COMPARISON OF COX PROPORTIONAL HAZARDS AND ACCELERATED FAILURE TIME MODELS IN EVALUATING DISCONTINUATION TIME OF EXCLUSIVE BREASTFEEDING

BY

OYEDELE, OYEWOLE KAZEEM

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CERTIFICATION

We certify that this research project was carried out by Oyedele, Oyewole Kazeem under our supervision for the award of Masters of Science degree (M. Sc) in Medical Statistics at the Department of Epidemiology and Medical Statistics, Faculty of Public Health, College of Medicine, University of Ibadan, Ibadan. Nigeria.

Supervisor

Signed...

Professor Olusola Ayeni

B.SC (Ibadan), M.SC (Medical Statistics) (London), PhD (London)

University of Ibadan, Nigeria.

Co-supervisor

Signed...

Dr Adeniyi Fagbamigbe

B.SC (Ilorin), M.SC (Medical Statistics) (Lancaster), PhD (Ibadan)

University of Ibadan, Nigeria.

Dedication

To my father Mr Adeoye A. Oyedele and my mother Mrs Adeyeye O. Oyedele and everyone that contributed to successful completion of this research project.

Acknowledgement

I give all praise and adoration unto Almighty Allah for helping me through with my postgraduate studies and successful completion of this research project.

My deepest gratitude goes to my supervisor Prof. Olusola Ayeni with whom I was privileged to enjoy the amazing opportunity to work with as a project student. His fatherly contribution in achieving expected standard of this research project is immeasurable.

Also, I extend my gratitude to my co-supervisor Dr Adeniyi Fagbamigbe for his constructive advice on establishing reasonably precise and concise title and as well his support throughout the research project period.

I am grateful to all lecturers of the Department of Epidemiology and Medical Statistics for imparting knowledge and also for their constructive criticism during Proposal Presentation of this research work. I appreciate suggestions and contributions of Dr (Mrs) Bidemi Yusuf and Dr Odunayo Akinyemi. I also appreciate Federal Ministry of Health in conjunction with United States Agency for International Development (USAID) for releasing the National AIDS/HIV and Reproductive Health Survey (NARHS 2012 plus II) data used for this project.

Finally, am grateful to Engr. Olayiwola Adeyeye, Dr Kehinde Akinbode, Mr Adesina Adetunji and my family members for their assistance throughout my postgraduate studies. I acknowledge my colleagues and friends for their invaluable contribution.

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List of Abbreviations

EBF: Exclusive Breastfeeding

WHO: World Health Organization

UNICEF: United Nation Children Education Fund

AAP: American Academy of Paediatrics

BFHI: Baby Friendly Hospital Initiative

FCT: Federal Capital Territory

LGA: Local Government Area

PSU: Primary Sampling Unit

NPC: National Population Census

EA: Enumeration Area

NDHS: Nigeria Demographic Health Survey

NARHS: National AIDS/HIV Reproductive Health Serological Survey

SPSS: Statistical Package for Social Science

STATA: Statistics and Data

CPH: Cox Proportional Hazards

AFT: Accelerated Failure Time

AIC: Akaike Information Criterion

BIC: Bayesian Information Criterion

LRT: Likelihood Ratio Test

DF: Degree of Freedom

ANC: Antenatal Care

SES: Social Economic Status

CI: Confidence Intervals

Abstract

Background: Despite WHO/UNICEF recommendation, EBF practice continues to be challenging to mothers, as only 35% of children were exclusively breastfed worldwide. In Nigeria, only 17% of infant were exclusively breastfed. Studies have utilized Cox Proportional Hazards in modelling breastfeeding data. This study compares this method with Accelerated Failure Time in modelling and evaluating time to discontinuation of EBF in Nigeria.

Objectives: Main objective of this research is to compare CPH and AFT modelling strategies and evaluate the model that better describes and predicts EBF discontinuation time in Nigeria. Specific objectives are to estimate average EBF duration and measure effect of its influential factors on mothers and infant.

Methods: A total of 2,163 eligible mothers whose child not more than 2 years old, were selected from mothers 5 years breastfeeding history (2007 – 2012) of NARHS multistage cluster survey that utilized NPC sampling frame in 2012. EBF discontinuation time was the outcome variable and the eleven explanatory variables were; Mother's age, zone, locality, education, occupation, marital status, SES, ANC visit, place of child delivery, BF initiation status and Postnatal visit. SPSS version 20 and STATA version 12 software packages were used for data analysis. Data were described using frequencies and percentages, EBF pattern was examined using its distribution and survival plots. L.R. test suitability of AFT model. Fitted CPH and AFT models determine predictors of EBF discontinuation time and comparison was made using AIC and confidence bounds around their estimates to determine the model with better precision.

Results: Not less than 113(5.2%) mothers were censored. EBF median duration was 6 months (5.9250 - 6.0250). Almost 81% of mothers discontinue EBF on/before child sixth month of birth. Hazard of discontinuing EBF in rural area was 1.0414 times more than hazard of urban slum. Mothers with at least primary education (Time ratio = 1.0728) have positive influence on survival time. EBF survivorship decreases as discontinuation time increases. CPH and AFT models identified Mother's Locality {p=0.017(0.7242, 0.9689), p=0.003(1.0245, 1.1244)} and place of child delivery {p=0.000(1.0530, 1.1909), p=0.000(0.9266, 0.9666)} respectively as predictors of EBF duration. Distribution of survival time skewed right and Weibull AFT model (p=0.0005<0.001) with smaller AIC and BIC value was more suitable parametric model than the exponential AFT model. Both CPH (p=0.008) and AFT (p=0.000) models adequately fit the data but AFT model has 100% chance of been a better fit than Cox model as its confidence bounds was also narrower. Hence AFT model gives a better precision.

Conclusion: This study concluded that 81% of nursing mothers in Nigeria discontinue EBF on/before child sixth month of birth, average EBF discontinuation time is six months and EBF discontinuation time can be predicted from mothers' locality and place of child delivery. EBF survivorship pattern showed stepwise decrease and follows Weibull model distribution. AFT model estimate gives better precision and therefore fit the data better than CPH model. Thus, Public Health researchers should employ parametric models in analysing censored data.

Keywords: Exclusive breastfeeding, Discontinuation time, Cox Proportional Hazard model, Weibull Accelerated Failure Time model.

Word count: 484

CHAPTER ONE

INTRODUCTION

1.1Background

Breastfeeding (BF) is the practice of feeding an infant or young child with breast milk directly from female human breasts (i.e., via *lactation*) rather than using infant formula. Babies have a sucking reflex that enables them to suck and swallow milk (Nutrition in 1st 1000 days, 2013). Experts recommend breastfeeding initiation within one hour of birth, exclusive breastfeeding for the first six months of life and continue breastfeeding until age of two with age-appropriate, nutritionally adequate and safe complementary foods (Kramer, 2002).

Under modern health care, woman breast milk was considered to be the healthiest form of milk for babies since it promotes health of infant by preventing them from diseases. Breast milk is a complete nutrition that is easy for the baby to digest. Infant therefore suck breast often. Act of breastfeeding is of benefit to both infant and mother; as it requires extra effort on part of the child in moving the jaw. Therefore, strengthen the child's jaw. Also decreases allergies, decreases risk of diabetes, pneumonia and celiac disease in infant. Benefits of BF practices to mothers among others includes; uterine shrinkage, decrease risk of breast cancer, decrease depression, decrease risk of osteoporosis, prolong lactation amenorrhea, quick return of the uterus to its normal size, and prevention of postpartum haemorrhage. Also, BF establishes a bond between mother and baby and can be less expensive than formula feeding.

Derek (2002), states that breast milk is an alkaline fluid, bluish white in colour with a specific gravity and it is an immunizing agent which is actively involved in the prevention of infections. Breast milk composition contains the following nutrient in their respective proportion:

- Protein 1.5%
- Fat 3.5%
- Lactose 7.0%
- Water 87.8%
- Salt 0.2%

Exclusive breastfeeding (EBF) is defined as "an infant's consumption of human milk without supplementation of any type (water, juice, nonhuman milk, or any food) except for vitamins, minerals, and medications (Gartner et al., 2005). National and international guidelines recommend that all infants be breastfed exclusively for the first six months of life. Breastfeeding may continue with the addition of appropriate supplementary foods until age of two years or more. EBF practice will dramatically reduce infant deaths in developing countries by reducing diarrhoea and infectious diseases (W.H.O/UNICEF, 2009). The anti-infection properties in breast milk help to protect infant against diseases. There is also an important relationship, between breastfeeding and child spacing (W.H.O, 1999). EBF practice is not only an unequalled way of providing ideal food for the healthy growth and development of infants but also of benefit to mothers as an integral part of their reproductive process. EBF was identified as a way of spacing birth and planning families, supporting this line of argument was 1998 W.H.O multinational study on breastfeeding and lactation amenorrhea which maintained that; EBF is associated with length of postpartum amenorrhea, thereby delays the return of menses. This is a viable approach to postpartum contraception since it prolongs infertility. Review of evidence on BF has shown that, on a population basis, exclusive breastfeeding for 6 months is the optimal way of feeding infants. Thereafter infants should receive complementary foods with continued breastfeeding up to 2 years of age or beyond (A.A.P, 2005).

Exclusive breastfeeding has numerous nutritional, immunological and psycho-social benefits for the mother as it enhances her relation to her infant, it is inexpensive, and it is intrinsically convenient, therefore, to enable mothers establish and sustain exclusive breastfeeding for the first 6 months. W.H.O and UNICEF recommends the following:

- Initiation of breastfeeding within the first hour of life.
- Exclusive breastfeeding – that is the infant only receives breast milk without any additional food or drink, not even water for the first six month of life.
- Breastfeeding on demand – that is as often as the child wants, day and night.
- No use of bottles, teats or pacifiers.

While breastfeeding is a natural act, it is also a learned behaviour. An extensive body of research (W.H.O, 2010) has demonstrated that mothers and other caregivers require active support for establishing and sustaining appropriate breastfeeding practices. W.H.O and UNICEF launched the Baby-friendly Hospital Initiative (BFHI) in 1992, to strengthen maternity practices in order to support breastfeeding. The foundations for the BFHI are based on steps to Successful Breastfeeding described for Protecting, Promoting and Supporting Breastfeeding.

The Federal Government of Nigeria, through the directorate of Family health, Federal ministry of health during her 2013 World breastfeeding week (WBW) advocated exclusive breastfeeding among nursing mothers with a view to reduce malnutrition and other related heath conditions that lead to infant and young child morbidity and mortality in the country, stressing that; though more than 90% Nigerian mothers have no problem in breastfeeding their young children, yet the exclusive breastfeeding practices is rarely adhered to, pointing out that this is caused by several factors to include socio-cultural beliefs, prejudices, taboos and economy (FMOH, 2013).

1.2 Cox versus Accelerated Failure Time Model

The Cox's proportional hazards and accelerated failure time models are two main methods of modelling survival data. The proportional hazards model developed by Sir David Cox is a popular semi parametric approach in modelling survival data. Cox (1972) observed that if the hazard is nonnegative and it is proportional over time, then it is possible to estimate parameter effect without considering the hazard function. In proportional hazard model, the effect of a unit increase in covariate is multiplicative with respect to hazard rate. For instance, exclusively breastfeeding a child for the first six month may halve the hazard of having diarrhoea. Cox proportional hazards model as a standard survival technique in medical research produces; relative risk (hazard ratio), baseline hazard and estimate survival function (Van Houwelingen, 2000). The model is generally represented as:

$$\lambda(t/x) = \lambda_0 \exp(x\beta)$$

Where; $\lambda(t/x)$ is the hazard of time to occurrence of event (outcome variable)

$\lambda_0(t)$ represents a reference point that depends on time (baseline hazard)

X's are the set of covariates (explanatory variables) and β's are regression coefficients

On the other hand, accelerated failure time model is a parametric model that encompasses a wider range of survival time distributions. Such as; Weibull, Exponential, Log normal, Log logistics, Gamma, Gompertz and generalized inverse Gaussian distribution (Collete., 2003). Accelerated failure time model do not assumes proportional hazard but describe situation where history of an event is accelerated or decelerated as a function of its predictor(s). For instance, dogs are known generally to grow seven times faster than humans. This implies that dogs lifespan accelerate seven times faster than humans. The model is generally represented as:

$$\mathbf{Log(T) = \mu + \beta x}$$

Where; **Log(T)** is the logarithm of the survival time (outcome variable)

μ is the constant (intercept term)

X's are the set of covariates (explanatory variables) and **β's** are regression coefficients

Cox Proportional hazard (semi-parametric) model is widely applied by researchers due to its robustness and simpler applicability compare to the accelerated failure time (parametric) model where assumption surrounding constant time ratio and underlying distribution of survival time stipulates the selection of appropriate model. Hence, this study aims to compare these two models and evaluate the one that explains the breastfeeding data better.

1.3 Statement of the Problem

Worldwide, only 35% of children between birth and their 5th month are breastfed exclusively (W.H.O, 2010). Discontinuation of exclusive breastfeeding is a major setback to proper growth and development of infant in Nigeria and other African countries, as only 17% of infant are exclusively breastfed in the first six month (NDHS, 2013). Thus advocating adherence of exclusive breastfeeding practices by government through the health ministry. There has been documentation (Ukegbu et al., 2011) on determinant of EBF practice in Nigeria, but little or none has been done to examine the effect of those factors on EBF time in Nigeria. Among them are combinations of factors like; mothers literacy, age, antenatal care, socio economy level, and locality (Agunbiade et al., 2012; Agho et al., 2011).

These factors are the barrier and constrains to the practice of EBF, as literacy of mothers and antenatal care visit have been found in earlier studies to be positively associated with practice of EBF (Aidam et al., 2005). Mascarenhas et al., (2006) findings show that low family income and low maternal age are associated with discontinuation of EBF. Though, few studies utilising Cox model has shown that successful early breastfeeding initiation largely depends on maternal related factors such as mother's age at the birth of the child, mother's health and her educational status (Dubois and Girard, 2003; Lande *et al.*, 2003; Scott *et al.*, 2006, Yahya et al., 2013). Also Yeneabat et al., (2014) and Chola et al., (2013) in their different studies respectively using Cox and AFT model approach identified place of residence and delivery as predictors of EBF discontinuation. However, studies on discontinuation time of EBF are scarcely available.

Cox proportional hazard is widely employed to examine effect of covariates on hazard function of a failure time event, since it is a semi parametric approach that accommodate survival time distribution the way it is and with fewer model assumptions (Pourhoseingholi et al., 2010). However, its dependence on proportional hazard and failure to account for the shape underlying the survival time make it less precise as it is only appropriate for relatively few probability distribution leading to monotonic increase or decrease in hazard function compared to Accelerated failure time model which is a less utilized parametric approach (Collete, 2003).

