University of Nairobi

School of Mathematics

ISSN: 2410-1397

Master Project in Biometry

Effect of breastfeeding practices on infant and child mortality in Africa: Systematic review and meta-analysis

Research Report in Mathematics, Number XX, 2021

Maureen Mutiso

September 2021

Submitted to the School of Mathematics in partial fulfilment for a degree in Masters of Science in Biometry

Master Project in Biometry **University of Nairobi**
September 2021

Effect of breastfeeding practices on infant and child mortality in Africa: Systematic review and meta-analysis

Research Report in Mathematics, Number XX, 2021

Maureen Mutiso

School of Mathematics
College of Biological and Physical sciences
Chiromo, off Riverside Drive
30197-00100 Nairobi, Kenya

Master Thesis
Submitted to the School of Mathematics in partial fulfilment for a degree in Masters of Science in Biometry

Submitted to: The Graduate School, University of Nairobi, Kenya

Abstract

Objective: Lack of exclusive breastfeeding for infants withi the age of 0 and 6 months and no breastfeeding for children aged 6 to 24 months is linked to increased odds of death before the second birthday. Infant mortality in these age groups is due to bot infectious and non-infectious causes. We examine the existing evidence for impact of proper breastfeeding on all-cause mortality in children aged 0 to 24 months in Africa.

Methods: We carried out a systematic search of the literature to examine the influence of other breastfeeding practices versus EBF on mortality rates in the initial 180 days post birth and the effect of no breastfeeding versus any breastfeeding type on mortality rates between 6 and 24 months post birth. We Performed our search in the PubMed and Cochrane Library databases. Data obtained was analyzed used the Generic Inverse Variance Method using the R Software, and heterogeneity was assessed using forest plots.

Results: The pooled effect size (Odds Ratios) for the difference in mortality between infants who were predominantly breastfed vs those that were fed on breast-milk alone was found to be 1.15, 95% CI [1.05; 1.27]. This implies that predominantly breastfed children were 15% more likely to die between the months of 0-6 compared to children who were fed on breast-milk alone. Compared to infants who were fed solely on breast-milk, infants that were not breastfed were 9.64 times more likely to die (OR = 9.64 95% CI [8.01; 11.62], Three studies). Compared to infants between the ages of 6-23 months who got any form of breastfeeding, infants who never received any breast-milk were 3.19 times more likely to die (OR = 3.19 95% CI [1.42; 7.15] Five studies).

Conclusion: The findings from our study are consistent with previous research on the protective ability of proper breastfeeding habits on infant and child mortality. They support the WHO recommended practices of EBF for the half an year and continued/partial breastfeeding up to the second birthday as key interventions in reducing infant and child deaths in these age groups.

Master Thesis in Mathematics at the University of Nairobi, Kenya.
ISSN 2410-1397: Research Report in Mathematics
©Maureen Mutiso, 2020
DISTRIBUTOR: School of Mathematics, University of Nairobi, Kenya

Declaration and Approval

I the undersigned declare that this dissertation is my original work and to the best of my knowledge, it has not been submitted in support of an award of a degree in any other university or institution of learning.

August 23,2021

Signature Date

Maureen Mutiso
Reg No. I56/24860/2019

In my capacity as a supervisor of the candidate's dissertation, I certify that this dissertation has my approval for submission.

August 20, 2021

Signature Date

Dr Nelson Onyango
School of Mathematics
University of Nairobi,
Box 30197, 00100 Nairobi, Kenya.
E-mail: onyango@uonbi.ac.ke

August 23., 2021

Signature Date

Prof Hesborn Wao
African Population and Health Research Center,
Box 10787, 00100 Nairobi, Kenya.
E-mail: hwao2020@gmail.com

Contents

Abstract ... ii

Declaration and Approval ... iv

Figures and Tables ... ix

List of Abbreviations ... x

Acknowledgments ... xi

1 Introduction ... 1

1.1 Background ... 1
1.2 Objectives ... 3
1.2.1 Overall objective ... 3
1.2.2 Specific objectives ... 3
1.3 Justification of Study ... 3

2 Literature Review ... 5

2.1 Introduction ... 5
2.1.1 Breastfeeding Practices and Infant Mortality from Infectious Diseases ... 5
2.1.2 Breastfeeding and Infant Mortality from Non-infectious Causes ... 10

3 Methods ... 13

3.1 Types of studies ... 13
3.2 Study participants ... 13
3.3 Study interventions/exposures ... 13
3.4 Search strategy used for identifying studies ... 14
3.5 Data extraction ... 16
3.6 Statistical methods used for data analysis ... 16
3.6.1 Odds Ratios and Relative Risk ... 16
3.6.2 Generic Inverse Variance Method ... 19
3.6.3 Forest plots ... 19
3.6.4 Test of heterogeneity among the studies ... 19
3.6.5 Theory of Fixed Effects and Random Effects Model ... 21

4 Results ... 23

4.1 PRISMA Diagram ... 23
4.1.1 Inclusion Criteria ... 23
4.1.2 Exclusion Criteria ... 23
4.2 Final articles for meta-analysis ... 25
4.3 Pooled Effect Sizes ... 26
4.3.1 Forest plot for pooled effect of breast feeding practices on mortality rates for children aged 0-6 months - Predominant VS Exclusive breast feeding ... 26

4.3.2 Forest plot for pooled effect of breast feeding practices on mortality rates for children aged 0-6 months - Partial VS Exclusive breast feeding ... 26

4.3.3 Forest plot for pooled effect of breast feeding practices on mortality rates for children aged 0-6 months - No Breast feeding VS Exclusive breast feeding ... 28

4.3.4 Forest plot for pooled effect of breast feeding practices on mortality rates for children aged 6 to 23 months - No Breast feeding Vs Any type of breastfeeding ... 29

5 Discussion ... 30

5.0.1 Strengths and Limitations ... 31

6 Conclusion ... 32

Bibliography ... 33

Figures and Tables

Figures

Figure 1. Prisma Diagram 24
Figure 2. Comparing Predominant VS Exclusive breast feeding between 0-6 months) 26
Figure 3. Comparing Partial VS Exclusive breast feeding between 0-6 Months........ 27
Figure 4. Comparing No Breast feeding VS Exclusive breast feeding between 0-6 Months........ 28
Figure 5. Comparing No Breast feeding vs Any type of breastfeeding between 6-23 Months 29

Tables

Table 1. Sample table to explain Odds Ratios and Relative Risk 16
Table 2. Final articles for meta-analysis 25

List of Abbreviations

ACI's	Acute Respiratory Infections
DHS	Demographic and Health Surveys
EBF	Exclusive Breastfeeding
HR	Hazard Ratio
IMCR	Infant and Child Mortality Rate
OR	Odds Ratio
PBF	Partial Breastfeeding
RCT	Randomized Controlled Trials
RR	Relative Risk
RSV	Respiratory Syncytial Virus
SIDS	Sudden Infant Death Syndrome
SRMA	Systematic Review and Meta-analysis
U2M	Under-2-Mortality
UNICEF	United Nation Children's Fund
WHO	World Health Organization

Acknowledgments

I am grateful to God Almighty for gifting me with life,good health and abundant grace to study. I sincerely thank my supervisors Dr N. Onyango and Prof.H. Wao for their dedicated input into this thesis. Their wise counsel and feedback went a long way in making this project a success. I also wish to acknowledge my family for supporting me in the intense study period.

Maureen Mutiso

Nairobi, 2021.

1 Introduction

1.1 Background

Infant mortality remains a critical area of concern as far as children health and survival is concerned in Africa. The death of babies before their second birthday continues to be a challenge not only in Kenya but in other developing and under developed nations in Africa. According to UNICEF's latest child mortality report published in September 2020, an estimated 2.6 million children whose age is below 5 years died in 2019 in the African region. Additionally, it is important to note infant deaths account for approximately 70% of the total under-5-mortality (UNICEF, 2021). The Sub-Saharan Region, made up of 44 nations located south of the Sahara Desert, accounted for over 90% of all the total deaths in Africa in 2019 (UNICEF, 2021). Statistics released by the World Bank further revealed that the mortality rate in Africa was 76 deaths per 1000 live births and the highest as compared to other regions in the world (World Bank, 2021). Other regions had much lower rates with Europe and Central Asia at 8 and North America at 6 while North Africa and Middle East was at 22 per 1000 births.

