



SCHOOL OF POSTGRADUATE STUDIES

**DETERMINANTS OF ANAEMIA AMONG CHILDREN AGED 6–59
MONTHS IN ZAMBIA: A MULTILEVEL ANALYSIS OF THE 2024 ZDHS.**

BY

GABRIEL MWILA

MSCEB24232282

MASTER OF EPIDEMIOLOGY AND BIOSTATISTICS

SUPERVISOR

PROFESSOR RICHARD MUTEMWA

**A research dissertation submitted to the University of Lusaka in partial fulfilment of the
requirements of a Master's Degree in Epidemiology and Biostatistics**

DECLARATION

I, Gabriel Mwila, declare that this dissertation entitled “**Determinants of Anaemia among Children Aged 6–59 Months in Zambia: A Multilevel Analysis of the 2024 Zambia Demographic and Health Survey**” is my original work and has been submitted in partial fulfilment of the requirements for the award of the **Master of Science in Epidemiology and Biostatistics** at the University of Lusaka.

I confirm that this dissertation has not been submitted, either wholly or in part, to any other institution for the award of any academic qualification. All sources of information used in this dissertation have been appropriately acknowledged and referenced.

Name: Gabriel Mwila

Signature: GM

Date: 28/ 08/2026

Name: Professor Richard Mutemwa

Signature: 

Date: 28/ 08/2026

DEDICATION

This dissertation is dedicated to my family for their unwavering love, encouragement, and support throughout my academic journey. Their patience, sacrifices, and belief in my abilities have been a constant source of motivation.

I also dedicate this work to all children affected by anaemia and malnutrition in Zambia and beyond. May the evidence generated from research such as this contribute towards strengthening policies and interventions aimed at improving child health, nutrition, and wellbeing.

ACKNOWLEDGEMENTS

I would like to express my sincere gratitude to everyone who contributed to the successful completion of this dissertation.

First and foremost, I thank God Almighty for granting me the strength, wisdom, and perseverance throughout this academic journey.

I extend my deepest appreciation to my supervisor, Professor Richard Mutemwa, for the valuable guidance, constructive feedback, and continuous support provided throughout the development of this dissertation. Your expertise and encouragement greatly contributed to the quality of this work.

I am grateful to the University of Lusaka, particularly the School of Post Graduate Studies, for providing the academic environment and resources necessary for undertaking this programme. I also appreciate all lecturers and staff members who contributed to my training in epidemiology and biostatistics.

My sincere appreciation goes to the Zambia Statistics Agency (ZamStats) and the DHS Program for making the 2024 Zambia Demographic and Health Survey data available for research purposes. Without this valuable resource, this study would not have been possible.

I would also like to acknowledge my colleagues and friends for their encouragement, support, and motivation throughout this journey. Your contributions, discussions, and words of encouragement were greatly appreciated.

Finally, I am deeply thankful to my family for their unconditional love, patience, sacrifices, and continued support. Your encouragement has been my greatest source of strength, and I dedicate this achievement to you.

Table of Contents

DECLARATION	1
DEDICATION	2
ACKNOWLEDGEMENTS	3
List of tables.....	6
List of Figures.....	6
Abbreviations	7
Abstract.....	8
1. CHAPTER 1: INTRODUCTION.....	9
1.1. Background.	9
1.2. The problem statements.	10
1.3. Rationale and Significance	11
1.4. Research Aim & Objectives.	11
2. CHAPTER 2: LITERATURE REVIEW.....	12
2.1. Global burden of childhood anaemia	12
2.2. Anaemia in sub-Saharan Africa	12
2.3. Anaemia in Zambia.....	13
2.4. Determinants of childhood anaemia.....	13
Child-level determinants.....	13
Maternal determinants.....	14
Household determinants	14
Community determinants.....	14
2.5. Evidence-based practice and the analytical implication.....	14
2.6. Evidence gap.....	15
2.7. Theoretical Framework.....	15
2.8. Conceptual Framework.....	16
3. CHAPTER 3: METHODOLOGY.....	16
3.1. Study Approach and Design.....	16
3.2. Data source and secondary analysis.	17
3.3. Study Population and sample size.	17
3.4. Sampling strategy.....	18
3.5. Variables Identification, definition and measurement.	19
3.6. Data management and quality assessment	21

3.7.	Data analysis.....	22
3.8.	Statistical significance, confidence intervals and interpretation of odds ratios	22
3.9.	Ethical considerations.....	23
3.10.	Study Period.	23
4.	CHAPTER 4: PRESENTATION OF FINDINGS.	25
4.1.	Background Characteristics.....	25
4.2.	Anaemia Prevalence.....	29
4.3.	Background characteristics and associations with Anaemia.	30
4.4.	Multilevel modelling of childhood anaemia among children aged 6-59 months in Zambia. 35	
4.5.	Random Effects	41
4.5.1.	Random intercept model	41
4.5.2.	Effect of adding explanatory variables on cluster-level variation.	42
4.6.	Model 2: Child-level factors associated with childhood anaemia.	43
4.7.	Model 3 Maternal factors related to childhood anaemia.	44
4.8.	Model 4 Household and community-level factors associated with childhood anaemia.	45
4.9.	Full Model.....	45
4.10.	Interpretation of adjusted associations	46
5.	CHAPTER 5: DISCUSSION	46
5.1.	Prevalence of childhood Anaemia	47
5.2.	Child-level factors of childhood anaemia.....	47
5.3.	Maternal factors associated with childhood anaemia.....	49
5.4.	Household and community-level determinants.....	50
5.5.	Strengths and limits of the Study.....	52
6.	CHAPTER 6: CONCLUSION.....	53
7.	CHAPTER 7: RECOMMENDATIONS.....	53
	REFERENCES.....	55
	APPENDICES	58

List of tables

Table 1: Definition and Measurement of Study Variables	21
Table 2: Study duration.....	24
Table 3: Background Characteristics	29
Table 4: Background Characteristics and Associations with Anaemia	35
Table 5: Multilevel modelling of childhood anaemia among children aged 6–59 months in Zambia	41

List of Figures

Figure 1: Sampling procedure and techniques.....	18
Figure 2: Anaemia Prevalence	Error! Bookmark not defined.