1.4 Rationale of the Study

Breastfeeding from its early initiation to the period of EBF and later addition of supplement all contribute to wellbeing of newborns. Thus, EBF is found to be the most challenging of all the three breastfeeding stages as it involves breastfeeding only "without addition of water or other liquids" for the first six month of life (Oche et al., 2011). However, EBF practice did not only prevent morbidity in infants but also in nursing mothers; EBF practice enhances jaw development, reduces risk of diarrhoea and pneumonia in infants. Also, it reduces risk of postmenopausal breast and ovarian cancer and as well prolongs lactation amenorrhea in mothers. (Chung et al., 2007, W.H.O, 1998). However, mothers who discontinue EBF would miss these benefits.

The World Health Organization multinational studies among seven countries including Nigeria have shown that practice of EBF has a reproductive advantage for mothers (W.H.O, 1999). EBF practice is associated with length of lactation amenorrhea due to the fact that it prolongs return of menses (ovulation) and thereby encourage family planning (child spacing). Hence, lactation amenorrhea is a viable approach to postpartum contraception. This study describes infant feeding pattern among selected subject in Sagarnu, (Nigeria) and was able to detect that early introduction of supplement was associated with return of menses and that users of lactation amenorrhea method will not experience postlochia bleeding before postpartum day 56. Most studies on EBF emphasized on its determinant and influential factors to the discontinuation of EBF (Ajibade et al., 2013; Agunbiade et al., 2012) with little or no attempt at examining discontinuation time of EBF and its predictive pattern among breastfeeding mothers especially in Nigeria.

NDHS reports show that percentage of infant that are exclusively breastfed decreases from 17% in 2003 to 13% in 2008 and increases to 17% in 2013 indicating that nursing mothers in Nigeria are affected by factors militating against the practice of EBF as determined by (Nwosu et al., 2004). Appropriate infant feeding practices are needed if Nigeria is to reach the child survival Millennium Development Goal of reducing infant mortality from the 100 deaths per 1000 live births to the stated target of 35 deaths per 1000 live births by the year 2015. (Agho et al., 2012). Therefore, there is need to study this group of Nigerians, measure the time pattern and use appropriate statistical models to determine factors influencing rate at which EBF is discontinued in order to plan and strategize ways towards improving EBF practice in Nigeria.

Even though Accelerated failure time model does not find wide applicability compared to Cox proportional hazards model which is simpler and more robust (semi-parametric by accommodating any survival time distribution) method applied in estimating covariates effect, but the allowance for specifying wider range of survival time distribution (Weibull, Exponential, Log normal, Log logistics, Gamma, Gompertz and generalized inverse Gaussian distribution) and in circumstances where Cox proportional hazards assumption is not tenable such that models based on hazard family are not fruitful (Collete., 2003), accelerated failure time model which simply regress logarithm of survival time on covariate will tend to give a more precise estimate of such measure of covariate effect as obtained by (Chola et al., 2013). Hence, the need for this study to compare both survival modelling strategies and use appropriate statistical technique to evaluate the model that best explain exclusive breastfeeding pattern in Nigeria.

1.5 Objectives of the Study

General Objectives:

To compare two modelling strategies and evaluate the model that better describes and predicts discontinuation time of exclusive breastfeeding in Nigeria.

Specific objectives are to:

- Estimate average duration of exclusive breastfeeding among nursing mothers.
- Examine influence of individual socio-demographic and health factors on EBF duration.
- Provide a statistical model that best predicts time to discontinuation of EBF practice.
- Compare result of Cox proportional hazards model with Accelerated failure time model.

1.6 Research Questions

- What is the average duration of EBF practice in Nigeria?
- What individual socio-demographic and health factors affect EBF practice in Nigeria?
- How can EBF discontinuation time in Nigeria be modelled?
- Which of the models is better?

1.7 Hypothesis

It was hypothesized that:

- Any difference in duration of EBF practice among Nigerian nursing mothers irrespective of differences in demographic and health characteristics.
- Any difference in effect of individual socio-demographic and health factors on EBF discontinuation rate.
- Discontinuation time of EBF in Nigeria depend on contribution of socio-demography and health characteristics of nursing mothers.
- Accelerated failure time model fits the EBF data better than the Cox proportional hazards model.

CHAPTER TWO

LITERATURE REVIEW

2.1 Breast milk, Breastfeeding and Its Initiation

Breast milk is the natural first food for babies; it provides all the energy and nutrients that the infant needs for the first months of life and it continues to provide up to half or more of a child's nutritional needs during the second half of the first year, and up to one-third during the second year of life. A.A.P. (2005) opined that breast milk is ultimately the best source of nutrition for a new baby, as its component helps to protect babies against infections and diseases. Breast milk has perfect combination of proteins, fats, vitamins, carbohydrates and water. Derek (2002) found that breast milk contains 1.5% protein, 3.5% fat, 7.0% vitamins, while 88% of breast milk contains carbohydrate and water. Proteins in breast milk are easily digested compare to formula or cow's milk and also contain greater proportion of whey that helps guide against infections. Fats in breast milk helps the baby in brain development, both fat soluble vitamins (including vitamins A, D, E and k) and water soluble vitamins (such as; Vitamin c, riboflavin, niacin and panthothenic acid) are all essential for baby development. Carbohydrate decreases amount of unhealthy bacteria in the stomach (Biancuzzo et al., 1999).

American Academy of Paediatrics (A.A.P., 2005) revised its policy on breastfeeding as being a public health issue rather than a life style choice. The policy recommends that babies are solely breastfed for their first six months of life, iron enriched foods can then be introduced into babies diet during the next six months. The innocenti declaration of 1990 that urged all governments to develop national breastfeeding policy and set breastfeeding target enables joint W.H.O/UNICEF adoption of policy that promote breastfeeding culture, which encourage EBF in the first six months of life (Agunbiade et al., 2012). According to Gartner et al. (2005), extensive research using improved epidemiologic methods and modern laboratory techniques documents diverse and compelling advantages for infants, mothers, families, and society from breastfeeding and use of human milk for infant feeding. These advantages includes; health, nutritional, immunological, developmental, psychological, social, economical, and environmental benefits.

Thus, the need for early initiation of breast milk to newly-born children immediately after delivery has been shown in many studies to be capable of giving the children the required immunity to diseases through mother's antibodies and this in turn, lowers the risk of early childhood deaths (Adebayo, 2004; Kramer and Kakuma, 2004; Edmond *et al.*, 2006). This is due to the possibility of ingesting maternal colostrums into the baby few times after parturition. The colostrums is a yellowish liquid mixture that is rich in protein, sugar, vitamins, minerals and antibodies that helps facilitate child survivorship (Yahya et al., 2013). WHO and UNICEF recommend breastfeeding initiation within the first hour of life. This is because the baby sucking reflex is strongest and baby is alert to receive breast milk (Widstrom et al., 1990).

2.2 Exclusive Breastfeeding and Its Importance

W.H.O recommends exclusive breastfeeding for the first six months of life, after which "infants should receive nutritionally adequate and safe complementary foods while breastfeeding continues up to two years of age or beyond. Exclusive breastfeeding for the first 6 months of life improves growth, health and survival status of newborns and it is one of the most natural and best forms of preventive medicine (W.H.O, 2008). EBF plays a pivotal role in determining the optimal health and development of infants, and is associated with a decreased risk for many early-life diseases and conditions, including otitis media, respiratory tract infection, diarrhoea and early childhood obesity (Chung et al, 2007). Due to the fact that exclusive breastfeeding provides infants with superior nutritional contents, thus, it is capable of improving infant immunity and possible reduction in future health care spending (W.H.O, 2001).

Several studies (WHO/UNICEF, 2009) have shown that both mothers and infants benefit from practicing exclusive breastfeeding. According to the American Academy of Paediatrics (A.A.P, 2005), research shows that breastfeeding provides advantages with regard to general health, growth, and development. Infants who are not breastfed are at a significant increased risk for a large number of acute and chronic diseases including lower respiratory infection, ear infections, bacteraemia, bacterial meningitis, botulism, urinary tract infection, and necrotizing enterocolitis. Kramer et al. (2001) and Oche (2011) in their different studies reported that exclusive breastfeeding reduces infant mortality by protecting them from common childhood illnesses like diarrhoea and pneumonia.

Elizabeth et al. (2007) and Hale (2007) in their different studies reveal that breast milk is associated with fewer allergies and less diabetes later in life. Thus, mothers who exclusively breastfed are at a reduced risk of developing postmenopausal breast cancer, experienced timely return of uterus to its pre-pregnancy state, reduced bleeding and increased weight loss in postpartum period. Despite all benefits obtained by mothers and infants, the practice of exclusive breastfeeding is still low globally (Agunbiade et al., 2012). This is due to influential factors affecting the practice of exclusive breastfeeding worldwide (especially Nigeria). Hence, how exclusive is our exclusive breastfeeding?

2.3 How exclusive is Exclusive Breastfeeding in Nigeria?

Though at the innocenti declaration in 1990, W.H.O/UNICEF called for policies that would cultivate a breastfeeding culture by encouraging women to breastfeed their children exclusively for the first 6 months of life and then up to 2 years of age or beyond with supplement (W.H.O, 2008). This lead to establishment of Baby Friendly Hospital Initiative (BFHI) implemented in about 16,000 hospitals in 171 countries (including Nigeria) and it has contributed to improving the establishment of exclusive breastfeeding worldwide. While improved maternity services help to increase the initiation of exclusive breastfeeding, support throughout the health system is required to help mothers sustain exclusive breastfeeding.

However, a recent estimate by the W.H.O showed that worldwide only 35% of children between birth and their 5th month are breastfed exclusively (W.H.O, 2010). Based on the W.H.O Global data on Infant and Young Child Feeding in Nigeria, 22.3% of children were exclusively breastfed for less than 4 months, while 17.2% were exclusively breastfed for less than 6 months, in the year 2003. According to the Nigerian Demographic and Health Survey (NDHS) in 2008 17% of children were exclusively breastfed for less than 4 months, while 13% were exclusively breastfed for less than 6 months. Agunbiade et al. (2012) found that 19% of southwest (Nigeria) nursing mothers practice exclusive breastfeeding. W.H.O multinational studies conducted in Sagamu, Nigeria reveal that nursing mothers introduce milk/milk based supplement early and even semi solid food at about four months.

Whereas, importance of breastfeeding as a determinant of infant nutrition and a preventive way of reducing child mortality and morbidity has long been recognized and documented in the public health literatures. In response to this, the Nigerian government established the Baby-Friendly Hospital Initiative (BFHI) in Benin, Enugu, Maiduguri, Lagos, Jos and Port Harcourt with the aim of providing mothers and their infants a supportive environment for breastfeeding and to promote appropriate breastfeeding practices (Salami et al., 2012), therefore helps to reduce infant morbidity and mortality rates. Despite these efforts, child and infant mortality continue to be major health issues affecting Nigeria. The infant mortality rate for the most recent five-year period (1999-2003) is about 100 deaths per 1,000 live births (F.O.S. Nigeria, 2004) and EBF rates in Nigeria continue to fall well below the W.H.O/UNICEF recommendation of 90% EBF in children less than 6 months in developing countries (W.H.O/UNICEF., 2009).

Judging by NDHS 2008 and 2013 reports, all these figures are far below the 90% level recommended by the W.H.O/UNICEF. Child mortality remains high in low and middle-income countries. Nigeria has the highest under-five rural mortality rate of 242.7 per 1,000 among selected sub-Saharan African countries (Anyamele et al., 2009). Successful breastfeeding is crucial to the curbing of infant malnutrition and achieving the millennium development goals four (reducing child mortality) and five (improving maternal health). (M.D.G, Nigeria report, 2001). With all these available evidence, achieving both goals are still far from reach.

2.4 Gynaecology Advantage of Exclusive Breastfeeding

Breastfeeding may delay the return to fertility for some women by suppressing ovulation. A breastfeeding woman may not ovulate, or have regular periods, during the entire lactation period. The period in which ovulation is absent differ for each and every woman. This lactation amenorrhea has been used as an imperfect form of natural contraception, with greater than 98% effectiveness during the first six months after birth if specific nursing behaviours are followed (Prince and Robinson, 2004). Dada et al. (1998) report that introduction of semi-solid food at about four month by Nigerian nursing mothers is associated with return of menses which account for four month median duration of abstinence. The study also reveal that Sagamu nursing mothers remain amenorrheaic for seven months despite the introduction of supplement and no woman get pregnant until her child was weaned. Elizabeth et al. (2011) and Kramer et al. (2001) in their separate studies opined that breastfeeding mothers are at a reduced risk for developing postmenopausal breast cancer, have higher bone density after menopause, experience a more timely and efficient return of the uterus to its pre-pregnancy state, experience reduced bleeding and increased weight loss in the postpartum period, increased length of time between pregnancies, a decreased risk of ovarian cancer, and a decreased risk of postmenopausal hip fractures.

Several studies have corroborated the claim that; length of exclusive breastfeeding of infant is associated with postpartum amenorrhea as a viable method of postpartum contraception, which is a natural way of regulating fertility and child spacing (Family Planning). Amongst them are the WHO multinational studies on breastfeeding and lactation amenorrhea conducted in seven countries of diverse culture, including Nigeria (Sagamu) reported that; breastfeeding behaviour vary across settings indicating that breastfeeding promotion and family planning advice should be site and culture specific (WHO I, 1998) . Also, breastfeeding practice is strongly linked with duration of postpartum amenorrhea (WHO II, 1998). Relative to infant feeding status, the study confirm the use of lactation amenorrhea for family planning since it is a viable approach to postpartum contraception (WHO III, 1999) and that most users of lactation amenorrhea method will not experience postlochia bleeding before postpartum day 56 (WHO IV, 1999).

2.5 Factors Influencing Exclusive Breastfeeding Discontinuation

Discontinuation of EBF in Nigeria tends to be a major challenge to the growth and development of newborn in the society. Agunbiade et al. (2003) concluded that, Breastfeeding mothers are faced with multiple challenges as they strive to practice exclusive breastfeeding. Thus, scaling up of exclusive breastfeeding among mothers requires concerted efforts at the macro, meso and micro levels of the Nigerian society. Brodribb et al. (2007) opined that health, socio-cultural, environmental, and personal factors are influential in a woman's decision to breastfeed. Also, WHO multinational study on breast feeding reported that breastfeeding promotion should be culture specific indicating the effect of socio-cultural differences. Berhe et al. (2013) affirm that several ranges of factors, among which are place and mode of delivery and antenatal visit are determinant of timely initiation and practice of exclusive breastfeeding in Northern Ethiopia.

Studies have identified several factors associated with practice of exclusive breastfeeding in Nigeria. Onayade et al. (2004) and Ukegbu et al. (2011) in their urban-based study identified those factors to include; mothers' level of education, family size, occupation and age. According to Nwosu et al. (2004), the identified factors that significantly influence the practice of EBF including nursing mothers' age, marital status, occupation, family income, maternal education and parity, in which the age of nursing mothers is a factor that significantly influences the practice of exclusive breast feeding. Lawoyin et al. (2001) also supported this assertion. Ajibade et al. (2013) identified cultural factors to be associated with the discontinuation of exclusive breastfeeding in rural communities of Osun (Nigeria). Adetugbo et al. (1996) and Elizabeth et al. (2011) in their separate studies highlighted maternal education, support system and intent as recurring factors influencing early breastfeeding cessation. Also, Agho et al. (2011) reported association between antenatal care and rate of exclusive breastfeeding in Nigeria stating that mothers who attend four or more antenatal visit are likely to practice exclusive breastfeeding.