Under-2-Mortality in Africa is fueled by various causes among them transmittable and non-transmittable diseases. According to WHO, the major causes of infant and child mortality in Africa are Pneumonia, Malaria, Diarrhea and Pre-term birth complications. Data obtained from the WHO website shows that Pneumonia accounted for 16% of the total deaths in 2016 while Diarrhea and Malaria accounted for 20% of total deaths in children whose age is below two years of age. It is important to note that 45% of all U2M in Africa is attributed to malnutrition as an underlying factor as revealed in a study conducted in South Africa (Itaka & Omole, 2020). The neonatal period which is a critical phase that determines survival rate has also in the past had a high mortality rate of 28 deaths per 1000 live births and main cause been Neonatal Sepsis and birth complications. These facts point to the conclusion that majority of deaths in children under the age of 2 are caused by Infectious diseases which are preventable.

The WHO has in the past and continually put great emphasis on the need for all nations in the WHO African region to cooperate in lowering the high ICMR in Africa. The health watchdog recommends many interventions that if properly practiced can significantly reduce U2M. One of such interventions is optimal infant feeding practices as well as adherence to laid out vaccination schedules. WHO continually gives and updates guidelines on the optimal breastfeeding habits for babies under the age of 2 years. The different breastfeeding categories are defined as below:

1. Exclusive Breastfeeding- The baby is fed on breast milk only from the nursing mother or from a wet nurse. This category allows vaccines and other medicines as the only other fluids that can be offered to the baby before 6 months (Organization et al., 2008).
2. Predominant Breastfeeding- Under this practice, the infant is fed on breast-milk as the main source of nutrients (Organization et al., 2008). However, the child can be offered water and other water-based fluids like fruit juices.
3. Partial/Complimentary Breastfeeding- Babies on this feeding program are fed on breast-milk as well as other solid foods and infant formula (Organization et al., 2008).

Additionally, the WHO recommends optimal breastfeeding practices that can boost immunity among infants and children under 2. These practices are initiation to breastfeeding before the lapse of the initial 60 minutes post birth and feeding on breast milk alone until the baby turns 6 months old (WHO, 2009). Further, mothers are advised to practice complementary feeding and continued breastfeeding up to the age of 2 years for maximum immunity against childhood diseases (WHO, 2009).

The recommendations on optimal infant feeding habits by WHO are based on scientific research conducted in Africa and other continents linking proper breastfeeding and reduced infant mortality rates. Numerous studies have pointed to the importance of breastfeeding in boosting infant's immunity and thus bringing down the ICMR .Timely initiation to breastfeeding has been found to increase the odds of survival for babies under the age of 2 according to findings from a study by Neovita Group (Group et al., 2016). Further findings have revealed that optimal breastfeeding has a protective ability against Diarrhea which is among the top causes of U2M in Africa (Ogbo et al., 2017).

Three more studies based in Africa have determined that the WHO breastfeeding practices have protective effects against ARIs including pneumonia and Bronchiolitis (Shi et al., 2015; Ahmed et al., 2020; Troeger et al., 2017). These, amongst many other studies, highlight the significance of breastfeeding in reducing infant deaths among many other key factors.

The present study will pool results from all eligible studies and come up with more robust effect estimates that can be confidently relied upon in implementing the WHO recommended infant feeding practices.

1.2 Objectives

1.2.1 Overall objective

To assess the evidence for the effect of breastfeeding practices on infant mortality from all causes

1.2.2 Specific objectives

i. To conduct a systematic review to identify relevant papers that studied the effect of breast feeding practices on infant and child mortality in Africa.

ii. To determine the effect Non-breastfeeding,predominant or partial infant wet nursing in the first six months of life compared to exclusive breastfeeding on infant mortality.

iii. To determine the effect of lack of breastfeeding between 6 and 24 months of age compared to any form of breastfeeding on child mortality.

1.3 Justification of Study

The link between breastfeeding and child mortality has been widely researched in Africa. This fact implies that there are many individual researches that have investigated and reported the impact of optimal breastfeeding practices and the risk of death under infants and children aged 2 years and below. Each of these studies employs a unique study design to generate results, unique sample size and different age groups are assessed for each study. For instance, Zhao et al. (2020) uses secondary data from DHS and a sample size of 215,000 participants in assessing the impact breastfeeding has on IMR within the within the initial 180 days of life (Zhao et al., 2020). A different research carried out in Ethiopia in 2020 used a prosperity matching concept and a sample size of 4,000 participants to assess the impact of breastfeeding practices on ICMR from ARIs and Diarrhea Ahmed et al. (2020). Several other reviews and analyses investigated the effect of best breast-feeding practices on mortality from Malaria, obesity and malnutrition related complications across Africa.

The already existing research on this subject is wide yet diverse with regards to methods, cause of mortality, sample sizes and breastfeeding categories assessed. In order to be able to draw more robust conclusions on the subject, our present study pools results from the different studies that meet our eligibility criteria. Some of the main advantages of a SRMA is increased precision as the pooled result is obtained from more studies and provide more convincing evidence (Deeks et al., 2019). Further, our SRMA will provide a solid base upon which recommendations based on the results can be relied upon. According to Wao et al in their detailed book chapter on the rationale and methods of conducting SRMA, the health sector requires recommendations based on precision and high level reliability which is achieved through SRMA (Wao et al., 2017). The other reason why this study is important is because despite having many SRMAs on the subject, none has focused solely on studies performed within the African Continent.

2 Literature Review

2.1 Introduction

In this section, we examine in details literature that has in the past discussed the relationship between exclusive breastfeeding and infant mortality. These studies have been carried out in different nations within the African Continent.

2.1.1 Breastfeeding Practices and Infant Mortality from Infectious Diseases

The African continent has witnessed an increase in research on the association between optimal breastfeeding practices and Under-2 Mortality. This is fueled by existing facts that show that over 40% of infant and child deaths occur in Africa. Further, WHO recommends proper breastfeeding practices as one of the main interventions in curbing Infant and child deaths and this has contributed to more research in the field (WHO, 2009).

A recent study conducted by Zhao et al. (2020) provides an in-depth analysis of the relationship between infant and child deaths and breastfeeding practices. The research was based in Africa and covered 35 nations within the Sub-Saharan area making it by far the most robust study on this subject. The study categorized breastfeeding practices as exclusive (nothing else fed to the baby except breast-milk and vaccines), Predominant (breast-milk together with other fluids like water and juices), and partial (breastfeeding to together with solid foods and /or baby formula) (Zhao et al., 2020). Findings from this pooled analysis revealed that children not breastfed in the initial six months post birth were much more exposed to death before reaching their second birthday compared to those who were breastfed. Further evidence showed that babies breastfed for a period shorter than six months had more chances of mortality than their counterparts on wet-nursing as per WHO recommended practice of up to 24 months. Concerning our study, these findings cement our hypothesis that optimal breastfeeding practices significantly reduce the risk of Under-2-Mortality.

Infant and child mortality in Africa is a major health concern for governments, Non-profit organizations, and all stakeholders in the health sector. One major cause of these deaths is diarrhoea diseases especially for children under 5 years. It is estimated that out of the 2,100 deaths that occur in children aged zero to five years globally due to Diarrhea, three quarters occur in Africa (Ogbo et al., 2017). Further findings revealed that 42% of these deaths happened in the Sub Saharan African region which includes 44 nations located to the south of the Sahara Desert. A research carried out in 2017 by Ogbo et al. (2017) revealed that one of the main causes of the high diarrhoea diseases morbidity and mortality rates in this region is sub-optimal infant feeding practices. The study used DHS data from 9 countries with the highest cases of diarrhea to investigate the association between deaths from the disease and infant feeding practices. Results from this study revealed that timely introduction to breast-milk and EBF for the first 6 months reduced the odds of contracting and dying from diarrhea by 80% (Ogbo et al., 2017).Additionally, the initiation to complementary foods include solid foods and formula based milk before the expiry of 6 months greatly increased the risk of acute diarrhoea disease and mortality from the same. Findings from this research resonate with the objectives of our study in measuring the pooled impact of EBF versus other baby feeding habits on children aged 0 to 6 months in relation to all-cause mortality in African countries.

