UNIVERSITY OF CAPE COAST

WOMEN'S EMPOWERMENT, CHILD-FEEDING PRACTICES AND CHILDHOOD ANAEMIA IN GHANA

JOSEPHINE AKUA ACKAH

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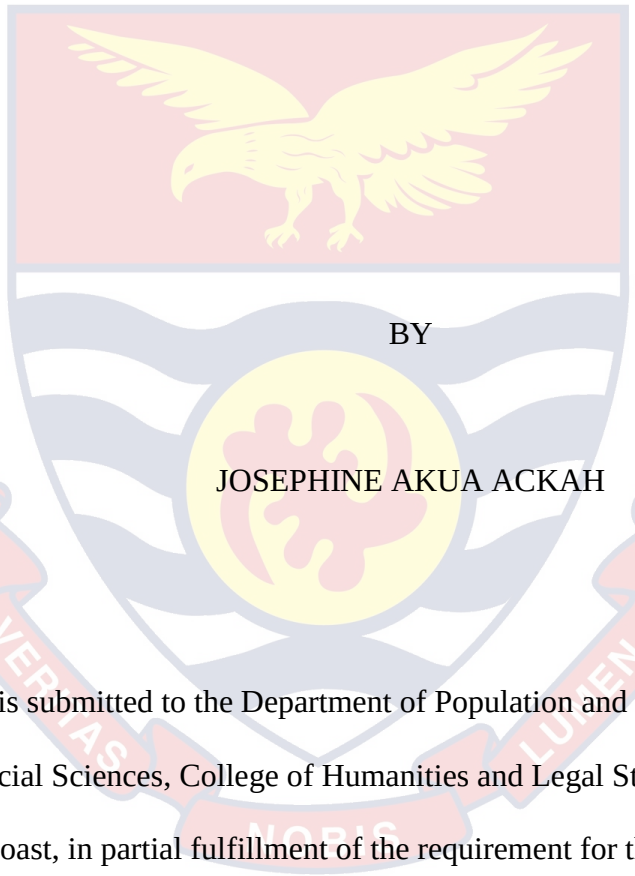

BY

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DECLARATION

Candidate's Declaration

I hereby declare that this thesis is the result of my own original research and that no part of it has been presented for another degree in this university or elsewhere.

Candidate's Signature……Date…….

Name……

Supervisor's Declaration

I hereby declare that the preparation and presentation of the thesis were supervised in accordance with the guidelines on supervision of thesis laid down by the University of Cape Coast.

Supervisor's Signature……Date……

Name ……

ABSTRACT

This study examined the associative effect of women's empowerment (decision making and violence justification attitudes) and child feeding practices (iron rich foods and Vitamin A supplements) on childhood anaemia in Ghana. Specifically, it explored if these factors account for any of the observed variation in childhood anaemia at the household, community and district levels as well as whether the association between child feeding and childhood anaemia is dependent on women's empowerment. Pooled data from three rounds of the Ghana Demographic and Health Surveys – 2003, 2008 and 2014 – was analyzed to explore the conceptualized associations by employing multilevel logistic regression methods. The findings showed that childhood anaemia is highly prevalent in Ghana. Among the empowerment indicators, only violence justification was significantly associated with the condition. For children whose mothers disapproved violence, the odds of being anaemic was lower (OR-0.74, 95%CI: 0.71-0.77). This however became insignificant after accounting for maternal education. Children's consumption of iron rich foods was significantly associated with childhood anaemia (OR-1.23, 95%CI: 1.03-1.47) but intake of Vitamin A supplements was not. Women's empowerment and child feeding did not account for any substantial amount of the observed variation in childhood anaemia at the household (3.6%), community (0%), and district levels (0%). The associative effect of child feeding practices on childhood anaemia was not dependent on women's empowerment. Interventions that address childhood anaemia should be attentive to identifying and targeting hotspot areas while strengthening advocacy for female education and programs that empower women against violence supportive attitudes.

KEYWORDS

Women's empowerment

Childhood anaemia

Child feeding practices.

Ghana

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DEDICATION

To my siblings

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LIST OF ABBREVIATIONS

DHS : Demographic and Health Survey(s)

GDHS : Ghana Demographic and Health Survey(s)

GHS : Ghana Health Service

GSS : Ghana Statistical Service

ICF : Inner City Fund

UNICEF: United Nations International Children's Emergency Fund

WHO : World Health Organization

CHAPTER ONE

INTRODUCTION

Background of the study

As an important public health problem, childhood anaemia, a condition characterized by haemoglobin levels below 11 g/dl (Alzain, 2012), poses a major threat to children's health. It leads to impaired physical, mental, motor, and language development and also increases the risk of mortality (Abebe, et al., 2018; Scott, Chen-Edinboro, Caufield, & Murray-Kolb, 2014). Despite efforts to ensure better child health, the prevalence of childhood anaemia has remained relatively high. Globally, it is estimated at 43% and the corresponding regional differentials show a higher burden of the condition in developing countries (World Health Organization (WHO), 2015). Regional estimates reveal that South-East Asia (53.8%), and Africa (62.3%) record the highest prevalence (WHO, 2015). In Ghana, the condition has persistently been high over a decade: 76% in 2003, 78% in 2008, and 66% in 2014 (GSS, GHS, & ICF International, 2015).

The causes of anaemia are multifactorial, but, about fifty percent of all cases are attributed to iron deficiency (Stoltzfus, Mullany, & Black, 2004). In addition to this, studies report on several socio-economic, demographic and health determinants of this condition. Children aged below two years, stunted, living in poorest households, whose parents have no education and who live in rural areas are more likely to be anaemic (da Silva, Fawzi, Cardoso, & ENFAC Working Group, 2018; Khanal, Karkee, Adhikari, & Gavidia, 2016; Moschovis et al., 2018; Nkulikiyinka, Binagwaho & Palmer, 2015; Qian-Qian, et al., 2017).

As a nutrient-deficient condition, childhood anaemia persists among children that receive poor nutritional and unhygienic care practices (Kraemer & Zimmermann, 2007). Ensuring better child-care practices in general and feeding, in particular, can lead to improved outcomes. The World Health Organization (2009) affirms the importance of optimal feeding for children and therefore recommends a set of infant and young child feeding practices which includes breastfeeding, intake of diversified foods, and nutrient supplements. These feeding practices are essential in improving children's health including their haemoglobin levels.

There are differential impacts of these feeding practices on childhood anaemia. Studies document that the more diversified children's food is, the better their haemoglobin levels (Belachew & Tewabe, 2020; Saaka, 2017; Woldie, Kebede &Tariku, 2015). Poor dietary diversity among children is associated with a 1.9 increase in the odds of a child being anaemic (Parbey et al., 2019). More specifically, foods with high iron rich contents are associated with lower odds of being anaemic for children (Kao, et al., 2019; Mya, Kyaw, & Tun, 2019; Prieto-Patron, Horst, Hutton, & Detzel, 2018; Visser, et al., 2020). Also, the intake of nutrient supplements such as vitamins, iron, and other minerals yields significant results, as it helps improve children's haemoglobin levels (Ekvall, Premji, & Bjorkman, 2000; Lannotti, Tielsch, Black, & Black, 2006; Munayco, et al., 2013). Regarding breastfeeding, studies report that it provides minimal benefits to children's haemoglobin levels due to the low iron content in breastmilk (Cai, Harding, & Friel, 2015; Clark, et al., 2017; Friel, Qasem, & Cai, 2018; Hipgrave, et al., 2014; Jia, et al., 2015)

Child feeding practices constitute one of the principal responsibilities of primary caregivers who are usually women (Ruiz & Nicolás, 2018). They play a key role in determining children's haemoglobin status through the quantity and quality of child-feeding. Women's ability to ensure the best child-feeding practices is also partly influenced by how empowered they are (Quisumbing & Smith, 2007). Kabeer (2001) defined the empowerment of women as their ability to contribute to strategic life choices in a context where this ability was previously denied to them. Empowerment positions women in a state of power where they can participate in decisions regarding themselves, their household, and communities (Kabeer, 2005; O'Neil, Domingo & Valters, 2014).

The theory of health empowerment postulates that when an individual is empowered, it facilitates his/her awareness to participate consciously in health care decisions (Shearer, 2004). Juxtaposing this with the women-child care nexus, it can be theorized that empowering women increases their ability to make prompt and good health decisions for their children; more specifically, participating consciously in better child feeding practices that can improve the health of children. This conceptualization is further underpinned by the Model of child-care framework (Urke & Mittlemark, 2015) that stipulates that the associative effect of child-feeding practices on child health outcomes is partly dependent on maternal resources of which empowerment is notable.

Women can be empowered in varied dimensions and this mainly includes economic, socio-cultural, familial/interpersonal, legal, political, and psychological (Malhotra, Schuler & Boender, 2002). Each dimension has varying impact on children's care and health outcomes. Regarding those that

examine the associative effect of women's empowerment on child feeding practices, common dimensions used are the economic, socio-cultural, familial/interpersonal, and legal (Alaofe, Zhu, & Burney, 2017; Na et al., 2015; Rehman, Ping & Razzaq, 2019; Sabroni & Quisumbing, 2018).

A synthesis of the findings indicates that, on average, women with high levels of economic, socio-cultural, and familial/interpersonal empowerment can ensure better feeding practices for their children (Alaofe, Zhu, & Burney, 2017; Na et al., 2015; Rehman, Ping & Razzaq, 2019; Sabroni & Quisumbing, 2018). Better child feeding practices, consequently, impact children's haemoglobin levels positively (Michelazzo, Oliveira, Stefanello, Luzia, & Rondo, 2013; Mya, Kyaw, & Tun, 2019; Scherbaum & Srour 2016), hence, suggesting a pathway that infers the potential influence of women's empowerment on childhood anaemia through feeding practices.

Ghana has experienced progress in women's empowerment over the past decades. The country's gender inequality index has reduced between 1995 and 2019 from 0.632 to 0.538 (UNDP, 2020). Underpinning this progress are overt and covert legal laws, policies, programs and advocacy to enhance the status of women in the country (Anyidoho & Manuh, 2010). Notable include the 1992 constitution, National Gender Policy, educational programs and advocacy against domestic violence (Anyidoho & Manuh, 2010; Dowuona-Hammond et al., 2020).

Evidence from the Ghana Demographic and Health Surveys (GDHS) also shows that indicators such as decision making, control over income, and attitude to violence which measure women's economic and familial/interpersonal empowerment, has progressed over the past decade. For

example, between 2003 and 2014, the percentage of women who participate in household decision-making increased by 27% while those that justify violence reduced by 20% (GSS, GHS, & ICF, 2015). With regards to control over income, it increased slightly from 58 percent in 2008 to 63 percent in 2014 (GSS, GHS, & ICF, 2015).

Alongside the improvement in women's status in Ghana is the decline in the prevalence of childhood anaemia from 78% in 2003 to 66% in 2014 (GSS, GHS, & ICF, 2015). Existing interventions that have contributed to this decline include the Essential Nutrition Actions (ENA), high dose vitamin A supplementation, and nutrition behaviour change communication (Ministry of Health, 2013). In the recent National Nutritional Policy (Ministry of Health & Ghana Health Service, 2016), some measures the Ministry of Health plans to adopt to prevent and control micronutrient deficiencies such as anaemia include food fortification and micronutrient supplementation.

These measures require the engagement of mothers who are children's primary caregivers (Ruiz & Nicolás, 2018). In the policy, the Ministry of Health acknowledged women's empowerment as one of the important nutrition-sensitive approaches (Ministry of Health & Ghana Health Service, 2016). The enhanced empowerment status of women in Ghana has the potential of improving children's feeding and consequently, their anaemia outcomes. Understanding the dynamics between women's empowerment and childhood anaemia in the Ghanaian context can be useful for future policies.

Statement of the problem

The direct association between women's empowerment and childhood anaemia has been investigated in few studies. Two of the studies were

conducted in Burkina Faso (Heckert, Olney & Ruel, 2019) and India (Ray, 2020). There were mixed results regarding the impact of empowerment on childhood anaemia from these two countries. Indicators of empowerment used were decision making and spousal communication (which measure familial/interpersonal empowerment). While in Burkina Faso (Heckert, Olney & Ruel, 2019), decision making and spousal communication were not significant predictors of childhood anaemia, in India, Ray (2020) reported contrarily that children belonging to women who participate in household decisions were significantly less likely to be anaemic. The inconclusiveness in findings suggests the need for further investigation while considering other indicators of empowerment and geographical contexts. In this study, the association of interest is examined in Ghana where little research attention has been advanced despite the improvement in women's empowerment over the period.

Children belong to different households, communities, and districts. Each of these socio-spatial hierarchical units – household, communities, and districts – have inherently varied socio-economic characteristics that make them different and therefore contribute to defining whether a child will be malnourished or not (Mokgatlhe & Nnyepi, 2014). The likelihood of being anaemic for children can therefore be influenced by the household, community, or district they belong to. In Ghana, Nikoi and Anthamatten (2013) reported that childhood anaemia is significantly clustered across hierarchical structures. Further geospatial findings on childhood anaemia in Ghana affirms this and report higher burden of the condition in some districts in the Upper East, Upper West and Brong Ahafo regions (Tampah-Naah et al.,

2019). While this is the case, these studies have not investigated the extent to which differences between households, communities and districts account for the clustered nature of the childhood condition. Furthermore, it is unknown whether women's empowerment and child-feeding practices account for any of the observed clustering in childhood anaemia at the household, community, and district levels.

Conceptually, the theory of health empowerment (Shearer, 2004) and Model of child-care (Urke & Mittlemark, 2015) suggest that women's empowerment is essential for better child-feeding practices which also has positive influence for children's haemoglobin levels. Existing studies have investigated this relationship in isolation – women's empowerment and child-feeding practices (Alaofe, Zhu, & Burney, 2017; Na et al., 2015; Rehman, Ping & Razzaq, 2019; Sabroni & Quisumbing, 2018); women's empowerment and childhood anaemia (Heckert, Olney & Ruel, 2019; Ray, 2020) and childhood anaemia and child feeding practices (Michelazzo, Oliveira, Stefanello, Luzia, & Rondo, 2013; Mya, Kyaw, & Tun, 2019; Scherbaum & Srour 2016). The indirect association can only be inferred. This study provides an empirical basis to test whether the associative effect of child feeding practices on childhood anaemia is dependent on women's empowerment levels.

This study addresses three important questions within the Ghanaian context. Does a mother's empowerment matter for children's anaemic status? Do women's empowerment and child feeding practices account for any observed clustering/variation in childhood anaemia at the household, community and district levels? Is the associative effect of child feeding practices on childhood anaemia dependent on women's empowerment?

Understanding these dynamics is important for decisions on interventions and policies that target the empowerment of caregivers as an essential remedy to mitigate the high levels of childhood anaemia in Ghana.

Research Objectives

The main objective of this study is to examine the associative effects of women's empowerment and child feeding practices on childhood anaemia in Ghana. The specific objectives of the study are as follows:

To examine:

1. the associative effect of women's empowerment on childhood anaemia in Ghana
2. if women's empowerment and child feeding practices account for some observed variations in childhood anaemia at the household, community, and district levels.
3. whether the effect of child feeding practices on childhood anaemia is dependent on women's empowerment.

Hypotheses

Given the conceptualized associations for women's empowerment, child-feeding practices, and childhood anaemia, which is also underpinned by the theory of health empowerment and Model of childcare, it is hypothesized that,

1. There is a significant and negative association between women's empowerment and childhood anaemia.
2. Women's empowerment and child feeding practices account for some of the observed variations in childhood anaemia at the household, community, and district levels.

3. The effect of child-feeding practices on childhood anaemia is significantly dependent on a mother's empowerment level.

Significance of the study

The findings of the study have the potential to contribute to policy decisions and strategies that will aid accelerate progress towards the national and global agenda of improving child health and women's empowerment as stipulated in the United Nations Sustainable Development Goals (SDGs) 2 and 5. Institutions such as the Ghana Health Service, UNICEF, Ministry of Gender and Social Protection and the Domestic Violence and Victim Support Unit can streamline the findings of this study into their respective advocacy and educational programs. Lastly, as a literary document, it will serve as an academic reference to researchers and students whose interests are advanced toward promoting women's empowerment and addressing childhood anaemia in Ghana.

Organization of the study

This study is organized into five chapters. Chapter One elaborates the need for this study and captures important elements such as background information to concepts, statement of the problem, objectives, hypotheses, and significance of the study. In Chapter Two, related studies and literary documents are systematically reviewed together with the theoretical and conceptual framework, underlying this study. The data and methods employed in examining the association between women's empowerment and childhood anaemia are presented in Chapter Three. While Chapter Four captures the results of the study and discusses it in tandem with existing studies and

theoretical underpinnings, Chapter Five summarises and draws conclusions on the key findings and provides recommendations.

Chapter Summary

This chapter provides background information on the linkages between women's empowerment, child-feeding practices, and childhood anaemia. It further identifies the gaps in the literature with particular emphasis on evidence from Ghana. The main aim of this study is to examine the association between women's empowerment, child-feeding practices, and childhood anaemia in Ghana by testing three hypotheses. Also included in this chapter is the significance of the study as well as how this study report is organized according to chapters.

CHAPTER TWO

REVIEW OF RELATED LITERATURE

Introduction

This chapter reviews relevant literature on the interrelationships between women's empowerment, child feeding practices, and childhood anaemia. Theories, empirical evidence, and conceptual framework guiding this study are critically reviewed. Literature search strategies that were used in retrieving information for the review, are also provided.

Literature search strategy

A comprehensive search strategy was adopted for this study to identify relevant studies and other literary documents that clearly define the relationships linking women's empowerment, child feeding practices, and childhood anaemia. Four academic databases were searched. They are PubMed, Science Direct, Cochrane Library and Google Scholar. In addition to these, the general Google platform was searched for other important documents. Inclusiveness of studies was limited to observational, experimental, commentaries, books, and reports for which information on women's empowerment, child feeding, and childhood anaemia was available. In Table 1, the specific search terms that were used in the databases mentioned above have been listed.

Restriction on the year of publication was set differently for empirical and non-empirical literature. Empirical studies on women's empowerment, child feeding, and childhood anaemia were included if they were published between 2000 and 2020. The duration of this period was sufficient (not too long or short) to amass adequate empirical evidence that reflects current issues

on women's empowerment, child feeding and childhood anaemia. Specific preference was given to those for which children aged below five years were study units. For non-empirical studies such as those that cover concepts and theories, there was no set time limit. Only studies that have been published in English were used for this review.

After screening all identified documents, 119 articles and/or reports were included for this chapter's review. Included literary documents were narratively synthesized under four main themes - concepts and dimension of women's empowerment; women's empowerment, child feeding practices, and childhood anaemia: interrelationships; other predictors of childhood anaemia and theoretical and conceptual framework.

Table 1: Search terms for literature review

Women's empowerment	**Feeding**	**Childhood anaemia**	**Others**
empowerment	*Feeding*	*Anaemia*	*Definition; dimensions*
agency	*Breastfeeding*	*Haemoglobin level*	*Theories, frameworks; models*
autonomy	*Diet*	*child, young children*	*Indicator, measure,*
control over resources	*Food*	*Children 6 -59 months*	*Prevalence; determinants; risk factors*
Decision making	*Nutrient supplement*		*Global; Africa; Ghana*
Bargaining power			
Women; woman; mother			

Source: Author's construct

Women's empowerment: Concept and dimensions

The advocacy for women's empowerment was borne out of the need to eliminate the endearing limitations and its associated forms of discrimination and violence associated with conservative and traditional roles ascribed to women by society (O'Neil, Domingo, & Valters, 2014). Societal structures that manifested through patriarchy, family practices and religious myths produced hierarchies and internalised beliefs that constrained women into a subordinate position (private sphere) (Stromquist, 1995) where they had limited participation in household decisions and exposure to the opportunities available in the public sphere; components of unfreedom. According to Sen (1999), unfreedom comprised all forms of barriers that could exist in the economic, social or political realms of society. The limiting traditional roles of women qualify as a case of unfreedom. Empowering women was therefore a strategy to promote freedom (capabilities to make things happen) whose beneficial achievements include improved maternal and child health outcomes. Its relevance has been advanced in the Sustainable Development Goal 5.

As a concept, women's empowerment has been defined by several actors (Batliwala, 1994; Chen & Tanaka, 2014; Kabeer, 2001; Sen, 1993). A common theme that runs across the definitions by these actors is the need for women to have more control over both internal and external influences. This includes autonomy, control over resources and income as well as enhanced self-reliance and esteem. A more widely accepted definition that has also been adopted for this study has been articulated by Kabeer (2001) who defined empowerment as "the expansion in women's ability to make strategic life choices in a context where this ability was previously denied to them". It thus

constitutes a process where women move from a state of powerlessness to a state with power (Kabeer, 2005; O'Neil, Domingo, & Valters, 2014).