Breastfeeding practices, including initiation and duration, are influenced by factors which include health, psychosocial, cultural, political, and economic factors. Among these factors, decisions regarding initiation and duration of breastfeeding in low-income countries are influenced by education, employment, place of delivery, family pressure, and cultural values (WHO; 2008). Tampah-Nah and Kumi-kyereme (2013) study in Ghana identified region and place of delivery as determinant of EBF. In Nigeria, while breastfeeding initiation is on the increase, the duration, and practice of exclusive breastfeeding among women who had their delivery in a health facility, and outside such facility, has remained low (NDHS, 2008).

2.6 Predicting Infant Feeding Pattern from Cox and AFT models

Based on the information gathered from the Nigerian Demographic and Health Surveys (NDHS) for 1990, 1999, 2003 and 2008, early breastfeeding initiation improves overtime though following a sinusoidal pattern (Yahya et al., 2013). Agho et al. (2011) reported that 22% of neonatal deaths could be prevented if all infant were put to breast within first hour of birth due to the fact that suboptimum breastfeeding especially non exclusive breastfeeding in the first six months of life, result in 1.4 million deaths and 10% disease burden among under 5 children in both middle and low income countries (Black et al., 2008). Even though, 90% of Nigerian nursing mother have no problem breastfeeding yet the timely initiation and practice of exclusive

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Studies have described infant feeding pattern in Nigeria, standing out among them is the W.H.O multinational study on breastfeeding and lactation amenorrhea conducted in Sagamu, Nigeria. In its description of infant feeding pattern reported that most mothers introduce milk/milk based supplement as early as first month and later semi-solid supplement in the fourth month, accounting for approximate four month median duration of exclusive breastfeeding (Dada et al., 1998). Agunbiade et al. (2012) in their own study reported that only 19% among 200 nursing mothers recruited practice exclusive breastfeeding. Oche et al. (2011) study that recruited 179 nursing mothers reported that 31% had adequate knowledge of exclusive breastfeeding with 53% of them initiating it early while only 31% of them practice exclusive breastfeeding. Adetugbo et al. (1996) studies between two groups in Ile-Ife found that breastfeeding was delayed within 6 hours of delivery and average duration of breastfeeding was nearly four month. Umar et al. (2013) opined that; 32 out of 143 mothers in their study commenced weaning before 4 months and only 32% of them practiced exclusive breastfeeding. Yeneabat et al. (2014) cross-sectional study in North West Ethiopia reported median duration of EBF in rural and urban are 5 months and 6 months respectively. Also, they considered the Cox proportional hazard model and found that place of resident and mode of delivery predicts cessation of EBF. Chola et al. (2013) study on infant feeding survival in Uganda opined that; residence, place of delivery and infant feeding advice are predictors of EBF duration. Also, parametric models (Weibull and exponential AFT) fitted the data better than Cox model. National sample from Canada also reveal that 90.3% of women initiated breastfeeding and 51.7% were exclusively breastfeeding at 3 months, while only 14.7% were breastfeeding at 6 months. Robert et al. (2014) reported 3 months median duration of EBF and a backward selection Cox model found that maternal age, partner interest and occupation did not predict EBF discontinuation.

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CHAPTER THREE

METHODOLOGY

3.1 Study Design and Area

This study utilized secondary data of breastfeeding history from the 2012 National HIV/AIDS and Reproductive Health Survey (NARHS). The design was retrospective cross-sectional population based study covering sampled households of men and women in their reproductive ages in all the 36 states and the Federal Capital Territory (FCT) of Nigeria. Nigeria been the most populated country in Africa is located in West Africa region is lying between longitudes $2^0 40'$ and $14^0 41'$ east and latitudes $4^0 16'$ and $13^0 53'$ north. It is bordered by Niger in the north, Chad in the northeast, Cameroon in the east and Benin in the west. Administratively and politically, Nigeria is made up of 36 states and Federal Capital Territory (FCT) grouped into six geo political zones, divided into local government areas and subdivided into localities (urban and rural). The average population density of the country as at last population census coverage was estimated as 150 people per square kilometre.

3.2 Description of NARHS Data 2012

The 2012 National HIV/AIDS and Reproductive Health Survey (NARHS Plus II) was a nationally representative survey carried out to provide information on key HIV & AIDS and reproductive health knowledge and behavioural related issues. The survey included a second wave of the biological marker component (HIV testing) and was called NARHS plus II. The major objective of NARHS Plus is to obtain accurate HIV prevalence estimates and information on behavioural and other risk factors related to HIV infection at the national, zonal and to some extent the state level. In addition, it aims to provide information on the situation of reproductive and sexual health and its determinants in Nigeria, and to provide data for the assessment of the impact of on-going Family Planning and HIV/ AIDS behavioural change interventions, as well as to yield insights into existing gaps for its effectiveness. The survey pre-test was done in Kogi-state.

3.3 Sample Size and Technique

A probability sampling type; specifically, multistage cluster sampling method was used to select eligible individuals with known probability. A national representative sample, consisting males and females in their respective reproductive ages, dwelling in household, of rural and urban settlement of Nigeria was drawn from the updated master sampling frame of rural, urban and enumeration areas developed and maintained by the National Population Commission (NPC). Administratively, Nigeria was divided into states, each state subdivided into Local Government Areas (LGAs). In recent update, NPC ensures LGAs are conveniently subdivided into Enumeration Areas (EAs) which form the basis for defining the Primary Sampling Units (PSU) called cluster into stages:

Stage 1; involved the selection of rural and urban localities.

Stage 2; involved the selection of Enumeration Areas (EA) within the selected rural and urban localities.

Stage 3; involved the listing and selection of households.

Stage 4; involved selection of individual respondents for interview and testing.

Overall, 35,520 households and 35,520 individual respondents were selected for final interview of which 32,190 households (91%) and 31,235 individuals (88%) were successfully interviewed; resulting in a 3% non-response rate.

3.4 Study Target/Population

This study targets all breastfeeding mothers and children in Nigeria. Populations of study gathered by National HIV/AIDS and Reproductive Health and Serological Survey (NARHS plus) in 2012 are the multistage sampling of breastfeeding mothers and their under two children pair with some common characteristics of interest in all the 36 states and FCT of Nigeria. From the15,639 sample of women between ages of 15 – 49 years that was interviewed, 2163 mothers were nursing child that were under two years of age, which are the population been studied in order to minimize recall (responder) bias and as well was the sample used for the study analysis.

3.5 Data Collection Procedures/Variables

Data collection took place between September and December 2012 from a total of 32,543 Households (Rural = 22,192 & Urban = 10,351). The 31,235 individual respondents interviewed in NARHS plus II consist of 15,596 males and 15,639 females, showing a response rate of 88%. The mean age of female respondents was 29.2 (SD = 9.5) years, lower than that of male which was 34.0 (SD = 4.0) years. Data collection commence based on the final stage of sampling, which is to select individual respondent for interview and testing and thus, this selection was done by canvassing from household to household with personal interactive interviewer using administering, structured and semi structured questionnaires – one each for individual and household. The survey captured several variables, among which for the purpose of this study are socio-demographic and health characteristics.

3.5.1 Outcome variable

The outcome variable in this study is time to introduction of supplement identified through combination of questions that identified onset (initiation), duration and discontinuation time of exclusive breastfeeding. Only mothers whose last child is under 2 years among birth from 5 years preceding the survey are included in the study. Those questions are:

Q214 How long ago did you give birth?

Q222 How long after birth did you first put child to breast?

Q228 For how many months did you breastfeed?

Q232 At what age did you first introduce liquids, or foods apart from breast milk?

3.5.2 Explanatory Variables

Eleven variables were identified to predict time at which mothers introduce supplement apart from breast milk. These variables are of socio demographic and health characteristics. The variable name and category as well as coding of those variables are shown in the table below:

Table 1: Predicting Variables and Their Categorical Coding

Socio-demographic Variables	Coding	Health Variables	Coding
X_1;Age in years	15 – 19 = 0 20 – 29 = 1 30 – 39 = 2 40 – 49 = 3	X_7;SES	Poorest = 0 Poorer = 1 Average = 2 Richer = 3 Richest = 4
X_2;Geo political zone	North Central = 0 North East = 1 North West = 2 South East = 3 South South = 4 South West = 5	X_8;Numberof ANC	Less than 4 = 0 4 or more = 1
X_3;Locality	Rural = 0 Urban = 1	X_9;Plc of Delivery	Home = 0 Private centres = 1 Government Hospitals = Other Private/Public = 3 Faith based = 4
X_4;Educational Status	No formal Education = 0 Primary = 1 Secondary = 2 Tertiary = 3	X_{10};BF Initiation	Immediately = 0 Hours later = 1 Days after = 2
X_5;Occupational Status	Unemployed = 0 Self employed = 1 Tertiary = 2	X_{11};Postnatal Visit	No = 0 Yes = 1
X_6;Marital Status	Never Married = 0 Married= 1 Divorce/Separated/Widow = 2		

3.6 Data Management and Analysis

Data was entered and analyzed using SPSS version 20.0 and STATA version 12. Data editing and cleaning was done in order to exclude missing data and as well maintain sample size for all study variables. Descriptive statistics reporting; frequency and percentage were used to summarize socio-demographic and health variables presented in tables. Using Kaplan- Meier method, Median discontinuation time of EBF (survival curve) was obtained from the 50^{th} percentile (the point at which survivorship is 0.5) before plotting the respective hazard curve.

Cox proportional hazards model was used to assess the association between each explanatory variable and time of EBF discontinuation. The analysis was considered to show significant association when the p-value is less than α level of significance (set as 0.05 in this study). Multivariate analysis was carried out using Cox proportional hazards and Accelerated failure time model to determine predictors of exclusive breastfeeding discontinuation among the set of explanatory variables using generally recommended regression model selection approach. Also, the risk/hazard ratio was obtained by taking the exponent of the regression coefficient, while the accelerated/time factor which is the inverse of risk/hazard ratio was also obtained. Hence, the models were compared to determine the better model using Akaike information criterion that incorporate -2logL, AIC value, Akaike deviance and Akaike weight to measure strength of evidence in choosing the better model.

3.7 Analysis of Time to EBF Discontinuation

Time to EBF discontinuation (event of interest) is the time period between the time of breastfeeding initiation (Origin) and time at which supplement was introduced. Outcome indicators are: Event indicator (0/1); indicating the event is censored if the child was still under EBF else the event will be considered as observed indicating that EBF has been discontinued. For the censored events, the time to EBF discontinuation is computed as the time period between the time of breastfeeding initiation at birth and time of introduction of supplement. The censoring indicators for the two situations can be expressed as; $d_i \begin{cases} =1 \text{ if the event was observed} \\ =0 \text{ if the event was censored} \end{cases}$

Censoring refers to the situation where the individual can no longer be followed up and event of interest has not occurred during the observed follow-up period. Censoring which could be right, left and interval may occur in this study if mother did not practice exclusive breastfeeding.

Follow-up time is the time at which subjects are studied whether they introduce supplement 'time at risk', which may differ between individuals. There is need to account for these differences using survival analysis approach.

The survivor function, $S(t)$, gives the probability of surviving beyond time t. $S(t)$ is a non increasing function with a value 1 at the time origin and a value 0 as t approaches infinity.

$$S(t) = P(T > t) = \int_t^{\infty} f(u)\,du = 1 - F(t)$$

The hazard function, $\lambda(t)$, is the instantaneous failure rate at time t, conditional on survival up to time t.

$$\lambda(t) = \frac{P(t \le T < t + \partial t)}{P(T \ge t)} = \frac{f(t)}{S(t)}$$

3.8 Kaplan Meier versus Life Table Approach to Survival Time

Kaplan Meier method of estimating S(t) is known as the product-limit method but loosely called the Kaplan-Meier method. This method was named after the two researchers who first published the method in English in 1958. In essence, the Kaplan-Meier method is the life table method where the interval size is decreased towards zero so that the number of intervals tends to infinity. Each life table interval is of infinitesimal length; just enough for one event or time increment survival time is measured on a discrete scale (e.g. minutes, hours, days, months, or years) so the interval length is limited by the accuracy to which survival time is measured. The Kaplan-Meier method was developed for applications where survival time is measured on a continuous scale only those intervals containing an event contribute to the estimate, so we can ignore all other intervals. Thus, this approach was used in this study. Kaplan-Meier estimate of S(t) is given as:

$$s(t) = \prod_{j=1}^{k} \frac{(n_j - d_j)}{n_j}$$

Where; n_j is the number of subjects to be observed at time t_j and

d_j is the number of subjects observing event of interest at time t_j.

Life table method for estimating $S(t)$ is also known as the actuarial method. The approach is to divide the period of observation into a series of time intervals and estimate the conditional (interval-specific) survival proportion for each interval. The cumulative survivor function, $S(t)$, at the end of a specified interval is then given by the product of the interval-specific survival proportions for all intervals up to and including the specified interval. In the absence of censoring, the interval-specific survival proportion is $p = (m - d)/m$, where d is the number of events observed during the interval and m is the number of patients alive at the start of the interval. In the presence of censoring, it is assumed that censoring occurs uniformly throughout the interval such that each individual with a censored survival time is at risk for, on average, half of the interval. This assumption is known as the actuarial assumption. This requires the assumption that censoring is *non-informative*. That is, we make the assumption that, conditional on the values of any explanatory variables, censoring is unrelated to prognosis (the probable course and outcome of the disease). Thus, Life table estimate of survivor function is:

$$s(t) = \prod_{j=1}^{k} \frac{(m_j - d_j)}{m_j}$$

Where; m_j is the number of subjects to be observed at time t_j and

d_j is the number of subjects observing event of interest at time t_j.

3.9 Fitting Cox Proportional Hazard (CPH) Model

The Cox proportional hazards model was named after its inventor Sir David Cox after his seminar in 1972. This model does not make any assumption about the shape of the underlying hazards, but makes the assumption that the hazards for subject subgroups are proportional over follow-up time. We are usually more interested in studying how survival varies as a function of explanatory variables (the relative rates) rather than the shape of the underlying hazard function (the absolute rate). In addition, the quantitative impact of these predictors on important lifetime variables of interest (such as median survival) can be described. The Cox model for this study with eleven (11) explanatory variables is express as:

$$\lambda(t|X) = \lambda_0(t)\exp(X_1\beta_1 + X_2\beta_2 + \cdots + X_{11}\beta_{11})$$

Where; $\lambda(t|X)$ is the hazard of discontinue EBF at time t

$\lambda_0(t)$ represents a reference point that depends on time which is the baseline hazard

β's are the regression coefficients and

$X_{i,\ i=1,2,\dots,11}$ are the set of Predictors (explanatory variables).

These explanatory variables are as follows:

X_1=Age, X_2=Zone, X_3=Locality, X_4=Education Status, X_5=Occupation Status, X_6=Marital Status, X_7=Wealth index, X_8=number of ANC Visit, X_9=Place of delivery, X_{10}=BF Initiation, X_{11}=Postnatal care visit.