Despite the spirited emphasis put on the importance of breastfeeding across the globe, most countries still report low numbers of infants on EBF. A recent study was conducted by Motsa, Ibisomi, and Odimegwu (2016) to investigate the relationship between feeding practices among infants and mortality rates among babies aged less than a year in the Southern part of Africa. The study employed a cox proportional hazards method to analyze demographic data of infants from Lesotho, Zambia, Zimbabwe, and Swaziland (Motsa, Ibisomi, and Odimegwu, 2016). Findings from this research work reveal that 82% of infants in the regions under study are partially breastfed while only 12% are on EBF. According to Motsa et al. (2016), only 6% of babies below one year were not breastfed at all. Evidence from this study indicates that an infant mortality rate of 500 deaths per 1000 births was recorded among infants who were never breastfed. This is in comparison to a rate of 30 deaths per 1000 births among infants on EBF and PBF. Exclusive breastfeeding was particularly found to be significant in lowering mortality in infants with a hazards ratio of 0.03 and a confidence interval (CI:0.02- 0.04). It is important to note that this association was identified after controlling for other covariates including the mother's wealth status, birth parity, birth weight, and area of residence. The study analyzed infant deaths from all infectious diseases that affect infants and not just one cause of mortality. As evidenced by results from this research work, any form of breastfeeding is beneficial in reducing infant mortality although EBF reduces infant deaths by the greatest margin.

The first six months of life form a critical phase of an infant's life. The survival rates in this age depend on among other factors the time of breastfeeding initiation and the feeding practice after the first 72 hours of life. A study conducted in Ghana and Tanzania by the Neovita Study Group expounds on the importance of breastfeeding in early infancy by using results from three randomized control studies. According to this study, initiating breastfeeding within the first 60 minutes post birth reduced the chances of neonatal mortality by 15% compared to those babies introduced to breastfeeding within 2 to 23 hours after birth (Group et al., 2016). This is majorly achieved through less exposure to contamination through other feeding practices like formula milk and solid foods. Further, babies fed on breast milk alone for the initial 6 months post birth were more likely to survive until they attain 24 months compared to the babies on partial or no breastfeeding. This study synchronizes with the objective of our study which is to examine the impact of EBF for the initial 6 months post birth on infant and child mortality. Neovita Study group establishes that early initiation to breast milk has great potential to lower deaths among babies aged 0 to 30 days. In addition to this, having infants exclusively breastfed for the first 6 months after birth also lowers their risk of both morbidity and mortality.

Transmittable diseases account for over half of deaths in young ones below the age of two years globally. In a bid to assess how breastfeeding relates to infant and child mortality among HIV-positive mothers, World Health Organization embarked on a pooled analysis study of data from eight nations. The study focused on children below two years and analyzed the effect of not breastfeeding at all on infant and child mortality (Victoria et al., 2000). According to the evidence from this research work, the odds of death from contagious diseases is six-fold higher in babies not breastfed compared to their breastfed counterparts in the first 60 days post birth (Victoria et al., 2000). The level of protection offered by breastfeeding reduces with age and this is explained by reduced dependence on breast-milk and the initiation to complementary feeding. It is necessary to take note of the fact that higher breastfeeding levels were observed in mothers with low education status as well as low social-economic status. (Victoria et al., 2000) notes that this is particularly important as far as breastfeeding practices among HIV-positive mothers are concerned. Babies born to HIV-positive mothers enjoy more protection against infectious diseases if they are breastfed through the first 24 months post birth (Victoria et al., 2000). While this is a true finding, the decision to breastfeed among these mothers entirely depends on them and their families. These findings can thus be of significance to healthcare workers who attend to affected mothers as they can advise accordingly on the importance of breastfeeding in reducing deaths among infants.

One of the most critical aspects of breastfeeding is the initiation of the practice to a newborn. Not only is breastfeeding important but also the time from when a baby is born to the start of breastfeeding as far as infant mortality is concerned. Edmond et al. (2006) investigated the effect of untimely breastfeeding initiation on mortality in the neonatal period through a randomized control trial in Ghana. The study had a sample of 10,947 breastfed infants assessed during their first one month of life which is the neonatal period (Edmond et al., 2006). The study reveals that 71% of the infants were put on breast-milk within 24 hours post birth and 99.7% within 72 hours after and that 70% of the babies on EBF in the initial 28 days after birth. Edmond et al. (2006) establish that there is a fourfold higher risk of death among neonates who are given milk-based fluids and solids together with breast milk. The research further revealed that the risk of infant deaths in the first 28 days after birth increases significantly with the longer the time taken to initiate breastfeeding from one hour of life to the seventh day. Introducing neonates to breastfeeding 24 hours after birth places the baby at a 2.4-fold increased risk of death during the initial 28 days post birth (Edmond et al, 2006). This effect holds significant even when neonates at a higher risk of death are excluded from the study analysis. Edmond et al. (2006) further revealed that 16% of deaths among neonates could be evaded if all newborns were breastfed within the one day post birth and 22% within the first 60 minutes. This research work points to the importance of not only breastfeeding infants but also initiating it within the shortest time possible after birth.

Contagious diseases like Pneumonia continue to remain a threat to infant survival rates across the globe. According to Lamberti et al. (2013) , Pneumonia accounted for approximately 1.4 million deaths in 2010 occurring amongst children under 5 years. Lamberti et al. (2013) conduct a meta-analysis study whose key objective is to investigate whether breastfeeding affects infant and child mortality arising from Pneumonia. The study takes into account evidence from 10 cohort and case-control studies conducted in different regions of the world. The relative risk of infant mortality from Pneumonia was higher at 2.5 among partially breastfed infants as compared to babies under EBF (Lamberti et al., 2013). Infants who were not receiving any breast-milk were also had much more chances of succumbing to Pneumonia compared to their counterparts who received some breast milk. The risk of infant deaths from all causes was also higher for predominantly, partially and not breastfed infants in comparison to their counterparts on EBF (Lamberti et al., 2013). This study shines more light on the role played by breastfeeding in protecting infants and children of up to 24 months from death as a result of Pneumonia.

Acute Respiratory Infections (ARIs) remain one of the top five causes of mortality in infants and children whose age is below 2 in most low and medium-income nations (Troeger et al., 2017). Many studies have brought forth evidence linking optimal infant feeding practices to reduced risk of ARIs. Ahmed et al. (2020) conducted a study in 2020 in Ethiopia to examine the impact of proper breastfeeding habits on the risk of infant deaths from ARIs. The study employed multi-variate logistics regression using data from DHS Ethiopia. Findings obtained from this research revealed that children and infants initiated to breastfeeding within the first 120 minutes post birth were 81% less likely to contract ARIs in comparison to those not initiated on time (Ahmed et al., 2020). Infants and children not on EBF For the first 6 months were 65% more likely to fall ill with ARIs compared to their counterparts on EBF (Ahmed et al., 2020). Additionally, infants and children initiated to bottle-feeding within the initial 24 months post birth were 13% more likely to fall ill with ARIs as compared to those not on bottle-feeding (Ahmed et al., 2020). The Ethiopian-based research assesses the odds of contracting ARIs for the different breastfeeding categories and does not report on the mortality rates. Despite this aspect of the study, it plays a significant role in highlighting the link between the WHO-recommended baby feeding procedures and the risk of ARIs which account for many deaths in children aged two years and below. Concerning our study, these findings are consistent with our two objectives as well as our scope of assessing U2M from infectious diseases.