Abbreviations

Abbreviation	Meaning
AIC	Akaike Information Criterion
ANC	Antenatal Care
AOR	Adjusted Odds Ratio
BIC	Bayesian Information Criterion
CI	Confidence Interval
DHS	Demographic and Health Survey
EA	Enumeration Area
ICC	Intraclass Correlation Coefficient
LMICs	Low- and Middle-Income Countries
LR	Likelihood Ratio
MOR	Median Odds Ratio
OR	Odds Ratio
PHC	Primary Health Care
PSU	Primary Sampling Unit
SDG	Sustainable Development Goal
SSA	Sub-Saharan Africa
WHO	World Health Organization
ZDHS	Zambia Demographic and Health Survey
ZMW	Zambian Kwacha

Abstract

Introduction: Anaemia among children aged 6–59 months remains an important public health problem globally, particularly in low- and middle-income countries. The condition is associated with impaired cognitive and motor development, increased susceptibility to infection and other adverse child health outcomes. In Zambia, nationally representative evidence shows a substantial burden of childhood anaemia. However, determinants operate at individual, household and community levels, and conventional single-level analyses may not adequately account for the hierarchical structure of Demographic and Health Survey data. This study therefore examined the prevalence and factors associated with anaemia among children aged 6–59 months in Zambia using the 2024 Zambia Demographic and Health Survey (ZDHS).

Methods: This was a quantitative, analytical cross-sectional study based on secondary analysis of the 2024 ZDHS. The study population comprised children aged 6–59 months with available haemoglobin measurements and information on selected explanatory variables. Of 8,673 children initially identified, 3,393 were eligible for the analytical dataset after exclusion of observations with missing or incomplete information; 3,300 children contributed to the final weighted analytical estimates. Descriptive and bivariate analyses were used to estimate prevalence and examine crude associations. A multilevel mixed-effects binary logistic regression model with a random intercept for enumeration areas was fitted to estimate adjusted odds ratios (AORs) and 95% confidence intervals (CIs). Statistical significance was assessed at a two-sided alpha level of 0.05. The hierarchical modelling strategy progressed from a null model to child-level, maternal-level, household/community-level and fully adjusted models. Model fit was assessed using AIC, BIC, likelihood-ratio testing, ICC and MOR.

Results: In the analytical sample, 52% of children aged 6–59 months were classified as anaemic. Children aged 24–59 months had lower odds of anaemia than children aged 6–23 months (AOR=0.55; 95% CI: 0.43–0.71). Children who had experienced fever in the preceding two weeks had higher odds of anaemia (AOR=1.64; 95% CI: 1.25–2.17), as did underweight children compared with children of normal weight (AOR=1.69; 95% CI: 1.13–2.54). Children who had received deworming medication had lower odds of anaemia (AOR=0.76; 95% CI: 0.58–1.00). Compared with children from the poorest households, those from poorer households had lower odds of anaemia (AOR=0.66; 95% CI: 0.49–0.90), while the association for the richest households was also in the lower-odds direction (AOR=0.53; 95% CI: 0.29–0.97). Rural residence was associated with lower odds of anaemia compared with urban residence (AOR=0.71; 95% CI: 0.52–0.97). The final model retained residual community-level clustering, with an ICC of 6.6% (95% CI: 2.7–15.4) and MOR of 1.59.

Conclusion: Childhood anaemia remains common among children aged 6–59 months in Zambia. The findings indicate that age, recent fever, underweight status, deworming, household socioeconomic position and residence are associated with anaemia after adjustment for measured covariates. The persistence of community-level variation supports the use of multilevel approaches and indicates that prevention requires integrated child nutrition, infection prevention and socioeconomic interventions.

Keywords: Anaemia; children aged 6–59 months; Zambia; Zambia Demographic and Health Survey; multilevel analysis; odds ratio; child nutrition; epidemiology.

1. CHAPTER 1: INTRODUCTION.

1.1. Background.

Anaemia is a condition in which the number of red blood cells or the haemoglobin concentration is lower than normal. It is a major public health problem affecting young children, pregnant and postpartum women, and women of reproductive age. Globally, approximately 40% of children aged 6–59 months are affected by anaemia, representing about 269 million children. The burden is greatest in low- and middle-income countries and is particularly pronounced in the WHO African and South-East Asia Regions (Balarajan et al., 2011; World Health Organization, 2025). Anaemia is associated with impaired cognitive and motor development in children and may increase morbidity and mortality, while its causes include nutritional deficiencies, infection, chronic disease, blood loss and inherited disorders (World Health Organization, 2025).

At the global level, the burden of childhood anaemia is therefore both a nutrition and a broader public health concern. The most common nutritional cause is iron deficiency, but folate, vitamin B12 and vitamin A deficiencies, infections such as malaria, inflammation and inherited disorders also contribute (World Health Organization, 2025). The concentration of anaemia in young children is especially important because children aged 6–23 months experience rapid growth and increased nutrient requirements while complementary feeding is being established.

In sub-Saharan Africa, the burden remains high. A multilevel analysis of DHS data from 32 sub-Saharan African countries involving 135,619 children aged 6–59 months found substantial variation in anaemia prevalence across countries and identified child, maternal, household and community-level determinants (Tesema et al., 2021). The same study included Zambia and reported an anaemia prevalence of 59% using the survey data available at that time. These findings demonstrate why childhood anaemia should not be viewed only as an individual biological condition; it is also shaped by the household and community environments in which children live.

In Zambia, childhood anaemia remains an important health problem. The 2024 ZDHS reports that 62.2% of children aged 6–59 months who were tested for anaemia were anaemic (Zambia Statistics Agency et al., 2024). The survey report also cautions that haemoglobin measurement and classification should be interpreted carefully because the 2024 survey used single-drop capillary

blood and the application of updated haemoglobin cut-offs and adjustment procedures affects comparability with earlier surveys (Zambia Statistics Agency et al., 2024).