It is not important that an individual having all values of the explanatory variables equal to zero be realistic rather, $\lambda_0(t)$ represents a reference point that depends on time which is the baseline hazard, just as β_0 denotes an arbitrary reference point in other types of regression models. Hence, the risk ratio is estimated as:

$$\lambda(t|X) = \exp(\beta_1 + \beta_2 + \cdots + \beta_{11})$$

The sign of the coefficient indicates how a covariate affects the hazard rate. Thus, a positive coefficient increases the hazard rate indicating a worse prognostic factor for predictors in higher category. Also a negative coefficient decreases the hazard rate indicating better prognostic effect among higher group of predictors. The statistical significance of the regression coefficient indicates whether there is need for the corresponding covariate in the presence of others.

The hazard ratio can be interpreted in the following three forms;

- Hazard Ratio > 1 indicate exposure harmful to survival
- Hazard Ratio < 1 indicate exposure benefits survival
- Hazard Ratio = 1 indicate no effect from exposure

Cox Proportional Hazard Model is based on the following assumptions:

- The hazard function should be non-negative for all t > 0.
- The model assumes that the ratio of the hazard functions for any K^{th} subject subgroups (groups with different values of the explanatory variable) is constant over follow-up time.
- The Cox model assumes proportional hazards.

3.10 Fitting Accelerated Failure Time (AFT) Model

AFT Models is an alternative model to the widely used Cox model. It describes stretching out or contraction of survival time as a function of predictor variables. It is a parametric model that assumes; survival time follows a particular distribution and ratio of time-factor is constant (Υ) for all fixed values of survival function. Also, it is a log linear model that incorporates wider range of distributions and known for intuitive physical interpretation. Below are properties of common survival time distributions in Accelerated failure time model:

Table 2: AFT Model Distributions and Properties

Distribution of T	Distribution of Error term	Hazard Shape	Possible Model	Constant term in the model
Exponential	Extreme value (1parameter)	Constant	PH and AFT	1
Weibull	Extreme value (2parameter)	Monotone	PH and AFT	2
Gompertz	Log gompertz	Monotone	PH only	2
Lognormal	Normal	Variable	AFT only	2
Loglogistic	Logistic	Variable	AFT only	2
Generalize gamma	Log gamma (3parameter)	Variable	AFT only	3

The goal of accelerated failure time model is to estimate parameter of a known survival time distribution. For this study with 11 predictors, the model is expressed on the log scale as:

$$\text{Log}(T) = \alpha_0 + \alpha_1 X_1 + \alpha_2 X_2 + \text{---} + \alpha_{11} X_{11} + \sigma\varepsilon$$

Where; **Log (T)** is the logarithm of outcome variable (time to supplement introduction)

α_0 is the intercept term

α's are the regression coefficients and

σ is the error scale parameter

X_i, $i = 1, 2, \ldots, 11$ are the set of Predictors (explanatory variables).

These explanatory variables are as follows:

X_1=Age, X_2=Zone, X_3=Locality, X_4=Education Status, X_5=Occupation Status, X_6=Marital Status, X_7=Wealth index, X_8=number of ANC Visit, X_9=Place of delivery, X_{10}=BF Initiation, X_{11}=Postnatal care visit are the explanatory variables and

ε is independently and identically distributed random error term.

The acceleration factor denoted as ϒ, like the hazard ratio also evaluates the effect of predictors on the survival time and can be estimated as:

$$\Upsilon = \exp(\alpha_1 + \alpha_2 + - - - + \alpha_{11})$$

The sign of the coefficient indicates how a covariate affects the log of survival times. Thus, a positive coefficient increases the log of survival time indicating worse prognostic effect in higher group of predictors and a negative coefficient decreases the log of survival time indicating better prognosis for subject in higher group. The statistical significance of the coefficient indicates whether there is need for the corresponding predictor in the presence of others in the model.

The accelerated factor can be interpreted in three forms;

- Accelerated factor > 1 indicate exposure benefits survival
- Accelerated factor < 1 indicate exposure harmful to survival
- Accelerated factor =1 indicate no effect from exposure

Accelerated failure Time Model is based on the following assumptions:

- Distribution of survival time is known
- Ratio of time-factor is constant (Υ) for all fixed values of survival function
- Error term is assume to be distributed in relation to survival time

3.11 Likelihood Ratio Test of Appropriate AFT model

When there are two or more competing AFT models, Likelihood ratio test that incorporate log likelihood and chi-square value with p+1 degree of freedom (where P is the number of parameter) is used to discriminate between them. The appropriate model tends to be significant at $p<\alpha$ (set as 0.05). This is carried out by fitting the two or more model separately and then compute -2logL statistics and compared with percentage point of chi- square distribution of known degree of freedom. The suitable model will have the smallest -2logL statistics and highest chi-square value. The statistic is obtained as:

$$\mathbf{D = -2\log [L_1 / L_2]}$$

Where; **D** is the difference with an asymptotic chi-square distribution of q degree of freedom

L_1 and L_2 are the maximized likelihood for the comparing models.

D test the hypothesis as; H_0: β_{p+1} , ---- ,β_{p+q} = 0 against

$$\mathbf{H_1: \beta_{p+1}, ---- ,\beta_{p+q} \neq 0}$$

A large D implies rejection of null hypothesis (test is significant) and therefore lead to the conclusion that model 2 with additional q variate to model 1 improved the model adequacy. Also estimate of AIC and BIC supports this assertion.

3.12 Merit and Demerit of CPH and AFT Models

Cox proportional hazards model is a robust semi-parametric modelling approach (allow us to fit the survival data the way it is), it is simple to apply and not based on stringent assumptions compared to Accelerated failure time model that is statistically rigorous to apply and also the distribution of survival time stipulate the choice of appropriate parametric model to be fit. However, estimate of Accelerated failure time model is of better precision as it's characterize with a narrower confidence bounds compared to Cox proportional hazards model.

3.13 Variable Selection Strategy

According to Collete, (2003) automatic variable selection procedures (forward, backward and stepwise) fail in selecting the optimal variables, do not consider hierarchical principle and strictly depend on stopping rule to determine variable inclusion and exclusion. This study therefore, utilizes the generally recommended model strategy in indentifying set of significant explanatory variables that have the potential of being included in the model. The Procedures to this general model strategy are as follows:

Step 1: Fitting the null model and the model that contain each of the variables one at a time, then compare the value of -2LogL with that of the null model to determine set of variables that significantly reduce the value of -2LogL statistic.

Step 2: Variables that appear important in step1 are then fitted together. Some variables may cease to be important in presence of others. Consequently variables that do not significantly increase -2logL when omitted are then discarded.

Step 3: Unimportant variables not considered in step 2 may become important in the presence of others. These variables are then added one at a time and any that reduce -2logL significantly are retained in the model. A final check is done to ensure variable included significantly decrease value of -2logL and variables excluded significantly increase value of -2logL.

Table 3: General Method of Variable Selection

Variables	-2logL	P-value
Age		
Zone		
Locality		
Education		
Occupation		
Marital		
Wealth		
ANC num		
Delivery Plc		
BF Initiation		
Postnatal		

Using this method in selecting appropriate variable involves conducting likelihood ratio test to measure and check model adequacy. To guide against rigid application of a particular significant level in deciding whether to include or exclude a variable term, this study utilized 10% recommended level of significance.

3.14 Assessment of Model Adequacy

This study uses chi-square goodness of fit test in assessing degree of fitness of both Cox proportional hazard and Accelerated failure time model. This test was adopted in order to examine the adequacy of relationship between discontinuation time of EBF and categorical explanatory variables included in each model. The hypothesis is set as:

$H_0 : \beta_j (j = 1, 2, ---, 11) = 0$ vs $H_1 : \beta_j (j = 1, 2, ---, 11) \neq 0$ in the presence of other terms.

The test statistic $t = \beta / S.e(\beta)$, $t^2 \sim \chi^2_1$ d.f (wald test). The rejection of null hypothesis for any

β_j $(j = 1,2,---,11)$ will lead to significant need of its corresponding predictor in the presence of others.

3.15 Comparing Fitted Models Using AIC

This study utilized Alkaike Information Criterion (AIC) "developed by Hirotugu Akaike (1973) where he used information theory to build numerical equivalent of occam's razor (fewer model parameter is preferred) establishing relationship between Kullback-Leibler information divergence and Maximum likelihood. Akaike goal is to minimize information loss between observed data (real world) and model distribution, which is achieved by minimizing Kullback-Leibler information distance. This discrepancy (Δ_k) reflects average separation between generating and fitted model, AIC is therefore an asymptotic unbiased estimator of Δ_k. Cox Proportional hazard and Accelerated failure time model are compared to determine the model that fits the data better by minimizing information loss. AIC is valid for comparing non nested models, and can be express as:

$$\mathbf{AIC = 2k\text{-}2LogL}$$

Where; k is the number of parameter and

L is the maximum likelihood value.

The 2k part of the formula is effectively a penalty for including extra predictors in the model while -2logL part is a reward for the fitted model and the data. Though, smaller value of AIC indicate best model. However, quantifying substantial difference in criterion values lead to scale up by Burnham and Anderson (2002):

Table 4: Burnham and Anderson Akaike Deviance Scale

Akaike Deviance Scale	Empirical Support
0.0 – 2.9	Substantial Evidence
3.0 – 9.9	Considerable less Support
>10.0	Very Unlikely

Akaike deviance (Δ) and Akaike weight (W) measures strength of evidence in choosing the best model:

- **Akaike deviance = $\Delta_i = AIC_i - AIC_{min}$**
- **Akaike weight = $W_i = \frac{\exp(-\frac{\Delta}{2})}{\sum_{i=1}^{R}\exp(-\frac{\Delta}{2})}$**

Table 5: Akaike Information Approach to Model Comparison

Model Type	No of parameter(K)	-2logL	AIC	Akaike deviance	Akaike Weight
CPH model					
AFT model					

3.16 Comparison of Precision from CPH and AFT Models Estimate

When either Cox proportional hazards model or accelerated failure time model are fitted, estimates of β's obtained are accompanied with their respective standard errors. This standard error is used as a linear combination with tabulated value in constructing confidence bounds around β estimate. The hypothesis is set as; $H_0 : \beta = 0$ vs $H_1 : \beta \neq 0$ and the test statistic $t = \beta / s.e(\beta) \sim N(0, 1)$ or $t^2 \sim \chi^2_1$ **d.f (wald test)**. The rejection of the null hypothesis implies that **β** is non negative and the test is significant. This means that the confidence interval does not include zero.

$100(1-\alpha)\%$ C.I $= \beta \pm Z_{\alpha/2}$ s.e. (β). If the sample size is large or

$= \beta \pm t_{n1-1;\alpha/2}$ s.e (β). If the sample size is not large.

Thus, the C.I bounds with the narrower interval between CPH and AFT models parameter estimate will give a better precision.

CHAPTER FOUR

RESULTS

4.1 Descriptive Analysis of Predictors

From NARHS 2012 total record of 31,235 respondents; the female respondents used for this analysis were 15,630 (50%). Description of predicting variables are based on demographic and health characteristics of respondents. A total of 2,163 mothers whose child were under 2 and at least initiated exclusive breastfeeding were selected for this study.

4.1.1 Demographic and Socio-economic Characteristics of Respondents

Table 6 below shows distribution of respondents based on their demographic and Socio-economic characteristics. 18% of respondents are in the lowest age category (15 - 19), 34.4% are in their 20's while 27% and 20% are in age range 30-39 and 40-49 respectively. Highest population of respondent was found in the north west (6152) (19.7%) which is 0.5% in proportion more than north central (19.2%) while the lowest was in south east (13%).Proportion of respondents in south west (15.9%) is 0.1% more than South South (15.8%) and north east respondents account for 15.6% of the total record.68.7% of respondents are from urban locality while 31.3% are from rural locality. Most (39%) of respondent have secondary education while few (12.3%) have tertiary education.16.9% have primary education and 31.8% are with no formal education. 44.6% are unemployed, 48.4% are self-employed and 7.1% of respondent are employed. 31.6% of respondent are not married, 64.4% are married while 4% are either divorced/separated or widowed. Highest proportion (22.4%) of respondents are in the poorest social economic class while 17% are in richest class, 20.4% of respondent are average Nigerians.

Table6: Demographic and Social-economic Distribution of Respondents

Age groups	Frequency	Percentage
15 – 19	5243	18.3
20 – 29	9848	34.4
30 – 39	7793	27.2
40 – 49	5720	20.0
Total	28604	100.0
Zone		
North Central	6008	19.2
North East	4875	15.6
North West	6152	19.7
South East	4282	13.7
South South	4939	15.8
South West	4979	15.9
Total	31235	100.0
Locality		
Rural	21448	31.3
Urban	9787	68.7
Total	31235	100.0

Table6 Cont'd: Demographic and Social-economic Distribution of Respondents

Education	Frequency	Percentage
No formal education	9914	31.8
Primary education	5264	16.9
Secondary education	12172	39.0
Tertiary education	3835	12.3
Total	31185	100.0
Occupational Status		
Unemployed	13899	44.6
Self employed	15078	48.4
Employed	2198	7.1
Total	31175	100.0
Marital Status		
Never Married	9792	31.6
Married	19943	64.4
Divorce/Separated/Widow	1245	4.0
Total	30980	100.0

Table6 Cont'd: Demographic and Social-economic Distribution of Respondents

Social Economics Status	Frequency	Percentage
Poorest	6973	22.4
Poorer	6646	21.3
Average	6371	20.4
Wealthier	5898	18.9
Wealthiest	5287	17.0
Total	31175	100.0

4.1.2 Distribution of Respondents by Health Seeking Behaviour and BF Initiation Status

Table 7 below shows distribution of respondents by their health seeking behaviour and breastfeeding initiation status 62.3% of mothers attend antenatal care among which 605(21.2%) visit was less than four times and 2251(78.8%) of that antenatal visit was more than 4 while 37.7% did not attend antenatal. 1153(30%) of mothers delivered at home, 218(5.7%) of delivery was faith based, (699)18.2% of mothers give birth at private centre and (1165)43.3% of mother's delivery was in government hospital. (2315)37.7% of mothers attend postnatal care while 3820(62.3%) did not attend. 2227(39.2%) of mothers initiate breastfeeding early while 2472(43.5%) and 982(17.3%) of mothers delayed breastfeeding initiation by hours and days respectively.