Infant mortality from ARIs and specifically Pneumonia and Bronchitis remain a cause of concern for all those in the health sector. Shi et al. (2015) carried out a Meta analysis to investigate the most significant risk factors for Pneumonia and Bronchitis. The researchers pooled results from 27 individual studies and assessed over eighteen risk factors of ARIs in children under 5 (Shi et al., 2015). The risk factors examined include maternal smoking, presence of siblings, birth weight, malnutrition, crowding, gender of the child, prematurity, parental education, exposure to indoor air pollutants, and breastfeeding (Shi et al., 2015). Three of the individual study results included in the pooled analysis showed a significant association between the risk of contracting Bronchitis and Pneumonia and lack of breastfeeding. Infants and children who were not breastfed for the first two weeks after birth and not on EBF for the first six months were 2.24 times likely to experience Pneumonia and Bronchitis caused by the Respiratory Syncytial Virus (RSV) (Shi et al., 2015). The fact that the study reviewed is a meta-analysis of over 20 studies provides confidence in the reported association between lack of optimal breastfeeding and risk of ARIs in young ones below the age of two. Lastly, the study builds on the aim of our study which is to provide pooled results that can be relied on in making robust conclusions on the protective ability of optimal breastfeeding practices.

The WHO has in the recent past ranked Malaria in the three with regard to high infant and child mortality rates in Africa. According to WHO, over 400,000 children aged below 60 months die from Malaria annually within WHO African Region only (WHO, 2021). Several studies have linked proper breastfeeding habits to a decreased risk of Malaria related mortality. One of such research works is a cross-sectional study executed by Brazeau et al. (2016) in Kinshasa, DRC in 2016. The study's main objective was to determine any association between EBF and the risk of clinical Malaria in 6-month-old babies. Brazeau et al. (2016) used over 400 infants on both EBF and NBF feeding practices to examine the impact of both on the risk of malaria infection and consequently clinical malaria. Findings from this research work revealed that infants not fed on anything else apart from breast-milk for the first 180 days post birth were 13% less likely to contract and die from clinical Malaria as compared to their non-breastfed counterparts (Brazeau et al., 2016). The study also assessed the effect of both bed net use and EBF on the risk of clinical malaria with findings revealing that the odds of survival greatly increased when EBF infants used treated mosquito bed nets (Brazeau et al., 2016). Findings from this study form a significant portion of the already available evidence of the protective ability of EBF against most causes of infant mortality. About the present research, the study gives evidence on one of the main causes of child mortality, Malaria, and thus strengthening our research on all-cause mortality.

2.1.2 Breastfeeding and Infant Mortality from Non-infectious Causes

Infant mortality is not only caused by infectious diseases but also by other causes such as Sudden Infant Death Syndrome (SIDS). Research has been ongoing to establish whether breastfeeding has any protective effect on babies in light of SIDS. Hauck et al. (2011) conducted a combined analysis study in 2011 to gather evidence on the protective effect breastfeeding has. The study incorporates eighteen case-control studies on breastfeeding and SIDS for which standard odds ratio is calculated. Hauck et al. (2011) established that babies who received whichever amount of breast-milk for any period were 60% less likely to die from SIDS by obtaining an OR of 0.40 and a 95% confidence interval of 0.35-0.44. Additionally, the study established that exclusive breastfeeding had an even higher protective ability against SIDS as infants on EBF were 73% less likely to die as a result of the same (Hauck et al., 2011). This particular study is significant in the study of infant mortality and breastfeeding. This is because it confirms the evidence of the protective ability of breastfeeding not only against infectious diseases but also as a result of non-infectious causes more so SIDS.

In recent years, there has been increased concern over the rise in cases of childhood obesity in both medium and high-income countries. In a bid to evaluate the relationship between breastfeeding and the likelihood of obesity in children, Yan et al. (2014) executed a pooled analysis of various researches reporting a significant relationship between breastfeeding and obesity in children. The meta-analysis used a total of 25 studies with over 220,000 participants from 12 countries (Yan et al., 2014). Further, the study uses the I-Squared statistic to assess the heterogeneity of the pooled studies and funnel plots to determine the level of publication bias. According to this research, breastfeeding is linked to a significantly decreased risk of obesity by 78% (Yan et al., 2014). Further findings from the study reveal that the duration an infant/child is breastfed has a dose-response effect on the likelihood of childhood obesity. This particular study strengthens the already available research evidence suggesting that wet-nursing not only has a protective ability against infectious diseases but also against lifestyle conditions like obesity. Obesity has in the recent past become a great health concern after WHO reported that 42 million children aged under five were obese in 2010 (Yan et al., 2014). This revelation formed the basis of increased research in the possible relation between breastfeeding and childhood mortality. This particular study strengthens the already available evidence that breastfeeding not only protects children against infectious but also non-infectious causes of mortality. It further resonates with our study on the protective ability of optimal breast-feeding practices in preventing U2M.

Malnutrition is one of the major underlying factors for exposure to diseases in children aged 24 months and below. Although malnutrition is not infectious, it increases the risk of children contracting and dying from infectious diseases due to critically compromised natural immunity levels. A study was carried out by Itaka & Omole (2020) to determine the factors linked to malnutrition in babies under the age of 60 months hospitalized in South Africa. The factors investigated in the study included the level of income for the parents, employment status, and breastfeeding history. Breastfeeding and income levels were found to be a significant factors as far as malnutrition is concerned among hospitalized children (Itaka & Omole, 2020). Additionally, lack of breastfeeding increased the odds of severe malnutrition among children under five years by 3.9 in comparison to their properly breastfed counterparts (Itaka & Omole, 2020). Severe malnutrition is linked to a much higher risk of death from both Pneumonia and Diarrhea which rank among the top five causes of U2M in Africa. This fact explains why it is important to emphasize the importance of adhering to the WHO-recommended babies' feeding procedures as a way of reducing malnutrition and consequently lowering IMRs in African countries.

3 Methods

3.1 Types of studies

This study was a systematic review and meta-analysis (SRMA) and it included randomized control trials (RCTs) and observational studies. The RCTs were both cluster and quasi-experimental randomised trials, while the observational studies were both cohort and case-control studies. The selection of eligible studies to include in the SRMA was further guided by formulating an answerable research question using the PICO (Population, Intervention, Comparison, Outcomes) framework criteria (Wao et al., 2017).

In this study, the population of interest was the infants aged 6 months and below and children within 6 to 24 months age group. The intervention was breastfeeding practices while the comparison was no breastfeeding or non-exclusive breastfeeding. Lastly, the outcome was the mortality of infants and children.

3.2 Study participants

This study meta-analysed studies that were done in Africa about the direct and indirect breast feeding effects practices on infant and child mortality. We considered infants below 6 months of age and children between 6 and 23 months of age.

We excluded studies that were not based within the African continent, those that reported results on only one cause of infant and child mortality, studies that had enrolled children aged over 24 months and studies not reporting Breastfeeding categories as per WHO guidelines.

3.3 Study interventions/exposures

To determine the effect of predominant, partial or non-breastfeeding in the first six months of life compared to exclusive breastfeeding on infant mortality - "predominant, partial or non-breastfeeding" was the exposure variable while "exclusive breastfeeding" was the control variable.

To determine the effect of non-breastfeeding between 6 and 23 months of age compared to any form of breastfeeding on child mortality - "non-breastfeeding" was the exposure variable while "any form of breastfeeding" was the control variable.

3.4 Search strategy used for identifying studies

The study searched both gray and published literature from PUB-MED and Cochrane Library. The search strategy and word combinations that was used to search all the databases are indicated below. Three independent reviewers - AK, MM and SM screened the abstracts and eliminated any irrelevant articles. The reviewers screened each of the perceived-relevant articles in-order to identify those that will be included in the meta-analysis.