Women's empowerment comprises four important components - resources, agency, outcome/achievement and process (Desai, 2010). Resources are those facilities and pre-conditions that enhance women's ability to exercise choices. They may be materialistic (physical, human, financial) or ideological (values, beliefs and attitudes) (Desai, 2010; Kabeer, 2005). Some enablers of women's empowerment include education, access to decent work, and social protection (Hunt & Samman, 2016). Women's ability to identify their goals and act upon them is what defines agency (Desai, 2010; Donald, Koolwal, Annan, Falb, & Goldstein, 2017;Kabeer, 2005). That is, women should have the right to make choices and be involved in determining the set of choices that are important for them and their families (Alkire, Meinzen-Dick, Quisumbing, Seymour, & Vaz, 2013). Outcome/achievement is the benefits or observable results associated with empowerment (Desai, 2010; Kabeer, 2005). They include improvement in wellbeing, education, health, economic and political participation. Lastly, empowerment is a process that changes over time (Desai, 2010; O'Neil, Domingo, & Valters, 2014). The movement from powerlessness and to a state of power (Stromquist, 1995; Lazo, 1993) requires time and the influence of both resources and agency.

The construct is multidimensional and manifests in diverse ways (Mandal, Muralidharan, & Pappa, 2017). The fact that a woman is empowered in one facet does not necessarily mean that she has power in all aspects. Pioneers like CIDA (1997), Stromquist (1995), and Malhotra, Schuler, and Boender (2002) identify common facets such as economic, political, legal,

social, as well as psychological/cognitive empowerment. In contemporary times, the six dimensions of empowerment as conceptualized by Malhotra, Schuler and Boender (2002) has received increased attention in women's empowerment literature. This is because the framework captures all aspects of empowerment and merges all the sub-domains that have been identified by other authors. The dimensions are economic, socio-cultural, familial/interpersonal, legal, political and psychological. In addition to these six dimensions, Malhotra, Schuler and Boender (2002) acknowledge that empowerment exists at different levels of social aggregation. These levels have been operationalized to include household, community and beyond community levels (regional, national and global). In Table 2, the six dimensions and the various indicators that can be used to measure them across the three levels of social aggregation are presented.

While these six dimensions are independent, they can also be interrelated. Economic and legal empowerment can foster and enhance other dimensions such as social, political, and familial/interpersonal empowerment and vice versa. For instance, women's access and control over income and other financial resources can increase their decision-making through bargaining and engagement in intra-household resource allocation (Paul & Kumari, 2018). Furthermore, studies show that women who have low financial independence are more likely to suffer from domestic violence (Desilets et al., 2019). Also, women's knowledge of legal rights and support system for domestic violence can contribute to downsizing their attitude and experience of domestic violence (Domingo & O'Neil, 2014). At the household level, women's decision-making and domestic violence attitudes and experience are

important indicators of familial/interpersonal empowerment. Additionally, having economic independence and knowledge of legal rights can improve women's self-esteem and thus, their psychological empowerment (Desilets et al., 2019; Domingo & O'Neil, 2014; Paul & Kumari, 2018).

Table 2: Dimensions of empowerment at the household, community and broader arenas

Dimension	Household	Community	Broader Arenas
Economic	Women's control over income, relative contribution to family support, access to and control of family resources	Women's access to employment, ownership of assets and land, access to credit, involvement and/or representation in local trade associations, access to markets	Women's representation in high paying jobs, women CEOs, representation of women's economic interests in macroeconomic policies, state and federal budgets
Socio-Cultural	Women's freedom of movement, lack of discrimination against daughters, commitment to educating daughters	Women's visibility in and access to social spaces, access to modern transportation, participation in extra-familial groups and social networks, shift in patriarchal norms, symbolic representation of the female in myth and ritual activities.	Women's literacy and access to a broad range of educational options, positive media images of women, their roles and contributions
Familial/ Interpersonal	Participation in domestic decision-making, control over sexual relations, ability to make childbearing decisions, use of contraception, access to abortion, control over spouse selection and marriage timing, freedom from domestic violence.	Shifts in marriage and kinship systems indicating greater value and autonomy for women, local campaigns against domestic violence	Regional/national trends in timing of marriage, options for divorce, political, legal, religious support for such shifts; systems providing easy access to contraception, safe abortion, reproductive health services
Legal	Knowledge of legal rights, domestic support for exercising rights	Community mobilization for rights, campaigns for rights awareness, effective local enforcement of legal rights	Laws supporting women's rights; access to resources and options; advocacy for rights and legislation; use of judicial system to redress rights violations.

Dimension	Household	Community	Broader Arenas
Political	Knowledge of political system and means of access to it, domestic support for political engagement, exercising the right to vote	Women's involvement or mobilisation in the local political system/campaigns, support for specific candidates or legislation, representation in loval bodies of government	Women's representation in regional and national bodies of government; strength as a voting bloc; representation of women's interests in effective lobbies and interest groups
Psychological	Self-esteem, self-efficacy, psychological wellbeing	Collective awareness of injustice, potential of mobilization	Women's sense of inclusion and entitlement; systematic acceptance of women's entitlement and inclusion

Source: Malhotra, Schuler and Boender (2002)

Empowerment in Ghana

In Ghana, several overt and covert policies, strategies and advocacies have been advanced toward promoting women's empowerment. Some include the National Population Policy (National Population Council, 1994), National Gender Policy (Ministry of Gender, Children and Social protection, 2015), Girl Child Education Advocacy (IBIS, UNICEF, SNV & WFP, 2009; Anyidoho & Manuh, 2010), as well as the Domestic Violence Act, instituted to provide legal protection for women (Allah-Mensah & Osei-Afful, 2017). Through donations and partnerships with international and non-governmental organizations, the country has been able to make progress on women's empowerment by implementing these policies and strategies (Anyidoho & Manuh, 2010). The Demographic and Health Surveys in Ghana report on some domains of women's empowerment and makes tracking progress possible. They include decision making, attitude to wife-beating, control over income, and ownership of property (GSS, GHS & ICF, 2015). These domains measure

the economic and familial/interpersonal empowerment dimensions at the household level.

On decision making, the 2014 GDHS recorded that 62 percent of women claim they take part in major household decisions; an improvement from the 35 percent, reported in 2003 (GSS, GHS, ICF, 2004). The areas of decision-making included health, major household purchases, and visits to family members. The percentage of women who agree to a husband being justified for wife beating for at least one specified reason reduced from 48 percent in 2003 (GSS, GHS, ICF, 2004) to 37 percent in 2008 and further to 28 percent in 2014 (GSS, GHS & ICF, 2015). The reasons were burnt food, arguing, neglecting children, going out without informing and refusing sex.

Furthermore, for control over income, the proportion increased from 58 percent in 2008 to 63 percent in 2014 (GSS, GHS & ICF, 2015). Ownership of assets enables women's economic empowerment and provides protection in the face of marital dissolution and abandonment. This domain was only addressed in the 2014 GDHS. The report revealed that 81 percent and 78 percent of women aged 15-49 did not own a house or any land respectively. This observation can be partially explained by the customary land tenure systems that favour men over women as well as the economic powerlessness that limits women's ability to own assets (Higgins & Fenrich, 2012).

The improvement in these domains of empowerment – decision making, attitude to violence, and control over income - has implications for household wellbeing; more specifically, children's health. From the 2014 GDHS report, there was lower prevalence of infant and under-five deaths

among children whose mothers partake in household decisions and disapprove of violence (GSS, GHS & ICF, 2015).

Women's empowerment, child feeding practices and childhood anaemia: inter-relationships.

Children are usually major beneficiaries when women are involved in intra-household resource allocation (Quisumbing & Smith, 2007). This may partly be informed by the caregiving roles they play which include feeding, hygiene practice and health care (Scantlan & Previdelli, 2013). On the account of child nutrition, feeding becomes paramount since it is directly associated with the provision of nutrients needed for physical body growth and development. As has been recommended by the World Health Organization (2009), age-appropriate feeding for children is essential -breastfeeding, complementary and full feeding as well as provision of nutrient supplements. These feeding practices provide substantial benefit for children's health including their haemoglobin levels. Empowering women means that giving them more power to engage in activities and allocation of resources with substantial benefits for children.

Women's empowerment and feeding practices

Studies that have explored the association between women's empowerment and child feeding practices have presented mixed results. Studies adopt diverse empowerment indicators, and the accruing results show significance in some settings while in others, empowerment is not so important. Regarding breastfeeding, Kulkarni et al. (2020) found in Nepal that women's decision-making and social participation were significantly and positively associated with early initiation and exclusiveness. Ziaei et al. (2014)

however reported that in Nicaragua, it was rather women with low autonomy that exclusively breastfed and continued to breastfeed their children. They explained that women with low autonomy are more likely to be economically constrained and beyond six months, they are not able to afford complementary feeds, thereby, resorting to continuous breastfeeding.

This brings to light the possible behavioural pattern of some empowered mothers regarding breastfeeding. Since they may be mostly the working and economically independent, they initiate complementary feeding earlier than expected. Some authors have called for empowerment interventions targeted at breastfeeding given its influential impact on child health outcomes (Hadisuyatmana et al. 2021; Kang, Choi & Ryu, 2008). Other evidence also points to the fact that women who resided in homes where violence is present stop exclusive breastfeeding earlier (Mezzavilla et al, 2017).

Regarding the association between women's empowerment and diet intake, the most common feeding measure used is the dietary diversity score (Ruel, 2003; WHO, 2008). The dietary diversity score summarises the number of foods out of the seven food groups given to a child. The seven food groups are (1) grains, roots and tubers; (2) legumes and nuts; (3) dairy products; (4) flesh foods; (5) eggs; (6) vitamin -A-rich fruits and vegetables and (7) other fruits and vegetables. Minimum dietary diversity is the consumption of at least four food groups out of the seven groups if breastfed and out of six groups if not breastfed, in the last 24 hours.

Different domains of empowerment have been used to examine the association between women's empowerment and child-feeding practices

leading to mixed results. Most studies are cross-sectional in nature and adopted different analytical methods. In some settings, some dimensions of empowerment have been important in promoting good feeding practices for children while in other contexts, it has not. Nonetheless, on average, a synthesis of the studies shows that having high levels of economic, social and familial/interpersonal empowerment impacts children's diet positively (Ickes et al., 2017;Na, et al., 2015; Rehman, Ping & Razzaq, 2019) .

Na et al. (2015) used the DHS from ten sub-Saharan African countries to assess the impact of economic, socio-familial (decision making regarding family visits, women's own health, and attitude to violence), and legal dimensions (women's judicial and legislative entitlements) of empowerment on infant and child feeding practices. Feeding practices were measured using minimum dietary diversity, minimum meal frequency, and minimum acceptable diet. They concluded that the three empowerment dimensions influence feeding practices differently. While the economic dimension was positively associated with minimum child feeding practices, socio-familial and legal empowerment showed negative and unclear patterns in associations, respectively. The overall empowerment score was also significantly associated with feeding practices in only three countries.

In Pakistan, Rehman, Ping, and Razzaq (2019) similarly used some domains of economic and socio-familial empowerment to investigate how important they are for child food and nutrition security. Specifically, they focused on women's land ownership and decision making in large-scale family purchase. They used the Pakistan DHS and adopted ordinary least squares regression model in analyzing the data. Their results revealed that women's

land ownership and autonomy in large-scale family purchases increased children's food and nutrition security. Juxtaposing this study with that of Na et al.'s, it can be concluded that using an index that combines several domains of empowerment can influence the associative effects observed. In Na et al.'s study, socio-familial empowerment couldn't ensure good child feeding practices. However, in Rehman et al.'s study, autonomy - one of the items used in computing the socio-familial empowerment score in Na et al.'s study - was an important predictor for child food and nutrition security. Again, the possibility that the results from the two studies are influenced by geographic specific issues is acknowledged.

In Uganda, Ickes et al. (2017) found that decision making was not important in determining infant and young child feeding practices, however, "empowerment" was. In this study, a special index that was based on items featuring women's freedom and control over their lives (based on a 10-step ladder of responses) was computed into an empowerment score. The items used in deriving this empowerment score relate to the socio-familial dimension of empowerment. This suggests that in Uganda, while one aspect of socio-familial empowerment is important for child feeding, another (specifically, decision making) is not. Latent across the three studies is the possibility of underestimating the role of empowerment when a composite index (that combines different indicators) is used.

Another important index that has been explored is the Women's Empowerment in Agriculture Index (WEAI). This index is a score computed from items relating to production, resources, income, leadership and time. Sabroni and Quisumbing (2018) used the Bangladesh Integrated Household

Survey (BIHS) which is nationally representative of rural Bangladesh to investigate how the WEAI influence dietary quality across the life course. Their findings revealed that a unit increase in WEAI resulted in an increase in children's diversity score by 45%. Similarly, a study in Benin found WEAI to be positively associated with a child's dietary diversity score but if only the child was a female (Alaofe, Zhu, & Burney, 2017).

There is little empirical evidence available to examine the direct associative effect of women's empowerment on children's nutrient supplement intake. Nonetheless, women who are able to purchase micronutrient supplements for their children are more likely to be educated and affluent (Gericke, Merlin, & Bekker, 2008). Since education and wealth are common enablers of women's empowerment, an indirect pathway can be assumed. That is, the more educated and wealthier a woman is, the higher the likelihood that she is empowered (Bushra & Wajiha, 2015; Khan, Shahbaz, Naz, Umber, & Amir, 2016) and in effect, capable of providing timely nutrient supplementation for her children. In the 2014 GDHS report, a higher percentage of children that received vitamin A and iron supplements were in wealthier households and belonged to women who were educated (GSS, GHS, ICF, 2015).

Child feeding practices and childhood anaemia

As women become more empowered with benefits toward children's feeding, improved child health outcomes including anaemia status is only imminent. A child (aged below five years) is considered anaemic if he/she has a haemoglobin level that is lower than 11g/dl (WHO, 2015). This condition increases the risk of dying among children and contributes to varying forms of

impairment and morbidity - physical, mental, motor and language (Abebe, et al., 2018; Scott, Chen-Edinboro, Caufield, & Murray-Kolb, 2014). The prevalence of childhood anaemia is high at the global (43%) and African level (62.3%) (WHO, 2015). In Ghana, the trends show an increase from 76% in 2003 to 66% in 2014 (GSS, GHS, & ICF International, 2015).

About half of all anaemia cases are as a result of iron-deficiency (Stoltzfus, Mullany, & Black, 2004). This means that children that do not receive the adequate amount of iron through feeding are more likely to be deficient. Studies that explore the association between feeding practices and childhood anaemia show differential impact of the three feeding practices identified above – breastfeeding, dietary intake and nutrient supplementation.

Breastfeeding and exclusively for six months have been recommended as an important child-care practice due to the health benefits it has for children (Scherbaum & Srour 2016). Nevertheless, for childhood anaemia, the evidence diverges from this expectation. Biologically, there is minimal iron content (0.4mg/L) in human breast milk (Friel, Qasem, & Cai, 2018; Cai, Harding, & Friel, 2015) and consequently, little impact for improved haemoglobin levels among children. Some studies in China (Clark, et al., 2017; Hipgrave, et al., 2014; Jia, et al., 2015) found that breastfeeding at later infancy did not protect children from iron deficiency anaemia. In Brazil, Marques, Taddei, Lopez and Braga (2014) reported that exclusive breastfeeding protected children from anaemia only in the first four months of life. Beyond this age, the risk of being anaemic increased.

Additionally, the evidence from Nigeria and Ghana corroborated that continuous breastfeeding has no beneficial impact on children's haemoglobin

levels (Buck, et al., 2019; Saaka & Galaa, 2017). Specifically, in Ghana, Saaka and Galaa (2017) found higher odds of 1.9 of being anaemic among children that were continuously breastfed compared to those that were not. Conclusively, breastfeeding does not have a substantial impact on children's haemoglobin levels irrespective of its duration. Given this, it is imperative that children aged six months and above are fed with more iron rich foods and provided with the needed nutrient supplements.

Dietary intake is key in supplementing the nutritional needs that were missed during breastfeeding. The more diversified children's food is, the more nutritious their diet and therefore, it is expected that the less likely they are to suffer from anaemia. In Ghana, Parbey et al. (2019) reported that children with poor dietary diversity were 9.15 times likely to be anaemic. Additionally, using an institution based cross-sectional study in Northeast Ethiopia, Woldie, Kebede and Tariku (2015) similarly concluded same. The findings of other studies also converge on the protective role a diversified diet has on children's anaemia status (Belachew & Tewabe, 2020; Saaka, 2017).

Even though a more diversified diet is important, in relation to anaemia, those that contain high quantities of iron is recommended (Domellof et al., 2014). Iron content is however not the same for all food groups. Almost all animal foods (meat, poultry, fish, shellfish, eggs), legumes and green leafy vegetables have high iron content of more than 1mg per 100 grams compared to the rest (National Institutes of Health, 2020). Though scarcely investigated in Ghana, other studies across the globe identify the consumption of iron rich foods as necessary in building children's haemoglobin levels (Kao, et al., 2019; Kebede, Engebertsen, Bilal, & Lindtjorn, 2020; Mya, Kyaw, & Tun,

2019; Prieto-Patron, Horst, Hutton, & Detzel, 2018; Visser, et al., 2020). Prieto-Patron, et al. (2018) used the DHS of 41 countries to examine the risk factors of childhood anaemia and found that the consumption of meat, poultry, fish and eggs significantly reduced the odds of being anaemic among children by 9%. In Myanmar, the consumption of iron-rich foods was significantly and inversely associated with moderate anaemia (Mya, Kyaw, & Tun, 2019) and in Costal Kenya, Kao et al. (2019) found lower haemoglobin levels among children that ate fewer eggs.

Nutrient supplements are also important for children's growth and development. With regards to childhood anaemia, however, the results from existing studies diverge and lead to unsettled conclusions. While some studies affirm the protective effect of nutrient supplements (Lannotti, Tielsch, Black, & Black, 2006; Ekvall, Premji, & Bjorkman, 2000; Munayco, et al., 2013; Michelazzo, Oliveira, Stefanello, Luzia, & Rondo, 2013), other studies find it to be ineffective (Thomas, Demirchyan, & Khachadourian, 2020; Nikoi & Anthamatten, 2013). Most of these studies were either randomised control trials, cross-sectional or cohort studies and they concluded that multiple-micronutrient supplements (contain more than one micronutrient including iron) provide more protection for children compared to the use of single micronutrient supplements (contains only one micronutrient. For example, only Vitamin A or iron).

In Ghana, the DHS documents children's intake of single micronutrient supplements such as Vitamin A and iron. In the recent survey, while the uptake of vitamin A among children increased by 9%, that of iron supplements had reduced by 4% (GSS, GHS, ICF, 2015). Vitamin A accelerates the process of

several stages of iron metabolism (Hurrell & Egli, 2010), making it an important micronutrient that serves as a protective measure against anaemia. Its associative influence on childhood anaemia has been addressed in various studies (Al-Mekhlafi, et al., 2014; Michelazzo, Oliveira, Stefanello, Luzia, & Rondo, 2013). In a double-blind randomized trial in Morocco, vitamin A was able to reduce childhood anaemia from 54% to 38% (Zimmermann, et al., 2006).

Globally, iron supplementation is used as an intervention strategy to reduce anaemia among children (WHO, 2015) with some studies reporting its intake as an important protective factor (Neuberger, Okebe, Yahav, & Paul, 2016; Lozoff, et al., 2016). Other studies have however found that iron supplementation alone does not suffice the iron needs in children (Thomas, Demirchyan, & Khachadourian, 2020; Nikoi & Anthamatten, 2013) and as such, combining it with other micronutrient and antimalarial drugs will provide more efficient results (Lannotti, Tielsch, Black, & Black, 2006; Ekvall, Premji, & Bjorkman, 2000; Munayco, et al., 2013; Michelazzo, Oliveira, Stefanello, Luzia, & Rondo, 2013).

Women's empowerment and childhood anaemia

The evidences provided above point to the fact that women's empowerment is a distal factor that influences childhood anaemia through child feeding practices. Studies that examined the direct association between empowerment and childhood anaemia report mixed findings. In Burkina Faso (Heckert, Olney & Ruel, 2019), women's decision-making and spousal communication was not important predictors of children's haemoglobin status, however in India, Ray (2020) found women's participation in household

decisions to be important, reducing the risk of anaemia among children. The indicators that have been examined so far measure the familial/interpersonal dimension of empowerment. Examining other dimensions and domains in other geographical settings is important in arriving at a more conclusive and synthesized explanation of whether women's empowerment is important at all for children's anaemia status.

Other determinants of childhood anaemia

Beyond the influence of women's empowerment and child-feeding, there are other socio-economic and demographic determinants of childhood anaemia which will be accounted for in this study. Globally and nationally, the literature converges at some common factors and can be broadly, categorized into child, maternal, household and community level factors.