The determinants of childhood anaemia operate across multiple levels. At the child level, age, sex, nutritional status and recent illness may influence haemoglobin concentration. At the maternal level, maternal anaemia, education and use of health services may influence child nutrition and exposure to infection. At household level, wealth, water, sanitation and household resources affect food security, dietary quality and access to care. At community level, residence, disease ecology, access to services and local socioeconomic conditions may create contextual differences in anaemia risk.

Evidence-based practice refers to the use of the best available research evidence together with professional expertise and the characteristics, needs and context of the population when making health decisions. The purpose of this study is not to constitute evidence-based practice by itself, but to generate population-level evidence that can contribute to evidence-based policy and programming. The multilevel analysis is particularly relevant because DHS observations are hierarchically structured: children are observed within households and enumeration areas. Treating such observations as independent can underestimate uncertainty and obscure contextual variation (Elkasabi et al., 2020; Corsi et al., 2012).

The present study therefore uses a quantitative secondary analysis of the 2024 ZDHS to estimate the prevalence of anaemia and identify factors associated with anaemia among children aged 6–59 months while accounting for clustering at the community level.

1.2. The problem statements.

Despite continued implementation of child nutrition, malaria prevention, deworming and maternal and child health interventions, anaemia remains common among young children in Zambia. The 2024 ZDHS reported an anaemia prevalence of 62.2% among tested children aged 6–59 months (Zambia Statistics Agency et al., 2024). The continued burden is concerning because anaemia occurs through interconnected nutritional, infectious, biological, socioeconomic and environmental pathways.

Existing evidence identifies multiple determinants, but much of the evidence is based on single-level or cross-sectional analyses that do not fully account for the clustering of children within communities. Without accounting for clustering, the estimated standard errors may be inappropriate and contextual differences may remain unexplained. There is therefore a need for an updated national analysis that uses the 2024 ZDHS and explicitly accounts for the hierarchical structure of the data.

This study addresses that gap by examining child-, maternal-, household- and community-level factors simultaneously using a multilevel mixed-effects logistic regression model.

1.3. Rationale and Significance

The study provides updated evidence on the distribution and determinants of childhood anaemia using nationally representative data. The findings can support interpretation of which characteristics remain associated with anaemia after adjustment for other measured factors and whether residual variation exists between communities. This distinction is important for programme design: individual-level interventions may be insufficient where contextual differences remain.

The analysis also demonstrates the value of secondary analysis of national survey data. Rather than collecting new primary data, the study uses an existing nationally representative dataset to address a specific epidemiological question and applies an analytical approach that is appropriate for the survey's hierarchical structure.

1.4. Research Aim & Objectives.

Overall Objective: To identify the factors associated with anaemia among children aged 6-59 months in Zambia using the 2024 ZDHS.

Specific Objectives.

1. To establish the prevalence of anaemia in children aged 6-59 months in Zambia.
2. To measure the association between child-level characteristics and anaemia status.

3. To determine the sociodemographic, economic and community-level factors associated with anaemia among children.

2. CHAPTER 2: LITERATURE REVIEW.

This section will review the current literature on the research topic to understand the state/burden of anaemia in Zambia. The empirical review will highlight and show trends, gaps and support for the determinants of childhood anaemia at individual, household and community level.

2.1. Global burden of childhood anaemia

WHO estimates that 40% of children aged 6–59 months globally were affected by anaemia based on 2019 estimates (World Health Organization, 2025). Anaemia is particularly concentrated in low- and lower-middle-income settings and among children living in poorer households and rural settings. Its consequences extend beyond haemoglobin concentration: severe anaemia may impair cognitive and motor development and is associated with increased morbidity and mortality (World Health Organization, 2025).

The global burden is multifactorial. Iron deficiency is an important cause, but infection, inflammation, folate and vitamin B12 deficiency, malaria and inherited conditions can also contribute. Consequently, interventions based solely on iron supplementation may not address all pathways leading to childhood anaemia (Balarajan et al., 2011; World Health Organization, 2025).

2.2. Anaemia in sub-Saharan Africa

Sub-Saharan Africa carries a disproportionate burden of childhood anaemia. Tesema et al. analysed DHS data from 32 countries and included 135,619 children aged 6–59 months. The analysis found substantial differences between countries and identified age, nutritional status, recent illness, maternal characteristics, household wealth and other contextual factors as important determinants (Tesema et al., 2021).

The regional evidence also supports multilevel analysis. Children live within households and communities that share food environments, health services, sanitation conditions, disease

exposure and socioeconomic resources. Consequently, the same individual characteristic may have different implications depending on the context in which a child lives.

2.3. Anaemia in Zambia

The 2024 ZDHS provides the most recent nationally representative evidence used in this dissertation. The published survey report estimates that 62.2% of children aged 6–59 months tested for anaemia were anaemic (Zambia Statistics Agency et al., 2024). Earlier Zambian evidence also demonstrates a substantial burden. Nawa et al. reported 53.8% anaemia among children aged 6–59 months using secondary analysis of the 2021 Malaria Indicator Survey (Nawa et al., 2024).

The difference between the published 2024 ZDHS estimate and the analytical estimate obtained in this dissertation is addressed explicitly in Chapter 4. The current analysis used a defined complete-case analytical sample and therefore should not be presented as a direct reproduction of the published ZDHS national estimate. Differences in analytical eligibility, missing-data exclusions, weighting procedures and haemoglobin classification can affect comparability.

Zambian studies also indicate geographic variation. Evidence from malaria-endemic areas has linked febrile illness and malaria transmission with anaemia, while other studies have reported associations with household socioeconomic conditions and dietary patterns (Eisele et al., 2011; Kobayashi et al., 2022).

2.4. Determinants of childhood anaemia

Child-level determinants

Age is consistently associated with childhood anaemia. Children in the 6–23-month period have high nutrient requirements during rapid growth and are transitioning to complementary foods. Regional evidence has identified younger age as an important determinant of anaemia (Tesema et al., 2021). Nutritional status is also relevant: underweight, stunting and wasting may reflect inadequate dietary intake and increased vulnerability to infection. Recent fever and diarrhoeal illness may contribute through inflammation, reduced intake and, in malaria-endemic settings, haemolysis (Tesema et al., 2021; Eisele et al., 2011).