COCHRANE Search Terms

ID Search

#1 - MeSH descriptor: [Breast Feeding] explode all trees

#2- infant mortality

#3 - child mortality

#4- Africa

#5 - #1 and #2 or #3 and #4

PubMed Search Terms

((Breastfeeding [Title/Abstract] OR "breast feed*"[Title/Abstract] OR breast*[Title/Abstract] OR breastfed*[Title/Abstract] OR "breast fed*"[Title/Abstract] OR "human milk" [Title/Abstract] or "bottle feed*" [Title/Abstract] or "bottle fed*"[Title/Abstract]) AND ("infant mortalit*"[Title/Abstract] OR "neonatal mortalit*" [Title/Abstract] OR "post-neonatal mortalit*" [Title/Abstract] OR "fetal death*"[Title/Abstract] OR "infant death*"[Title/Abstract] OR mortalit*[Title/Abstract] OR"child mortalit*" [Title/Abstract]) AND (Africa OR Kenya* OR Tanzania* OR Uganda* OR Namibia* OR Mozambique OR South Africa* OR Nigeria* OR Niger OR Gambia* OR Senegal* OR Guinea* OR Congo* OR Rwanda* OR Burundi OR Togo* OR Mali* OR Burkina Faso OR Zambia* OR Ghana* OR Somalia OR Sudan* OR "South Sudan*" OR Ethiopia* OR Eritrea* OR Lesotho OR Botswana OR Zimbabwe OR Angola OR Benin OR Cameroon OR "Central African Republic" OR CAR OR Chad OR Comoros OR "Democratic Republic of the Congo" OR "Republic of the Congo" OR DRC OR "Cote d'Ivoire" OR "Ivory coast" OR Djibouti OR "Equatorial Guinea" OR Gabon OR Guinea OR "Guinea-Bissau" OR Liberia OR Madagascar OR Malawi OR Mauritania OR "Sao Tome and Principe" OR Seychelles OR "Sierra Leone" OR Liberia OR Mauritius OR Swaziland OR Egypt OR Algeria OR Morocco OR Tunisia OR Libya OR Congo OR Comoros OR "Cabo Verde" OR)) NOT review[Title/Abstract] NOT editorial[Title/Abstract] NOT letter[Title/Abstract] NOT comment[Title/Abstract]

3.5 Data extraction

Data extraction from the final list of papers was done using spreadsheets organised to pick the authors' names, the publication year, the type of study, the sample sizes of the exposure and control groups and the number of participants that have the outcome of interest in each of the study groups.

3.6 Statistical methods used for data analysis

The study used MS Excel software for data entry, and the meta-analysis was performed using R-Software. The pooled estimates of the outcome (infant and child mortality) were calculated from the relative risks (RR) or Odds Ratios (OR) and their 95% confidence intervals (CI) and standard errors (SE) of the studies identified by the systematic review by the inverse variance method. Heterogeneity among the selected studies was investigated using forest plots and quantified using the I-Squared statistic.

3.6.1 Odds Ratios and Relative Risk

Table 1. Sample table to explain Odds Ratios and Relative Risk

Groups	Outcome	No-Outcome	Total
Experimental Group	a1	a2	a1 + a2
Control Group	a3	a4	a3 + a4
Total	a1 + a3	a2 + a4	a1 + a2 + a3 + a4

Given Table 1, the Odds of of disease among the groups is computed as:

$$\text{Odds of outcome among exposed group} = \frac{a1}{a2} \tag{1}$$

$$\text{Odds of outcome among non-exposed group} = \frac{a3}{a4} \tag{2}$$

$$\text{The OR is therefore computed as} = \frac{\text{Odds of outcome among exposed group}}{\text{Odds of outcome among control group}} \tag{3}$$

$$= \frac{a1 * a4}{a2 * a3} \tag{4}$$

The confidence interval for the Odds Ratio is given by,

$$CI(\log(OddsRatio))) = \log(OddsRatio) \pm Z_{(\alpha/2)}\,\mathrm{se}(\log(OddsRatio))) \tag{5}$$

Where

$$\mathrm{se}(\log(OR)) = \sqrt{(1/a1 + 1/a2 + 1/a3 + 1/a4)} \tag{6}$$

Using the same data in Table 1, the risk of outcome among the groups is computed as:

$$\text{Risk of outcome among experimental group} = \frac{a1}{a1 + a2} \tag{7}$$

$$\text{Risk of outcome among control group} = \frac{a3}{a3 + a4} \tag{8}$$

$$\text{The Risk Ratio is thus computed as} = \frac{\text{Risk of disease among experimental group}}{\text{Risk of disease among non-exposed group}} \tag{9}$$

$$= \frac{a(c + d)}{c(a + b)} \tag{10}$$

The confidence interval for the Risk Ratio is given by,

$$CI(\log(RiskRatio)) = \log(RiskRatio) \pm Z_{(\alpha/2)}\,\mathrm{se}(\log(RiskRatio)) \tag{11}$$

Where

$$\mathrm{se}(\log(RiskRatio)) = \sqrt{(1/a1 - 1/(a1+a3) + 1/a3 - 1/(a3+a4))} \tag{12}$$

3.6.2 Generic Inverse Variance Method

The inverse variance method (IVM) of pooling effect estimates in meta-analysis works for both dichotomous and continuous data and can be implemented in RevMan or R-software. In this study, we used R-software so that we produce a code that can make replication of our study straightforward. The IVM is one of the best methods of pooling estimates because it assigns studies weights that are proportional to the variance (square of the standard errors) of the effect estimates. This implies that bigger studies (sample size) which statistically tend to have smaller standard errors are given larger weights than smaller studies studies and this reduces the uncertainty of the pooled effect estimate Deeks et al. (2019).

For the weighting, the inverse of the variance $1/\hat{\sigma}_k^2$ of each study k is used. Then we calculate a weighted average of all studies:

$$\text{The generic inverse variance weighted estimate}(\hat{\theta}_F) = \frac{\sum_{k=1}^{K} \hat{\theta}_k/\hat{\sigma}_k^2}{\sum_{k=1}^{K} 1/\hat{\sigma}_k^2} \tag{13}$$

Where

$$\hat{\theta}_k \text{is the intervention effect estimated in the kth study (OR and RR).} \tag{14}$$

$$\hat{\sigma}_k \text{is the standard error of that estimate.} \tag{15}$$

3.6.3 Forest plots

We used forest plots to present the meta-analysis results in an easily digestable form. A forest plot is used to show the effect estimates and confidence intervals of each of the study and the meta-analysis (Lewis & Clarke, 2001; Deeks et al., 2019).

3.6.4 Test of heterogeneity among the studies

In practise, there are three heterogeneity measures which used to assess the degree of heterogeneity among studies during meta-analysis.

Assume that, k denotes the individual study, K denotes all studies in our meta-analysis, $\hat{\theta}_k$ is the estimated effect of k with a variance of $\hat{\sigma}_k^2$, and w_k is the individual weight of the study (i.e., its inverse variance: $w_k = \frac{1}{\hat{\sigma}_k^2}$.

Heterogeneity Measure 1: Cochran's Q

Cochran's Q-statistic is the difference between the observed effect sizes and the fixed-effect model estimate of the effect size, which is then squared, weighted and summed.

$$Q = \sum_{k=1}^{K} w_k \left(\hat{\theta}_k - \frac{\sum_{k=1}^{K} w_k \hat{\theta}_k}{\sum_{k=1}^{K} w_k} \right)^2 \tag{16}$$

Heterogeneity Measure 2: I^2 statistic

To test for heterogeneity among the studies the research used Higgins & Thompson (2002) - I^2 which is defined as the percentage of variability in the effect sizes which is not caused by sampling error. It is derived from Cochran's Q statistic:

$$= \max \left\{ 0, \frac{Q - (K-1)}{Q} \right\} \tag{17}$$

The I^2 statistic is interpreted as follows. When $I^2 = 25\%$ its considered as low heterogeneity - when $I^2 = 50\%$, its considered as moderate heterogeneity while when $I^2 = 75\%$ its taken to be substantial heterogeneity.

Heterogeneity Measure 3: Tau-squared

τ^2 is the between-study variance in our meta-analysis. As we show in Chapter 4.2.1, there are various proposed ways to calculate τ^2

The study specifically used the I^2 statistic value to assess heterogeneity and to determine whether we conduct a fixed or random effects meta analysis.

3.6.5 Theory of Fixed Effects and Random Effects Model

Fixed Effects Models

When doing meta-analysis, the concept of fixed and random effects model is paramount. Under Fixed Effects Model, the assumption is that there's only one value of the treatment effect and all the trials or studies are estimating this effect. This implies that the differences in the individual studies' treatment effects are caused by sampling error. Assume that the true effect size is denoted as $\hat{\theta}$, and the effect size for study k is denoted as $\hat{\theta}_k$ and the sampling error is denoted as ε_k;

Then the effect size for study k assuming a fixed effects model is given by:

$$\hat{\theta}_k = \hat{\theta} + \varepsilon_k \tag{18}$$

Random Effects Models

Random Effects Models are different in that the assumption is there is a distribution of real values of the treatment effect or effect size depending on factors like duration of the study, dosages, location, etc - and that each study estimates its own value. Therefore, the goal of the random-effects model is not to estimate the one true effect size of all studies, but the mean of the distribution of true effects.