Table7: Distribution of Respondents by Health Seeking Behaviour and BF Initiation Status

No of ANC Visit	Frequency	Percentage
ANC Visit less than 4	605	21.2
4 or more ANC Visit	2251	78.8
Total	2856	100.0
Place of Delivery		
Home	1153	30.0
Government Hospital	1165	43.3
Private Centre	699	18.2
Other public/private	112	2.9
Faith based	218	5.7
Total	3847	100.0
Postnatal Visit Status		
Yes	2315	37.7
No	3820	62.3
Total	6135	100.0

Table7 Cont'd: Distribution of Respondents by Health Seeking Behaviour and BF Initiation Status

Breastfeeding Initiation	Frequency	Percentage
Immediately after	2227	39.2
Hours after	2472	43.5
Days after	982	17.3
Total	5681	100.0

4.2 Survival Estimate of Breastfeeding Duration

Median discontinuation time (duration) of exclusive breastfeeding is found to be 6 months (5.9250 – 6.0750). This time varied across the subgroup category as that of age group 15 – 19 is 5 months (4.5150 – 5.4850) while other age categories are 6 months. Mothers from South South and South East breastfeed exclusively for 4 months (3.5840 – 4.416) and 5 months (4.3350 – 5.6650) respectively while others breastfeed for 6 months. Breastfeeding mothers not married exclusively breastfeed for 5 months (3.9930 – 6.0070) while married mothers exclusively breastfeed for 6 months. Middle socio economic class mother exclusively breastfeed for 5 months (4.7790 – 5.2210) while the rich ones respectively breastfeed exclusively for 6 months. Mothers who deliver in other public/private centres and those whose delivery were in faith based home respectively breastfeed on average for 5 months (3.6510 – 6.3490) and 4 months (3.0950 – 4.9050).

Table 8: Median Duration of Exclusive Breastfeeding

AVERAGE (MEDIAN)				
	Estimate	Standard error	Lower 95%CI	Upper 95%CI
Overall	6.0000	0.0380	5.9250	6.0750
Age group	Estimate	Standard error	Lower 95%CI	Upper 95%CI
15 – 19	5.0000	0.2470	4.5150	5.4850
20 – 29	6.0000	0.0540	5.8940	6.1060
30 – 39	6.0000	0.0420	5.9180	6.0820
40 – 49	6.0000	0.1340	5.7370	6.2630
Zone				
North Central	6.0000	0.0650	5.8730	6.1270
North East	6.0000	0.0800	5.8440	6.1560
North West	6.0000	0.0610	5.8800	6.1200
South East	5.0000	0.3390	4.3350	5.6650
South South	4.0000	0.2120	3.5840	4.4160
South West	6.0000	0.0510	5.9000	6.1000
Locality				
Rural	6.0000	0.0370	5.9270	6.0730
Urban	6.0000	0.0490	5.9050	6.0950

Table 8 Cont'd: Median Duration of Exclusive Breastfeeding

Education Level	Estimate	Standard error	Lower 95%CI	Upper 95%CI
No education	6.0000	0,0700	5.8640	6.1360
Primary	6.0000	0.0890	5.8260	6.1740
Secondary	6.0000	0.0550	5.8930	6.1070
Tertiary	6.0000	0.0390	5.8580	6.1420
Occupation				
Unemployed	6.0000	0.0400	5.9210	6.0790
Self employed	6.0000	0.0510	5.8990	6.1010
Employed	6.0000	0.1180	5.7690	6.2310
Marital Status				
Never Married	5.0000	0.5140	3.9930	6.0070
Married	6.0000	0.0260	5.9480	6.0520
Divorce/separated/widow	6.0000	0.2340	5.5420	6.4580
Social Economic Class				
Poorest	6.0000	0.0860	5.8300	6.1700
Poorer	6.0000	0.0890	5.8260	6.1740
Average	5.0000	0.1130	4.7790	5.2210
Richer	6.0000	0.0520	5.8990	6.1010
Richest	6.0000	0,0500	5.9010	6.0990

Table 8 Cont'd: Median Duration of Exclusive Breastfeeding

No of Antenatal Visit	Estimate	Standard error	Lower 95%CI	Upper 95%CI
ANC less than 4	6.0000	0.1080	5.7890	6.2110
4 or more ANC	6.0000	0.0360	5.930	6.0700
Place of Delivery				
Home	6.0000	0.0870	5.8290	6.1710
Government Hospitals	6.0000	0.0350	5.9310	6.0690
Private centre	6.0000	0.0980	5.8070	6.1930
Other public/private	5.0000	0.6880	3.6510	6.3490
Faith based home	4.0000	0.4620	3.0950	4.9050
Breastfeeding initiation				
Immediately	6.0000	0.0410	5.9200	6.0800
Hours later	6.0000	0.0540	5.8940	6.1060
Days after	6.0000	0.1080	5.7880	6.2120
Postnatal Status				
No	6.0000	0.0560	5.8910	6.0640
Yes	6.0000	0.0330	5.9360	6.1090

4.2.1 Survival Curve of EBF Discontinuation Time:

Figure 1 below shows the survival curve in exclusive breastfeeding. Time origin is 0 months while endpoint of time is 15 months. Cumulative survival probability in exclusive breastfeeding is on the vertical axis against breastfeeding time on the horizontal axis. More than 100 breastfeeding mothers were censored. Survivor probability is at the peak (1.0) at the start of breastfeeding and then decreases step wisely as exclusive breastfeeding discontinuation time increases. Survivorship was constant (downward straight line movement) at 0.5 equivalent to 6 months EBF median duration. This implies that average duration of EBF is the time at which S(t) = 0.5 which is 6 months on the graph. Survivorship then decreases tending towards zero as time increases and reaching endpoint.

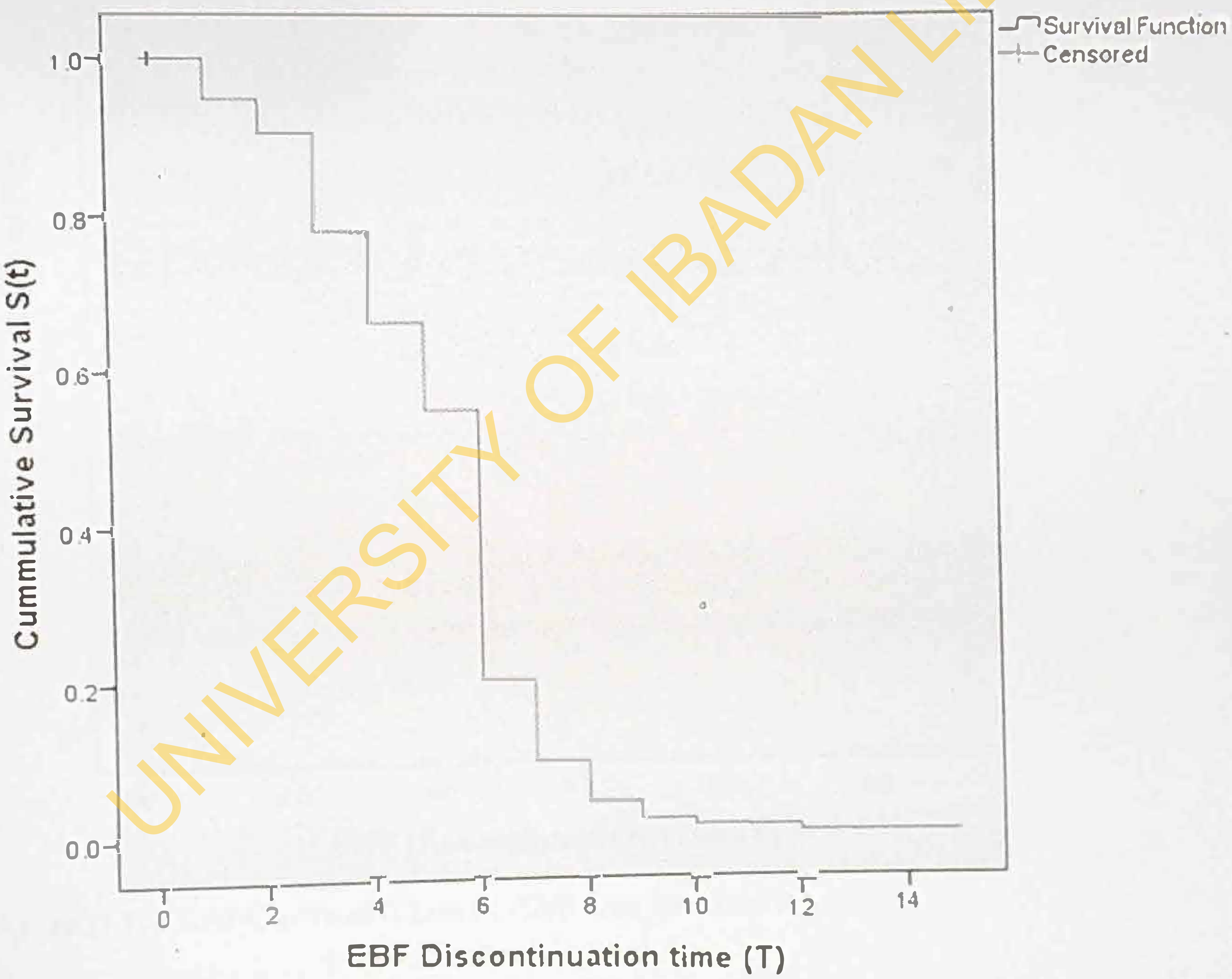

Figure1: Survival Curve of Time to EBF Discontinuation

4.2.2 Hazard Curve of EBF Discontinuation Time:

Figure 2 below is the hazard curve of discontinuing exclusive breastfeeding. The cumulative hazard is on the vertical axis against EBF discontinuation time on the horizontal axis. 113 breastfeeding mothers were censored before earliest event. Hazard of discontinue EBF was at the minimum point 0 at time origin 0 and then increases as time increases, since the hazard measures instantaneous failure rate of discontinuing EBF. A gradual increase in hazard was observed until the sixth month of EBF before a sudden rise in hazard until twelfth month. A constant hazard was then observed towards end time.

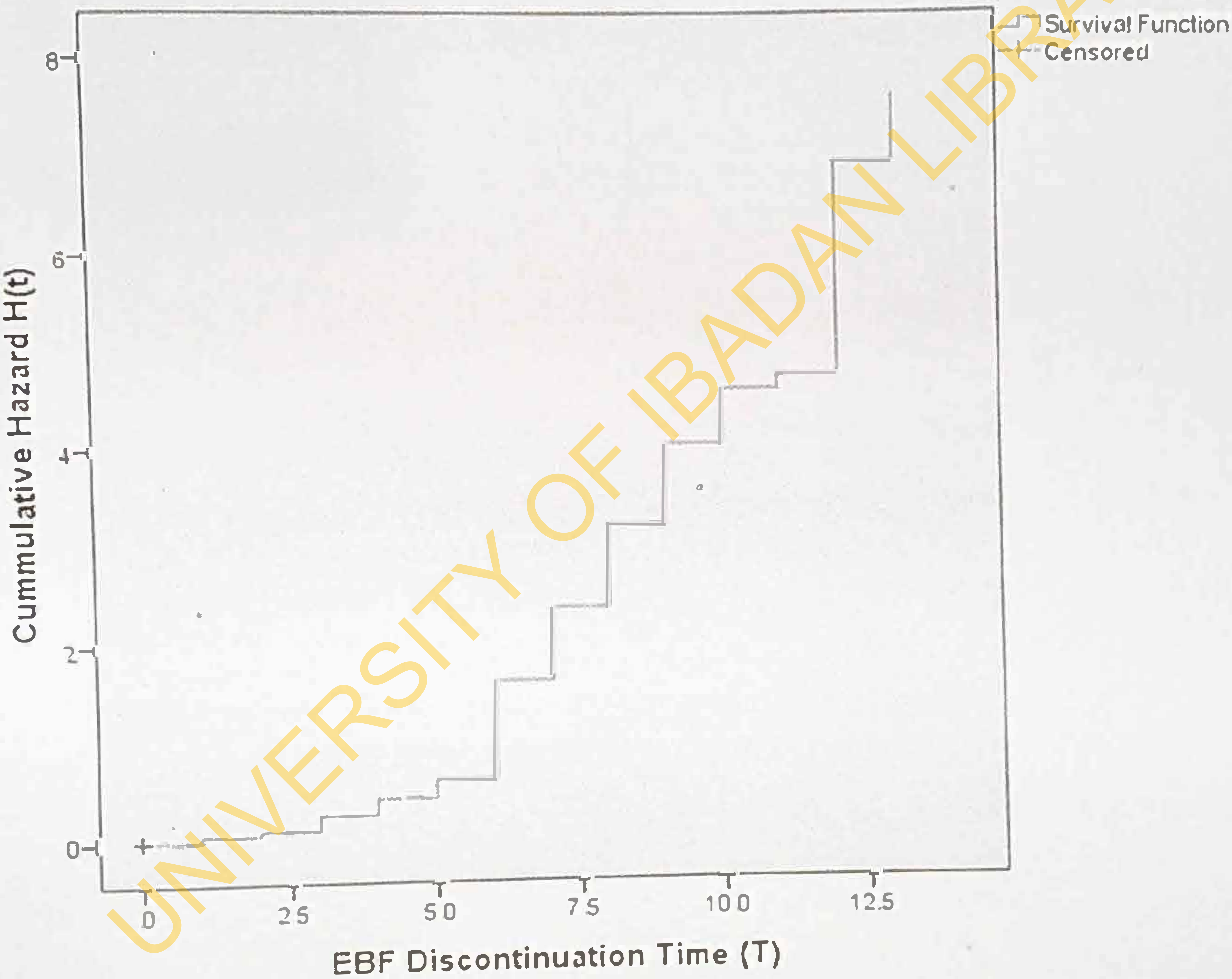

Figure2: Hazard Curve of Time to EBF Discontinuation

4.3 Pattern and Distribution of Survival Time

Table 9 and figure 3 below shows the survival time pattern and distribution of time to discontinuation of exclusive breastfeeding obtained from proportion of mother's population. The distribution is asymmetric and rightly skewed with mean median and mode value of 4.94, 6.00 and 6.00 respectively. Discontinuation time of EBF plotted on the horizontal axis ranges between 0 and 15 against mother's population on the vertical axis. 113(5.2%) mothers did not exclusively breastfeed up to one month, more than 711(32.9%) mothers exclusively breastfeed up to six month while total of 18(0.8%) mothers exclusively breastfeed up to a year and beyond.