Maternal determinants

Maternal education and maternal anaemia may influence child health through dietary practices, health service utilisation, household resources and shared nutritional exposures. Moschovis et al. found associations between maternal and household characteristics and anaemia among young children in sub-Saharan Africa (Moschovis et al., 2018). However, the extent to which these associations persist after adjustment for child and household characteristics varies between settings.

Household determinants

Household wealth can influence access to nutritious foods, health services and preventive interventions. WASH conditions may influence anaemia through enteric infection and inflammation. A multi-country analysis of DHS data found associations between water and sanitation indicators and anaemia, although the pathways are complex and may vary by context (Kothari et al., 2019).

Community determinants

Community-level factors include rural or urban residence, local poverty, malaria transmission, availability of health services, community nutrition environments and other shared exposures. Multilevel analyses demonstrate that residual community-level variation may remain even after individual and household factors are included (Tesema et al., 2021).

2.5. Evidence-based practice and the analytical implication

Evidence-based practice differs from evidence generation. Evidence-based practice is the process of integrating the best available evidence with clinical or programme expertise, context and population needs. This dissertation contributes evidence that can inform that process. The analytical approach is important because a single-level model assumes that observations are independent after accounting for measured covariates. DHS data violate this assumption because children within the same enumeration area may share unmeasured contextual exposures. A multilevel model allows a random intercept to represent residual differences between clusters and produces estimates that account for within-cluster dependence (Elkasabi et al., 2020; Corsi et al., 2012).

2.6. Evidence gap

The available literature establishes that childhood anaemia in Zambia is multifactorial, but there is limited updated evidence from the 2024 ZDHS that simultaneously examines child, maternal, household and community-level determinants while accounting for cluster-level variation. This study addresses the gap by using a nationally representative secondary dataset and a multilevel binary logistic regression framework.

2.7. Theoretical Framework

The study is guided by the Mosley and Chen analytical framework for child survival (Mosley and Chen, 1984). The framework proposes that distal socioeconomic and environmental determinants influence child health through proximate determinants that act through biological and behavioural mechanisms. In this dissertation, household socioeconomic conditions and community context are treated as distal or contextual influences; child nutritional status, recent illness and health interventions are proximate determinants; and haemoglobin concentration and anaemia status represent the health outcome.

The framework is suitable for DHS data because the survey captures variables at multiple levels and the study outcome is shaped by interacting biological, behavioural, household and contextual pathways.

2.8. Conceptual Framework

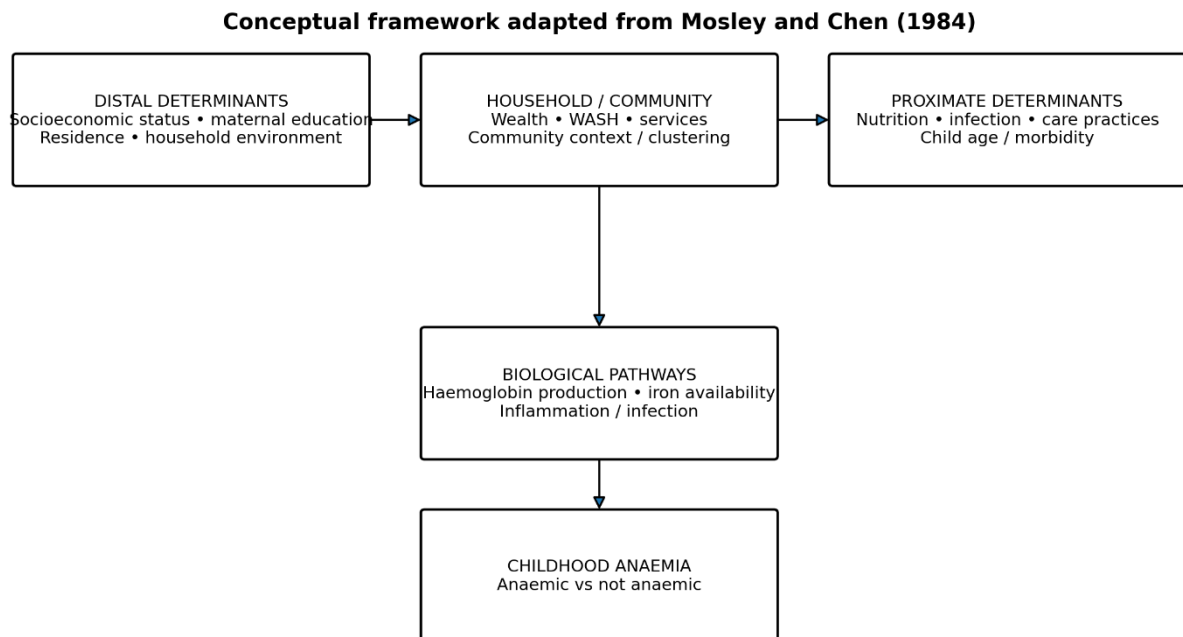


Figure 1: Conceptual framework adapted from the Mosley and Chen framework. The framework links distal socioeconomic and contextual factors to proximate determinants, biological pathways and childhood anaemia.

3. CHAPTER 3: METHODOLOGY.

3.1. Study Approach and Design.

This study used a quantitative approach and an analytical cross-sectional design. The analysis was conducted using secondary data from the 2024 Zambia Demographic and Health Survey. A quantitative approach was appropriate because the study objectives required estimation of anaemia prevalence and statistical assessment of associations between a binary outcome and multiple explanatory variables.

The cross-sectional design means that exposure and outcome information were observed within the same survey period. Consequently, associations identified in this study should not be interpreted as proof of causality or temporal sequence.

3.2. Data source and secondary analysis.

The study used the 2024 Zambia Demographic and Health Survey (ZDHS), implemented by the Zambia Statistics Agency and the Ministry of Health with partners. The ZDHS used a stratified two-stage cluster sampling design. Enumeration areas were selected at the first stage and households at the second stage. The survey collected household, maternal and child health information and included haemoglobin measurements for children aged 6–59 months (Zambia Statistics Agency et al., 2024).