The child level factors include age, sex, malnutrition, fever, malaria, deworming and intake of iron supplements. (da Silva, Fawzi, Cardoso, & ENFAC Working Group, 2018; Moschovis et al., 2018; Khanal, Karkee, Adhikari, & Gavidia, 2016; Nkulikiyinka, Binagwaho & Palmer, 2015; Qian-Qian, et al., 2017). Children who are below 2 years, stunted, feverish, diagnosed with malaria and had not taken iron supplements have higher odds of being anaemic. There are, however, inconsistencies in whether sex is an important predictor or not. In the works of Ewusie et al. (2014) and Semedo et. al., (2014), sex was not a significant predictor of childhood anaemia. In other contexts, it was. Studies in Northeast Ethiopia (Woldie, Kebede, & Tariku, 2015) and Ghana (Nikoi & Anthamatten, 2013) reported that males had a higher likelihood of being anaemic. This suggests that anaemia prevention strategies should be context specific and considerate to males, when

necessary. Furthermore, specifically in Ghana, the use of treated nets and intake of iron supplements were not significantly associated with childhood anaemia (Nikoi & Anthamatten, 2013).

Maternal factors also play crucial roles in determining the health of a child. Some maternal level factors associated with childhood anaemia include age, education, religion, body mass index, parity, intake of iron supplements and employment status. Children whose mothers have high education, Christians, low parity, normal body mass index and employed were significantly less likely to be anaemic (Dey, Goswani & Dey, 2013; Goswani & Das, 2014; Moschovis et al. 2018; Nkulikiyinka, Binagwaho & Palmer, 2015).

Common household and community factors that are significantly associated with childhood anaemia are wealth and place of residence. Several studies document that children belonging to the richest households and staying in urban areas have lower odds (Dey, Goswani& Dey, 2013; Goswani & Das, 2014; Moschovis et. al. 2018; Nkulikiyinka, Binagwaho & Palmer, 2015). This is expected because wealthier households and urban areas are respectively, associated with financial capability and accessibility opportunities to nutritional and health resources. In addition to these, Moschovis et al. (2018) reported family structure and water/sanitation as additional important determinants of childhood anaemia.

Alongside these determinants is the spatial clustering of childhood anaemia. Nikoi and Anthamatten (2014) found in their study that the prevalence of childhood anaemia was significantly clustered. Their study examined the 2008 GDHS using generalized linear mixed model. Tampah-

Naah et al. (2019) examined the spatial distribution of childhood morbidity using five rounds of the Ghana Demographic and Health Surveys (1993, 1998, 2003, 2008 and 2014). Regarding childhood anaemia, their study found that in 2014, hotspot areas constituted districts in the Upper East, Upper West, Northern and Brong Ahafo regions. They explained that in these districts, there are possible food insecurity issues coupled with poor dietary intake among children. Their findings suggest that socio-economic and child care characteristics differ across space in Ghana and in effect, result in the clustering of child health outcomes such as childhood anaemia.

Gaps

In the women's empowerment, child-feeding, childhood anaemia triad relationship, some gaps have been identified which are addressed in this study. As indicated earlier, in Ghana, women's status (empowerment) has improved with implications for child feeding. However, little research attention has been dedicated to understanding the direct association between women's empowerment and childhood anaemia.

Findings from empirical studies show that childhood anaemia is clustered. The sampling design of the Ghana Demographic and Health Surveys are in such a way that children are selected from households, households from clusters/communities and these clusters from districts. Using such data helps in understanding how childhood anaemia varies across these three levels of social residence but existing studies have not explored this focus. Also, it is important to investigate whether women's empowerment and child feeding practices account for any of the observed variations in childhood anaemia at the household, community and district levels since they constitute important socio-

economic determinants of childhood anaemia. This has also received little research attention.

Lastly, given existing evidence, it can be assumed that the effect of child-feeding practices on childhood anaemia is dependent on women's empowerment. However, the relationships have been studied in isolation: women's empowerment and child feeding; child feeding and childhood anaemia as well as empowerment and childhood anaemia. Establishing an empirical evidence to test whether this indirect effect exist is yet to be explored, especially, in the Ghanaian context. Information on this will be useful for interventions targeted at using empowerment as a medium to address childhood anaemia in Ghana.

Theoretical and Conceptual framework

The model of child-care is adapted as a conceptual framework for the study. This framework is further supported with the theories of structuration and health empowerment. These theories have been chosen because their underlying tenets adequately define the conceptualized relationship that associates women's empowerment with childhood anaemia as it operates through child-feeding practices.

The structuration theory

The structuration theory by Anthony Giddens expounds the relationship between individuals and the social forces that act upon them (Baber, 1991; Giddens, 1984, Whittington, 2010). Using terms such as agency and structure, Giddens portrays how individuals' control over life situations and external factors shape their life through a repetitive process over a period of time. This repetitive process which is characterized by mutual dependence between

agency and structure is referred to as structuration. Elaborating more on mutual dependence, he proposed that people have limited knowledge and control over their actions due to the influence from social structures; nonetheless, people constitute the elements that recreate the social structure and produce social change (Lamsal, 2012).

Cultural norms, socio-economic structures, and political systems (structure) determine the amount of power and control (agency) women wield in their households. In a society where structural systems operate in such a manner that women are empowered to make decisions and have control over resources, it increases their potential (agency) in offering the best care practices for their children leading to improved child health outcomes such as better haemoglobin levels. However, in a society where women's agency is limited (such as in a patriarchal society), decisions over child health are affected and the observed outcomes do not conform with the standard.

Structure and contextual factors

Whittington (2010) explains that structures are relatively enduring and general principles of system ordering. These general principles emanate from structural properties (rules and resources) of which political, economic, socio-cultural systems and geographical properties are inclusive (O'Neil, Domingo, & Valters, 2014). These structural properties can be considered as contextual factors that house and impact internal resources such as women's empowerment. These structures determine access and opportunities individuals can have. With respect to women's empowerment, contextual factors such as education, wealth, place of residence and religion are common enablers. Studies on women's empowerment have concluded on how being educated,

rich, and living in urban areas are essential in attaining high levels of empowerment (Bushra & Wajiha, 2015; Khan, Shahbaz, Naz, Umber, & Amir, 2016). With respect to religion, women who belong to the Islamic religion are less likely to be empowered than those in the Christian religion (Njoh & Akiwumi, 2012). This is because, compared to the Christian religion, the Islamic religion have stricter patriarchal rules and these influences the extent to which women can exercise their power.

Women's empowerment as agency and the concept of Power

From Gidden's perspective, agency is the capacity to act or not to act (Giddens, 1984; Whittington, 2010). Agency interacts with power and is enhanced by people's control over resources. This concept in relation to women's empowerment implies not only actively exercising choices but also engaging in activities that challenges power relations (Kabeer, 2005). Power manifests in varied forms. According to Rowlands (1997), power can be categorised into four main forms: power to, power over, power within and power with.

Placing these forms of power into the concept of empowerment in this study, "power over" explains the inherent will in women to resist any form of violence or oppression. Women's attitude to violence is a determinant of their experience with violence. When women feel their husbands are justified to beat them, it reduces their power to resist violence and vice versa. This has implications over other aspects of life such as child-care practices. "Power to" and "power with" position women at a stronger position where they can make and influence decisions (Rahman, 2013). In the context of this study, it includes decisions over health care, social events and household purchases.

Additionally, "power with" and "power to" is expressed by women's control over income which can accelerate their response to urgent issues which hither to were impossible due to financial constraints. Attitude to violence, control over income and decision-making collectively influence women's "power within". Favourable empowerment levels improve women's self-acceptance and self-respect and consequentially, have a greater potential to determine choices they make for themselves and their children.

Theory of health empowerment

The structuration theory explains women's empowerment and its associated contextual factors, but it does not provide a clear explanation to the pathway that links women's empowerment to childcare practices and childhood anaemia. This gap is addressed by the theory of health empowerment. Particularly influenced by the writings of Rogers, the theory recognizes health empowerment as emanating from a combination of personal (self-capacity) and socio-contextual resources (social networks and social service support) (Shearer, 2009). The dynamic process of consciously participating in a process of changing oneself and one's environment, recognising patterns and engaging inner resources for well-being (Shearer & Reed, 2004) constitute health empowerment.

It also emphasizes the facilitation of one's awareness to participate consciously in health and health care decisions (Shearer, 2004). When women are empowered, they are able to make informed decisions about the health of themselves and their children. This is because, influenced by an increased personal and socio-contextual resources, they tend to have an expanded base of health information and resources that can drive healthy living. As such, they

are able to initiate better child-care practices which include feeding children with balanced diets, immunisation, adopting infection prevention strategies such as the use of treated mosquito nets and ensuring a hygienic environment.

Women's health empowerment is able to impact child health outcomes due to the child-care practices they provide. Since with higher levels of empowerment, there is a high likelihood that the best child-care practices will be adopted, child health outcomes will also turn out to be good. The findings around the globe indicate that the child-care practices that have been found to be determinants of child health outcomes are also influenced by women's empowerment. For instance, decision making and attitude to violence have been found to significantly improve child diversity score (Ndaimani, Mhlanga, & Dube-Mawerewere, 2018; Bose, 2011; Muraya, Jones, Berkley, & Molyneux, 2017). Likewise, dietary diversity is relevant in determining child health outcomes including anaemia (Malako, Teshome, & Belachew, 2018; Saaka & Galaa, 2017).

Conceptual framework

The Model of child-care was adapted from the UNICEF conceptual framework on the determinants of undernutrition to explain how through child-care practices, other proximate determinants can influence child health and development. In the original UNICEF framework, child-care practices constituted one of the underlying causes of undernutrition. The other causes were household food security and environment and health services. The focus of the model of child-care as adapted by the Research Group at the University of Bergen, cited in Urke and Mittelmark (2015), was to highlight the significant role of child-care practices. In this model, contextual factors

influence child-care and consequently, child health in three main pathways – food security, maternal and infrastructure resources. It is however acknowledged that these contextual factors can have a direct influence on child health and child-care outside these pathways.

Food security, maternal and infrastructure resources independently impose some influence on child-care practices which may occur in the form of feeding, psychosocial care, and health care. When better child-care practices are endorsed, it leads to improvement in child health and development as well as vice versa. The role of genes and happenstance on child health is also essential as they can have immediate and direct negative impact on child health irrespective of social situation, living conditions and child-care practices. Happenstance refers to events such as wars, floods, violence, accidents and conflicts.

The model of child-care has been used in several studies to explain the determinants of child health. Urke and Mittlemark (2015) used it to model the associations between intimate partner violence, child-care practices and infant health by using the DHS in Bolivia, Columbia and Peru. It was used by Matanda (2015) to support the association between child physical growth and care practices in Kenya. In Ghana, Amugsi (2015) adapted the model to explain the relationship between child-care practices, resources for care and nutritional outcomes. In this study, this model is adapted to uniquely define the conceptual linkage that exists between women's empowerment and childhood anaemia as influenced by child-feeding practices. Unlike the child-care model, the adapted version in Fig. 2 includes only maternal resources with specific focus on women's empowerment. Likewise, among the various child-care

practices, only child feeding was focused. Also, in this study, the child health outcome is childhood anaemia.

Adapted conceptual framework

The adapted conceptual framework – Figure 2 - is informed by theories, the model of child-care and empirical findings as reviewed in this chapter. First (a in Fig 2), education, wealth, religion and place of residence are considered as contextual elements that influence women's empowerment. Empirical evidence suggests that being educated, living in richer households, being Christian and living in urban areas provide an enabling context within which women can be empowered (Bushra & Wajiha, 2015; Khan, Shahbaz, Naz, Umber, & Amir, 2016). In a broader context, they comprise economic, geographical and socio-cultural contexts within which individuals live - important part of their experience of identity, participation and opportunities as has been highlighted in the model of child-care (Urke & Mittelmark, 2015). The economic and socio-cultural characteristics are not the same for every household, community or district. Education, religion and wealth constitute important household characteristics. Place of residence can be defined within the community or district setting where opportunities varies. These variations contribute to the different levels of empowerment among women and consequently on child feeding practices.

Women's empowerment form an important aspect of their agency and determines the "what" and "extent" of their abilities. This agency gives them power (to, with, over and within) to access opportunities and perform responsibilities (Kabeer, 2005; Lamsal 2012, Rowland, 1997; Whittington, 2010) of which child-care is predominant. Common indicators of

empowerment include decision making, control over resources and attitude to violence. In Figure 2 (b), the framework shows a relationship between empowerment and child feeding. When women are empowered, they are more likely to engage in healthy behaviours as postulated by the theory of health empowerment (Shearer & Reed, 2004). In this regard and supported by empirical evidence (Alaofe, Zhu, & Burney, 2017; Na et al., 2015; Rehman, Ping & Razzaq, 2019; Sabroni & Quisumbing, 2018), it is assumed that with higher empowerment levels, women are more likely to ensure better dietary diversity as well as regular and timely intake of nutrient supplements for their children.

Furthermore, better child feeding can boost children's haemoglobin levels and therefore reduce their odds of being anaemic (c in Fig.2). Childhood anaemia is clustered and in Ghana, evidence from Nikoi and Anthamatten (2010) and Tampah-Naah et al. (2019) affirms this. Clustering can result from differences between household, community and district levels that are a product of varying economic characteristics and socio-cultural influences. It is useful to understand how much of this clustering is as a result of differences in mother's empowerment levels and child feeding practices.

In Figure 2, it is also shown that the identified contextual elements can influence childhood anaemia through other pathways (d). Possible pathways include infrastructure and food security resources as seen in the model of child-care. Since there are varying differences in these contextual elements at the household, community and district levels, they tend to influence the variation of childhood anaemia. In addition to these are other socio-economic, demographic and other health factors that have been found to influence

childhood anaemia (e). Some include children's age, mother's age, parity and stunting (da Silva, Fawzi, Cardoso, & ENFAC Working Group, 2018; Moschovis et. al., 2018; Khanal, Karkee, Adhikari, & Gavidia, 2016; Nkulikiyinka, Binagwaho & Palmer, 2015; Qian-Qian, et al., 2017).

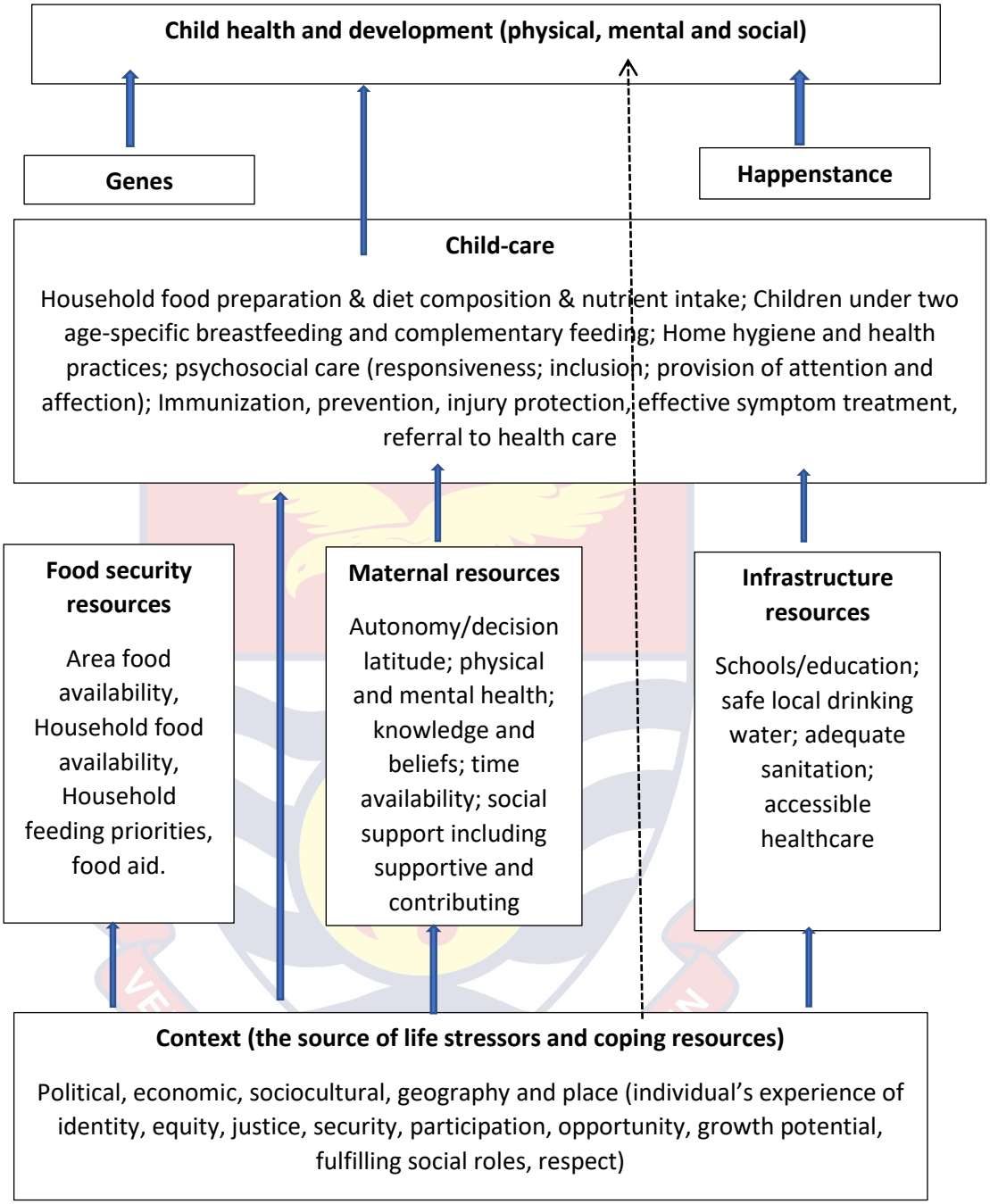

Figure 1: Model of child-care

Source: Adapted by the Research Unit for Social Determinants of Health in Very Poor Ruralities (MB Mittlemark Director), University of Bergen Research Group *Multicultural Venues in Health, Gender and Social Justice* (http://www.uib.no/rg/mcvenues), from UNICEF (1990); Engle, Menon and Haddad (1999); Smith and Haddad (2000) as cited in Urke and Mittelmark (2015).

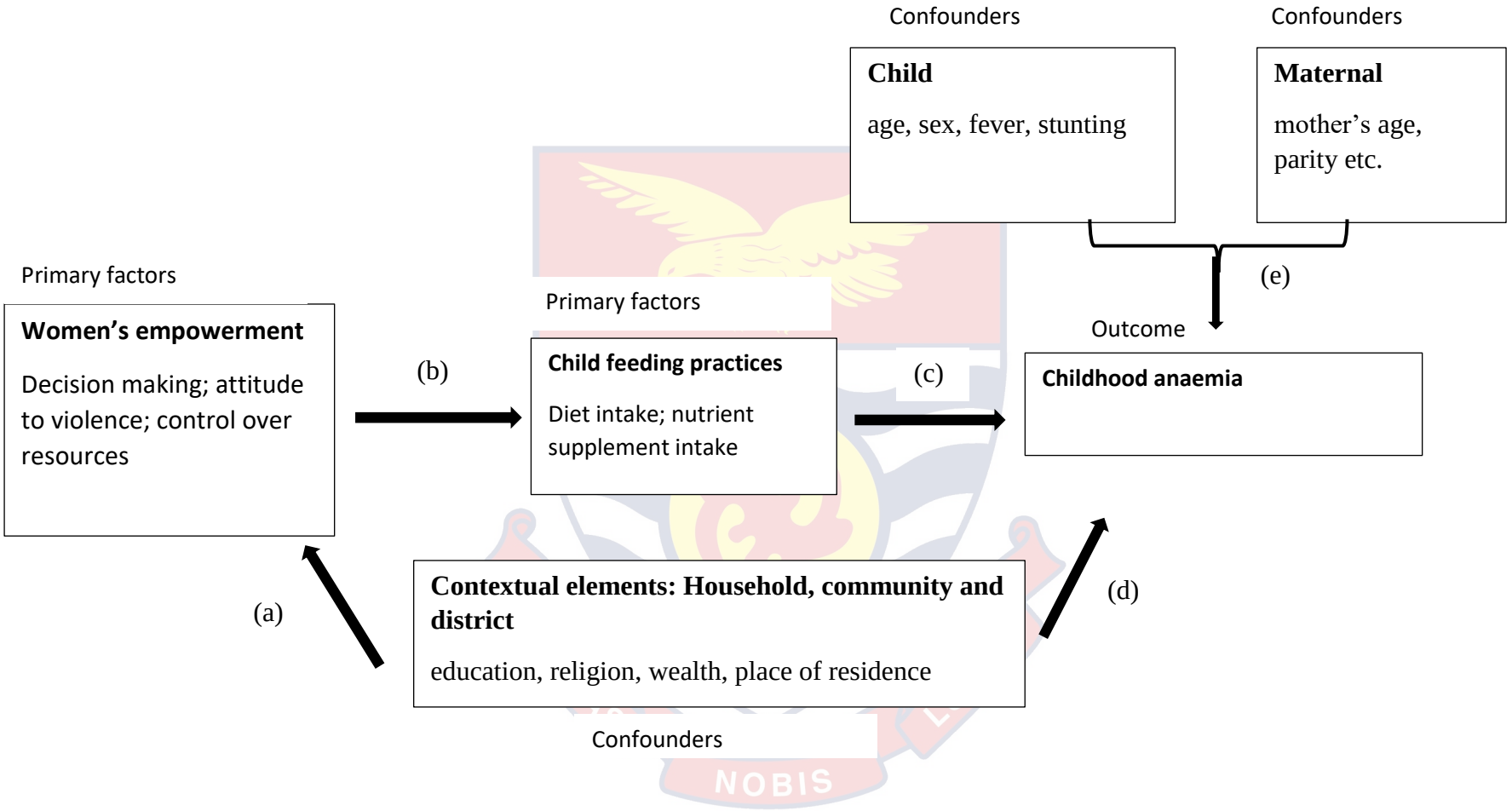

Figure 2: Conceptual framework on women's empowerment and childhood anaemia

Source: Author's construct as adapted from the Research Unit for Social Determinants of Health in Very Poor Ruralities (MB Mittlemark Director), University of Bergen Research Group *Multicultural Venues in Health, Gender and Social Justice* (http://www.uib.no/rg/mcvenues)

Chapter Summary

To arrive at related literature for this study, a comprehensive search strategy was adopted in four databases - PubMed, ScienceDirect, Cochrane Library and Google Scholar – on issues relating to women's empowerment, child feeding practices and childhood anaemia. Resulting evidence shows that relationships have been studied in isolation – women's empowerment and child feeding; child feeding and childhood anaemia and empowerment and childhood anaemia. Studies that test the conceptualized pathway have been limited. The study adapted the Model of care and supported ensuing conceptualizations with the theory of structuration and health empowerment. In the next chapter, the methods used for the study are provided.