Table 9: Population Distribution of Exclusive Breastfeeding Duration

Time (Months)	Mother's population by EBF Discontinuation time	Percentage (%)
0	113	5.20
1	107	4.90
2	87	4.00
3	260	12.00
4	243	11.20
5	231	10.70
6	711	32.90
7	218	10.10
8	110	5.10
9	46	2.10
10	16	0.70
11	3	0.10
12	16	0.70
13	1	0.05
15	1	0.05
Total	2163	100.00

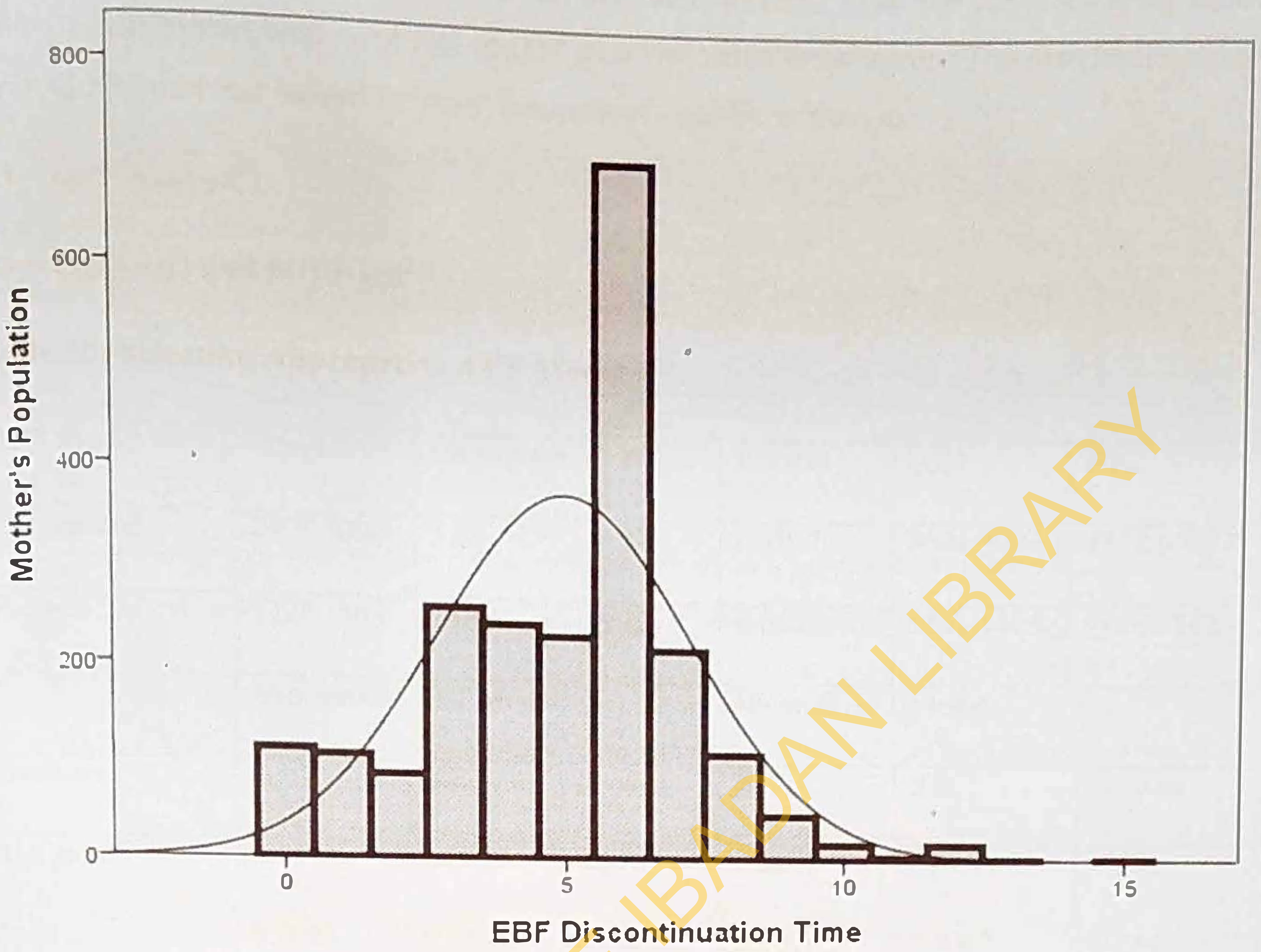

Figure 3: Population Distribution of EBF Discontinuation Time

4.4 Likelihood Ratio (LR) Test of Appropriate AFT Model:

Table 10 below shows the test comparing Weibull accelerated failure time model ($Log(T) = 1.7525 + 0.0085X_1 + 0.0093X_2 + 0.0631X_3 - 0.0087X_4 + 0.0157X_5 - 0.0103X_6 + 0.0054X_7 + 0.0184X_8 - 0.0539X_9 - 0.0090X_{10} - 0.0215X_{11} + 0.3628\varepsilon$) with exponential accelerated failure time model ($Log(T) = 1.8276 + 0.0199X_1 + 0.0023X_2 + 0.1008X_3 + 0.00787X_4 + 0.0178X_5 - 0.00867X_6 - 0.0047X_7 + 0.0136X_8 - 0.0536X_9 - 0.0305X_{10} - 0.0198X_{11} + \varepsilon$). Since survival time distribution is rightly skewed, it could follow an exponential or Weibull distribution. These two parametric models were fitted with all the eleven predictors and the one that suit the data better was obtained to be the survival time distribution. The result shows that Weibull AFT model will suit the data better as it's significant at $P<0.001$ (Chi-square = 33.16 at 13 df) with smaller value of -2logL (1325.1306 < 2497.3094) and the corresponding AIC and

BIC are respectively lower than exponential AFT model. Thus the survival time follows a Weibull distribution with error rate (σε) of extreme value distribution. The distribution function, survival function and hazard function respectively can be written as:

$f(t) = \lambda p t^{p-1} \exp(-\lambda t^{p})$

$s(t) = \exp(-\lambda t^{p})$ and $h(t) = \lambda p t^{p-1}$

Table 10: Selecting Appropriate AFT Model

AFT Model	-2logL	Chi-square	DF	P-value	AIC	BIC
Exponential	2497.3094	5.89	12	0.8807	2521.3094	2528.6797
Weibull	1325.1306	33.16	13	0.0005	1351.1306	1416.5317

	Exponential AFT Model			Weibull AFT Model		
Predictors	B	S.E	p-value	B	S.E	p-value
Age group	0.0199	0.0439	0.650	0.0085	0.0159	0.591
Zone	0.0023	0.0186	0.902	0.0093	0.0067	0.164
Locality	0.1008	0.0745	0.176	0.0631	0.0271	0.020*
Education	0.0078	0.0371	0.833	-0.0087	0.0134	0.515
Occupation	0.0178	0.0551	0.747	0.0157	0.0198	0.429
Marital Status	-0.0087	0.1391	0.950	-0.0103	0.0526	0.845
S.E.S	-0.0047	0.0293	0.873	0.0054	0.0107	0.615
ANC Num	0.0136	0.0742	0.854	0.0184	0.0271	0.496
Delivery Place	-0.0536	0.0316	0.090	-0.0539	0.0114	0.000***
BF Initiation	-0.0305	0.0444	0.492	-0.0090	0.0163	0.581
Postnatal	-0.0198	0.0621	0.750	-0.0215	0.0226	0.342

Table 10 Cont'd: Selecting Appropriate AFT Model

Constant	1.7525	0.2177	0.000***	1.8276	0.8209	0.000***
ln-P				1.0139	0.0233	0.000***
P				2.7563	0.0642	
1/p				0.3628	0.0085	

Legend: * P < 0.05 *** P < 0.001

4.5 Cox Model Describing Predictors Effect on EBF Discontinuation Time:

Table 11 below for fitted model; $\boldsymbol{\lambda(t/x) = \lambda_0(t)exp(-0.0345X_1 -0.0138X_2 -0.1709X_3 - 0.0066X_4 -0.0323X_5 -0.0264X_6 +0.0003X_7 -0.0352X_8 +0.1178X_9 +0.0434X_{10} +0.0346X_{11}}$ shows the overall estimate and estimate of individual predictor variable explaining duration of exclusive breastfeeding. The goodness of fit test is significant at P-value of 0.001, indicating model fitness. From all the 11 predictors, only locality of respondent and place of child delivery are significant at $p< 0.022(1.0252 - 1.3720)$ and $p<0.001(1.0556 - 1.1965)$ respectively. Thus these two predictors respectively have negative and positive influence on EBF duration, indicating that hazard of discontinuing EBF is lower among mothers in urban than those in rural areas and hazard of discontinuing EBF is higher among mothers that delivered at home than those that does not delivered at home. Hazard of discontinuing exclusive breastfeeding is high (1.0562) in age category of 20-29 compared to 15-19 while it is low among the upper age class 30-39 and 40-49. North West and South West mothers significantly (P<0.05) (0.6325 – 0.9450) and (0.6438 – 0.9852) influence hazard of discontinuing EBF negatively.

Table 11: Cox Regression Analysis of Predictors Effect on EBF Time

Overall Estimate					
-2log Likelihood	Chi – square		Df		P – Value
14176.493	54.99		28		0.002**
	B	S.E	Hazard ratio	P - Value	95%CI
Age group	-0.0345	0.0424	0.9661	0.432	0.8864 – 1.0529
15 – 19#					
20 – 29	0.5469	0.1446	1.0562	0.690	0.8076 – 1.3814
30 – 39	-0.0115	0.1419	0.9886	0.936	0.7462 – 1.3096
40 – 49	-0.0444	0.1713	0.9566	0.804	0.6735 – 1.3588
Zone	-0.0138	0.0182	0.9863	0.455	0.9512 – 1.0227
North Central#					
North East	-0.1206	0.9694	0.8864	0.270	0.7154 – 1.0983
North West	-0.2547	0.0804	0.7751	0.014	0.6325 – 0.9450
South East	0.1598	0.1376	1.1733	0.1732	0.9323 – 1.4765
South South	0.1146	0.1146	1.1215	0.262	0.9180 – 1.3700
South West	-0.2276	0.0865	0.7964	0.036	0.6438 – 0.9852
Locality	-0.1709	0.0628	0.8429	0.022*	0.7284 – 0.9754
Rural#					
Urban	-0.0406	0.0787	0.9602	0.620	0.8178 – 1.1275

Table 11 Cont'd: Cox Regression Analysis of Predictors Effect on EBF Time

	B	S.E	Hazard ratio	P - Value	95%CI
Education	-0.0066	0.0368	0.9930	0.859	0.9239 – 1.0682
No Education#					
Primary	-0.1538	0.0872	0.8575	0.102	0.7130 – 1.0312
Secondary	-0.0057	0.0893	0.9943	0.949	0.8337 – 1.1858
Tertiary	-0.2346	0.1123	0.7909	0.099	0.5987 – 1.0447
Occupation	-0.0323	0.0532	0.9681	0.555	0.8692 – 1.0782
Unemployed#					
Self employed	-0.0233	0.6814	0.9770	0.739	0.8522 – 1.1201
Employed	-0.1410	0.1449	0.8685	0.398	0.6262 – 1.2044
Marital Status	-0.0264	0.1412	0.9739	0.855	0.7331 – 1.2939
Never Married#					
Married	-0.1113	0.1715	0.8947	0.561	0.6145 – 1.3026
Divorce/Separated/widow	-0.0332	0.2881	1.0337	0.905	0.5986 – 1.7851
No of Antenatal Visit	-0.0352	0.0718	0.9654	0.636	0.8344 – 1.1170
Less than 4 Visit#					
4 or more Visit	-0.0021	0.0758	1.0021	0.978	0.8639 – 1.1623

Table 11 Cont'd: Cox Regression Analysis of Predictors Effect on EBF Time

	B	S.E	Hazard ratio	P - Value	95%CI
Place of Delivery	0.1168	0.0359	1.1239	0.000***	1.0556 – 1.1965
Home#					
Private Centre	-0.0469	0.8015	0.9541	0.577	0.8094 – 1.1250
Government Hospital	0.1385	0.1272	1.1485	0.211	0.9245 – 1.4269
Other Private/Public	0.3894	0.2761	1.4761	0.037*	1.0230 – 2.1299
Faith based home	0.2523	0.1952	1.2869	0.096	0.9559 – 1.7325
Breastfeeding initiation	0.0434	0.0466	1.0443	0.331	0.9569 – 1.1397
Immediate#					
Hours later	0.0332	0.0679	1.0338	0.613	0.9088 – 1.1760
Days after	0.0585	0.1045	1.0602	0.553	0.8740 – 1.2861
Postnatal Visit	0.0346	0.0645	1.0352	0.579	0.9162 – 1.1696
No#					
Yes	-0.0045	0.0629	0.9955	0.943	0.8795 – 1.1267

Table 11 Cont'd: Cox Regression Analysis of Predictors Effect on EBF Time

	B	S.E	Hazard ratio	P - Value	95%CI
Social Economic Class	0.0003	0.0295	1.0002	0.993	0.9442 – 1.0597
Poorest#					
Poorer	-0.0691	0.9274	0.9324	0.482	0.7673 -1.1331
Average	-0.0084	0.1042	0.9917	0.937	0.8071 – 1.2185
Richer	-0.0920	0.1094	0.9121	0.443	0.7210 – 1.1539
Richest	-0.1110	0.1171	0.8949	0.396	0.6925 – 1.1565

Legend: # reference category * P < 0.05 ** P < 0.01 *** P < 0.001

4.6 Weibull AFT Model Describing Predictors Effect on EBF Discontinuation Time

Table 12 below for fitted Weibull AFT mode; $\mathbf{Log(T) = 1.8276 + 0.0085X_1 + 0.0093X_2 + 0.0631X_3 - 0.0087X_4 + 0.0157X_5 - 0.0103X_6 + 0.0054X_7 + 0.0184X_8 - 0.0539X_9 - 0.0090X_{10} - 0.0215X_{11} + 0.3628\varepsilon}$ shows that the overall model is significant at P<0.001(chi-Square = 71.82), proving the fitness of the model. Only respondent locality and delivery place are significant at P<0.05(1.0101 – 1.1231) and P<0.01(0.9266 – 0.9689) respectively positively and negatively influence survival time to EBF discontinuation, indicating that mothers in urban have accelerated (stretching) effect on EBF discontinuation time (Time ratio>1) compare to rural mothers and also mothers that delivered at home have decelerated (contrasting) effect on EBF discontinuation time compare to mothers that do not delivered at home. North West and South West are respectively significant at P<0.05 (1.0176 – 1.1781) and P<0.05 (1.0221 - 1.1896) indicating accelerated (stretching) influence in survival time as it accelerated factor (time ratio>1). Delivery in government hospitals, other private/public centres and faith based places are significant at (P<0.05; 0.8413 – 0.9824), (P<0.01; 0.7242 – 0.9409) and (P<0.05; 0.7944 – 0.9815) respectively, indicating contrasting influence in survival time of EBF as time ratio<1.