This dissertation is a secondary analysis. No primary data were collected by the researcher for the present study. The analytical process began after the 2024 ZDHS data were made available for authorised research use. The original DHS survey was implemented through its own ethical, sampling, fieldwork and quality-assurance procedures. The present study subsequently defined an analytical population, cleaned and recoded selected variables, applied survey weights, and conducted statistical analyses to answer the specified research objectives.

The use of the term “secondary analysis” is therefore intentional: the researcher did not conduct the fieldwork described in the ZDHS; instead, the researcher analysed the existing survey data to address a new epidemiological question.

3.3. Study Population and sample size.

This study was made with secondary data from the 2024 Zambia Demographic and Health Survey (ZDHS). The first datasets were from 8,673 children aged 6-59 months. Since the data of DHS was the secondary data of the study, the sample size of the survey was chosen based on the number of children that were eligible for the survey rather than a priori sample size.

We excluded children who were missing, implausible, or had incomplete information on the key variables from the final analysis. Thus, the analytical sample was all eligible children aged 6-59 months with complete information about haemoglobin concentration and selected explanatory variables which included 3,393 children. To adjust for differences in probability of selection and interview between cases in a sample due to design or happenstance, sampling weights were applied. In DHS surveys, most surveys choose a sample with unequal probability in order to

expand the number of cases available (and hence reduce sample variability) for some areas or subgroups for which statistics are needed.

In this case, weights need to be applied when tabulations are made of statistics to provide the proper representation. The weights are calculated when the design of samples makes it difficult to calculate the rate for different responses (Croft et al., 2023). Survey weights were applied using the “svy” command to account for the DHS’s complex sampling design.

This approach adjusted for clustering and unequal probabilities of selection to guarantee a nationally representative and unbiased estimate. The final weighted sample of children with haemoglobin results included in the analysis was 3,300 children aged 6-59 months. Figure 1: Sampling procedure and sampling technique anemia status and its determinants among children aged 6-59 months.

Figure 1: Sampling procedure and techniques

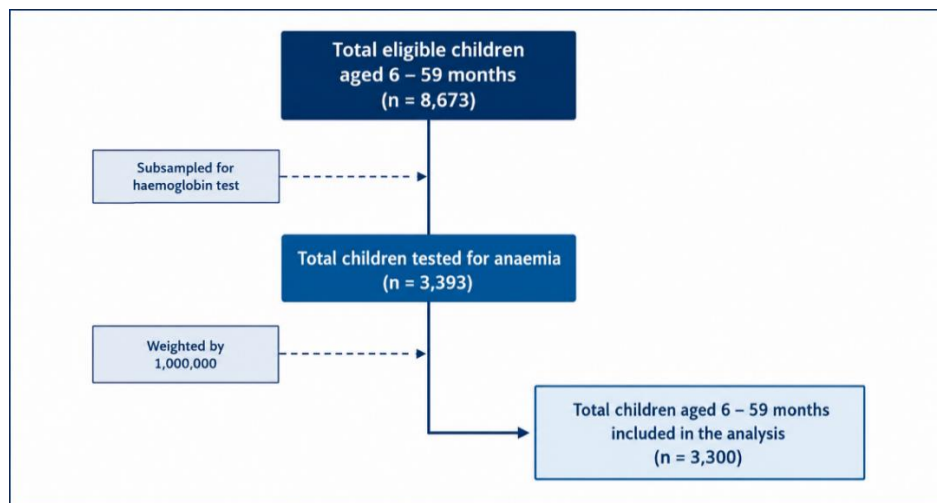


Figure 1: Sampling procedure and techniques

3.4. Sampling strategy.

The ZDHS sampling strategy was stratified by province and urban-rural residence first and then followed by cluster sampling in two stages. Enumeration areas were selected in the first stage and

households were selected in the second stage. Sampling weights were applied to the data to account for unequal probability of selection and non-response. In this study, the child-level data from the Children’s Recode file (KR) was used to analyze.

3.5. Variables Identification, definition and measurement.

Table 1: Key variables of the study and the DHS source variables for their definition and operationalisation for analysis. Variable selection and categorisation is based on DHS analytical guidance and prior child health studies using nationally representative survey data. Stunting was defined as height-for-age Z-score (HAZ) below -2 standard deviations from the median of WHO Child Growth Standards reference population. Underweight was defined as weight-for-age Z-score (WAZ) below -2 standard deviations from the median of WHO Child Growth Standards reference population. Wasting was defined as weight-for-height Z-score (WHZ) below -2 standard deviations from the median of WHO Child Growth Standards reference population (Asgedom et al., 2024).

Table 1: Definition and measurement of study variables.

Category	Variable	DHS Variable(s)	Definition / Measurement	Coding for Analysis
Outcome	Childhood anaemia	hw57	WHO-classified childhood anaemia status based on altitude-adjusted haemoglobin	0 = Not anaemic, 1 = Anaemic
Child/Mother-level	Age of child	b19	Age in completed months	6–23, 24–59 months
	Sex of child	B4	Biological sex	Male, Female
	Birth order	BORD	Sequence number of a child among all live births	1, 2 – 3, 4 – 5, 6+

Category	Variable	DHS Variable(s)	Definition / Measurement	Coding for Analysis
	Vitamin A supplementation in the last six months	H34	Child received a vitamin A supplement during the six months preceding the survey	Yes, No
	Drugs for intestinal parasites in the last six months	H43	Child aged 6–59 months received medication for intestinal parasites (deworming drugs) during the six months	Yes, No
	Cough in the last two weeks	H31	Child aged 6–59 months had a cough in the last two weeks	Yes, No
	Fever in the last two weeks	H22	Fever in the last two weeks	Yes, No
	Nutritional status	HW70/HW71	Height-for-age / weight-for-age z-scores	Normal, Stunted/Underweight
	Diarrhoea in the last two weeks	H11	Diarrhoea in last 2 weeks	Yes, No
	Maternal age	V012	Age of mother in completed years	<20, 20–29, ≥30
	Maternal education	V106	Highest education level attained	None, Primary, Secondary+
	Maternal anaemia	V457	Maternal haemoglobin status	Anaemic, Not anaemic

Category	Variable	DHS Variable(s)	Definition / Measurement	Coding for Analysis
	Wealth index	V190	Household wealth quintile	Poor, Middle, Rich
	Household size	V136	Number of household members	<6, ≥6
	Water source	V113	Source of drinking water	Improved, Unimproved
	Sanitation	V116	Type of toilet facility	Improved, Unimproved
Community-level	Residence	V025	Type of residence	Urban, Rural
	Region	V024	Province of residence	Provinces

Table 1: Definition and Measurement of Study Variables

We categorize variables according to epidemiological importance, DHS reporting standards and consistency with the previous literature. We collapse categories when necessary to ensure enough cell size and model stability.