The true effect size in random effects models is therefore defined as:

$$\hat{\theta} = \mu + \zeta_k \tag{19}$$

This implies that the effect size of a study k is defined mathematically as:

$$\hat{\theta}_k = \mu + \zeta_k + \varepsilon_k \tag{20}$$

This second source of error is introduced by the fact that even the true effect size θ_k of study k is only part of an over-arching distribution of true effect sizes with mean μ

The decision on whether to interpret the fixed or random effects model depends on the between-study heterogeneity. In practice, it is very difficult to meta-analyse studies that are homogeneous and therefore random effects models are commonly used. If there's no evidence of between-study heterogeneity, then one should use a fixed effects model.

4 Results

4.1 PRISMA Diagram

4.1.1 Inclusion Criteria

- Studies based in Africa
- Studies reporting Infant mortality as the outcome variable
- Studies reporting all-cause mortality or mortality arising from infectious causes
- Studies that had their participants as infants and children under the age of 2

4.1.2 Exclusion Criteria

- Studies that were not based within the African continent
- Studies that reported results on only one cause of infant and child mortality
- Studies that had enrolled children aged over 24 months
- Studies not reporting Breastfeeding categories as per WHO guidelines

We conducted our search in May and June 2021. Out of the 4378 citations retrieved from the search, 4071 remained after we removed all the duplicates since were searching from different databases. A further 3,878 articles were excluded upon screening the title because of either the location of the study if stated in the title or the outcome stated by the title. The next screening was based on a review of the abstract which provided details the mortality measures examined. In this stage we only retained 54 full-text articles which were thoroughly assessed for competency. The last inspection phase was more rigorous and studies were excluded based on the breastfeeding categories assessed, the causes of mortality reported and the study participants enrolled in the research. After this stage, 8 studies were found to fit our inclusion/exclusion criteria and were selected for use in the Meta-analysis (Figure 1).

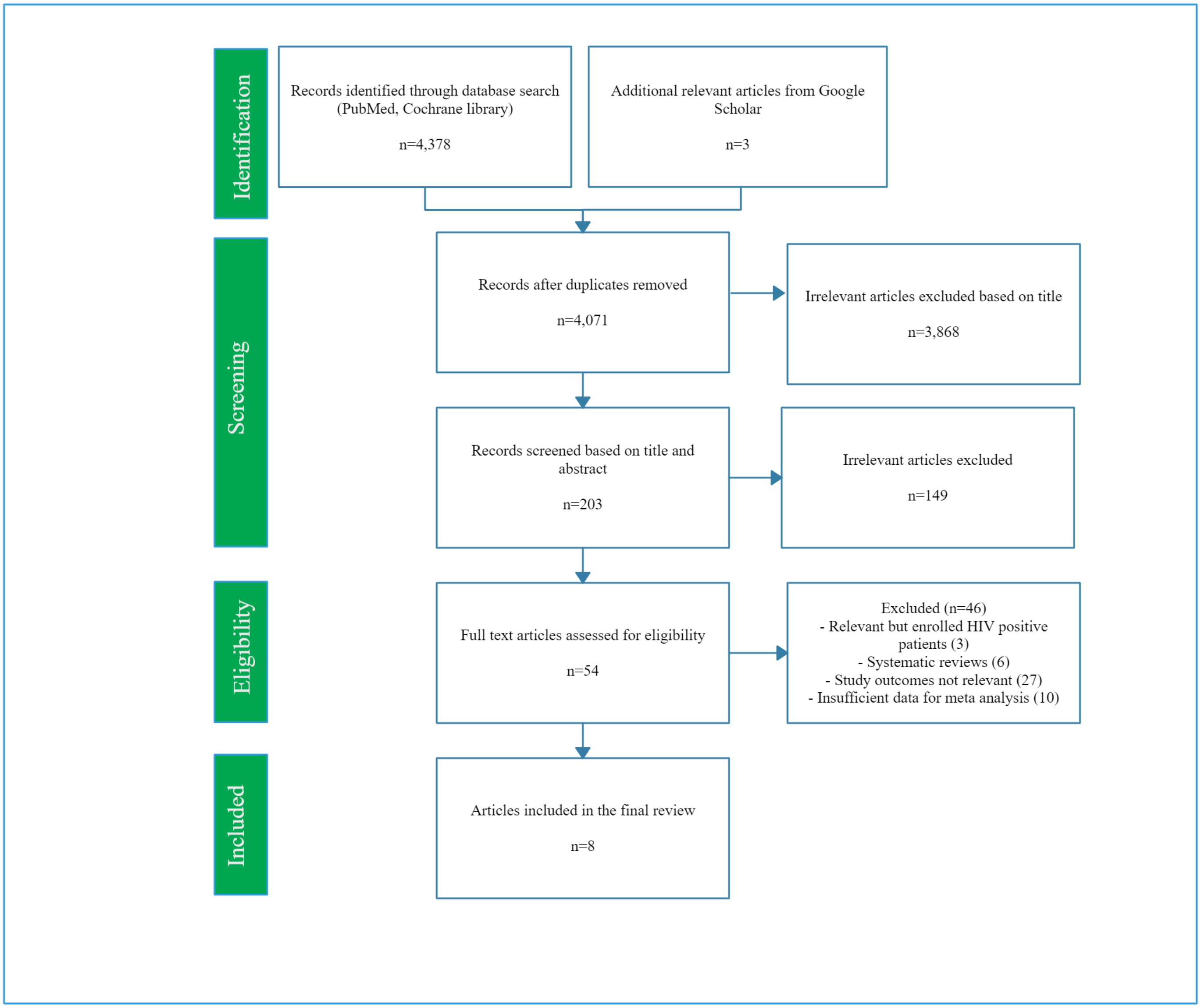

Figure 1. Prisma Diagram

4.2 Final articles for meta-analysis

The study found 8 studies as shown in the Prisma Diagram (Figure 1) and the table of final studies (Table 2).

Table 2. Final articles for meta-analysis

S No.	Author	Year	Country	Setting	Study Design	Sample Size	Breat feeding groups assessed	Effect Size	Age	Results (Mortality)
1	de Francisco	1993	Gambia	Rural, LMIC	Case–control	431	No vs. any	OR	12–23 months	0.9 (0.3–2.6)
2	Edmond	2006	Ghana	Rural, LMIC	Secondary data	10947	Predominant vs. exclusive	OR	3–28 days	1.45 (1.02–2.04)
							Partial vs. exclusive	OR	3–28 days	5.0 (2.86–9.09)
							Partial vs. excl./ predominant	OR	3–28 days	4.55 (2.63–7.69)
							Partial vs. predominant	OR	3–28 days	–
3	Garenne	2006	Senegal	Rural, LMIC	Cohort	3534	No vs. any	OR	12–23 months	2.0 (1.4–3.1)
4	Molbak	1994	Guinea Bissau	Semi urban, LMIC	Cohort	849	No vs. any	OR	12–23 months	3.45 (1.41–8.33)
5	Bahl	2005	Ghana India Peru	Urban/Periurban, LMIC	Secondary data from RCT	9424	Predominant vs. exclusive	OR	6–26 weeks	1.11 (0.6–2.07)
							Partial vs. exclusive	OR	6–26 weeks	1.88 (1.02–3.49)
							Partial vs. predominant	OR	6–26 weeks	1.69 (1.1–2.61)
							Partial vs. excl./predominant	OR	6–26 weeks	1.69 (1.1–2.63)
							No vs. exclusive	OR	6–26 weeks	8.99 (4.29–18.8)
							No vs. predominant	OR	6–26 weeks	8.08 (4.45–4.7)
							No vs. partial	OR	6–26 weeks	4.77 (2.65–8.61)
							No vs. excl./predominant	OR	6–26 weeks	8.33 (4.55–14.3)
6	Ghana VAST Study Team	1994	Ghana	Rural, LMIC	Cohort	1099	No vs. any	OR	12–24 months	7.9 (1.2–53.2)
7	Biks	2015	Ethiopia	Urban/Periurban, LMIC	Longitudinal	1752	No vs. exclusive	OR	Birth - 6 Months	10.37 (6.77-15.90)
8	Zhao	2020	Sub Saharan Africa	LMICs	Secondary Data from DHS	215576	Exclusive	OR	1—11 Months	1 (Reference)
						215576	Predominant	OR	1—11 Months	1.13 (1.02-1.25)
						215576	Partial	OR	1—11 Months	1.28 (1.10-1 49)
						215576	None	OR	1—11 Months	952 (7.68-11.79)
						211395	Exclusive	OR	12—23 Months	1 (Reference)
						211395	Predominant	OR	12—23 Months	1.02 (0.82-1.26)
						211395	Partial	OR	12—23 Months	0.92 (0.67-1.25)
						211395	None	OR	12—23 Months	8.19 (5.13-13.09)