Table 12: Weibull Regression Analysis of Predictors Effect on EBF time

Overall estimate					
-2logLikelihood	Chi-Square		Df		P-Value
1286.4694	71.82		30		0.0000
	B	S.E	Time Ratio	P-value	95%CI
Age group	0.0085	0.0160	1.0086	0.591	0.9777 – 1.0404
15 – 19#					
20 – 29	-0.0422	0.0476	0.9587	0.395	0.8699 – 1.0566
30 – 39	-0.0170	0.0511	0.9832	0.744	0.8879 – 1.0886
40 – 49	-0.0075	0.0642	0.9925	0.908	0.8743 – 1.1268
Zone	0.0093	0.0067	1.0093	0.164	0.9962 – 1.0226
North Central#					
North East	0.0380	0.0406	1.0387	0.331	0.9621 – 1.1214
North West	0.0907	0.0409	1.0950	0.015*	1.0176 – 1.1781
South East	-0.0422	0.0405	0.9587	0.319	0.8825 – 1.0415
South South	-0.0233	0.0358	0.9769	0.525	0.9092 – 1.0498
South West	0.0977	0.0427	1.1026	0.012*	1.0221 – 1.1896
Locality	0.0631	0.0271	1.0651	0.020*	1.0101 – 1.1231
Rural#					
Urban	-0.0180	0.0290	1.0181	0.543	0.9608 – 1.0789

Table 12 Cont'd: Weibull Regression Analysis of Predictors Effect on EBF time

	B	S.E	Time ratio	P - Value	95%CI
Education	-0.0087	0.0133	0.9913	0.515	0.9656 – 1.0177
No formal education#					
Primary	0.0703	0.0360	1.0728	0.036*	1.0045 – 1.1458
Secondary	-0.0188	0.0315	0.9814	0.559	0.9215 – 1.0452
Tertiary	0.0558	0.0537	1.0574	0.272	0.9572 – 1.1680
Occupation	0.0157	0.0206	1.0158	0.429	0.9771 – 1.0561
Unemployed#					
Self employed	0.0069	0.0251	1.0069	0.782	0.9588 – 1.0574
Employed	0.0757	0.0645	1.0787	0.205	0.9594 – 1.2127
Marital Status	-0.0103	0.0521	0.9898	0.845	0.8928 – 1.0973
Never Married#					
Married	0.0390	0.0721	1.0398	0.574	0.9076 – 1.1913
Divorce/Separated/Widow	-0.0243	0.0980	0.9760	0.809	0.8016 – 1.1883
Number of ANC Visit	0.0184	0.0276	1.0186	0.496	0.9660 – 1.0740
Less than 4#					
4 or more	0.0034	0.0273	1.0034	0.901	0.9513 – 1.0583

Table 12 Cont'd: Weibull Regression Analysis of Predictors Effect on EBF time

	B	S.E	Time ratio	P - Value	95%CI
Socio-economic Status	0.0054	0.0108	1.0054	0.615	0.9845 – 1.0268
Poorest#					
Poorer	0.0398	0.0370	1.0406	0.263	0.9706 – 1.1156
Average	0.0105	0.0381	1.0106	0.780	0.9386 – 1.0881
Richer	0.0548	0.0454	1.0563	0.203	0.9709 – 1.1492
Richest	0.0687	0.0503	1.0711	0.144	0.9769 – 1.1744
Place of Delivery	-0.0539	0.0108	0.9475	0.000***	0.9266 – 0.9689
Home#					
Private centres	0.0006	0.0303	1.0006	0.985	0.9430 – 1.0617
Government hospitals	-0.0953	0.0360	0.9091	0.016*	0.8413 – 0.9824
Other Private/Public	-0.1918	0.0551	0.8255	0.004**	0.7242 – 0.9409
Faith based	-0.1244	0.0477	0.8830	0.021*	0.7944 – 0.9815
Breastfeeding initiation	-0.0090	0.0162	0.9910	0.581	0.9598 – 1.0232
Immediately#					
Hours later	0.0023	0.0237	1.0023	0.923	0.9569 – 1.0496
Days after	-0.0158	0.0347	0.9843	0.653	0.9186 – 1.0547

Table 12 Cont'd: Weibull Regression Analysis of Predictors Effect on EBF time

	B	S.E	Time ratio	P - Value	95%CI
Postnatal Visit	-0.0215	0.0221	0.9787	0.342	0.9363 – 1.0231
No#					
Yes	-0.0051	0.0227	0.9949	0.822	0.9514 – 1.0403
Constant	1.8276	0.5105	6.2190	0.000***	5.2948 – 7.3045
Constant(category)	1.6829	0.4720	5.3814	0.000***	4.5314 – 6.3904
ln_P	1.0139	0.0233	1.0139	0.000***	0.9682 -1.0596
ln_P(category)	1.0287	0.0233	1.0287	0.000***	0.9830 – 1.0744
P	2.7563	0.0642	2.7563		2.6332 – 2.8851
1/p	0.3628	0.0085	0.3628		0.3466 – 0.3798
P(category)	2.7974	0.6526	2.7974		2.6723 – 2.9282
1/p(category)	0.3575	0.0083	0.3575		0.3415 – 0.3742

Legend: # reference category

*** P < 0.05 ** P < 0.01 *** P < 0.001**

4.7 Cox Model Variable Selection and Likelihood Ratio Test

Table 13 below shows outcome of using general variable selection strategy in selecting optimal variable for the Cox model. The procedure started by fitting model without any covariate (null model). Each variable are then added one at a time and difference in -2logL are compared with chi-square value of 1 degree of freedom (3.84). At this stage Locality (with difference of 4.673) and delivery place (with difference of 10.409) are respectively significant at 5% and 0.1%. These two variables are therefore fitted together at the second stage. This was significant at $p<0.001$ and the removal of any of locality and delivery place will significantly increase -2logL value. At the third stage the two important variable (Delivery place and Locality) are retained in the model since the removal of either will result in respective significant increase of 10.409(P=0.001) and 4.672(P=0.031) in -2logL, then the remaining 9 unimportant variables in the first step are added in turn to the model that already contain Locality and Delivery place. 3 variables (Age, Zone and Postnatal) of these additions fail to significantly reduce -2logL value by at least chi-square value of 3.84. Thus all the 3 variables are discarded from the model and the 8 important final optimal variables are Delivery place, Locality, Education, Occupation, Marital Status, Wealth, ANC number, and BF initiation.

Table 13: Variable Selection Strategy in Cox Model

Variable(s) in the model	-2log Likelihood		Chi-Square	P-value
	Block	Model		
None (Null model)#	28181.092	28181.092	0.000	
Age	28181.092	28180.829	0.263	0.608
Zone	28181.092	28181.092	0.000	0.995
Locality	28181.092	28176.419	4.673	0.031*
Education	28132.747	28131.330	1.417	0.234
Occupation	28103.169	28101.479	1.690	0.194
Marital status	28069.725	28069.709	0.016	0.901
Wealth	28151.046	28151.021	0.025	0.876
ANC num	14420.080	14419.987	0.093	0.760
Del plc	19233.972	19223.563	10.409	0.001***
BF initiation	28165.610	28164.965	0.645	0.422
Postnatal	28181.092	28181.083	0.009	0.923
Del plc + Locality	19233.972	19212.444	21.528	0.000***
Del plc + Locality + Age	19212.444	19211.919	0.525	0.50<p<0.975
Del plc + Locality + Zone	19212.444	19210.863	1.581	0.50<p<0.10
Del plc + Locality + Education	19212.972	19181.247	31.725	0.000***
Del plc + Locality + Occupation	19212.972	19152.949	60.023	0.000***
Del plc + Locality + Marital status	19212.972	19150.388	62.056	0.000***

Del plc + Locality + Wealth	19212.972	19198.534	14.438	0.000***
Del plc + Locality + ANC num	19212.972	14329.556	4883.416	0.000***
Del plc + Locality + BF initiation	19212.972	19195.098	17.874	0.000***
Del plc+ Locality+ Postnatal	19212.972	19211.559	1.413	0.50<p<0.10

Legend: # reference category

*** P < 0.05 ** P < 0.01 *** P < 0.001**

4.8 Fitting Cox Proportional Hazards (CPH) Model

Table 14 below shows the fitted Cox proportional hazards model for the eight selected important variables (delivery place, locality, education, occupation, marital, S.E.S, ANC number, BF initiation) identified by the general variable selection strategy; $\lambda(t/x) = \lambda_0(t)\ \exp(0.1132X_9 - 0.1771X_3 - 0.0093X_4 - 0.0465X_5 - 0.4272X_6 - 0.0037X_7 - 0.0436X_8 + 0.0433X_{10})$. Respondent delivery place and locality respectively have positive and negative influence on hazard of EBF discontinuation time. Implying that hazard of discontinuing EBF is higher among mothers who delivered at home than those that do not deliver at home and also hazard of discontinuing EBF is lower among mothers in urban than mothers in rural areas. Place of delivery is significant at P<0.001(1.0530 – 1.1909) with hazard ratio>1 (1.1198) while Locality is significant at P<0.05 (0.7242 – 0.9689) with hazard ratio<1 (0.8377).

Table 14: Fitted Cox Regression Model

Model variables	B	S.E	Hazard ratio	P-value	95%CI
Place of Delivery	0.1132	0.0351	1.1198	0.000***	1.0530 – 1.1909
Locality	-0.1771	0.0622	0.8377	0.017*	0.7242 – 0.9689
Education	-0.0093	0.0362	0.9908	0.800	0.9223 – 1.0644
Occupation	-0.0465	0.0519	0.9545	0.385	0.8593 – 1.0603
Marital Status	-0.4272	0.1378	0.9581	0.766	0.7229 – 1.2701
S.E.S	-0.0037	0.0292	0.9963	0.899	0.9407 – 1.0551
ANC number	-0.0436	0.0705	0.9573	0.554	0.8286 – 1.1060
BF initiation	0.0433	0.0465	1.0442	0.331	0.9570 – 1.1394

Legend: * P < 0.05 ** P < 0.01 *** P < 0.001

4.9 Weibull AFT Model Variable Selection and Likelihood Ratio Test

Similar to previous method in selecting variables for Cox model, optimal variables are also selected using the general model selection procedure in order to fit a Weibull AFT model. The procedure started by fitting a null model (model without covariate) and one variable at a time, such that difference in -2logL is compared with chi-square of 1 df (3.84). At this stage Delivery place and Locality of respondent are significant at P<0.001 and P<0.05 with -2logL value of 20.79 and 3.569 respectively. Education and occupation are both significant at 10% and would be considered at the second stage where delivery place and locality are fitted together and both education and occupation are added in turn before -2logL difference in the exclusion of any of the variable was be compared with chi-square of 1 degree of freedom (3.84). Thus Education is excluded from the model as the -2logL difference (0.3614) on it inclusion is not significant compared to chi-square value of 3.84. Whereas, the removal of either of delivery place, Locality and Occupation tends to increase -2logL statistic with significant difference of 731.19, 11.574 and 5.8556 respectively. At the last stage the 3 important variables (Delivery place, Locality and

Occupation) are fitted together and the remaining 7 unimportant variables are added one at a time. From all, addition of Zone and ANC number to the model already containing Delivery place, Locality and Occupation was both significant at P<0.001 with respective reduction of 4.4290 and 319.8800 in -2logL value. The final model therefore contain Delivery place, Locality, Occupation, Zone and ANC number.

Table 15: Variable Selection Strategy in Weibull Model

Variable(s) in the model	-2log Likelihood		Chi-Square	P-value
	Block	Model		
None (Constant model)#	2398.6258	2398.6258	0.0000	
Age	2398.6258	2398.6216	0.0042	0.948
Zone	2398.6258	2398.5186	0.1072	0.743
Locality	2398.6258	2395.0566	3.5690	0.031*
Education	2398.4038	2394.7938	3.6100	0.058
Occupation	2390.9414	2387.7514	3.1900	0.074
Marital status	2397.3910	2396.8810	0.5100	0.473
Wealth	2394.4822	2394.4322	0.0500	0.827
ANC num	1369.7124	1369.4224	0.2900	0.588
Del plc	1690.0486	1669.2586	20.790	0.000***
BF initiation	2398.3582	2398.1982	0.1600	0.691
Postnatal	2398.6258	2398.6258	0.0000	0.999
Del plc + Locality	1690.0424	1657.1124	32.930	0.000***
Del plc + Locality + Education	1657.1124	1656.751	0.3614	0.5<p<0.97
Del plc + Locality + Occupation	1657.1124	1651.394	5.7184	P<0.010

Del plc + Occupation	1651.394	1662.9678	11.574	P<0.001
Locality + Occupation	1651.394	2382.5802	731.19	0.000***
Del plc + Locality + Occupation + Age	1651.394	1651.2346	0.1594	P<0.975
Del plc + Locality + Occupation + Zone	1651.394	1646.9650	4.4290	P<0.050
Del plc + Locality + Occupation + Marital	1651.394	1651.0104	0.3836	P<0.50
Del plc + Locality + Occupation + Wealth	1651.394	1648.4116	2.9824	P<0.10
Del plc + Locality + Occupation + ANC num	1651.394	1331.5140	319.88	0.000***
Del plc + Locality + Occupation + BF initiate	1651.394	1649.0894	2.3046	0.5<p<0.1
Del plc + Locality + Occupation + Postnatal	1651.394	1649.2538	2.1402	0.5<p<0.1

Legend: # reference category

*** P < 0.05 ** P < 0.01 *** P < 0.001**

4.10 Fitting Weibull Accelerated Failure (AFT) Time Model

Table 16 below shows the result of Weibull accelerated failure time model for the 5 set of optimal variables selected to be important to the model; $\mathbf{Log(T) = 1.7878 - 0.0551X_9 + 0.0707X_3 + 0.0187X_5 + 0.0091X_2 + 0.0188X_8 + 0.3626\varepsilon}$. Delivery place and locality have negative and positive influence on hazard of exclusive breastfeeding discontinuation at a respective significant point of P<0.001(0.9266 – 0.9666) and P<0.010(1.0245 – 1.1244). Indicating that hazard of discontinuing EBF is higher among mothers who delivered at home than those that do not delivered at home and also hazard of discontinuing EBF is lower among mothers who reside in urban than those in rural areas.

Table16: Fitted Weibull AFT Regression Model

Model variables	B	S.E	Accelerated factor	P-value	95%CI
Place of Delivery	-0.0551	0.0102	0.9464	0.000***	0.9266 – 0.9666
Locality	0.0707	0.0255	1.0733	0.003**	1.0245 – 1.1244
Occupation	0.0187	0.0189	1.0189	0.314	0.9824 – 1.0567
Zone	0.0091	0.0066	1.0092	0.163	0.9963 – 1.0221
ANC number	0.0188	0.0270	1.0191	0.476	0.9676- 1.0733
Constant	1.7878	0.1933	5.9765	0.000***	5.6094 – 6.3676
ln(P)	1.0144	0.0232	1.0144	0.000***	0.9689 – 1.0599
P	2.7577	0.0640	2.7577		2.6351 – 2.8860
1/p	0.3626	0.0084	0.3626		0.3465 – 0.3795

Legend: ** P < 0.01 *** P < 0.001

4.11 Assessment of Model Adequacy (L-R Chi-Square Test)

Table 17 below shows the outcome of Likelihood ratio chi-square for Cox proportional hazards and Weibull AFT models. The null hypothesis that the model does not adequately fit the data was rejected for both models as they are respectively significant at P<0.01(Chi-square=20.5783) and P<0.001(Chi-square = 31.3138), indicating the fitness of the two models.

Table 17: Model Adequacy Assessment

Model type	-2logLikelihood	Chi – square	Df	P – Value
COX Model	14210.906	20.5783	8	0.008**
Weibull AFT	1329.581	31.3138	7	0.000***

Legend: **P<0.01 *** P < 0.001

4.12 Cox and Weibull AFT Model Comparison (AIC)

Table 18 below shows results of comparing Cox proportional hazard model with Weibull accelerated failure time model. Akaike information criterion estimate for Weibull AFT model (1343.581) is smaller than estimate of Cox model (14226.910). Akaike deviance of zero give a substantial support for Weibull AFT model and also the Akaike weight of 100% indicate a relative 100% probability of Weibull AFT been a better model than the Cox proportional hazard model. Hence Weibull AFT model fit the data better than Cox model.