3.6. Data management and quality assessment

Data management included identification of the relevant child-level observations, restriction to children aged 6–59 months, assessment of missingness, recoding of variables, assessment of implausible values and construction of the binary anaemia outcome. The analysis retained the DHS cluster identifier to account for hierarchical dependence.

Multicollinearity was assessed using variance inflation factors. The mean VIF was 1.43 and all individual VIF values were below 3, indicating no evidence of problematic multicollinearity among the variables retained in the final model.

3.7. Data analysis

Analysis was conducted in Stata. Three analytical stages were used.

1. Descriptive analysis: survey-weighted frequencies and percentages were used to describe the study population and estimate the prevalence of anaemia.
2. Bivariate analysis: the distribution of anaemia was compared across explanatory variables using design-appropriate statistical tests. P-values were used to assess evidence of association at the 5% significance level.
3. Multivariable analysis: a multilevel mixed-effects binary logistic regression model with a random intercept for enumeration area was fitted. The model was developed sequentially: Model 1 was the null model; Model 2 included child-level variables; Model 3 included maternal variables; Model 4 included household/community variables; and Model 5 was the fully adjusted model.

The random intercept represents unobserved cluster-level differences in the log-odds of anaemia. The intraclass correlation coefficient (ICC) was used to quantify the proportion of unexplained variance attributable to between-cluster differences, while the median odds ratio (MOR) quantified the residual cluster heterogeneity on the odds-ratio scale. Model fit was assessed using AIC and BIC, with lower values indicating better relative fit after accounting for model complexity.

3.8. Statistical significance, confidence intervals and interpretation of odds ratios

A two-sided significance level of $\alpha=0.05$ was used. The p-value threshold was therefore not chosen separately for each variable; rather, the study adopted 0.05 as the pre-specified threshold for statistical evidence of an association. A p-value below 0.05 was interpreted as evidence against the null hypothesis for the relevant statistical test. P-values were interpreted together with effect estimates and 95% confidence intervals rather than in isolation.

A 95% confidence interval was applied to odds ratios. The 95% confidence level means that the estimation procedure is expected to produce intervals containing the true population parameter in approximately 95% of repeated samples under the model assumptions. For the final model, the adjusted odds ratio and its 95% CI were the principal measures of association.

Odds ratios below 1 indicate lower odds of anaemia relative to the reference category, whereas odds ratios above 1 indicate higher odds. For example, an AOR of 0.56 corresponds to 44% lower odds of anaemia compared with the reference category, calculated as $(1-0.56) \times 100$. An AOR of 1.64 corresponds to 64% higher odds, calculated as $(1.64-1) \times 100$. The term “lower odds” is preferred to “lower probability” because an odds ratio directly compares odds rather than probabilities.

Adjusted odds ratios differ from crude or unadjusted odds ratios. A crude OR represents the association between one exposure and the outcome without adjustment for other variables. An adjusted OR estimates the association while controlling for the other variables included in the model, thereby reducing confounding by measured covariates. The source analysis used for this dissertation reports bivariate p-values and multilevel model ORs/AORs, but it does not provide a separate survey-weighted crude logistic regression output for every exposure. Therefore, crude ORs have not been reconstructed from weighted cross-tabulations, because doing so could misrepresent the design-based estimate. The final dissertation explicitly reports the available adjusted estimates and identifies the bivariate analysis separately.

3.9. Ethical considerations.

Before data were collected, the 2024 ZDHS was approved by the national and institutional review boards. Data were provided by the DHS Program for use. Since this study is based on secondary analysis of anonymised data, there was no direct contact with study participants, and no ethical risks were anticipated. Additional approval was obtained from the National Health Research Authority (NHRA) by reference number **NHRA-3514/21/04/2026**.

3.10. Study Period.

The table summarizes the activities, tasks, outputs, and period of study for our proposed study. The study was completed within 6 (six) months.

Activity/task	Outputs/Deliverables	Jan/Feb	Mar/Apr	May/June	Jul
Proposal finalisation	Final approved proposal	✓			

Ethics & approvals	Approval	✓	✓		
Data acquisition & setup	Datasets ready; data management log		✓		
Data preparation (merge)	Merged dataset		✓	✓	
Data quality & recoding	Analysis dataset; codebook			✓	
Descriptive analysis	Prevalence + characteristics tables			✓	
Bivariate analysis	Bivariate results table			✓	
Multilevel modelling	Multilevel logistic regression tables + ICC				✓
Interpretation & writing	Full draft dissertation chapters				✓
Final review & submission	Submission-ready dissertation				✓

Table 2: Study duration

4. CHAPTER 4: PRESENTATION OF FINDINGS.

4.1. Background Characteristics.

Table 3 shows the percent distribution of background characteristics of study population. The majority (63%) were aged 24-59 months and 37% were 6-23 months. Sex distribution was relatively balanced with 48.2% male and 51.8% female children in the sample. On birth order, 25.6% were firstborn, 37.1% were second and third, 22.4% were fourth and fifth and 14.9% were sixth and higher.