CHAPTER THREE

RESEARCH METHODS

Introduction

In this chapter, the methods used to examine the association between women's empowerment, child feeding, and childhood anaemia are presented. Issues covered include research design, study area, data description, study variables as well as the methods of analysis.

Study Area

The study area is Ghana. The country has a land cover spanning 238,537 square kilometres and bordered by three francophone countries – Burkina Faso, Togo and Cote D'Iviore. Currently, the country is divided into sixteen administrative regions – Ashanti, Bono, Bono East, Ahafo, Central, Eastern, Greater Accra, Northern, Savannah, North East, Upper East, Upper West, Volta, Oti, Western and Western North.

The 2010 Population and Housing Census reported a total population of 24,658,823 in Ghana with an annual growth rate of 2.5% (GSS, 2013). Out of the total population, 13.8% are children under five years (GSS, 2013). Over the years, the Government of Ghana has engaged in a number of actions to improve child health outcomes, focusing mainly on childhood immunisation and nutritional improvements (Ministry of Health & Ghana Health Service, 2016). Others have also been indirect with major emphasis on the agency of caregivers (Ministry of Gender, Children and Social protection, 2015).

At the gender front, Ghana has initiated several policies, strategies and advocacies to advance the empowerment of women. They include National Population Policy (National Population Council, 1994), National Gender

Policy (Ministry of Gender, Children and Social protection, 2015), Girl Child Education Advocacy (IBIS, UNICEF, SNV and WFP, 2009; Anyidoho & Manuh, 2010), as well as the Domestic Violence Act instituted to provide legal protection for women (Allah-Mensah & Osei-Afful, 2017). The enhancement of women's empowerment through these actions has implications on children's feeding practices at the household level. Examining the associations between women's empowerment, child feeding and childhood anaemia using Ghana as a case study is important as it provides evidence from a context where actions have been taken to advance women's empowerment.

Research design

This study is guided by a cross-sectional survey research design. This research design employs methods of data collection and analysis to estimate the prevalence of an outcome of interest for a given population as well as the factors that influence this outcome (Levin, 2006; Setia, 2016; Zangirolami-Raimundo et al., 2018). Data collection is done at a specific point in time and captures a snapshot of the population of interest.

Researchers can test hypotheses to examine associations between two or more variables (Zangirolami-Raimundo et al., 2018). Associations between two variables may be positive, negative or none. A positive association means that an increase in unit of one variable leads to a corresponding increase in the other. A negative association implies an increase in the outcome variable is dependent on a decrease in the explanatory variable and vice versa. When there is no association, it means the two variables of interest have no relationship. Several statistical methods can be used to test associations between variables from data of cross-sectional surveys. They include ordinary least squares, chi-

square, regression methods, structural equation model, chi-square, ANOVA and other simulation methods (Hasan & Alam, 2018). The choice of statistical method is dependent on the outcome variable as well as the study's objective.

This study seeks to examine how a mother's empowerment is associated with the prevalence of childhood anaemia and whether child feeding practices mediate this relationship. To test the associations, the study finds the use of this research design as suitable and therefore uses data from a nationally representative cross-sectional survey. The survey data contains the needed variables to test the associations of interest for this study. Given what has been reported in the literature, the proposed relationship between women's empowerment and childhood anaemia is negative. With an increase in a mother's empowerment, the chances of being anaemic among children are expected to reduce. Statistical methods that were used to examine this relationship include Pearson's chi-square and Logistic regression.

Description of Data

The data for this study comes from the Ghana Demographic and Health Surveys (GDHS) (https://dhsprogram.com/Data/). The GDHS is a cross-sectional nationally representative study that collects demographic and health information on women, men and members of their household. Six rounds (1988, 1993, 1998, 2003, 2008 and 2014) of the GDHS have been conducted in Ghana, led by the Ghana Statistical Service in collaboration with allied institutions and stakeholders. For this study, the data was limited to the last three rounds - 2003 GDHS, 2008 GDHS and 2014 GDHS. This is because the outcome variable of interest, childhood anaemia, derived from information on haemoglobin levels is only available in these rounds.

The selected rounds of surveys adopted a two-stage stratified sampling design. At the time of the surveys, the country was stratified into ten regional domains (the ten regions of Ghana) as shown in the map below. At the first stage of sampling, clusters (Census Enumeration Areas) were selected from the most recent Ghana Population and Housing Census (GPHC), with the 2003 and 2008 GDHS selected from the 2000 GPHC and 2014 GDHS selected from the 2010 GPHC (GSS, GHS, & ICF 2004; 2008; 2015). The 2003 and 2008 GDHS sampled 412 clusters each, while the 2014 GDHS sampled 427 clusters. At the second stage, households were sampled from each of the selected clusters using a systematic random sampling approach. The number of households sampled for the 2003, 2008 and 2014 GDHSs were 6,251, 12,323 and 12,831, respectively (GSS, GHS, & ICF 2004; 2008; 2015). Sampling weights were applied to all the selected surveys to account for unequal sampling probabilities.

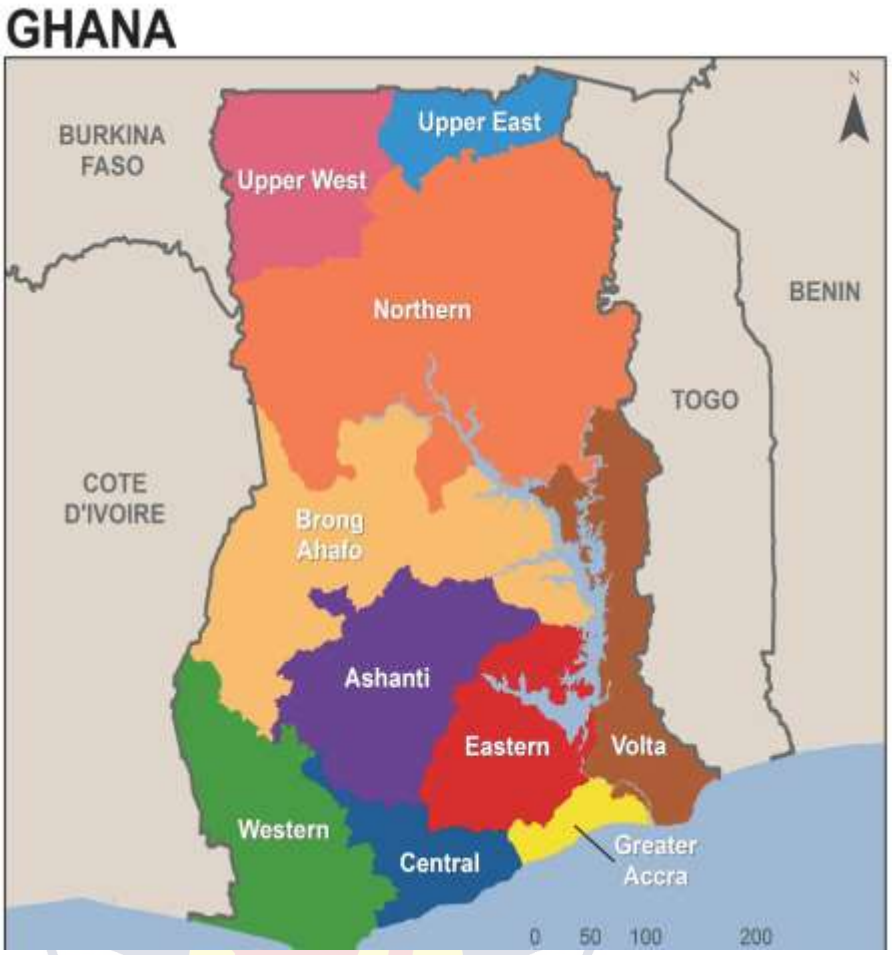

Figure 3: Map of Ghana

Source: GSS, GHS & ICF (2015)

Sample size and study population

The study population is children aged 6 to 59 months. The study focused on this group because anaemia testing in the GDHS is limited to children in this age group. Data from the children recode files for the three successive surveys (2003, 2008 and 2014) were used for the analyses. The file contains information on immunization, haemoglobin levels, anaemia status, malnutrition, fever and other health outcomes for children below age five years as well as child, maternal and household characteristics for children and other members of their households .

The three selected successive GDHSs collected information on 12,720 children (2003 GDHS = 3844, 2008 GDHS = 2992, and 2014 GDHS = 5884) who were less than five years. The analysis of this study covered 5101 (2003 GDHS = 2154, 2008 GDHS = 1589, and 2014 GDHS = 1358) children aged 6 to 59 months for whom information on anaemia status and complete data were available.

Variables

Dependent variable

The dependent variable, anaemia status, is based on information from the haemoglobin level of each child in the GDHSs. According to the World Health Organization (2015), a child is considered anaemic if he/she has a haemoglobin level lower than 11g/dl. This standard was used in categorizing children as anaemic or not anaemic in this study. The dependent variable was coded 1 (anaemic) if a child's haemoglobin level is less than 11 g/dl and 0 otherwise.

Primary factors

The primary factors constitute measures of women's empowerment and indicators of child feeding practices. To ensure consistency, variables measuring women's household empowerment that were available across all three surveys were selected for the index derivation. They are decision making and violence justification (attitude to wife beating).

***Decision making*:** In the surveys, women were asked questions regarding the person who has final say on their (woman's) own health care, visits to family and purchase of large household items. For each of these, the responses included (1) respondent alone; (2) respondent and husband/partner;

(3) husband/partner alone; (4) respondent and someone else jointly; (5) someone else; (6) others. Creating an index for decision making went through a two-stage process. First, each of the three decision making variables was dichotomized with 0 representing those who did not participate in decision making (husband/partner alone; someone else; others) and 1 for those who participated in decision making (respondent alone; respondent and husband/partner alone; respondent and someone else).

Afterwards, a score for decision making was created by combining the three decision items – health care, visit and purchase of household items. This score ranged between 0 (those who did not participate in any of the three decisions) and 3 (those who participated in all decisions). The score was then recoded into a categorical variable with three categories – no participation, partial participation, and full participation. No participation represented those that did not partake in any of the three decisions; partial participation constituted those that partook in either one or two of the decisions and full participation characterized those that participated in all three decisions.

***Violence justification*:** this was measured using questions on women's attitude toward wife beating. In the surveys, women were asked whether a husband/partner is justified in hitting or beating his wife under five specific conditions: (1) if she goes out without telling him; (2) if she neglects the children; (3) if she argues with him; (4) if she refuses to have sex with him and (5) if she burns the food. For each of these conditions, responses included yes (1), no (0) and don't know (8). All "don't know" responses were recoded as 0. All the five items were combined into a score that ranged between 0 and 5. This score was then recoded into three categories: No justification, partial

justification, and full justification. No justification constituted those that rejected violence for any of the five reasons. Partial justification comprised those that justify violence for at most three reasons while full justification summed up those that justify violence for four or five reasons. For the last category, the two responses were combined to ensure a better distribution of within group sample size. Additionally, the characteristics of those that justify four reasons may not differ substantially from those that justify all five reasons.

Two variables proxied child-feeding practices in this study. They are intake of vitamin A in the last 6 months and consumption of iron-rich foods.

Consumption of iron-rich foods: In the GDHSs, information on children's diet is collected to estimate the amount of food consumed within a specific time period. Only dietary items that have high iron content of at least 1mg per 100 grams and above were considered – green leafy vegetables, legumes and animal foods (meat, poultry, fish, shellfish, eggs) (National Institutes of Health, 2020). A score was computed using the three iron-rich foods (green leafy vegetables, legumes, and animal foods). The score ranged between 0 and 3. This was then transformed into a categorical variable with values, yes (consumed at least one of the three foods) and no (consumed none of the foods).

Confounding variables

To identify the true effect of women's empowerment and feeding practices on childhood anaemia, important confounders were accounted for. Studies have reported significant confounders of childhood anaemia (Dey et al., 2013; Goswmai & Das, 2014; Qian-Qian, et al., 2017; Moschovis et al.,

2018; Ewusie et al., 2014; Nikoi & Anthamatten, 2013; Parbey, et al., 2019; Ronald, et al., 2006; GSS, GHS & ICF 2015). Given data availability, selected confounders included sex, age of child, stunting, fever, maternal age, education, religion, parity, wealth, father's education and place of residence. These were broadly categorised into child level, maternal and household factors. Place of residence as a community factor was accounted for in the study to adjust for survey weights.

Table 3: Variables used for the study

Variables	Codes
Outcome variable	
Childhood Anaemia Status	Not anaemic = 0; Anaemic = 1
Primary factors	
Women's empowerment	
Decision making	
No participation	No participation = 0
Partial participation	Partial participation = 1
Full participation	Full participation = 2
Violence justification	
No justification	No justification = 0
Partial justification	Partial justification = 1
Full justification	Full justification = 2
Child-feeding practices	
Iron-rich foods	
No	No = 0
Yes	Yes = 1
Vitamin A	
No	No = 0
Yes	Yes = 1
Confounding factors	
Child level factors	
Age in months	
6-11	6-11 = 0
12-23	12-23 = 1
24-35	24-35 = 2
36-47	36-47 = 3
48-59	48-59 = 4
Sex	
Male	Male = 1
Female	Female = 2

Fever	
No	No = 0
Yes	Yes = 1
Stunting	
No	No = 0
Yes	Yes = 1
Maternal factors	
Age in years	
< 25	< 25 = 1
25-29	25-29 = 2
30-34	30-34 = 3
35-39	35-39 = 4
40 +	40 + = 5
Mother's education	
No education	No education = 0
Primary	Primary = 1
Secondary +	Secondary + = 2
Religion	
Christian	Christian = 1
Islamic	Islamic = 2
Other	Other = 3
Parity	
1 - 2	1 – 2 = 1
3 - 4	3 – 4 = 2
5 - 6	5 – 6 = 3
7+	7+ = 4
Household	
Wealth	
Poorest	Poorest = 1
Poorer	Poorer = 2
Middle	Middle = 3
Richer	Richer = 4
Richest	Richest = 5
Father's education	
No education	No education = 0
Primary	Primary = 1
Secondary +	Secondary + = 2
Community factors	
Residence	
Urban	Urban = 1
Rural	Rural = 2

Source: GDHS 2003; 2008 & 2014

Statistical analysis

Using data from the three most recent GDHSs, this study examined the trends in childhood anaemia and explored its association with women's empowerment and child feeding practices. Both bivariate and multivariate

analyses were employed to examine the associative effects. Bivariate analysis was conducted to examine the percentage distribution of childhood anaemia status by background characteristics for each of the three surveys. A chi-square test was conducted to ascertain whether these observed differences were significant ($p < 0.05$).

A multilevel logistic regression was conducted on pooled data to examine the effect of women's empowerment and child-feeding practices on the odds of a child being anaemic accounting for important confounders and clustering at the household, community and district levels. The data was pooled to examine trends in the odds of being anaemic. Given the sampling procedures adopted for the GDHS, a multilevel regression approach was employed to avoid underestimation or overestimation of the regression parameters (Dickinson & Basu, 2005; Snidjers & Bosker, 2012).

The structure of the GDHSs is such that children are sampled from households, households from clusters and clusters from districts. In the surveys, every selected household was given a unique ID number. The corresponding clusters from which households were selected are considered as communities in this study and each cluster was assigned a unique ID. The survey also provided details of districts from which clusters were selected and each district was given a unique number. Variables V002, V001 and SDIST in each of the three successive surveys constituted the unique IDs for households, communities and districts, respectively. These were used for the multilevel analysis.

A four-level logistic regression model was fitted with children at level 1, households at level 2 (n = 3965), communities at level 3 (n = 1130) and

districts at level 4 (n=165). The level 1 variance was constrained to 1 to follow the binomial distribution. The log odds of being anaemic for a child in household *i* in community *j* and district *k* is expressed as:

$$logit(\pi_{ijk}) = \beta_0 + \beta_1 X_{1\,(ijk)} \ldots \beta_n X_{n(ijk)} + v_k + u_{jk} + \varepsilon_{ijk} \quad \ldots\ldots\ldots (1)$$

where π is the log odds of being anaemic, β_0 represents the intercept; betas ($\beta_1 \ldots . \beta_n$) are the regression coefficient and $X_1 \ldots . X_n$ constitute explanatory variables. Residuals at the household, community and district levels (random effects) are denoted by $\varepsilon_{ijk} \sim N(0, \sigma^2{}_\varepsilon)$ $u_{jk} \sim N(0, \sigma^2{}_u)$ and $v_k \sim N(0, \sigma^2{}_v)$ respectively. Significance of the random effects at the household, community and district levels indicates that the household, community or district of residence of a child influences his/her anaemia status. Random effects at the household, community and district levels were considered to be significant at 5% if their Wald statistic was greater than 1.96 (z-score for 0.05 alpha) and 1% if the Wald statistic was greater than 2.58 (z-score for 0.01 alpha, respectively).

Interactions were used to test whether the effect of child feeding practices on childhood anaemia is dependent on the mother's empowerment levels. Indicators of women's empowerment and child-feeding practices formed the interaction terms.

Test for multicollinearity

A test for multicollinearity was performed using the Interval-by-Interval Pearson's R and Ordinal by Ordinal Spearman correlation. The test was conducted for independent variables that are plausibly associated (see

Appendix). The results showed low correlation among variables and in effect, low potential for multicollinearity.

Models

A sequential model building approach was adopted to examine the effect of women's empowerment and child feeding practices on childhood anaemia, accounting for important predictors. A null model (Model 0) was first fitted to identify the amount of variation in childhood anaemia attributable to differential between households, communities and districts. Model 1 accounted for the year of survey and place of residence. The year of survey was included to examine trends. Since DHS samples are stratified by urban/rural place of residence, adding place of residence account for most of the survey weights. Model 2 included the effects of the primary factors (women's empowerment and child feeding practices) on childhood anaemia.

The effects of the confounders were examined in Models 3 to 5. Model 3 assessed the effects of child level factors on childhood anaemia while in Model 4, maternal factors were accounted for. The final model (Model 5) included household factors. Interaction effects of the primary factors were examined in the final model. Confounders and interaction effects were retained if only they were significant at $p < 0.05$ (Snidjers & Bosker, 2012) in at least one of the models.

The intraclass correlation coefficient (ICC) was used to estimate the amount of variation in childhood anaemia that is attributable to differences at the household, community and district levels (Lorah, 2018). The ICC for any level is computed by dividing the variance of that level by the sum of the

variance of all the three levels. The ICC for the household, community and district levels are calculated respectively as follows.

$$ICC = \frac{\sigma^2{}_e}{\sigma^2{}_u+\sigma^2{}_v+\sigma^2{}_e} \quad \text{.....(2)}$$

$$ICC = \frac{\sigma^2{}_u}{\sigma^2{}_u+\sigma^2{}_v+\sigma^2{}_e} \quad \text{..... (3)}$$

$$ICC = \frac{\sigma^2{}_v}{\sigma^2{}_u+\sigma^2{}_v+\sigma^2{}_e} \quad \text{..... (4)}$$

where $\sigma^2{}_e$, $\sigma^2{}_u$ and $\sigma^2{}_v$ constitute the variance at the household, community and district levels respectively.