4.3 Pooled Effect Sizes

4.3.1 Forest plot for pooled effect of breast feeding practices on mortality rates for children aged 0-6 months - Predominant VS Exclusive breast feeding

The pooled effect size (Odds Ratios) for the difference in mortality between infants who were predominantly breast fed vs those that were exclusively breastfed was found to be 1.15, 95% CI [1.05; 1.27] (Figure 2, Three studies). This effect size was significant at 0.05 as seen from the confidence interval.

This implies that predominantly breast fed children were 15% more likely to die between the months of 0-6 compared to children who were exclusively breastfed.

In this comparison, we used the fixed effects model because the between study heterogeneity was low as indicated by the I^2 of 0%.

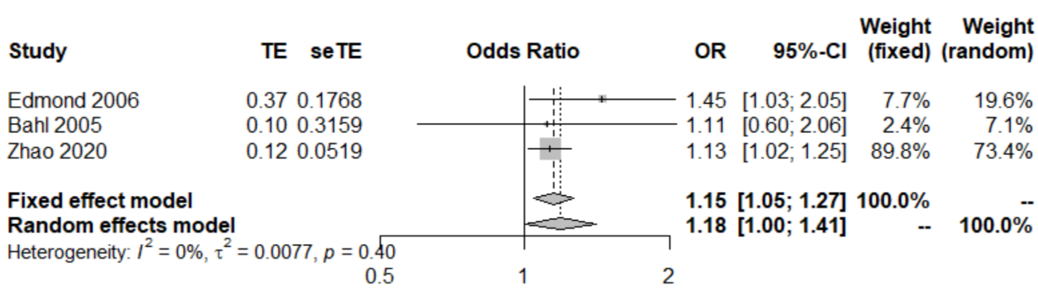

Figure 2. Comparing Predominant VS Exclusive breast feeding between 0-6 months)

4.3.2 Forest plot for pooled effect of breast feeding practices on mortality rates for children aged 0-6 months - Partial VS Exclusive breast feeding

The forest plot for comparing mortality between partial and exclusively breast fed infants is shown in Figure 3. The heterogeneity was found to be high (I^2 of 90%), and therefore we conducted a random effects model.

Compared to infants who were exclusively breastfed, infants that were partially breast fed were 2.22 times more likely to die (OR = 2.22 95% CI [1.01; 4.85], Three studies). This effect size was statistically significant.

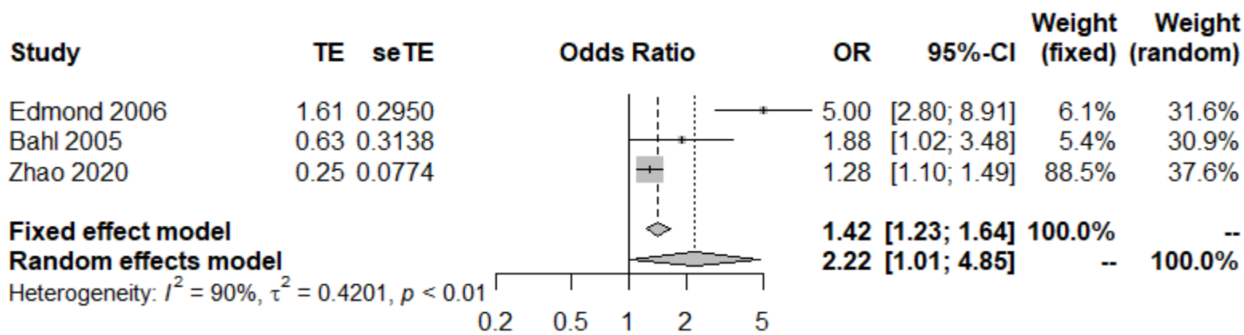

Figure 3. Comparing Partial VS Exclusive breast feeding between 0-6 Months

4.3.3 Forest plot for pooled effect of breast feeding practices on mortality rates for children aged 0-6 months - No Breast feeding VS Exclusive breast feeding

The forest plot for comparing mortality between infants aged 0-6 months that were not breast fed and exclusively breast fed infants is shown in Figure 4. The heterogeneity was found to be zero (I^2 of 0%), and therefore we conducted a fixed effects model.

Compared to infants who were exclusively breastfed, infants that were not breast fed were 9.64 times more likely to die (OR = 9.64 95% CI [8.01; 11.62], Three studies). This effect size was statistically significant.

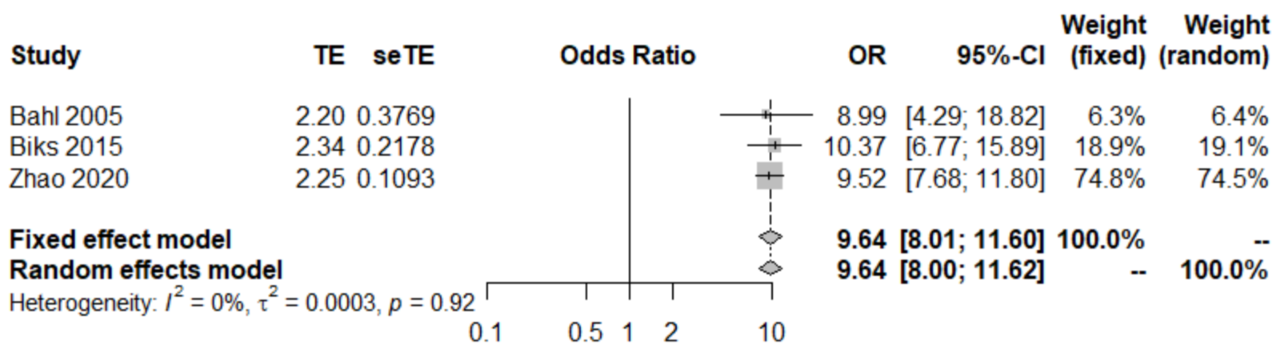

Figure 4. Comparing No Breast feeding VS Exclusive breast feeding between 0-6 Months

4.3.4 Forest plot for pooled effect of breast feeding practices on mortality rates for children aged 6 to 23 months - No Breast feeding Vs Any type of breastfeeding

The forest plot for comparing mortality between infants that were not breast fed vs those that received any form of breast feeding between 6 to 23 months is shown in Figure 5. The heterogeneity was found to be high (I^2 of 85%), and therefore we conducted a random effects model.

Compared to infants between the age of 6-23 months who got any form of breastfeeding, infants that were not breast fed were 3.19 times more likely to die (OR = 3.19 95% CI [1.42; 7.15], Five studies). This effect size was statistically significant.