Health interventions had been recently taken by the children of the study, 71% had received vitamin A supplements (in the last 6 months) and 61.2% had been given deworming drugs. The morbidity was severe in the last two weeks with 25.9% having a cough, 19.4% had a fever and 15.6% had diarrhoea in the last two weeks. Nutritional status showed that 12.8% of children were underweight, 33.3% were stunted and 2.6% were wasted.

The maternal characteristics indicated that 29.8% of mothers were aged 15-24 years, 46.1% 25-34 years and 24.1% 35-49 years. Primary school students had the highest educational level (45.9%) followed by secondary school students (40.6%). 8.2% had no formal education and 5.3% had higher education. Maternal anaemia affected 26.5% of mothers while 73.5% were not anaemic.

Antenatal care (ANC) attendance was fairly high and 84.4% of mothers attended four or more visits and 15.6% did not attend any fewer than four visits. Most deliveries (92.2%) were in health facilities, while 7.8% were made at home. Households reported diverse wealth distribution with 25.9% of the families being poorest, 21.7% poorer, 18.8% middle class, 18.4% richer and 15.2% richest. The majority (59.8%) of families were in rural areas, while 40.2% lived in urban areas. Only 53.4% had 6 or more members, and a relatively large household size.

Table 3: Background Characteristics Weighted Frequency and Percentages

Variable	Weighted Frequency	Percentage (%)
Child age in months		

6-23	1221	37
24-59	2079	63
Sex of Child		
Male	1589	48.2
Female	1711	51.8
Birth Order		
1	844	25.6
2-3	1225	37.1
4-5	739	22.4
6+	492	14.9
Vitamin A supplementation in the last six months		
No	954	29
Yes	2346	71
Drugs for intestinal parasites (deworming drugs) in the last six months		
No	1282	38.8
Yes	2018	61.2
Cough in the last two weeks		
No	2447	74.1
Yes	853	25.9

Fever in the last two weeks		
No	2659	80.6
Yes	641	19.4
Had Diarrhoea recently		
No	2785	84.4
Yes	515	15.6
Underweight Status		
Normal	2878	87.2
Underweight	422	12.8
Stunting status		
Normal	2200	66.7
Stunted	1100	33.3
Wasting status		
Normal	3215	97.4
Wasted	85	2.6
Maternal Age		
15 - 24	985	29.8
25 - 34	1521	46.1
35 - 49	794	24.1

Maternal Educational Status		
No Education	269	8.2
Primary	1515	45.9
Secondary	1341	40.6
Higher	175	5.3
Maternal Anaemia Status		
Not Anaemic	2419	73.5
Anaemic	871	26.5
ANC visits during pregnancy (n=1775)		
<4	277	15.6
4+	1498	84.4
Place of delivery		
Home	151	7.8
Health Facility	1776	92.2
Household Wealth Status		
Poorest	855	25.9
Poorer	716	21.7
Middle	618	18.8
Richer	608	18.4

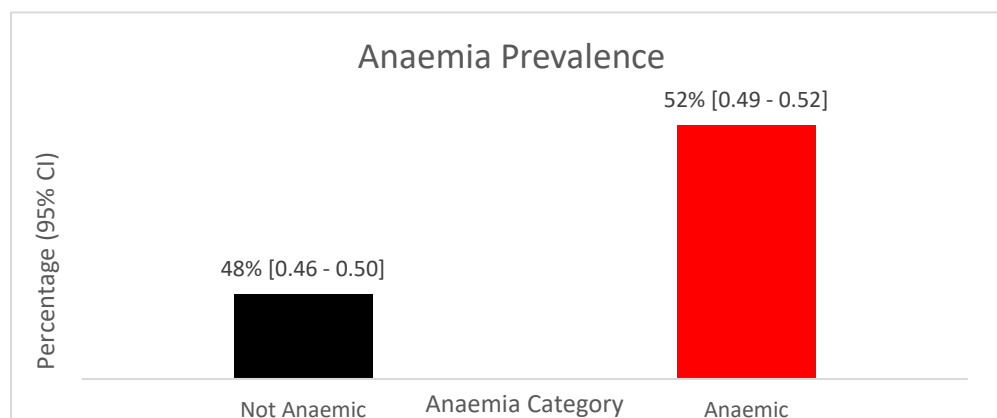
Richest	503	15.2
Household Size		
< 6	1538	46.6
>= 6	1762	53.4
Water source		
Unimproved	1164	35.8
Improved	2089	64.2
Sanitation Facility		
Improved	1126	34.6
Unimproved	1715	52.7
Open defecation	413	12.7
Residence		
Urban	1326	40.2
Rural	1974	59.8

Table 3: Background Characteristics

4.2. Anaemia Prevalence

The primary outcome was anaemia status among children aged 6–59 months. Figure/Table 4A presents the analytical prevalence. In the final analytical population, 52% of children were classified as anaemic and 48% were not anaemic. The published 2024 ZDHS national estimate was 62.2% among tested children (Zambia Statistics Agency et al., 2024); the difference is

discussed in Section 4.1 and should be interpreted in relation to the analytical sample and survey classification.



4.3. Background characteristics and associations with Anaemia.

Of the 3,300 children aged 6-59 months, 37% were 6-23 months and 63% were 24-59 months old. Anaemia was more common among the younger children (6-23 months: 67%) than in the older children (24-59 months: 43%; $p < 0.001$). A more balanced sample was found for females (51.8%) and males (48.2%) and anaemia was more common in males (54%) than females (49%; $p = 0.008$). The rate of birth was not significantly related to anaemia ($p = 0.15$).

Nutritional interventions had positive associations with anaemia: children who had been vitamin A supplemented in the last 6 months had lower prevalence (50%) than children who had not (56%; $p = 0.0025$), and children who received deworming drugs also had lower prevalence (48%) than those who did not (59%; $p < 0.001$). Recent morbidity was related to anaemia: children with fever (37%) or diarrhoea (37%) had higher prevalence than children who did not (50% vs 30% for diarrhoea; $p < 0.001$ and $p = 0.0059$), while cough was not related to anaemia ($p = 0.83$). Nutritional status was associated with anaemia.