The model of best fit was determined using the Akaike Information Criterion (AIC). The lower the AIC, the better the model and the closer it is to the unknown true data generating process (true model) (Akaike, 1973; Lee & Ghosh, 2009). The AIC is defined as

$$AIC_i = -2logL_i + 2V_i \quad \text{.....(5)}$$

where L_i is the maximum likelihood for model i and it is determined by adjusting the number of parameters (V_i) in a way to maximize the probability that the model of interest has generated the observed data (Wagenmakers & Farrel, 2004).

Nonetheless, the AIC in itself is limited in judging how much statistical importance should be attached to the best candidate model relative to the others (Wagenmakers & Farrel, 2004). To address this, the AIC weights were used to establish substantial evidence in favour of the best model. The AIC weights are computed as follows:

$$w_i\ (AIC) = \frac{\exp\left\{-\frac{1}{2}\Delta_i(AIC)\right\}}{\sum_{k=1}^{k} exp\left\{-\frac{1}{2}\Delta_i(AIC)\right\}} \quad \ldots\ldots\ldots\ldots\ldots\ldots (6)$$

where $\Delta_i(AIC)$ is the difference between the AIC of model i and the lowest AIC. Additional model statistics include the R-squared.

Ethical considerations

For this study, a request was sent to the DHS Program to access the GDHS datasets and was approved (see appendix 1) and I adhered to all the terms and conditions associated with the use of the datasets. The GDHSs were conducted with astute ethical considerations. Procedures and questionnaires for the DHS were reviewed and approved by the ICF Institutional Review Board. For respondents, emphasis was placed on informed and voluntary participation, privacy and confidentiality during data collection, data processing as well as biomarker referral, treatment and counselling.

Chapter summary

This chapter elaborates the methods and data that were used in this study. The three most recent GDHSs were pooled to examine the associative effect of women's empowerment on childhood anaemia. Both bivariate and multivariate analyses were explored to assess this associative effective. Interactions were used to test whether the effect of child feeding practices on childhood anaemia is dependent on women's empowerment. Other issues covered include research design, study area, sampling techniques, and ethical considerations. In the next chapter, the results are presented together with an in-depth discussion of the major issues that emanated from the results.

CHAPTER FOUR

RESULTS AND DISCUSSION

Introduction

This chapter presents the results of the analysis and discusses the key findings. The study's results are based on 2154, 1589 and 1358 children below age five years in the 2003, 2008 and 2014 GDHSs, respectively. Included in this chapter are the background characteristics of the sampled children, as well as the results of the bivariate analysis and multilevel logistic regression analysis.

RESULTS

Background characteristics of the sampled children

Table 4 shows the weighted percentage distribution of the sampled children by their background characteristics and year of survey. The results show that the percentage of children whose mothers were able to participate fully in decision making at the household level increased over time (Table 4). From the 2003 GDHS, only about a quarter (25.8%) of women participated fully in household decision making, compared to 42.7% from the 2008 GDHS and 50.3% from the 2014 GDHS. The results further show that the proportion of women who justify violence either partially or fully also declined over time (Table 4).

Across the three surveys, majority of the children had recently consumed iron rich foods, 71.5%, 74.0% and 58.7% from the 2003 GDHS, 2008 GDHS and 2014 GDHS, respectively. The results further revealed that with the exception of the 2008 GDHS (44.9%), more than half of the sampled children had vitamin A supplements in the last 6 months.

With regards to the child-level demographic characteristics, a higher percentage of the children were aged between 12 to 35 months and this was consistent in the 2003, 2008 and 2014 GDHSs (Table 4). Across all the surveys, the percentages of male and female children were similar (Table 4). Approximately, half of the children were males while the rest were females. From the 2003 and 2008 GDHSs, about one-quarter of the sampled children had fever in the two weeks preceding the survey, compared to 13.1% from the 2014 GDHS.

A higher proportion of children belonged to women between 25 and 29 years, 27.6%, 30.8% and 26.8% in the 2003, 2008 and 2014 GDHSs, respectively. Table 4 shows that women of Christian affiliation were dominant (over 70%) in all the surveys. With regards to parity, the proportions decreased with increasing parity and this was consistent across all the three surveys. The results further showed that the proportion of children that belonged to mothers with no education decreased from about 40% in the 2003 GDHS to about 30% in the 2014 GDHS.

In the three surveys, more children resided in the poorest households, 26.8%, 28.1% and 24.5% from the 2003, 2008 and 2014 GDHSs. Furthermore, in all surveys, more than half of the children had fathers with secondary or higher educational attainment (Table 4). The proportion of children by rural-urban residence, conforms to the population distribution of the country with majority of the sampled children resident in rural areas (Table 4).

Table 4: Weighted percentage distribution of sampled children by background characteristics and year of survey

BACKGROUND CHARACTERISTICS	2003 GDHS n=2154		2008 GDHS n=1589		2014 GDHS n=1358	
	%	n	%	n	%	n
PRIMARY FACTORS						
Women's empowerment						
Decision making						
No participation	38.8	751	18.5	312	17.1	235
Partial participation	35.4	768	38.8	638	32.5	417
Full participation	25.8	635	42.7	639	50.3	706
Violence justification						
No justification	45.2	912	58.4	889	62.7	837
Partial justification	35.6	781	31.7	527	26.7	347
Full justification	19.2	461	9.9	173	10.6	174
Child-feeding practices						
Iron-rich foods						
No	28.5	661	26.0	429	41.3	557
Yes	71.5	1493	74.0	1160	58.7	801
Vitamin A in last six months						
No	22.5	470	55.1	897	36.3	511
Yes	77.5	1684	44.9	692	63.7	847
CONFOUNDING FACTORS						
Child level factors						
Age in months						
6-11	15.9	348	14.3	234	19.6	265
12-23	30.1	645	30.6	483	41.9	570
24-35	27.7	577	28.1	439	7.9	105
36-47	12.8	294	10.9	170	15.4	197
48-59	13.5	290	16.1	263	15.2	221
Sex						
Male	49.3	1075	50.2	790	51.1	697
Female	50.7	1079	49.8	799	48.9	661
Fever in the last two weeks						
No	76.5	1650	77.9	1238	86.9	1163
Yes	23.5	504	22.1	351	13.1	195
Stunting						
No	67.6	1437	74.3	1183	84.0	1132
Yes	32.4	717	25.7	406	16.0	226
Maternal factors						
Age in years						
< 25	23.2	504	25.3	397	23.4	313
25-29	27.6	590	30.8	484	26.8	360
30-34	21.8	466	19.4	310	24.6	324
35-39	17.6	379	16.2	260	17.4	241
40 +	9.8	215	8.3	138	7.7	120
Mother's education						
No education	39.8	1006	34.3	627	30.2	511
Primary	23.8	472	25.2	386	19.6	282
Secondary +	36.4	676	40.5	576	50.2	565
Religion						
Christian	71.3	1423	70.1	1055	73.9	941
Islamic	17.9	432	18.8	311	18.8	293
Other	10.8	299	11.0	223	7.4	124

Table 4 Cont'd: Weighted percentage distribution of sampled children by background characteristics and year of survey

BACKGROUND CHARACTERISTICS	2003 GDHS n=2154		2008 GDHS n=1589		2014 GDHS n=1358	
	%	n	%	n	%	n
Parity						
1 - 2	35.6	753	37.2	573	36.1	462
3 - 4	29.9	636	36.2	564	32.5	463
5 - 6	20.8	449	16.9	282	22.1	295
7+	13.8	316	9.7	170	9.2	138
Household						
Wealth						
Poorest	26.8	745	28.1	566	24.5	474
Poorer	23.0	484	23.9	367	21.2	292
Middle	19.8	377	17.4	243	20.6	251
Richer	15.7	278	18.2	248	17.4	185
Richest	14.7	270	12.4	165	16.2	156
Father's education						
No education	39.1	977	33.7	623	29.5	479
Primary	9.3	207	9.6	156	9.3	151
Secondary +	51.6	970	56.7	810	61.2	728
community						
Residence						
Urban	31.0	555	33.8	473	43.8	525
Rural	69.0	1599	66.2	1116	56.2	833

% - Weighted percentage
Source: GDHS 2003; 2008; 2014

Bivariate results

Table 5 shows the weighted percentage distribution of anaemic children by background characteristics and year of survey. Across all the three surveys, more than 70% of the sampled children were anaemic. The results revealed that there has not been a consistent decline in the prevalence of childhood anaemia in the country. It increased from 78.1% in the 2003 GDHS to 81.7% in the 2008 GDHS before decreasing to 73.1% in the 2014 GDHS. Information from the pooled sample indicates that on average, about eight out of ten children below age five years were anaemic within the period (2003 – 2014).

Primary factors: Women's empowerment and child-feeding practices

Table 5 shows that across the three surveys, there was no significant difference in the percentage of children who were anaemic by mother's level of participation in household decision making. From the pooled sample, decision making was also not significant though the prevalence of anaemia was slightly lower (77.8%) for children whose mothers participated fully in decision making than for those whose mothers did not participate in household decision making (78.6%).

With regards to violence justification, the results indicate that for the 2003 GDHS, there was no significant difference in the percentage of children who were anaemic and their mother's justification of violence. Nonetheless, the differences were statistically significant for the 2008 GDHS and 2014 GDHS, with children whose mothers fully justify violence being more likely to be anaemic. The results from the pooled sample also affirmed a significant difference with a higher proportion of anaemic children (82.6%) belonging to mothers who fully justify violence compared to those who disapprove violence (75.2%).

With reference to child-feeding practices, the results indicated that for the 2003 and 2008 GDHSs, the percentage of children who were anaemic did not differ significantly for those who consumed and did not consume iron-rich foods, but for the 2014 GDHS, the results showed a statistically significant difference. For the pooled sample, the differences were statistically significant as children who consumed iron-rich foods had a higher prevalence (78.9 %) of anaemia. Regarding vitamin A supplementation, a significant result was reported in only the 2008 GDHS. The results from the pooled sample indicated

that a higher proportion of children (80%) who were anaemic constituted those that did not take Vitamin A in the last six months.

Child level factors

With respect to the child-level factors, the results revealed that across all the three surveys, the percentage of anaemic children varied significantly by age, with a higher percentage of younger children (6-23 months) being anaemic (Table 5). Sex differentials in childhood anaemia was only significant for the 2008 GDHS with more males (84%) being anaemic compared to females (79.6%). Additionally, children who were stunted and those who had fever had significantly higher prevalence of anaemia. The results from the pooled sample showed that there was higher prevalence of childhood anaemia among the stunted (85.2%) and those who had fever (84.5%,).

Maternal factors

Regarding maternal factors, all the three surveys showed significant differences in the percentage of anaemic children by mother's educational attainment. This finding was also consistent for the pooled sample with the prevalence of anaemia among children whose mothers had secondary or higher education being lower (71.1%) compared to those whose mothers had no (84.8%) and primary education (79.6%). There were also significant differences in the percentage of anaemic children by mother's age, religion and parity for the 2008 and 2014 GDHSs as well as the pooled sample (Table 5). Lower prevalence was reported among children whose mothers were Christians (76.1%) compared to other religious groups. Similarly, lower prevalence was reported among children whose mothers had at most two children (76.7%) vis a vis those who had higher parities.

Household and community factors

Percentage of children anaemic varied significantly by household wealth status, father's education, and place of residence for all the three successive GDHSs. There was also statistically significant difference for these household and community factors in the pooled sample. The results show a higher proportion of anaemic children (85.9%) resides in poorest households. Furthermore, the percentage of anaemic children decreased significantly with increasing paternal educational attainment. Compared to children whose fathers had no (84.4%) and primary education (84.5%), the prevalence of anaemia was lower for those whose fathers have secondary or higher education (72.7%). Table 5 also showed that rural settings have a disproportionately higher percentage of anaemic children (82.6%) when compared to urban areas (69.3%).

Table 5: Weighted percentage distribution of anaemic children by background characteristics

Background Characteristics	2003 GDHS		2008 GDHS		2014 GDHS		Pooled sample (2003 – 2014)	
	% [95% CI]	n	% [95% CI]	n	% [95% CI]	n	% [95%CI]	n
Overall	78.1 [76.3, 79.9]	2154	81.7 [79.8, 83.6]	1589	73.1 [70.8, 75.6]	1358	77.9 [76.7, 79.1]	5101
PRIMARY FACTORS								
Women's empowerment								
Decision making	p-value = 0.255		p-value = 0.267		p-value = 0.313		p-value =0.763	
No participation	76.9 [73.5, 80.3]	751	84.8 [80.5, 89.1]	312	76.7 [70.7, 82.7]	235	78.6 [76.4, 80.8]	1298
Partial participation	77.6 [74.3, 80.9]	768	80.2 [76.8, 83.6]	638	73.6 [68.8, 78.4]	417	77.5 [75.5, 79.5]	1823
Full participation	80.7 [77.3, 84.1]	635	81.7 [78.4, 85.0]	639	71.6 [67.7, 75.5]	706	77.8 [75.9, 79.7]	1980
Violence justification	p-value = 0.086		**p-value = 0.026**		p-value < 0.001		p-value < 0.001	
No justification	75.9 [72.7, 79.1]	912	79.5 [76.5, 82.5]	889	70.0 [66.3, 73.7]	837	75.2 [73.6, 76.8]	2683
Partial justification	79.7 [76.6, 82.8]	781	84.5 [81.2, 87.8]	527	75.8 [70.7, 80.9]	347	80.3 [78.3, 82.3]	1655
Full justification	80.5 [76.5, 84.5]	461	86.1 [80.5, 91.7]	173	85.0 [79.3, 90.7]	174	82.6 [79.7, 85.5]	808
Child-feeding practices								
Iron-rich foods	p-value = 0.729		p-value = 0.426		p-value = 0.009		**p-value =0.012**	
No	78.6 [75.3, 81.9]	661	80.4 [76.5, 84.3]	429	69.3 [65.4, 73.2]	557	75.7 [73.5, 77.9]	1647
Yes	77.9 [75.8, 80.0]	1493	82.1 [79.9, 84.3]	1160	75.8 [72.8, 78.8]	801	78.9 [77.5, 80.3]	3454
Vitamin A in the last six months	p-value = 0.826		p-value = 0.037		p-value = 0.239		p-value =0.020	
No	77.8 [74.0, 81.6]	470	83.6 [81.0, 86.1]	897	75.1 [71.2, 79.0]	511	79.7 [77.8, 81.6]	1878
Yes	78.2 [76.2, 80.2]	1684	79.4 [76.4, 82.4]	692	72.1 [69.1, 75.1]	847	76.8 [75.3, 78.3]	3223
CONFOUNDERS								
Child level factors								
Age in months	p-value < 0.001		p-value < 0.001		p-value < 0.001		p-value < 0.001	
6-11	78.0 [73.5, 82.5]	348	87.2 [82.8, 91.6]	234	78.8 [73.8, 83.8]	265	80.6 [77.5, 83.7]	847
12-23	83.3 [80.3, 86.3]	645	86.1 [83.0, 89.2]	483	77.3 [73.8, 80.8]	570	82.1 [80.0, 84.2]	1698
24-35	77.9 [74.5, 81.3]	577	81.0 [77.3, 84.7]	439	65.7 [56.6, 74.8]	105	77.9 [75.1, 80.7]	1121
36-47	75.0 [69.7, 80.3]	294	73.5 [66.8, 80.2]	170	68.1 [61.7, 74.5]	197	72.4 [68.3, 76.5]	661
48-59	70.2 [64.8, 75.6]	290	75.6 [70.2, 81.0]	263	63.4 [56.8, 70.0]	221	70.1 [66.1, 74.1]	774

Table 5 Cont'd: Weighted percentage distribution of anaemic children by background characteristics

Background Characteristics	2003 GDHS		2008 GDHS		2014 GDHS		Pooled sample (2003-2014)	
	% [95% CI]	n	% [95% CI]	n	% [95% CI]	n	% [95% CI]	n
Sex	p-value = 0.843		**p-value = 0.032**		p-value = 0.618		p-value =0.199	
Male	78.0 [75.4, 80.6]	1075	83.8 [81.2, 86.4]	790	73.7 [70.4, 77.0]	697	78.6 [76.9, 80.2]	2562
Female	78.3 [75.8, 80.8]	1079	79.6 [76.7, 82.5]	799	72.5 [69.1, 75.9]	661	77.1 [75.4, 78.8]	2536
Fever in the last two weeks	**p-value = 0.046**		**p-value = 0.012**		p-value < 0.001		p-value < 0.001	
No	76.9 [74.8, 79.0]	1650	80.4 [78.1, 82.7]	1238	70.9 [68.3, 73.5]	1163	76.2 [74.9, 77.5]	4051
Yes	82.1 [78.7, 85.5]	504	86.4 [82.7, 90.1]	351	87.4 [82.5, 92.3]	195	84.5 [82.2, 86.8]	1050
Stunting	p-value < 0.001		p-value < 0.001		p-value < 0.001		p-value < 0.001	
No	74.7 [72.4, 77.0]	1437	80.1 [77.8, 82.4]	1183	71.3 [68.6, 74.0]	1132	75.3 [73.9, 76.7]	3752
Yes	85.3 [82.6, 88.0]	717	86.5 [83.1, 89.9]	406	82.6 [77.5, 87.7]	226	85.2 [83.2, 87.2]	1349
Maternal factors								
Age in years	p-value = 0.608		p-value = 0.009		**p-value = 0.025**		p-value < 0.001	
< 25	80.6 [77.0, 84.2]	504	86.2 [82.8, 89.6]	397	78.1 [73.5, 82.7]	313	81.7 [79.5, 83.9]	1214
25-29	78.5 [75.1, 81.9]	590	80.4 [76.8, 84.0]	484	68.3 [63.5, 73.3]	360	76.5 [74.3, 78.7]	1434
30-34	76.6 [72.6, 80.1]	466	75.9 [71.0, 80.8]	310	70.9 [66.0, 75.8]	324	74.6 [71.9, 77.2]	1100
35-39	76.9 [72.5, 81.3]	379	84.2 [79.7, 88.7]	260	74.1 [68.5, 79.7]	241	78.3 [75.5, 81.1]	880
40 +	77.2 [71.3, 83.1]	215	81.7 [74.9, 88.5]	138	79.4 [71.6, 87.2]	120	79.1 [75.2, 82.9]	473
Mother's education	p-value < 0.001		p-value < 0.001		p-value < 0.001		p-value < 0.001	
No education	83.5 [80.9, 86.1]	1006	87.4 [84.5, 90.2]	627	84.3 [80.7, 87.9]	511	84.8 [83.1, 86.5]	2144
Primary	79.0 [75.4, 82.6]	472	83.8 [80.1, 87.5]	386	74.6 [69.3, 79.9]	282	79.6 [77.2, 81.9]	1140
Secondary +	71.8 [68.5, 75.1]	676	75.6 [72.2, 79.0]	576	66.0 [62.4, 69.6]	565	71.1 [69.1, 73.1]	1817
Religion	p-value = 0.223		p-value = 0.097		p-value < 0.001		p-value < 0.001	
Christian	77.2 [75.0, 79.4]	1423	80.6 [78.2, 83.0]	1055	69.5 [66.6, 72.4]	941	76.1 [74.7, 77.5]	3419
Islamic	79.6 [75.4, 83.8]	432	82.2 [77.8, 86.6]	311	81.1 [76.2, 86.0]	293	80.8 [78.2, 83.3]	1036
Other	82.1 [77.0, 87.2]	299	87.5 [82.5, 92.5]	223	89.7 [83.7, 95.7]	124	85.5 [82.4, 88.6]	646
Parity	p-value = 0.749		**p-value = 0.038**		p-value = 0.007		**p-value =0.033**	
1 - 2	77.9 [74.9, 80.9]	753	80.2 [76.9, 83.4]	573	70.6 [66.5, 74.7]	462	76.7 [74.7, 78.7]	1788
3 - 4	77.5 [74.2, 80.8]	636	80.4 [77.1, 83.7]	564	73.1 [68.9, 77.3]	463	77.4 [75.3, 79.5]	1663
5 - 6	80.0 [76.2, 83.8]	449	83.2 [78.6, 87.8]	282	72.1 [67.0, 77.2]	295	78.5 [75.9, 81.1]	1026
7+	77.1 [72.2, 82.0]	316	89.9 [85.0, 94.8]	170	86.1 [80.0, 92.2]	138	82.5 [79.3, 85.7]	624

Table 5 Cont'd: Weighted percentage distribution of anaemic children by background characteristics

Background Characteristics	2003 GDHS		2008 GDHS		2014 GDHS		Pooled sample (2003 -2014)	
	% [95% CI]	n	% [95% CI]	n	% [95% CI]	n	% [95% CI]	n
Household								
Wealth	p-value < 0.001		p-value < 0.001		p-value < 0.001		p-value < 0.001	
Poorest	84.3 [81.3, 87.4]	745	89.5 [86.6, 92.4]	566	83.7 [79.7, 87.7]	474	85.9 [84.0, 87.8]	1785
Poorer	83.2 [79.8, 86.6]	484	87.1 [83.7, 90.5]	367	82.3 [77.8, 86.8]	292	84.2 [82.1, 86.3]	1143
Middle	81.8 [78.0, 85.6]	377	83.8 [79.4, 88.2]	243	70.1 [64.7, 75.5]	251	79.0 [76.4, 81.6]	871
Richer	67.5 [62.3, 72.7]	278	73.0 [67.8, 78.2]	248	64.9 [58.7, 71.0]	185	68.6 [65.4, 71.8]	711
Richest	65.4 [60.0, 70.8]	270	63.5 [56.6, 70.4]	165	57.7 [51.1, 64.3]	156	62.6 [59.0, 66.2]	591
Father's education	p-value < 0.001		p-value < 0.001		p-value < 0.001		p-value < 0.001	
No education	83.3 [80.7, 85.9]	977	86.9 [84.0, 89.8]	623	83.1 [79.4, 86.8]	479	84.4 [82.7, 86.1]	2079
Primary	83.4 [78.1, 88.7]	207	91.8 [87.3, 96.3]	156	77.4 [70.0, 84.8]	151	84.5 [81.2, 87.8]	514
Secondary +	73.3 [70.6, 76.0]	970	76.8 [74.0, 79.6]	810	67.6 [64.4, 70.8]	728	72.7 [71.0, 74.4]	2508
Community								
Residence	p-value < 0.001		p-value < 0.001		p-value < 0.001		p-value < 0.001	
Urban	69.9 [66.3, 73.5]	555	73.4 [69.6, 77.2]	473	65.2 [61.3, 69.1]	525	69.3 [67.1, 71.5]	1553
Rural	81.9 [79.9, 83.9]	1599	86.0 [83.9, 88.1]	1116	79.3 [76.4, 82.2]	833	82.6 [81.3, 83.9]	3548

% - Weighted percentage; CI – Confidence interval
Source: GDHS 2003; 2008; 2014

Multivariate Analysis

Examining household, community and district level differences

Table 6 shows the estimated odds ratios, their corresponding 95% confidence intervals and model summary statistics for the effect of women's empowerment, child feeding practices and other predictors of childhood anaemia. The null model (Model 0) shows significant ($p<0.05$) random effects variances at the household, community and district level, indicating that without accounting for any predictors, there exist significant variations between households, between communities and between districts in the proportion of children anaemic (see Appendix for Wald statistic results for the random effects). The Intraclass Correlation Coefficient (ICC) from the null model shows that 24.6% of the variation in childhood anaemia is attributable to differences at the household level, 50.8% at the community level and 24.6% at the district level (see values below Table 6).