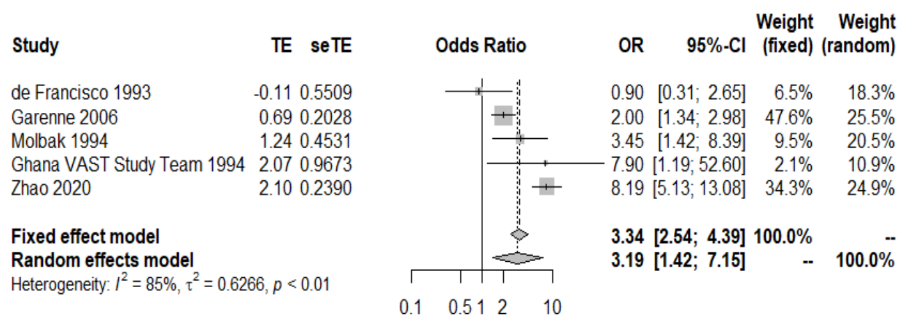

Figure 5. Comparing No Breast feeding vs Any type of breastfeeding between 6-23 Months

5 Discussion

The present research aimed to perform a systematic review of literature and pooled-analysis to examine the impact of breastfeeding practices on infant and child mortality in Africa. The main findings of the study were that i) infants below six months of age who were predominantly, partially and not breastfed were more likely to die in comparison to those that were exclusively breastfed with the highest risk in those who were not breastfed; ii) children between of 6-23 months who did not receive any form of breastfeeding were more likely to die in comparison to those who received any form of breastfeeding.

These findings are in line with other systematic reviews and meta-analyses that were done globally and outside Africa.

Zhao et al. (2020) for instance, conducted a secondary data analysis using DHS data in Sub-Saharan countries and found that children that were not on breast milk in the initial six months of life had a higher risk of death before reaching their second birthday who were breastfed. Further evidence showed that babies breastfed for a period shorter than six months were also at a higher risk of mortality than those breastfed as per WHO recommended practice of up to 24 months.

Similarly, Ogbo et al. (2017), in their study, revealed that timely introduction to breast milk and EBF for the initial six months post birth reduced the odds of contracting and dying from diarrhoea by 80%. Additionally, the start of complimentary feeding before the expiry of the initial six months post birth increased the risk of acute diarrhoea disease and mortality.

Also, Lamberti et al. (2013) performed a pooled-analysis using ten cohort and case-control studies in different world regions. They found that the relative risk of infant mortality from Pneumonia was higher at 2.5 among partially breastfed infants than babies under exclusive breastfeeding. Infants who were not receiving any breast milk were also at a much higher risk of succumbing to Pneumonia than their counterparts who received some breast milk. The risk of infant deaths from all causes was also 1.48 times higher for predominantly, partially and not breastfed young ones respectively as compared to those on exclusively breastfeeding.

This current study continues to shine more light on the role played by breastfeeding in protecting infants and children of up to 24 months from death caused by all mortality causes and more so contagious causes.

5.0.1 Strengths and Limitations

Our study was more inclusive as it incorporated results from studies that examined all-cause mortality and not just one particular cause. Additionally, the present study focused solely on Africa unlike other meta-analysis studies that studied results from Africa mixed up with those from other continents. The major limitation of our study is that we did not include any research results for deaths from HIV. This could pose a challenge of under-estimation particularly in countries with high cases of HIV infections.

6 Conclusion

Findings from the present study reinforce the WHO recommended infant feeding practices These practices are exclusive breastfeeding for babies aged 0-6 months and breastfeeding combined with feeding on healthy solid foods up to the age of 24 months. These feeding habits if put into practice can significantly lower the infant and child mortality rates in Africa.

Bibliography

Ahmed, K. Y., Page, A., Arora, A., Ogbo, F. A., Maternal, G., & collaboration (GloMACH), C. H. R. (2020). Associations between infant and young child feeding practices and acute respiratory infection and diarrhoea in ethiopia: A propensity score matching approach. *PloS one*, *15*(4), e0230978.

Brazeau, N. F., Tabala, M., Kiketa, L., Kayembe, D., Chalachala, J. L., Kawende, B., … Yotebieng, M. (2016). Exclusive breastfeeding and clinical malaria risk in 6-month-old infants: a cross-sectional study from kinshasa, democratic republic of the congo. *The American journal of tropical medicine and hygiene*, *95*(4), 827.

Deeks, J. J., Higgins, J. P., Altman, D. G., & Group, C. S. M. (2019). Analysing data and undertaking meta-analyses. *Cochrane handbook for systematic reviews of interventions*, 241–284.

Edmond, K. M., Zandoh, C., Quigley, M. A., Amenga-Etego, S., Owusu-Agyei, S., & Kirkwood, B. R. (2006). Delayed breastfeeding initiation increases risk of neonatal mortality. *Pediatrics*, *117*(3), e380–e386.

Group, N. S., et al. (2016). Timing of initiation, patterns of breastfeeding, and infant survival: prospective analysis of pooled data from three randomised trials. *The Lancet Global Health*, *4*(4), e266–e275.

Hauck, F. R., Thompson, J. M., Tanabe, K. O., Moon, R. Y., & Vennemann, M. M. (2011). Breastfeeding and reduced risk of sudden infant death syndrome: a meta-analysis. *Pediatrics*, *128*(1), 103–110.

Higgins, J. P., & Thompson, S. G. (2002). Quantifying heterogeneity in a meta-analysis. *Statistics in medicine*, *21*(11), 1539–1558.

Itaka, M. B., & Omole, O. B. (2020). Prevalence and factors associated with malnutrition among under 5-year-old children hospitalised in three public hospitals in south africa. *African Journal of Primary Health Care and Family Medicine*, *12*(1), 1–7.

Lamberti, L. M., Zakarija-Grković, I., Walker, C. L. F., Theodoratou, E., Nair, H., Campbell, H., & Black, R. E. (2013). Breastfeeding for reducing the risk of pneumonia morbidity and mortality in children under two: a systematic literature review and meta-analysis. *BMC public health*, *13*(3), 1–8.

Lewis, S., & Clarke, M. (2001). Forest plots: trying to see the wood and the trees. *Bmj*, *322*(7300), 1479–1480.

Motsa, L. F., Ibisomi, L., & Odimegwu, C. (2016). The influence of infant feeding practices on infant mortality in southern africa. *Maternal and child health journal*, *20*(10), 2130–2141.

Ogbo, F. A., Agho, K., Ogeleka, P., Woolfenden, S., Page, A., Eastwood, J., & Group, G. C. H. R. I. (2017). Infant feeding practices and diarrhoea in sub-saharan african countries with high diarrhoea mortality. *PloS one*, *12*(2), e0171792.

Organization, W. H., et al. (2008). *Indicators for assessing infant and young child feeding practices: part 1: definitions: conclusions of a consensus meeting held 6-8 november 2007 in washington dc, usa.* World Health Organization.

Shi, T., Balsells, E., Wastnedge, E., Singleton, R., Rasmussen, Z. A., Zar, H. J., … others (2015). Risk factors for respiratory syncytial virus associated with acute lower respiratory infection in children under five years: Systematic review and meta–analysis. *Journal of global health*, *5*(2).

Troeger, C., Forouzanfar, M., Rao, P. C., Khalil, I., Brown, A., Swartz, S., … others (2017). Estimates of the global, regional, and national morbidity, mortality, and aetiologies of lower respiratory tract infections in 195 countries: a systematic analysis for the global burden of disease study 2015. *The Lancet Infectious Diseases*, *17*(11), 1133–1161.

Victoria, C., et al. (2000). Effect of breastfeeding on infant and child mortality due to infectious diseases in less developed countries: a pooled analysis. *Lancet (British edition)*, *355*(9202), 451–455.

Wao, H., Onyango, R., Kisio, E., Njatha, M., & Onyango, N. O. (2017). Strengthening capacity for monitoring and evaluation through short course training in kenya. *African Evaluation Journal*, *5*(1).

WHO. (2009). *Infant and young child feeding: model chapter for textbooks for medical students and allied health professionals*. World Health Organization.

Yan, J., Liu, L., Zhu, Y., Huang, G., & Wang, P. P. (2014). The association between breastfeeding and childhood obesity: a meta-analysis. *BMC public health*, *14*(1), 1–11.

Zhao, M., Wu, H., Liang, Y., Liu, F., Bovet, P., & Xi, B. (2020). Breastfeeding and mortality under 2 years of age in sub-saharan africa. *Pediatrics*, *145*(5).