Source Of Advice	**Spouse**	**Relatives**	**Friends**	**Health Facility**
Prenatally (before birth)				
Perinatally (just after child birth)				
Postnatally (after birth)				

16. When you were pregnant, did you plan to exclusively breastfeed your child upon delivery until 6 months? **1** = No **2** = Yes
17. a. How many times a day did you breastfeed your child yesterday? ………..
   b. Why?……………………………………………………………………………
   ………………………………………………………………………………………
   ……………………………………………………………………………

C. Maternal Self-Efficacy

1. Do you think that you can produce enough breast milk every day to satisfy your child/children until they are six months old? **1** = No **2** = Yes

2. For each of the following statements, please choose the answer that best describes how confident you are with breastfeeding your new baby. Please mark your answer by circling the number that is closest to how you feel. There is no right or wrong answer.

   1 = not at all confident
   2 = not very confident
   3 = sometimes confident
   4 = confident
   5 = very confident

		Not at all confident				Very Confident
1	I can always determine that my baby (babies) is(are) getting enough milk	1	2	3	4	5
2	I can always successfully cope with EBF like I have with other challenging tasks	1	2	3	4	5
3	I can always EBF my baby (babies) without using formula as a supplement	1	2	3	4	5
4	I can always ensure that my baby(babies) is(are) properly latched on for the whole feeding	1	2	3	4	5
5	I can always manage the EBF situation to my satisfaction	1	2	3	4	5
6	I can always manage to EBF even if my baby (babies) is(are) crying	1	2	3	4	5
7	I can always keep wanting to breastfeed	1	2	3	4	5
8	I can always comfortably EBF with my family members present	1	2	3	4	5
9	I can always be satisfied with my EBF experience	1	2	3	4	5
10	I can always deal with the fact that EBF can be time consuming	1	2	3	4	5
11	I can always finish feeding my baby (babies) on one breast before switching to the other breast	1	2	3	4	5
12	I can always continue to EBF my baby (babies) for every feeding	1	2	3	4	5
13	I can always manage to keep up with my baby's (babies) breastfeeding demands	1	2	3	4	5
14	I can always tell when my baby (babies) has(have) finished breastfeeding	1	2	3	4	5

INFANT INFORMATION

A. Background Data

1. What is (are) the name(s) of your child (or children)?
   Singleton…………………………………………………..
   1st twin ……………………………………………………
   2nd twin ……………………………………………………

2. What is the gender of your child (or children) **1** = Male **2** = Female
   Singleton ☐ 1st twin ☐ 2nd twin ☐

3. What is the date of birth of your child/children (DD/MM/YY) ☐☐☐☐☐☐
4. What is the age of your child/children in completed months? …………
5. What was the age (**in weeks**) of your child/children **at birth**? ……….
6. What is the birth weight (**in kg**) of your child/children?
   Singleton…………… 1st twin ……………. 2nd twin ………….
   BTHWT
7. What is your perception of the suckling ability of your child/children at birth?
   (**1** = Poor**2** = Normal) Singleton ☐ 1st twin ☐ 2nd twin ☐

8. a. Was/Were your child/children admitted into the neonatal intensive care unit
   (NICU) after delivery? **1** = No**2** = Yes **(if No, go to morbidity data)**
   Singleton ☐ 1st twin ☐ 2nd twin ☐

   b. For how long (in weeks) was (were) your child (children) there?
   Singleton ……… wks. 1st twin……… wks. 2nd twin……….wks.

   c. How was (or were) your child (or children) fed in the NICU?
   ……………………………………………………………………………
   ……………………………………………………………………………
   ……………………………………………………………………………
   ………………

   d. What food was fed to your child (or children) while on admission at the NICU?
   ……………………………………………………………………………
   ……………………………………………………………………………

B. Morbidity Data

1. In the **last 24 hours**, has your child/children suffered from any of the following illnesses? **1** = No **2** = Yes **9** = Not applicable (N/A)

   a. Diarrhoea
   - Singleton ☐
   - Twin#1 ☐
   - Twin#2 ☐

   b. Fever
   - Singleton ☐
   - Twin#1 ☐
   - Twin#2 ☐

   c. Cough
   - Singleton ☐
   - Twin#1 ☐
   - Twin#2 ☐

   d. Cold/runny nose
   - Singleton ☐
   - Twin#1 ☐
   - Twin#2 ☐

2. In the **last 2 weeks**, has your child/children suffered from any of the following illnesses? **1** = No**2** = Yes **9** = Not applicable (N/A)

   a. Diarrhoea
   - Singleton ☐
   - Twin#1 ☐
   - Twin#2 ☐

   b. Fever
   - Singleton ☐
   - Twin#1 ☐
   - Twin#2 ☐

   c. Cough
   - Singleton ☐
   - Twin#1 ☐

Twin#2 ☐

d. ***Cold/runny nose***

Singleton ☐

Twin#1 ☐

Twin#2 ☐

APPENDIX III

DEPARTMENT OF NUTRITION AND FOOD SCIENCE
UNIVERSITY OF GHANA

FACTORS ASSOCIATED WITH EXCLUSIVE BREASTFEEDING OF GHANAIAN TWINS

Deuterium oxide (heavy water) dosing data sheet (Mother - Singleton pair)

No.		Mother			Baby		
1.	Date of dosing (Day 0)						
2.	Name						
3.	Mother – baby pair ID						
4.	Date of birth (DD/MM/YY)						
5.	Body weight (kg) **Day0**	1st	2nd	Mean	1st	2nd	Mean
6.	Body weight (kg) **Day14**	1st	2nd	Mean	1st	2nd	Mean
7.	Height/length (cm)	1st	2nd	Mean	1st	2nd	Mean
8.	Date and Time of **baseline**(**Day 0**)saliva sample						
9.	Dose number				Not applicable		
10.	Time of taking dose				Not applicable		
11.	Date and Time: **Day 1** saliva sample						
12.	Date and Time: **Day 2** saliva sample						
13.	Date and Time: **Day 3** saliva sample						
14.	Date and Time: **Day 4** saliva sample						
15.	Date and Time: **Day 13** saliva sample						
16.	Date and Time: **Day 14** saliva sample						

APPENDIX IV

DEPARTMENT OF NUTRITION AND FOOD SCIENCE
UNIVERSITY OF GHANA

FACTORS ASSOCIATED WITH EXCLUSIVE BREASTFEEDING OF GHANAIAN TWINS

Deuterium oxide (heavy water) dosing data sheet (Mother - Twin pair)

No.		Mother			1st twin (A)			2nd twin (B)		
1.	Date of dosing (Day 0)									
2.	Name									
3.	Mother – baby pair ID									
4.	Date of birth (DD/MM/YY)									
5.	Body weight (kg) **Day 0**	1st	2nd	Mean	1st	2nd	Mean	1st	2nd	Mean
6.	Body weight (kg) **Day 14**	1st	2nd	Mean	1st	2nd	Mean	1st	2nd	Mean
7.	Height/length (cm)	1st	2nd	Mean	1st	2nd	Mean	1st	2nd	Mean
8.	Date and Time of **baseline** (**Day 0**) saliva sample									
9.	Dose number				Not applicable			Not applicable		
10.	Time of taking dose				Not applicable			Not applicable		
11.	Date and Time: **Day 1** saliva sample									
12.	Date and Time: **Day 2** saliva sample									
13.	Date and Time: **Day 3** saliva sample									
14.	Date and Time: **Day 4** saliva sample									
15.	Date and Time: **Day 13** saliva sample									
16.	Date and Time: **Day 14** saliva sample									