When the year of survey and place of residence were included in the model (Model 1), the household level variance increased by 86.7%, whilst the community and district level variances declined by 34.7% and 60.0%, respectively. However, all the random effect variances remained significant at $p<0.05$. The increase in the household variance suggests that the year of survey and the place of residence increase the variability in childhood anaemia between households. At the community and district level, the decline in variances shows that the year of survey and place of residence explained 34.7% and 60.0% of the differences in childhood anaemia variance at the district and community levels, respectively. Year of survey and place of

residence were statistically significantly ($p<0.01$) associated with children's anaemia status.

Including the primary factors in the model (Model 2), violence justification and consumption of iron rich foods were identified to be statistically significantly ($p<0.05$) associated with childhood anaemia. However, involvement in household decision making and intake of vitamin A were not significantly associated with childhood anaemia. Accounting for the primary factors, the year of survey and place of residence remained significant at $p<0.01$. The inclusion of the primary predictors did not account for any of the observed differences in childhood anaemia at the community and district levels. At the household level, the primary factors explained only 3.6% of the remaining variation in childhood anaemia (Table 6, Model 2).

Model 3 adjusted for child level predictors. The significant child level predictors were child's age in months, fever in the last two weeks preceding the survey and stunting ($p<0.01$). After accounting for the child level factors, the consumption of iron-rich foods became statistically insignificant while violence justification, year of survey and place of residence remained statistically significant. Further analysis revealed that children's age offsetted the associative effect of iron rich foods consumption. The child level factors accounted for 3.7% and 16.7% of the remaining variation in childhood anaemia at the household and district levels, respectively. Nonetheless, the results show that higher variation (remaining community level variance increase by 17.4%) in childhood anaemia is observed between communities when the child level predictors are included in the model.

In Model 4, the maternal level factors were accounted for with maternal age and education emerging as significant ($p< 0.05$) predictors of childhood anaemia. It is interesting to note that, further analysis revealed that accounting for maternal education led to maternal justification of violence to become statistically insignificant. The results show that the maternal factors account for 40% and 22% of the remaining variation in childhood anaemia at the district and community levels, respectively. However, accounting for the maternal level factors resulted in an increase of 53.8% of the remaining variation at the household level. This indicates that higher variations in childhood anaemia exit between households via maternal age and education.

The household predictors, household wealth status and father's education, were added in Model 5. Both predictors were statistically significantly ($p< 0.01$) associated with childhood anaemia. When household factors were accounted for, mother's age and place of residence became insignificant. Model 6 shows that the household factors accounted for 32.5% of the remaining household variance and increased the between differences in childhood anaemia at the community level by 9.5%, with none at the district levels.

The analysis further investigated if a significant interaction exists between child-feeding practices and women's empowerment (objective 3 of the study). The results revealed that at the five-percent significance level, the effect of child-feeding practices on childhood anaemia is not dependent (interaction not significant and plausible) on women's empowerment (see appendix).

Interpretation of model coefficients

Interpretation of the model coefficients is based on the final model (Model 5) which accounted for the primary factors and the significant confounders. The Akaike weights (Table 6) show that Model 5 is the best candidate model. From the final model, the primary predictor significantly associated with childhood anaemia is consumption of iron-rich foods. The confounders identified to be statistically significantly associated with childhood anaemia are the year of survey, child's age, having fever, stunting, mother's education, household wealth status and father's education (Table 6, Model 5).

The results show that the odds of a child being anaemic was 1.43[1.15, 1.78] times higher for the 2008 GDHS (p =0.001) compared to the 2003 GDHS, however, the effects were not significantly different for the 2014 GDHS (OR = 0.87, 95%CI: 0.70-1.09, p =0.219). The results further indicated that children resident in rural areas have increased odds of being anaemic compared to those in urban areas (OR = 1.13, 95% CI: 0.88-1.45, p = 0.371). With regards to the primary factors, the results show that children who were recently given iron-rich foods were 23% (OR = 1.23, 95% CI:1.03-1.47, p = 0.021) more likely to be anaemic compared to those that did not consume iron-rich foods. Furthermore, the results show that there are no significant differences in the odds of child being anaemic given their mothers level of participation in household decision making, justification of violence, and intake of vitamin A supplements. Compared with children whose mothers did not participate in the three decisions, those whose mothers partially or fully participated in decisions had reduced odds though the results were not

statistically significant. Likewise, the odds of children whose mothers did not justify violence were not statistically different from those whose mothers justified violence.

Considering the confounders, the results show that an increase in the child's age is associated with a decline in the odds of a child being anaemic. Children aged 24-35 months, 36-47 months and 48-59 months have a statistically significantly reduced odds of 27% (OR = 0.73, 95%CI: 0.56 - 0.95, p = 0.013), 45% (OR = 0.55, 95%CI: 0.42 - 0.74, p <0.0001) and 55% (OR = 0.45, 95%CI: 0.34 - 0.60, p<0.0001), respectively, of being anaemic compared to children aged 6-11 months. Children who had fever had increased odds (OR=1.44, 95% CI: 1.17-1.78, p=0.0006) of being anaemic when compared to those who did not have fever. Similarly, children who were stunted had increased odds (OR =1.58; 95% CI: 1.30-1.93, p<0.0001) of being anaemic compared to those who were not stunted.

The results also show that children whose mothers have secondary or higher education are 0.69 [0.55, 0.87] times less likely to be anaemic when compared to those whose mothers had no formal education. At the household level, the results show that children from the richer and richest categories of households are 48% (OR - 0.52, 95%CI: 0.37-0.72, p<0.0001) and 57% (OR = 0.43, 95%CI: 0.29-0.63, p<0.0001) less likely to be anaemic when compared to those from the poorest households. Also, children whose fathers have secondary or higher education are 25% (OR = 0.75, 95%CI: 0.60-0.92, p = 0.011) less likely to be anaemic when compared to those whose fathers have no formal education.

Table 6: Multilevel logistic regression on childhood anaemia by background characteristics among sampled children under five years

Background Characteristics	Model 1 OR [95% CI]	Model 2 OR [95% CI]	Model 3 OR [95% CI]	Model 4 OR [95% CI]	Model 5 OR [95% CI]
Year					
2003 GDHS	1.00	1.00	1.00	1.00	1.00
2008 GDHS	1.37 [1.12, 1.67]**	1.40 [1.13 1.74]**	1.42 [1.14, 1.77]**	1.51 [1.21, 1.88]**	1.43 [1.15, 1.78]**
2014 GDHS	0.82 [0.67, 1.00]	0.90 [0.73, 1.11]	0.91 [0.73, 1.13]	0.96 [0.77, 1.20]	0.87 [0.70, 1.09]
Place of residence					
Urban	1.00	1.00	1.00	1.00	1.00
Rural	2.04 [1.69, 2.48]**	2.00 [1.65, 2.43]**	2.05 [1.68, 2.50]**	1.82 [1.49, 2.22]**	1.13 [0.88, 1.45]
Primary factors					
Empowerment					
Decision making					
No participation		1.00	1.00	1.00	1.00
Partial participation		0.89 [0.72, 1.09]	0.92 [0.75, 1.14]	0.93 [0.75, 1.14]	0.96 [0.78, 1.19]
Full participation		0.88 [0.72, 1.08]	0.92 [0.75, 1.14]	0.93 [0.76, 1.15]	0.95 [0.77, 1.18]
Violence justification					
No justification		0.74 [0.58, 0.94]*	0.77 [0.61, 0.99]*	0.89 [0.69, 1.14]	0.98 [0.76, 1.26]
Partial justification		0.89 [0.70, 1.15]	0.92 [0.72, 1.19]	0.97 [0.75, 1.25]	1.01 [0.78, 1.30]
Full justification		1.00	1.00	1.00	1.00
Child-feeding practices					
Iron-rich foods					
No		1.00	1.00	1.00	1.00
Yes		1.30 [1.10, 1.53]*	1.17 [0.98, 1.39]	1.22 [1.02, 1.45]*	1.23 [1.03, 1.47]*
Vitamin A					
No		1.00	1.00	1.00	1.00
Yes		0.93 [0.79 1.10]	0.86 [0.73, 1.03]	0.91 [0.76, 1.08]	0.93 [0.78, 1.11]
Confounders					
Child level factors					
Age in months					
6-11			1.00	1.00	1.00
12-23			1.10 [0.86, 1.40]	1.16 [0.90, 1.49]	1.17 [0.91, 1.51]
24-35			0.69 [0.54, 0.90]**	0.72 [0.55, 0.93]*	0.73 [0.56, 0.95]*
36-47			0.53 [0.40, 0.70]**	0.56 [0.42, 0.74]**	0.55 [0.42, 0.74]**
48-59			0.44 [0.34, 0.58]**	0.45 [0.34, 0.60]**	0.45 [0.34, 0.60]**

Table 6 Cont'd: Multilevel logistic regression on childhood anaemia by background characteristics among sampled children under five years

Background Characteristics	Model 1 OR [95% CI]	Model 2 OR [95% CI]	Model 3 OR [95% CI]	Model 4 OR [95% CI]	Model 5 OR [95% CI]
Fever in the last two weeks					
No			1.00	1.00	1.00
Yes			1.42 [1.16, 1.74]**	1.47 [1.19, 1.81]**	1.44 [1.17, 1.78]**
Stunting					
No			1.00	1.00	1.00
Yes			1.70 [1.40, 2.06]**	1.64 [1.35, 1.99]**	1.58 [1.30, 1.93]**
Maternal factors					
Age in years					
<25				1.00	1.00
25-29				0.82 [0.65, 1.03]	0.88 [0.70, 1.11]
30-34				0.78 [0.62, 1.00]*	0.85 [0.67, 1.08]
35-39				0.77 [0.59, 1.00]*	0.84 [0.65, 1.09]
40+				0.87 [0.63, 1.20]	0.90 [0.65, 1.23]
Mother's education					
No education				1.00	1.00
Primary				0.72 [0.58, 0.91]**	0.83 [0.66, 1.06]
Secondary +				0.51 [0.41, 0.63]**	0.69 [0.55, 0.87]**
Household factors					
Wealth					
Poorest					1.00
Poorer					1.01 [0.79, 1.30]
Middle					0.82 [0.62, 1.08]
Richer					0.52 [0.37, 0.72]**
Richest					0.43 [0.29, 0.63]**
Father's education					
No education					1.00
Primary					0.99 [0.73, 1.35]
Secondary +					0.75 [0.60, 0.92]*

Table 6 Cont'd: Multilevel logistic regression on childhood anaemia by background characteristics among sampled children under five years

Background Characteristics	Model 1 OR [95% CI]	Model 2 OR [95% CI]	Model 3 OR [95% CI]	Model 4 OR [95% CI]	Model 5 OR [95% CI]
Variance of the random Effects [SE]					
Household	0.28 [0.0087]**	0.27 [0.0085]**	0.26 [0.0083]**	0.40 [0.0103]**	0.27 [0.0084]**
Community	0.23 [0.0141]**	0.23 [0.0143]**	0.27 [0.0154]**	0.21 [0.0138]**	0.23 [0.0141]**
District	0.06 [0.0195]**	0.06 [0.0195]**	0.05 [0.0175]**	0.03 [0.0135]*	0.03 [0.0132]*
% Δ in random effect					
Household	86.7	-3.6	-3.7	53.8	-32.5
Community	-34.7	0	17.4	-22.2	9.5
District	-60.0	0	-16.7	-40.0	0
Deviance	5054.3	5034.6	4911.9	4868.2	4829.2
AIC	5068.3	5060.6	4949.9	4918.2	4888.2
AIC weights	0.00	0.00	0.00	0.00	0.999999968
R-squared (%)	18.0	18.4	22.7	25.7	24.7

OR – Odds ratio; CI – confidence interval; *p<0.05; **p<0.01

Source: GDHS 2003; 2008; 2014

Model Summary statistics from the null Model (Model 0)

Random effects

Household variance [SE]: 0.15 [0.0064]** ICC: 0.245

Community variance [SE]: 0.31 [0.016]** ICC: 0.508

District variance [SE]: 0.15 [0.03]** ICC: 0.245

Deviance: 5134.3

AIC: 5142.3 R-squared: 15.7

Discussion

Anaemia is highly prevalent among children below age five years in Ghana and only a marginal decline was observed between 2003 and 2014. Not less than seven out of ten sampled children aged below five years were anaemic within the period. The high prevalence of anaemia is not only pertinent to Ghana but to other sub-Saharan African countries as well where more than half of children aged below five years are anaemic (WHO, 2015).

The study first hypothesized that women's empowerment was significantly associated with childhood anaemia. The results revealed that without accounting for confounders, only women's justification for violence was significantly associated with childhood anaemia. Children whose mothers justified violence were more likely to be anaemic. Women's attitude to violence presupposes an innate acceptance of violence at any point in time and for any reason they consider it as justifiable (Flood & Pease, 2009). There is also evidence that women who show supportive attitudes for domestic violence are more likely to be victims of it (Ferrer & Boscch, 2014; Abramsky et al., 2011).

Violence places a psychological toll (anxiety and depression, social dysfunction and increased likelihood of substance abuse) on women (Pico-Alfonso, et al., 2006) and since they are primary care givers, it can affect the frequency and quality of child-feeding practices (Yount, DiGirolamo, & Ramakrishnan, 2011) and consequently, anaemia status. The insignificant effect observed for decision making corroborates the findings in Burkina Faso by Heckert et al. (2019) who discussed that despite women's ability to make decisions, it is possible that they may have inadequate knowledge of the multiple causes of anaemia in order to adequately address them. A woman's

ability to make decisions is as important as her ability to have access to resources to translate these decisions into actions. The study was limited in exploring the role women's control over resources play in the decision making – childhood anaemia nexus, however, this is important since participation in decision without having control over adequate financial and material resources can be problematic.

The structuration theory postulates that the extent of individuals' agency is always influenced by some structural elements (Lamsal, 2012). Structures can be social, political, cultural and economic (Whittington, 2010). In line with the conceptual framework, the study identified education as an important structural element that defines the extent to which women can exercise their agency. The findings from this study reflect this nexus between agency and structure. After accounting for maternal education, women's violence justification became insignificant and suggests a nested relationship between education and domestic violence attitudes in Ghana. The pathway linking education, violence attitudes and child health has been explained by some studies. There is evidence that higher educational levels are associated with low violence-supportive attitudes (Uthman, Lawoko, & Moradi, 2009; Trinh, Oh, Choi, To, & Do, 2016). This is because, education increases women's awareness of their legal rights and services that can protect them in the face of domestic violence. Consequently, with violence-disapproval attitudes, women can avert poor psychological health outcomes and ensure better child-feeding practices for their children.

Iron deficiency is a major contributor of childhood anaemia (Stoltzfus, Mullany, & Black, 2004), therefore, consumption of iron rich foods should prove useful for their haemoglobin levels as has been reported in existing

studies (Kao et al., 2019; Kebede, Engebertsen, Bilal, & Lindtjorn, 2020; Mya, Kyaw, & Tun, 2019; Prieto-Patron, Horst, Hutton, & Detzel, 2018; Visser, et al., 2020). However, the results showed that recent intake of iron-rich foods was significantly associated with higher odds of being anaemic among children. The data used for this study was cross-sectional and given that anaemia as a condition builds up over time, it is difficult to establish whether the intake of iron rich foods (information based on a 24-hour recall) occurred before the child got the condition. A tentative explanation is that since anaemia is generally high in the population, mothers are encouraged to give their children more iron-rich foods to improve their haemoglobin levels. Children's consumption of iron-rich foods is therefore not a risk factor but imply changing health behaviours of mothers in ensuring better feeding practices, having known that their children are mostly nutrient deficient. The results from this study corroborate findings in the 2017 Ghana Micronutrient Survey (University of Ghana et al., 2017) that adopted similar study design and period of reference for variables on diet (last 24 hours).

Vitamin A supplementation was not a significant predictor though the results indicated that it reduces the risk of being anaemic for children. Other studies have however reported significant protective effect of the intake of Vitamin A on childhood anaemia (Al-Mekhlafi, et al., 2014; Michelazzo, Oliveira, Stefanello, Luzia, & Rondo, 2013). As most children are anaemic, the intake of a single nutrient supplement (Vitamin A) is not enough. Other studies have recommended the use of multiple micronutrient supplements (contain more than one micronutrient including iron) as more effective (Lannotti, Tielsch, Black, & Black, 2006; Ekvall, Premji, & Bjorkman, 2000;

Munayco, et al., 2013; Michelazzo, Oliveira, Stefanello, Luzia, & Rondo, 2013).

The findings from this study pointed to the influence of household, community and district of residence as important in determining children's risks of being anaemic. A higher proportion of the variation (50.8%) was attributed to differences at the community level. In a study by Nikoi and Anthamatten (2014), they found that childhood anaemia in Ghana was indeed clustered, but their study failed to identify how much is attributed to the various hierarchical levels – household, community and district levels. This study therefore provides additional evidence on the clustering of childhood anaemia in Ghana.

The second hypothesis of the study tested whether women's empowerment and child feeding practices account for any of the observed variations at the household, community and district levels. The results revealed that the primary factors account for none of the variation at the community and district levels. At the household level, it only accounts for just 3.6% of the remaining variation. This means that interventions targeted at improving childhood anaemia through empowerment of caregivers and child feeding do not need to consider the clustering of these factors at the community and district levels. On the other hand, the results implied that child, maternal and household factors rather contribute to how clustered the childhood condition is at these three levels and must be given the needed attention when designing important interventions and programs.

From the theory of health empowerment and study's conceptualisation, the effect of child-feeding practices on childhood anaemia was perceived to be dependent on a mother's empowerment level. As such, the study's third

hypothesis tested this associative pathway. The results indicated otherwise. The effect of child-feeding practices on childhood anaemia was not dependent on women's empowerment. It is either the associative effect of child-feeding practices on childhood anaemia is dependent on other factors (as can be inferred from the model of care), or the indicators used to test this mediating effect are limited in providing adequate information about the perceived conceptualisation. Additionally, the mediating predictors between women's decision making/violence justification and childhood anaemia may not necessarily be child-feeding practices but other important child-care variables.