Table 18: Cox and AFT Models Comparison

Model Type	Number of Parameter	Log Likelihood	AIC Estimate	Akaike Deviance	Relative Likelihood	Akaike Weight
COX#	8	-7105.4530	14226.910	12883.329	0.0000	0%
AFT	7	-664.7905	1343.581	0.0000	1.0000	100%

Legend: # reference category

4.12 Cox and Weibull AFT Model Comparison (AIC)

Table 18 below shows results of comparing Cox proportional hazard model with Weibull accelerated failure time model. Akaike information criterion estimate for Weibull AFT model (1343.581) is smaller than estimate of Cox model (14226.910). Akaike deviance of zero give a substantial support for Weibull AFT model and also the Akaike weight of 100% indicate a relative 100% probability of Weibull AFT been a better model than the Cox proportional hazard model. Hence Weibull AFT model fit the data better than Cox model.

Table 18: Cox and AFT Models Comparison

Model Type	Number of Parameter	Log Likelihood	AIC Estimate	Akaike Deviance	Relative Likelihood	Akaike Weight
COX#	8	-7105.4530	14226.910	12883.329	0.0000	0%
AFT	7	-664.7905	1343.581	0.0000	1.0000	100%

Legend: # reference category

4.13 Comparison of Precision from CPH and AFT Models

Table 19 below shows result obtained from comparing significant estimate of the regression co-efficient for delivery place and locality of mothers, arising from Cox proportional hazards and accelerated failure time models. The confidence bounds founds in AFT model for location (0.0242, 0.1172) and delivery place (-0.0762, 0.0339) with respective deviance of 9.3% and 4.2% is narrower compared to confidence bounds in CPH model for location (-0.3227, -0.0316) and delivery (0.0517, 0.1747) with respective deviance of 29.11% and 12.3%. Therefore AFT model gives a better Precision than CPH model.

Table 19 Comparison of Cox and AFT Models by Confidence Bounds

Model Type	Variables	B estimates	95% C.I		C.I deviance	Precision status
			Lower C.I	Upper C.I		
CPH # Model	Location	-0.1771	-0.3227	-0.0316	0.2911	Wider C.I
	Del plc	0.1132	0.0517	0.1747	0.1230	
AFT Model	Location	0.0707	0.0242	0.1172	0.093	Narrower C.I Better Precision
	Del plc	-0.0551	-0.0762	-0.0339	0.0423	

Legend: # reference category

CHAPTER FIVE

DISCUSSION CONCLUSION AND RECOMMENDATION

5.1 Discussions

This study evaluates discontinuation time of exclusive breastfeeding, describe and determine its predictors and as well compare result of Cox proportional hazards model with accelerated failure time model using NARHS 2012 data. The survey provides information on Mothers who exclusively breastfed in the last 5 years preceding the survey. Since it's unrealistic for member of non-literate population to remember time at which EBF was discontinued in the previous 5 years birth (between 2007 and 2012). This study therefore utilized data on EBF histories of Mothers (nursing an under 2 year's old child) obtained from face-to-face interview with individual female respondent between 15 and 49 years and therefore allow us to estimate EBF discontinuation time and pattern in Nigeria.

Findings show that the median duration of EBF in Nigeria was 6 months and the cumulative probability of discontinuing EBF at the sixth month time is 80.9%. This is due to mothers' knowledge and awareness about the minimum recommended 6 month EBF practice worldwide and was is in conformity with the result of cross sectional study conducted by (Yeneabat et al., 2014) in Northern Ethiopia in which median duration of EBF was 6.06 months and the cumulative probability of introducing complementary feeding was 81%. But this varies across geo-political zone with median duration of EBF of 5 months in South South and 4 months in South East. Median duration of birth in private and faith based centres are respectively 5months and 4 months. This variation is in agreement with previous studies by (Yeneabat et al., 2014 and Adetugbo et al., 1996) that median duration of EBF varies between 4months and 6months with differences in locality and ethnicity. Pattern of EBF discontinuation shows that 81% mothers discontinues EBF on/before 6-months' time and therefore results in a rightly skewed distribution. This variation was described to follow a sinusoidal pattern by (Yahya et al., 2013) based on breastfeeding initiation time in Nigeria. Respective stepwise decrease and increase in survival and hazard curve pattern as time increases also substantiate this claim.

Our study indicates that mothers in older maternal ages tend to exclusively breastfeed longer than mothers in younger ages. This is because older breastfeeding mothers have more maternal experience since breastfeeding mothers in lower ages are likely to be nursing their first child. Also breastfeeding mothers with at least primary education exclusively breastfeed longer than mothers without formal education. This is due to literate mothers' level on knowledge and awareness of breastfeeding. This is in line with (Ukegbu et al., 2011) findings that good breastfeeding knowledge is significantly associated with EBF. Married mothers also breastfeed exclusively longer than single or divorced mothers. This is owing to husband influence on EBF practice. The influence of age, education and marital status on EBF duration corresponds to findings of (Onayade et al., 2004 and Nwosu et al., 2004) that maternal age, education, marital status and family size are among other factors that significantly influence EBF practice in Nigeria.

Mothers from South West and North West region tends to prolong EBF discontinuation time compared to those from North Central. Breastfeeding mothers residing in rural area will discontinue EBF earlier than breastfeeding mothers residing in urban slum. This is because breastfeeding mothers in urban areas are educationally advance and are aware of benefits of EBF practice to them and their child. This is in agreement with previous studies by (Ajibade et al., 2013) that cultural factors are associated with discontinuation of EBF in rural communities. Also (W.H.O., 2008) reported that cultural values and family pressure influence EBF practice in low income country. Mothers in the poor socio-economic class are more likely to discontinue EBF earlier than wealthier mothers. This is due to financial effect as wealthier mothers are more financially buoyant and could afford nutritional adequate replacement food while breastfeeding. This study also found out that late initiation of breastfeeding is associated with early discontinuation of EBF and mothers who attend postnatal care are more likely to prolong discontinuation time of EBF compare to those mothers who do not attend postnatal care.

Findings based on both Cox proportional hazards and accelerated failure time modelling strategies shows that EBF discontinuation time is significantly been influenced by mothers locality of resident and place of child delivery. This is similar to findings by study conducted by (Tampah-Nah and Kumi-kyereme., 2013) in Ghana on determinants of EBF that region and place of delivery are associated with practice of EBF. This was corroborated by the result of the generally recommended variable selection method which incorporates Cox and Weibull model that breastfeeding mothers locality of residence and place of child delivery are significant predictors of EBF discontinuation time in Nigeria. This conform with findings of (Yeneabat et al., 2014) cross sectional study in north west Ethiopia that place of residence and delivery mode predicts cessation of EBF and (Chola et al., 2013) study on infant feeding survival in Uganda find out that duration of EBF is been predicted by mothers resident, place of delivery and infant feeding advice. Also Robert et al. (2014) study in Belgium using backward elimination variable selection approach found out that maternal age and partner interest will not predict EBF discontinuation. time. In selecting the best parametric AFT model using both Akaike and Bayesian information criterion, it was reported that Weibull AFT model explain the data better than Exponential AFT model and therefore was deemed appropriate as the best model distribution of EBF discontinuation time. Also this study while using Akaike information criterion and confidence bounds around its parameter estimate to compare Cox semi-parametric model with Weibull parametric model discovered that Weibull accelerated failure time model gives a better precision and therefore fit the data better than the Cox proportional hazards model and thus will predict EBF discontinuation time in Nigeria. This agree with (Chola et al., 2013) that obtained Weibull and Exponential AFT model to be a better fit than the commonly used Cox proportional hazards model.

5.2 Limitations of the Study

The limitation of this study might have been incompleteness and inconsistency of NARHS data due to recall or responder bias, since the survey retrospectively captured breastfeeding history in the last five years. Hence, responses that conform to existing knowledge of 6 months EBF practice as recommended by W.H.O and UNICEF was widely reported to interviewers. Thus, the distribution shows a mode equivalent to median duration of 6 months. Whereas, (W.H.O 1999) study in Sagamu reported the median duration of EBF to be 7 days.

5.3 Strength of the Study

Major strength of this study is the incorporation and comparison of semi parametric (Cox proportional hazard) and parametric (Accelerated failure time) modelling strategies that account for censored observation. Since these strategies by controlling for confounding effect enable us to obtain joint estimates of effect of predicting variables on risk of discontinuing EBF. Also utilization of Partial Likelihood estimation function in estimating model parameters of both modelling strategies allow for avoidance of temporal bias. Utilization of large sample size in this study could also be considered as strength.

5.4 Conclusion

It can be concluded from this study that median duration of exclusive breastfeeding is 6 months and that this duration varies across mothers' place of delivery. 80.9% of mothers discontinue EBF on/before child first 6 month of life. The distribution of EBF discontinuation time skewed to right and follows a Weibull model distribution function. Thus, survival and hazard curve pattern shows respective stepwise increase and decrease as EBF discontinuation time increases. Mothers' locality of residence and place of child delivery significantly influence discontinuation time of EBF. Also this study discovered that significant factors which include mothers' locality and place of child delivery predict discontinuation time of EBF in Nigeria. Weibull AFT model best explain the data and therefore was selected as the most appropriate parametric AFT model compare to others, especially exponential AFT model. Also when comparing Weibull AFT model with Cox proportional hazard model, Weibull AFT model has 100% chance of been a better model, gives better precision and thus was a better fit.

5.5 Recommendation

Considering emanating result from this study, it is therefore recommended that information, education and communication (IEC) program that will target breastfeeding mothers who are more likely to discontinue exclusive breastfeeding early be formulated, implemented and monitored by health policy makers, health workers and health ministry respectively in order to facilitate achievement of fifth millennium development goal. Also this study recommends the use of parametric model in analysing censored observations.

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APPENDICES

Appendix 1: STATA Command Syntax for Cox and Weibull AFT Models

stcox Recodeage H001_ZONE Reclocation Recodeedu Recodeocupation Recode_marital Wealthquin RecodeANCnum Rplcofdel_1 Rinitiation Q220, nohr

stcox Recodeage H001_ZONE Reclocation Recodeedu Recodeocupation Recode_marital Wealthquin RecodeANCnum Rplcofdel_1 Rinitiation Q220

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streg Recodeage H001_ZONE Reclocation Recodeedu Recodeocupation Recode_marital Wealthquin RecodeANCnum Rplcofdel_1 Rinitiation Q220, dist(exponential) nohr

streg Recodeage H001_ZONE Reclocation Recodeedu Recodeocupation Recode_marital Wealthquin RecodeANCnum Rplcofdel_1 Rinitiation Q220, dist(exponential) nohr tr

streg Recodeage H001_ZONE Reclocation Recodeedu Recodeocupation Recode_marital Wealthquin RecodeANCnum Rplcofdel_1 Rinitiation Q220, dist(weibull) nohr

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streg i.Recodeage i.H001_ZONE i.Reclocation i.Recodeedu i.Recodeocupation i.Recode_marital i.Wealthquin i.RecodeANCnum i.Rplcofdel_1 i.Rinitiation i.Q220, dist(weibull) time nohr

streg i.Recodeage i.H001_ZONE i.Reclocation i.Recodeedu i.Recodeocupation i.Recode_marital i.Wealthquin i.RecodeANCnum i.Rplcofdel_1 i.Rinitiation i.Q220, dist(weibull) nohr tr

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estimates stats pstwei

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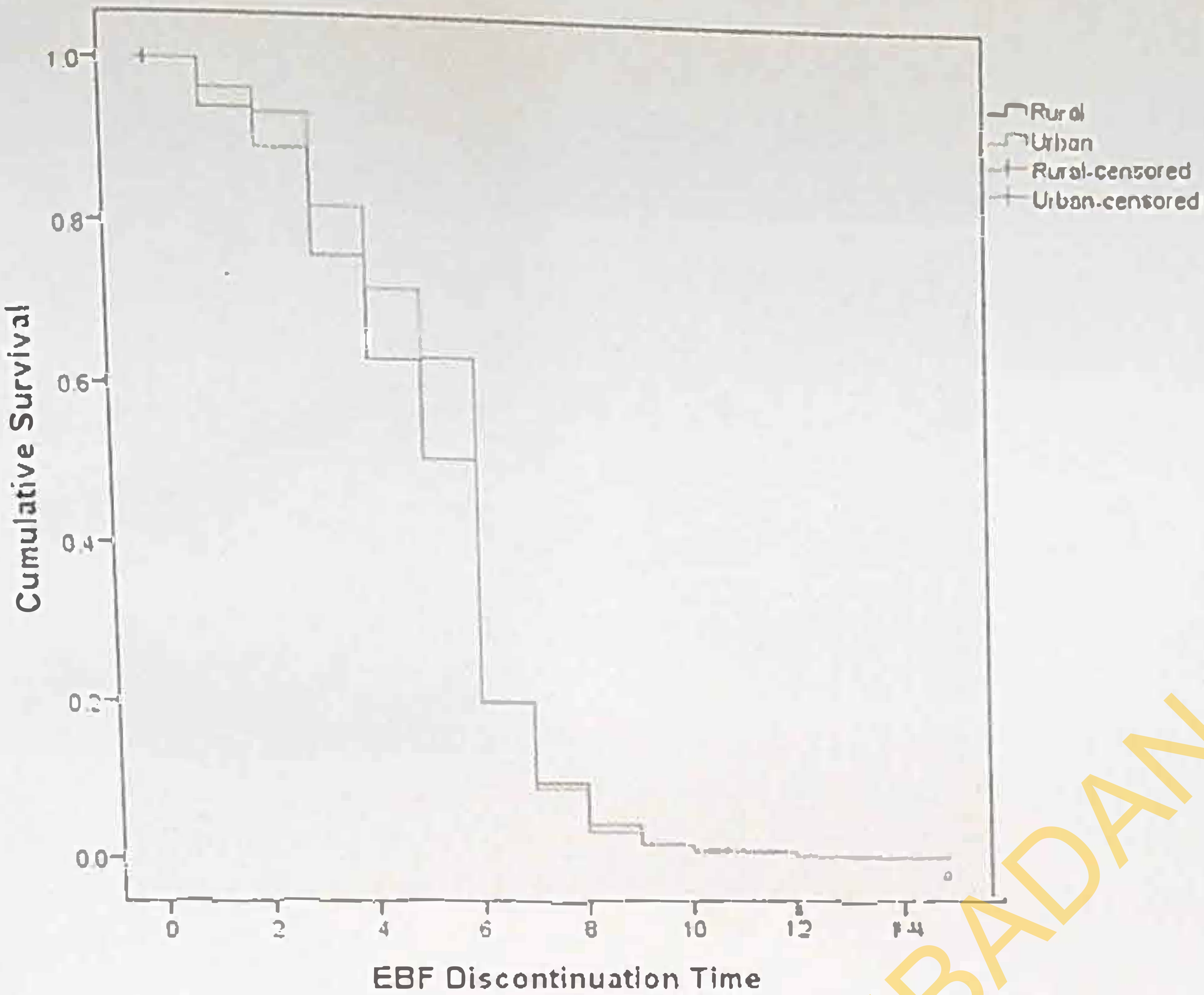
estimates table, stats(chi2 df N aic bic) style(oneline) estimates stats pstwei pstcox

Appendix 2: Kaplan Meier Curve of Significant Predictors

Appendix 2.1: Kaplan Meier Curve of Mothers Locality



Appendix 2.2 Kaplan Meier Curve of Child Place of Delivery