Child factors such as age, fever and stunting were significantly associated with childhood anaemia. Children who were stunted, had fever and young were more likely to be anaemic. The results are consistent with studies found in other geographical settings (da Silva, Fawzi, Cardoso, & ENFAC Working Group, 2018; Moschovis et. al., 2018; Khanal, Karkee, Adhikari, & Gavidia, 2016; Nkulikiyinka, Binagwaho & Palmer, 2015; Qian-Qian, et al., 2017). Maternal education was a protective factor and corroborates the results from other studies (Dey, Goswani & Dey, 2013; Goswani & Das, 2014; Moschovis et. al. 2018; Nkulikiyinka, Binagwaho & Palmer, 2015; Simbauranga et. al. 2015). Its usefulness for child health and development has been explored by Prickett and Augustine (2016) who found that increased maternal education was associated with valuable health investment behaviours at each phase of children's early development. Strengthening programs that promote female education is, therefore, predominantly imperative.

The significant effect of wealth and father's education on childhood anaemia has been affirmed in previous studies (Dey, Goswani& Dey, 2013; Goswani & Das, 2014; Moschovis et. al. 2018; Nkulikiyinka, Binagwaho &

Palmer, 2015) Children belonging to the highest households and having fathers with secondary or more education are less likely to be anaemic. With increased wealth, households have enhanced food security and ease with accessing health care services for children. Fathers with higher education are more likely to have an expansive base of information to understand the health needs of children and ensure that these health care needs are addressed. Additionally, they can consistently prompt and encourage mothers to engage in good child-care practices or even assist in doing so.

Strengths and Limitations

This study has some strengths and limitations. First, it is novel by investigating the mediating pathway that links women's empowerment to childhood anaemia through child feeding practices. Second, the study also provides useful information on how much of the variation in childhood anaemia that is attributable to household, community and district level differences as well as the extent to which women's empowerment and child feeding practices contribute to it. Lastly, the study uses nationally representative data and the findings project a picture of the phenomenon at the national level. Information on this will be useful for tracking progress on policies. Beyond these strengths are some limitations. They are as follows.

1. The study examined trends in childhood anaemia across the three surveys. However, due to the cross-sectional nature of the surveys, these trends show year-specific differences and not necessarily the individual-level changes in the anaemic status of children.
2. The period of reference for questions on diet was short for the three successive surveys. It was "last seven days" in the 2003 GDHS and 24 hours in the 2008 and 2014 GDHSs. This has implications on

interpretation as it is difficult to strictly imply that the consumption of iron-rich foods precedes being anaemic.

3. The concept of empowerment was measured using only two indicators - decision making and attitude to violence. These indicators also measure just the socio-familial dimension of empowerment at the household level. Associations derived from this study are therefore limited to only this dimension and scope of empowerment.

Chapter summary

Childhood anaemia has declined marginally over the period with significant differences at the household, community and district levels. Not all dimensions of empowerment are important determinants of childhood anaemia. While the effect of violence justification was significant, decision making was not. Furthermore, the influence of violence justification was nullified when maternal education was accounted for. Other important predictors of childhood anaemia were child's age, stunting, fever, mother's age, mother's education, wealth and father's education. In the next chapter are the summary, conclusions and recommendations for the study.

CHAPTER FIVE

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

Introduction

The empowerment process enhances women's ability to perform their responsibilities of which caregiving is notable. This study sought to examine whether a mother's empowerment is important in determining her child's anaemia status and if this association is mediated by child feeding practices. In this chapter, the summary, conclusions and recommendations for the study are presented.

Summary

This study examined the associations between women's empowerment, child feeding practices and childhood anaemia in Ghana. Specifically, the study examined whether: (1) women's empowerment is positively associated with childhood anaemia; (2) women's empowerment and child feeding practices account for any observed variations in childhood anaemia at the household, community and district levels (3) the effect of child-care practices on childhood anaemia is dependent on a mother's empowerment level. The conceptualizations drawn were underpinned by the structuration theory, theory of health empowerment and model of child-care.

To address the study's objectives while accounting for the effect of time, three successive GDHSs (2003, 2008 and 2014 GDHS) were pooled and analysed. Both bivariate and multivariate analysis was conducted. The bivariate analysis employed Pearson's chi-square to test whether the differences in childhood anaemia by background characteristics are significant. Regarding the multivariate analysis, a multilevel binary logistic regression was used to model the relationships while accounting for important confounders.

The results of this study are based on 2154, 1589 and 1358 children below age five years in the 2003, 2008 and 2014 GDHSs respectively.

The findings of the study affirmed that childhood anaemia is highly prevalent among children below age five years in Ghana. For empowerment, the weighted percentage distribution of the sample across the three surveys showed that the proportion of women who participated in household decisions and showed no justification for violence has increased over time. Similarly, majority of the sampled children had consumed iron-rich foods and were given Vitamin A supplements.

The multilevel analysis revealed that without accounting for any predictor (referring to the null model), 24.6% and 50.8% of the variation in childhood anaemia were attributed to differences at the household and community levels. An additional 24.6% was accounted for by differences at the district levels. This implies that, the household, community and district a child belongs to significantly influences his/her likelihood of being anaemic.

The first hypothesis tested whether women's empowerment can predict the anaemia status of children and the results showed that women's justification for violence is a significant predictor. Children who belonged to women that partially or fully justified violence were at higher odds of being anaemic. However, after maternal education was accounted for, the impact of violence justification waned, highlighting the importance of female education in mitigating violence-supportive attitudes among women. In this study, even though having a mother who participates in household decisions is protective, the results were not significant.

The results also showed that children's recent consumption of iron-rich foods prior to the survey was significantly associated with childhood anaemia,

however, with increased odds. A tentative explanation given was that since anaemia is generally high in the population, mothers are encouraged to give their children more iron-rich foods to improve their haemoglobin levels. Consumption of iron-rich foods therefore suggests changing health behaviour of mothers in ensuring better feeding practices, having known that their children are mostly nutrient deficient. Furthermore, contrary to that reported in other studies, the intake of Vitamin A supplements was not a significant predictor of childhood anaemia in Ghana.

The second hypothesis sought to test whether empowerment and child feeding practices account for any of the observed variations in childhood anaemia at the household, community, and district levels. The results revealed that women's empowerment and child feeding practices accounted for none of the observed variation in childhood anaemia at the community and district levels but at the household level, it accounted for only 3.6% of the remaining variations. This means that women's empowerment and child feeding practices are not key factors that contribute to the clustering of childhood anaemia at the household, community and district levels. Some significant child, maternal and household factors rather explained

The study also hypothesized that the associative effect of child-feeding practices on childhood anaemia was dependent on mother's empowerment levels. However, from the results, this hypothesis was rejected indicating otherwise. One of the possible explanations given was that the mediating predictors between women's decision making/violence justification and childhood anaemia may not necessarily be child-feeding practices but rather other important child-care variables. Additional investigation is required to clearly define this conceptual pathway.

In this study, significant covariates associated with childhood anaemia included child's age, fever, stunting, maternal education, wealth, and father's education. This indicates the need to adopt multifaceted approaches in dealing with childhood anaemia in Ghana.

Conclusions

This study is unique in identifying and exploring the linkage between women's empowerment and childhood anaemia as mediated by child feeding practices. The findings address important gaps that have not been tackled within the Ghanaian context and hypothesized conceptualizations that have not been tested empirically. The findings are useful for interventions as well as future research.

In Ghana, most children aged below five years are anaemic and the household, community and district they reside in are significantly important in determining their anaemia status. Given the high prevalence, there was no significant difference between children whose mothers could participate in decisions and those whose mothers did not. Women's domestic violence attitude was an important predictor of childhood anaemia and ensuring higher educational levels for women can be beneficial in reducing violence supportive attitudes with consequential effect on children's haemoglobin levels. Children who consumed iron rich foods had higher anaemia odds and this portray possible change in child feeding behaviour of mothers having known that childhood anaemia is highly prevalent in Ghana.

Women's empowerment and child feeding practices did not contribute to explaining any of the observed variation in childhood anaemia attributable to between community and district differences. At the household level, it accounted for only 3.6%. These factors are not important in explaining the

clustering of childhood anaemia at these levels. Other child, maternal and household predictors rather accounted for a substantial amount of the observed variations. Within the context of this study, the effect of child feeding practices on childhood anaemia was not dependent on women's empowerment. Addressing childhood anaemia in Ghana also requires addressing other important predictors such as fever, stunting, educational and wealth disparities.

Recommendations

1. The study found that childhood anaemia in Ghana is generally high with clustering at the household, community and district levels. It is recommended that hotspot areas be identified and targeted when designing interventions that address childhood anaemia in Ghana.
2. Existing advocacy programs designed to empower women against violence-supportive attitudes as well as promote female education should be strengthened.

Suggestions for further research

Further studies are needed to explore how other domains that measure the socio-cultural, legal, political, psychological and economic dimensions of empowerment can influence childhood anaemia and other child health outcomes.

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APPENDICES
APPENDIX 1
LETTER OF APPROVAL FROM THE DHS PROGRAM

Apr 17, 2020
Josephine Ackah

University of Cape Coast

Ghana

Phone: +233547029174

Email: josephine.ackah@stu.ucc.edu.gh

Request Date: 04/17/2020

Dear Josephine Ackah:

This is to confirm that you are approved to use the following Survey Datasets for your registered research paper titled: "Women's

Empowerment and Childhood anaemia in Ghana":

Ghana

To access the datasets, please login at: https://www.dhsprogram.com/data/dataset_admin/login_main.cfm. The user name is the registered email address, and the password is the one selected during registration.

The IRB-approved procedures for DHS public-use datasets do not in any way allow respondents, households, or sample communities to be identified. There are no names of individuals or household addresses in the data files. The geographic identifiers only go down to the regional level (where regions are typically very large geographical areas encompassing several states/provinces). Each enumeration area (Primary Sampling Unit) has a PSU number in the data file, but the PSU numbers do not have any labels to indicate their names or locations. In surveys that collect GIS coordinates in the field, the coordinates are only for the enumeration area (EA) as a whole, and not for individual households, and the measured coordinates are randomly displaced within a large geographic area so that specific enumeration areas cannot be identified.

The DHS Data may be used only for the purpose of statistical reporting and analysis, and only for your registered research. To use the data for another purpose, a new research project must be registered. All DHS data should be treated as confidential, and no effort should be made to identify any household or individual respondent interviewed in the survey. Please reference the complete terms of use at: https://dhsprogram.com/Data/terms-of-use.cfm.

The data must not be passed on to other researchers without the written consent of DHS. However, if you have coresearchers registered in your account for this research paper, you are authorized to share the data with them. All data users are required to submit an electronic copy (pdf) of any reports/publications resulting from using the DHS data files to: references@dhsprogram.com.

Sincerely,

Bridgette Wellington

Bridgette Wellington

Data Archivist
The Demographic and Health Surveys (DHS) Program

APPENDIX 2

T1: Tests of multicollinearity for selected variables

Variables		Decision making	Violence justification	Iron_rich	Residence	Education	Father's education	Religion	Wealth	Vita A	fever	Stunting
Decision making	Interval by interval Pearman's R		-0.031	-0.027	0.005	-0.011	0.030	0.041	-0.048	0.004	-0.005	-0.048
	Ordinal by Ordinal Spearman Correlation		-0.036	-0.026	0.003	-0.007	0.031	0.032	-0.054	0.004	-0.004	-0.05
Violence justification	Interval by interval Pearman's R			-0.049	0.154	-0.259	-0.248	0.169	-0.240	0.007	0.030	0.105
	Ordinal by Ordinal Spearman Correlation			-0.042	0.155	-0.258	-0.248	0.169	-0.241	0.007	0.031	0.101
Iron_rich	Interval by interval Pearman's R				-0.064	0.128	0.073	-0.084	0.114	0.069	0.055	-0.014
	Ordinal by Ordinal Spearman Correlation				-0.064	0.128	0.073	-0.087	0.111	0.069	0.055	-0.014
Residence	Interval by interval Pearman's R					-0.317	-0.276	0.133	-0.685	-0.035	-0.002	0.131
	Ordinal by Ordinal Spearman Correlation					-0.316	-0.278	0.104	-0.653	-0.035	-0.002	0.131
Education	Interval by interval Pearman's R						0.512	-0.402	0.513	0.091	0.001	-0.131
	Ordinal by Ordinal S.						0.512	-0.419	0.519	0.091	0.002	-0.131

T1 Cont'd: Tests of multicollinearity for selected variables

		Decision making	Violence justification	Iron_rich	Residence	Education	Father's education	Religion	Wealth	Vita A	fever	Stunting
Father's education	Interval by interval Pearman's R							-0.380	0.460	0.091	0.012	-0.108
	Ordinal by Ordinal Spearman Correlation							-0.394	0.476	0.091	0.011	-0.109
Religion	Interval by interval Pearman's R								-0.293	-0.060	0.014	0.104
	Ordinal by Ordinal Spearman Correlation								-0.295	-0.057	0.017	0.097
Wealth	Interval by interval Pearman's R									0.096	-0.005	-0.149
	Ordinal by Ordinal Spearman Correlation									0.097	-0.002	-0.143
Vita A	Interval by interval Pearman's R										0.044	-0.002
	Ordinal by Ordinal Spearman Correlation										0.044	-0.002
Fever	Interval by interval Pearman's R											0.005
	Ordinal by Ordinal Spearman Correlation											0.005

Source: GDHS 2003; 2008; 2014

APPENDIX 3

Table 2: Wald statistic for variance of the random effect

	Model 0	Model 1	Model 2	Model 3	Model 4	Model 5
Variance of the random effect [SE]						
Household	0.15 [0.0064]**	0.28 [0.0087]**	0.27 [0.0085]**	0.26 [0.0083]**	0.40 [0.0103]**	0.27 [0.0084]**
Community	0.31 [0.016]**	0.23 [0.0141]**	0.23 [0.0143]**	0.27 [0.0154]**	0.21 [0.0138]**	0.23 [0.0141]**
District	0.15 [0.03]**	0.06 [0.0195]**	0.06 [0.0195]**	0.05 [0.0175]**	0.03 [0.0135]*	0.03 [0.0132]*
Wald						
Household	23.44	32.18	31.76	31.33	38.83	32.14
Community	19.38	16.31	16.08	17.53	15.22	16.43
District	5.00	3.08	3.08	2.86	2.22	2.27

**Wald > 2.58 *Wald >1.96

Source: GDHS 2003;2008;2014

T3: Multilevel logistic regression on childhood anaemia by background characteristics among sampled children under five years with insignificant predictors

BACKGROUND CHARACTERISTICS	Model 1	Model 2	Model 3	Model 4	Model 5
	OR [95% CI]	OR [95% CI]	OR [95% CI]	OR [95% CI]	OR [95% CI]
Year					
2003	1.00	1.00	1.00	1.00	1.00
2008	1.37[1.12, 1.67]**	1.40 [1.13 1.74]**	1.46 [1.17, 1.83]**	1.49 [1.19, 1.86]**	1.48 [1.18, 1.84]**
2014	0.82 [0.67, 1.00]	0.90 [0.73, 1.11]	0.92 [0.73, 1.15]	0.95 [0.76, 1.19]	0.88 [0.71, 1.10]
Place of residence					
Urban	1.00	1.00	1.00	1.00	1.00
Rural	2.04 [1.69, 2.48]**	2.00 [1.65, 2.43]**	2.06 [1.69, 2.51]**	1.81 [1.48, 2.22]**	1.15 [0.90, 1.47]
PRIMARY FACTORS					
Women's empowerment					
Decision making					
No participation		1.00	1.00	1.00	1.00
Partial participation		0.89 [0.72, 1.09]	0.92 [0.74, 1.13]	0.92 [0.75, 1.14]	0.94 [0.76, 1.16]
Full participation		0.88 [0.72, 1.08]	0.91 [0.73, 1.12]	0.93 [0.75, 1.15]	0.93 [0.75, 1.15]
Violence justification					
No justification		0.74 [0.58, 0.94]*	0.76 [0.60, 0.97]*	0.90 [0.70, 1.15]	0.95 [0.74, 1.22]
Partial justification		0.89 [0.70, 1.15]	0.91 [0.71, 1.18]	0.98 [0.76, 1.27]	0.97 [0.75, 1.25]
Full justification		1.00	1.00	1.00	1.00
Child-care practices					
Iron-rich foods					
No		1.00	1.00	1.00	1.00
Yes		1.30 [1.10, 1.53]*	1.17 [0.98, 1.39]	1.22 [1.02, 1.46]*	1.21 [1.02, 1.45]*
Vitamin A					
No		1.00	1.00	1.00	1.00
Yes		0.93 [0.79 1.10]	0.87 [0.73, 1.03]	0.91 [0.76, 1.09]	0.93 [0.78, 1.11]
CONFOUNDING FACTORS					
Child level factors					
Sex of child					
Male			1.00	1.00	1.00
Female			0.88 [0.76,1.03]	0.87 [0.74, 1.01]	0.84 [0.72, 0.98]
Age in months					
6-11			1.00	1.00	1.00
12-23			1.13 [0.88, 1.44]	1.17 [0.91, 1.50]	1.17 [0.91, 1.50]
24-35			0.69 [0.53, 0.89]**	0.72 [0.55, 0.93]*	0.73 [0.57, 0.95]*
36-47			0.53 [0.40, 0.70]**	0.55 [0.41, 0.72]**	0.55 [0.42, 0.73]**
48-59			0.45 [0.34, 0.58]**	0.45 [0.34, 0.59]**	0.46 [0.35, 0.60]**
Fever in the last two weeks					
No			1.00	1.00	1.00
Yes			1.43 [1.17, 1.76]**	1.46 [1.18, 1.79]**	1.44 [1.17, 1.77]**

T3 Cont'd: Multilevel logistic regression on childhood anaemia by background characteristics among sampled children under five years with insignificant predictors

BACKGROUND CHARACTERISTICS	Model 1	Model 2	Model 3	Model 4	Model 5
Stunting	OR [95% CI]	OR [95% CI]	OR [95% CI]	OR [95% CI]	OR [95% CI]
No			1.00	1.00	1.00
Yes			1.68 [1.38, 2.04]**	1.63 [1.34, 1.99]**	1.55 [1.27, 1.88]**
Maternal factors					
Age in years					
<25				1.00	1.00
25-29				0.79 [0.62, 1.01]	0.86 [0.67, 1.09]
30-34				0.74 [0.56, 0.98]*	0.81 [0.62, 1.08]
35-39				0.72 [0.52, 0.99]*	0.82 [0.59, 1.12]
40+				0.79 [0.52, 1.19]	0.86 [0.57, 1.29]
Religion					
Christian				1.00	1.00
Islam				1.15 [0.91, 1.44]	1.06 [0.84, 1.34]
Other				1.10 [0.82, 1.46]	0.99 [0.74, 1.31]
Mother's education					
No education				1.00	1.00
Primary				0.75 [0.59, 0.95]*	0.83 [0.66, 1.06]
Secondary +				0.54 [0.43, 0.68]**	0.69 [0.54, 0.88]**
Parity					
1-2				1.00	1.00
3-4				1.11 [0.89, 1.39]	1.05 [0.85, 1.31]
5-6				1.09 [0.82, 1.47]	0.99 [0.74, 1.32]
7+				1.17 [0.80, 1.71]	1.04 [0.71, 1.52]
Household factors					
Wealth					
Poorest					1.00
Poorer					1.03 [0.80, 1.32]
Middle					0.83 [0.63, 1.10]
Richer					0.54 [0.39, 0.74]**
Richest					0.45 [0.31, 0.66]**
Father's education					
No education					1.00
Primary					0.99 [0.73, 1.34]
Secondary +					0.75 [0.60, 0.92]**
Variance of the random Effects [SE]					
Household	0.28 [0.0087]**	0.27 [0.0085]**	0.26 [0.0083]**	0.41 [0.0105]**	0.28 [0.0084]**
Community	0.23 [0.0141]**	0.23 [0.0143]**	0.29 [0.0160]**	0.21 [0.0138]**	0.21 [0.0136]**
District	0.06 [0.0195]**	0.06 [0.0195]**	0.05 [0.0184]**	0.03 [0.0133]**	0.03 [0.0143]*
% Δ in random effect					
Household	86.7	-3.6	-3.8	57.7	-31.7
Community	-34.7	0	26.1	-27.6	0.0
District	-60.0	0	-16.7	-40.0	0.0
AIC	5068.3	5034.6	4948.8	4924.4	4897.3

Source: GDHS 2003;2008;2014 OR – Odds ratio *[significant at 0.05] **[significant at 0.01]

T4a: Multilevel logistic regression on childhood anaemia by background characteristics among sampled children under five years with insig. interactions

BACKGROUND CHARACTERISTICS	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
	OR [95% CI]	OR [95% CI]	OR [95% CI]	OR [95% CI]	OR [95% CI]	OR [95% CI]
Year						
2003	1.00	1.00	1.00	1.00	1.00	1.00
2008	1.37 [1.12, 1.67]**	1.40 [1.13 1.74]**	1.42 [1.14, 1.77]**	1.51 [1.21, 1.88]**	1.43 [1.15, 1.78]**	1.39 [1.12, 1.74]**
2014	0.82 [0.67, 1.00]	0.90 [0.73, 1.11]	0.91 [0.73, 1.13]	0.96 [0.77, 1.20]	0.87 [0.70, 1.09]	0.85 [0.68, 1.07]
Place of residence						
Urban	1.00	1.00	1.00	1.00	1.00	1.00
Rural	2.04 [1.69, 2.48]**	2.00 [1.65, 2.43]**	2.05 [1.68, 2.50]**	1.82 [1.49, 2.22]**	1.13 [0.88, 1.45]	1.14 [0.89, 1.45]
PRIMARY FACTORS						
Women's empowerment						
Decision making						
No participation		1.00	1.00	1.00	1.00	1.00
Partial participation		0.89 [0.72, 1.09]	0.92 [0.75, 1.14]	0.93 [0.75, 1.14]	0.96 [0.78, 1.19]	0.76 [0.52, 1.09]
Full participation		0.88 [0.72, 1.08]	0.92 [0.75, 1.14]	0.93 [0.76, 1.15]	0.95 [0.77, 1.18]	0.73 [0.51, 1.04]
Violence justification						
No justification		0.74 [0.58, 0.94]*	0.77 [0.61, 0.99]*	0.89 [0.69, 1.14]	0.98 [0.76, 1.26]	0.98 [0.76, 1.25]
Partial justification		0.89 [0.70, 1.15]	0.92 [0.72, 1.19]	0.97 [0.75, 1.25]	1.01 [0.78, 1.30]	1.00 [0.78, 1.28]
Full justification		1.00	1.00	1.00	1.00	1.00
Child-feeding practices						
Iron-rich foods						
No		1.00	1.00	1.00	1.00	1.00
Yes		1.30 [1.10, 1.53]*	1.17 [0.98, 1.39]	1.22 [1.02, 1.45]*	1.23 [1.03, 1.47]*	0.92 [0.65, 1.31]
Vitamin A						
No		1.00	1.00	1.00	1.00	1.00
Yes		0.93 [0.79 1.10]	0.86 [0.73, 1.03]	0.91 [0.76, 1.08]	0.93 [0.78, 1.11]	0.94 [0.79, 1.12]
CONFOUNDING FACTORS						
Child level factors						
Age in months						
6-11			1.00	1.00	1.00	1.00
12-23			1.10 [0.86, 1.40]	1.16 [0.90, 1.49]	1.17 [0.91, 1.51]	1.17 [0.91, 1.50]
24-35			0.69 [0.54, 0.90]**	0.72 [0.55, 0.93]*	0.73 [0.56, 0.95]*	0.75 [0.58, 0.97]*
36-47			0.53 [0.40, 0.70]**	0.56 [0.42, 0.74]**	0.55 [0.42, 0.74]**	0.57 [0.43, 0.75]**
48-59			0.44 [0.34, 0.58]**	0.45 [0.34, 0.60]**	0.45 [0.34, 0.60]**	0.46 [0.35, 0.60]**
Fever in the last two weeks						
No			1.00	1.00	1.00	1.00
Yes			1.42 [1.16, 1.74]**	1.47 [1.19, 1.81]**	1.44 [1.17, 1.78]**	1.44 [1.17, 1.77]**
Stunting						
No			1.00	1.00	1.00	1.00
Yes			1.70 [1.40, 2.06]**	1.64 [1.35, 1.99]**	1.58 [1.30, 1.93]**	1.57 [1.29, 1.90]**

T4a Cont'd: Multilevel logistic regression on childhood anaemia by background characteristics among sampled children under five years with insig. interactions

BACKGROUND CHARACTERISTICS	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
Maternal factors	OR [95% CI]	OR [95% CI]	OR [95% CI]	OR [95% CI]	OR [95% CI]	OR [95% CI]
Age in years						
<25				1.00	1.00	1.00
25-29				0.82 [0.65, 1.03]	0.88 [0.70, 1.11]	0.89 [0.72, 1.12]
30-34				0.78 [0.62, 1.00]*	0.85 [0.67, 1.08]	0.86 [0.68, 1.08]
35-39				0.77 [0.59, 1.00]*	0.84 [0.65, 1.09]	0.84 [0.65, 1.08]
40+				0.87 [0.63, 1.20]	0.90 [0.65, 1.23]	0.90 [0.66, 1.23]
Mother's education						
No education				1.00	1.00	1.00
Primary				0.72 [0.58, 0.91]**	0.83 [0.66, 1.06]	0.84 [0.67, 1.06]
Secondary +				0.51 [0.41, 0.63]**	0.69 [0.55, 0.87]**	0.71 [0.56, 0.89]**
Household factors						
Wealth						
Poorest					1.00	1.00
Poorer					1.01 [0.79, 1.30]	1.02 [0.80, 1.30]
Middle					0.82 [0.62, 1.08]	0.83 [0.63, 1.09]
Richer					0.52 [0.37, 0.72]**	0.53 [0.38, 0.73]**
Richest					0.43 [0.29, 0.63]**	0.44 [0.30, 0.64]**
Father's education						
No education					1.00	1.00
Primary					0.99 [0.73, 1.35]	0.98 [0.73, 1.33]
Secondary +					0.75 [0.60, 0.92]**	0.74 [0.60, 0.91]**
Interaction						
Decision making * Iron-rich food						
Dec. (No)* Iron-rich (No)						1.00
Dec.(Partial)*Iron-rich (Yes)						1.40 [0.90, 2.16]
Dec. (Full)* Iron-rich (Yes)						1.48 [0.97, 2.27]
Variance of the random Effects[SE]						
Household	0.28 [0.0087]**	0.27 [0.0085]**	0.26 [0.0083]**	0.40 [0.0103]**	0.27 [0.0084]**	0.18 [0.0070]**
Community	0.23 [0.0141]**	0.23 [0.0143]**	0.27 [0.0154]**	0.21 [0.0138]**	0.23 [0.0141]**	0.26 [0.01518]**
District	0.06 [0.0195]**	0.06 [0.0195]**	0.05 [0.0175]**	0.03 [0.0135]**	0.03 [0.0132]*	0.03 [0.01367]*
% Δ in random effect						
Household	86.7	-3.6	-3.7	53.8	-32.5	-33.3
Community	-34.7	0	17.4	-22.2	9.5	13.0
District	-60.0	0	-16.7	-40.0	0	0
Deviance	5054.3	5034.6	4911.9	4868.2	4829.2	4824.8
AIC	5068.3	5060.6	4949.9	4918.2	4888.2	4890.8

Source: GDHS 2003; 2008; 2014 OR – Odds ratio *[significant at 0.05] **[significant at 0.01]

T4b: Multilevel logistic regression on childhood anaemia by background characteristics among sampled children under five years with insig. interactions

BACKGROUND CHARACTERISTICS	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
	OR [95% CI]	OR [95% CI]	OR [95% CI]	OR [95% CI]	OR [95% CI]	OR [95% CI]
Year						
2003	1.00	1.00	1.00	1.00	1.00	1.00
2008	1.37 [1.12, 1.67]**	1.40 [1.13 1.74]**	1.42 [1.14, 1.77]**	1.51 [1.21, 1.88]**	1.43 [1.15, 1.78]**	1.45 [1.16, 1.81]**
2014	0.82 [0.67, 1.00]	0.90 [0.73, 1.11]	0.91 [0.73, 1.13]	0.96 [0.77, 1.20]	0.87 [0.70, 1.09]	0.88 [0.70, 1.10]
Place of residence						
Urban	1.00	1.00	1.00	1.00	1.00	1.00
Rural	2.04 [1.69, 2.48]**	2.00 [1.65, 2.43]**	2.05 [1.68, 2.50]**	1.82 [1.49, 2.22]**	1.13 [0.88, 1.45]	1.15 [0.90, 1.48]
PRIMARY FACTORS						
Women's empowerment						
Decision making						
No participation		1.00	1.00	1.00	1.00	1.00
Partial participation		0.89 [0.72, 1.09]	0.92 [0.75, 1.14]	0.93 [0.75, 1.14]	0.96 [0.78, 1.19]	0.95 [0.76, 1.17]
Full participation		0.88 [0.72, 1.08]	0.92 [0.75, 1.14]	0.93 [0.76, 1.15]	0.95 [0.77, 1.18]	0.94 [0.76, 1.16]
Violence justification						
No justification		0.74 [0.58, 0.94]*	0.77 [0.61, 0.99]*	0.89 [0.69, 1.14]	0.98 [0.76, 1.26]	0.81 [0.54, 1.22]
Partial justification		0.89 [0.70, 1.15]	0.92 [0.72, 1.19]	0.97 [0.75, 1.25]	1.01 [0.78, 1.30]	0.78 [0.51, 1.19]
Full justification		1.00	1.00	1.00	1.00	1.00
Child-care practices						
Iron-rich foods						
No		1.00	1.00	1.00	1.00	1.00
Yes		1.30 [1.10, 1.53]*	1.17 [0.98, 1.39]	1.22 [1.02, 1.45]*	1.23 [1.03, 1.47]*	0.91 [0.59, 1.42]
Vitamin A						
No		1.00	1.00	1.00	1.00	1.00
Yes		0.93 [0.79 1.10]	0.86 [0.73, 1.03]	0.91 [0.76, 1.08]	0.93 [0.78, 1.11]	0.95 [0.79, 1.13]
CONFOUNDING FACTORS						
Child level factors						
Age in months						
6-11			1.00	1.00	1.00	1.00
12-23			1.10 [0.86, 1.40]	1.16 [0.90, 1.49]	1.17 [0.91, 1.51]	1.15 [0.90, 1.49]
24-35			0.69 [0.54, 0.90]**	0.72 [0.55, 0.93]*	0.73 [0.56, 0.95]*	0.72 [0.55, 0.94]*
36-47			0.53 [0.40, 0.70]**	0.56 [0.42, 0.74]**	0.55 [0.42, 0.74]**	0.55 [0.41, 0.73]**
48-59			0.44 [0.34, 0.58]**	0.45 [0.34, 0.60]**	0.45 [0.34, 0.60]**	0.45 [0.34, 0.59]**
Fever in the last two weeks						
No			1.00	1.00	1.00	1.00
Yes			1.42 [1.16, 1.74]**	1.47 [1.19, 1.81]**	1.44 [1.17, 1.78]**	1.44 [1.17, 1.77]**
Stunting						
No			1.00	1.00	1.00	1.00
Yes			1.70 [1.40, 2.06]**	1.64 [1.35, 1.99]**	1.58 [1.30, 1.93]**	1.58 [1.30, 1.93]**

T4b Cont'd: Multilevel logistic regression on childhood anaemia by background characteristics among sampled children under five years with insig. interactions

BACKGROUND CHARACTERISTICS	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
Maternal factors	OR [95% CI]	OR [95% CI]	OR [95% CI]	OR [95% CI]	OR [95% CI]	OR [95% CI]
Age in years						
<25				1.00	1.00	1.00
25-29				0.82 [0.65, 1.03]	0.88 [0.70, 1.11]	0.89 [0.71, 1.12]
30-34				0.78 [0.62, 1.00]*	0.85 [0.67, 1.08]	0.85 [0.67, 1.08]
35-39				0.77 [0.59, 1.00]*	0.84 [0.65, 1.09]	0.84 [0.65, 1.09]
40+				0.87 [0.63, 1.20]	0.90 [0.65, 1.23]	0.90 [0.65, 1.25]
Mother's education						
No education				1.00	1.00	1.00
Primary				0.72 [0.58, 0.91]**	0.83 [0.66, 1.06]	0.82 [0.65, 1.05]
Secondary +				0.51 [0.41, 0.63]**	0.69 [0.55, 0.87]**	0.69 [0.54, 0.87]**
Household factors						
Wealth						
Poorest					1.00	1.00
Poorer					1.01 [0.79, 1.30]	1.02 [0.80, 1.31]
Middle					0.82 [0.62, 1.08]	0.82 [0.62, 1.09]
Richer					0.52 [0.37, 0.72]**	0.52 [0.37, 0.72]**
Richest					0.43 [0.29, 0.63]**	0.43 [0.29, 0.63]**
Father's education						
No education					1.00	1.00
Primary					0.99 [0.73, 1.35]	1.00 [0.73, 1.35]
Secondary +					0.75 [0.60, 0.92]**	0.74 [0.60, 0.92]**
Interaction						
Violence justification * Iron-rich food						
Vio. (No)* Iron-rich (Yes)						1.37 [0.84, 2.25]
Vio.(Partial)*Iron-rich (Yes)						1.53 [0.90, 2.60]
Vio. (Full)* Iron-rich (No)						1.00
Variance of the random Effects [SE]						
Household	0.28 [0.0087]**	0.27 [0.0085]**	0.26 [0.0083]**	0.40 [0.0103]**	0.27 [0.0084]**	0.40 [0.0104]**
Community	0.23 [0.0141]**	0.23 [0.0143]**	0.27 [0.0154]**	0.21 [0.0138]**	0.23 [0.0141]**	0.20 [0.0133]**
District	0.06 [0.0195]**	0.06 [0.0195]**	0.05 [0.0175]**	0.03 [0.0135]**	0.03 [0.0132]*	0.03 [0.013]*
% Δ in random effect						
Household	86.7	-3.6	-3.7	53.8	-32.5	48.1
Community	-34.7	0	17.4	-22.2	9.5	-13.0
District	-60.0	0	-16.7	-40.0	0	0
Deviance	5054.3	5034.6	4911.9	4868.2	4829.2	4824.0
AIC	5068.3	5060.6	4949.9	4918.2	4888.2	4890.0

Source: GDHS 2003; 2008; 2014 OR – Odds ratio *[significant at 0.05] **[significant at 0.01]

T4c: Multilevel logistic regression on childhood anaemia by background characteristics among sampled children under five years with insig. interactions

BACKGROUND CHARACTERISTICS	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
	OR [95% CI]	OR [95% CI]	OR [95% CI]	OR [95% CI]	OR [95% CI]	OR [95% CI]
Year						
2003	1.00	1.00	1.00	1.00	1.00	1.00
2008	1.37 [1.12, 1.67]**	1.40 [1.13 1.74]**	1.42 [1.14, 1.77]**	1.51 [1.21, 1.88]**	1.43 [1.15, 1.78]**	1.43 [1.15, 1.78]**
2014	0.82 [0.67, 1.00]	0.90 [0.73, 1.11]	0.91 [0.73, 1.13]	0.96 [0.77, 1.20]	0.87 [0.70, 1.09]	0.87 [0.70, 1.09]
Place of residence						
Urban	1.00	1.00	1.00	1.00	1.00	1.00
Rural	2.04 [1.69, 2.48]**	2.00 [1.65, 2.43]**	2.05 [1.68, 2.50]**	1.82 [1.49, 2.22]**	1.13 [0.88, 1.45]	1.14 [0.89, 1.46]
PRIMARY FACTORS						
Women's empowerment						
Decision making						
No participation		1.00	1.00	1.00	1.00	1.00
Partial participation		0.89 [0.72, 1.09]	0.92 [0.75, 1.14]	0.93 [0.75, 1.14]	0.96 [0.78, 1.19]	0.96 [0.78, 1.18]*
Full participation		0.88 [0.72, 1.08]	0.92 [0.75, 1.14]	0.93 [0.76, 1.15]	0.95 [0.77, 1.18]	0.94 [0.76, 1.15]
Violence justification						
No justification		0.74 [0.58, 0.94]*	0.77 [0.61, 0.99]*	0.89 [0.69, 1.14]	0.98 [0.76, 1.26]	1.10 [0.74, 1.65]
Partial justification		0.89 [0.70, 1.15]	0.92 [0.72, 1.19]	0.97 [0.75, 1.25]	1.01 [0.78, 1.30]	0.77 [0.51, 1.17]
Full justification		1.00	1.00	1.00	1.00	1.00
Child-care practices						
Iron-rich foods						
No		1.00	1.00	1.00	1.00	1.00
Yes		1.30 [1.10, 1.53]*	1.17 [0.98, 1.39]	1.22 [1.02, 1.45]*	1.23 [1.03, 1.47]*	1.24 [1.04, 1.47]*
Vitamin A						
No		1.00	1.00	1.00	1.00	1.00
Yes		0.93 [0.79 1.10]	0.86 [0.73, 1.03]	0.91 [0.76, 1.08]	0.93 [0.78, 1.11]	0.93 [0.60, 1.44]
CONFOUNDING FACTORS						
Child level factors						
Age in months						
6-11			1.00	1.00	1.00	1.00
12-23			1.10 [0.86, 1.40]	1.16 [0.90, 1.49]	1.17 [0.91, 1.51]	1.18 [0.92, 1.51]
24-35			0.69 [0.54, 0.90]**	0.72 [0.55, 0.93]*	0.73 [0.56, 0.95]*	0.74 [0.58, 0.96]*
36-47			0.53 [0.40, 0.70]**	0.56 [0.42, 0.74]**	0.55 [0.42, 0.74]**	0.56 [0.43, 0.74]**
48-59			0.44 [0.34, 0.58]**	0.45 [0.34, 0.60]**	0.45 [0.34, 0.60]**	0.47 [0.36, 0.62]**
Fever in the last two weeks						
No			1.00	1.00	1.00	1.00
Yes			1.42 [1.16, 1.74]**	1.47 [1.19, 1.81]**	1.44 [1.17, 1.78]**	1.43 [1.17, 1.76]**
Stunting						
No			1.00	1.00	1.00	1.00
Yes			1.70 [1.40, 2.06]**	1.64 [1.35, 1.99]**	1.58 [1.30, 1.93]**	1.55 [1.28, 1.89]**

T4c cont'd: Multilevel logistic regression on childhood anaemia by background characteristics among sampled children under five years with insig. interactions

BACKGROUND CHARACTERISTICS	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
Maternal factors	OR [95% CI]	OR [95% CI]	OR [95% CI]	OR [95% CI]	OR [95% CI]	OR [95% CI]
Age in years						
<25				1.00	1.00	1.00
25-29				0.82 [0.65, 1.03]	0.88 [0.70, 1.11]	0.87 [0.70, 1.09]
30-34				0.78 [0.62, 1.00]*	0.85 [0.67, 1.08]	0.83 [0.66, 1.05]
35-39				0.77 [0.59, 1.00]*	0.84 [0.65, 1.09]	0.82 [0.63, 1.05]
40+				0.87 [0.63, 1.20]	0.90 [0.65, 1.23]	0.87 [0.64, 1.19]
Mother's education						
No education				1.00	1.00	1.00
Primary				0.72 [0.58, 0.91]**	0.83 [0.66, 1.06]	0.83 [0.66, 1.05]
Secondary +				0.51 [0.41, 0.63]**	0.69 [0.55, 0.87]**	0.68 [0.54, 0.86]**
Household factors						
Wealth						
Poorest					1.00	1.00
Poorer					1.01 [0.79, 1.30]	1.02 [0.80, 1.30]
Middle					0.82 [0.62, 1.08]	0.84 [0.64, 1.10]
Richer					0.52 [0.37, 0.72]**	0.54 [0.39, 0.74]**
Richest					0.43 [0.29, 0.63]**	0.45 [0.31, 0.65]**
Father's education						
No education					1.00	1.00
Primary					0.99 [0.73, 1.35]	0.99 [0.73, 1.34]
Secondary +					0.75 [0.60, 0.92]**	0.76 [0.62, 0.93]**
Interaction						
Violence justification * Vitamin A						
Vio. (No)* Vita (Yes)						0.83 [0.51, 1.34]
Vio.(Partial)*Vita (Yes)						1.50 [0.90, 2.52]
Vio. (Full)* Vita (No)						1.00
Variance of the random Effects [SE]						
Household	0.28 [0.0087]**	0.27 [0.0085]**	0.26 [0.0083]**	0.40 [0.0103]**	0.27 [0.0084]**	0.18 [0.0070]**
Community	0.23 [0.0141]**	0.23 [0.0143]**	0.27 [0.0154]**	0.21 [0.0138]**	0.23 [0.0141]**	0.24 [0.0147]**
District	0.06 [0.0195]**	0.06 [0.0195]**	0.05 [0.0175]**	0.03 [0.0135]**	0.03 [0.0132]*	0.04 [0.0152]*
% Δ in random effect						
Household	86.7	-3.6	-3.7	53.8	-32.5	-33.3
Community	-34.7	0	17.4	-22.2	9.5	4.3
District	-60.0	0	-16.7	-40.0	0	33.3
Deviance	5054.3	5034.6	4911.9	4868.2	4829.2	4817.2
AIC	5068.3	5060.6	4949.9	4918.2	4888.2	4883.2

Source: GDHS 2003; 2008; 2014 OR – Odds ratio *[significant at 0.05] **[significant at 0.01]