Children who were underweight were more likely to have anaemia (66%) than children who had normal weight (50%; $p < 0.001$), stunted children were more likely to have anaemia (58%) than those who were not stunted (47%; $p < 0.001$), and wasted children were more likely to have anaemia (65%) than normal (51%; $p = 0.013$). Maternal characteristics were also key.

The children of younger mothers (15-24 years) had higher prevalence of anaemia (58%) compared to the children of older mothers (25-34 years: 49%; 35-49 years: 50%; $p < 0.001$). Maternal education was negatively associated with anaemia: children of mothers with no education had the highest prevalence (53%), while those with higher education had the lowest (36%; $p < 0.001$).

Maternal anaemia was found to correlate with child anaemia as well ($p = 0.005$). Most of the children (84.4%) were born to mothers who went to 4+ ANC visits and this was not significantly associated with anaemia ($p = 0.765$). Place of delivery was not strongly associated (home: 59% of the population, health facilities: 52% of people; $p > 0.05$). In fact, household wealth was clearly associated with anaemia: children from the poorest households had higher prevalence (58%) compared to the richest (43%; $p < 0.001$).

The number of people living in their household, water source, sanitation facilities, and residence (urban/rural) did not significantly exhibit an association with anaemia ($p > 0.05$). These results indicate that childhood anaemia in Zambia is strongly impacted by child age, sex, nutritional status, recent morbidity, maternal profile, and household socio-economic conditions, and therefore multi-level interventions must be taken into account.

Table 4: Background Characteristics and Associations with Anaemia

Variable	Not Anaemic	Anaemic	Percentage (%)	p - value
Child age in months				
6-23	406	814	37	<0.001
24-59	1185	895	63	
Sex of Child				
Male	725	864	48.2	0.0082
Female	866	845	51.8	

Birth Order				
1	379	465	25.6	0.15
2-3	614	611	37.1	
4-5	365	374	22.4	
6+	232	260	14.9	
Vitamin A supplementation in the last six months				
No	415	539	29	0.0025
Yes	1175	1171	71	
Drugs for intestinal parasites (deworming drugs) in the last six months				
No	522	760	38.8	<0.001
Yes	1069	949	61.2	
Cough in the last two weeks				
No	1176	1270	74.1	0.83
Yes	414	440	25.9	
Fever in the last two weeks				
No	1330	1328	80.6	<0.001
Yes	260	382	19.4	
Had Diarrhoea recently				
No	1373	1412	84.4	0.0059

Yes	217	298	15.6	
Underweight Status				
Normal	1447	1430	87.2	<0.001
Underweight	143	280	12.8	
Stunting status				
Normal	1129	1071	66.7	<0.001
Stunted	462	638	33.3	
Wasting status				
Normal	1560	1655	97.4	0.013
Wasted	30	55	2.6	
Maternal Age				
15 - 24	408	577	29.8	<0.001
25 - 34	781	740	46.1	
35 - 49	401	393	24.1	
Maternal Educational Status				
No Education	125	144	8.2	<0.001
Primary	686	830	45.9	
Secondary	668	673	40.6	
Higher	111	63	5.3	

Maternal Anaemia Status (N = 3290)				
Not Anaemic	1210	1209	73.5	0.005
Anaemic	377	494	26.5	
Duration of Breastfeeding N = 1,927)				
Ever Breastfed	432	529	50	<0.001
Never Breastfed	20	23	2	
Still Breastfeeding	298	625	48	
ANC visits during pregnancy (n=1775)				
<4	104	173	15.6	0.765
4+	576	922	84.4	
Place of delivery (N = 1927)				
Home	61	90	7.8	
Health Facility	689	1087	92.2	
Household Wealth Status				
Poorest	357	498	25.9	<0.001
Poorer	350	366	21.7	
Middle	299	319	18.8	
Richer	299	309	18.4	
Richest	286	217	15.2	

Household Size				
< 6	737	801	46.6	0.785
>= 6	853	909	53.4	
Water source (N = 3254)				
Unimproved	536	629	35.8	0.084
Improved	1035	1054	64.2	
Sanitation Facility (N = 3254)				
Improved	847	868	34.6	0.439
Unimproved	528	598	52.7	
Open defecation	195	218	12.7	
Residence				
Urban	670	656	40.2	0.067
Rural	920	1054	59.8	

Table 4: Background Characteristics and Associations with Anaemia

4.4. Multilevel modelling of childhood anaemia among children aged 6-59 months in Zambia.

We carried out multilevel binary logistic regression analysis for individual, maternal, household and community-level factors of anaemia among children aged 6-59 months in Zambia. While children included in the 2024 Zambia Demographic and Health Survey (ZDHS) were grouped within various census areas (clusters), we fitted a random intercept multilevel logistic regression model to account for unexplained heterogeneity between clusters.

We fitted five different models: the null model (Model 1), individual child-level factors (Model 2), maternal-level factors (Model 3), household/community-level factors (Model 4), and a final fully adjusted model that combines individual, maternal, household and community-level factors (Model 5).

The survey weights were applied to all the analyses. Before fitting the final model, we assessed multicollinearity of all explanatory variables with the variance inflation factor (VIF). The mean VIF was 1.43 and all the variables were below 3, indicating that there is no problem with multicollinearity among the independent variables. The highest VIF values were found for birth order (VIF = 2.93), household wealth index (VIF = 2.76), and maternal age category (VIF = 2.60) which are lower than the standard 10. All variables were included in the final multivariable model.

Table 5: Factors associated with anaemia

Variables	Null model OR (95% CI)	Model II Child factors OR (95% CI)	Model III Maternal factors OR (95% CI)	Model IV Household factors OR (95% CI)	Model V Final model OR (95% CI)
Child age in months					
6-23 months		1			1
24–59 months		0.37*** (0.31–0.45)			0.55*** (0.43–0.71)
Sex of Child					
Male		1			1

Female		0.82* (0.70–0.96)			0.81 (0.65– 1.00)
Birth Order					
1		1			1
2–3		0.87 (0.71– 1.06)			0.99 (0.72– 1.35)
4–5		0.87 (0.68– 1.10)			1.27 (0.80– 2.01)
6+		0.94 (0.73– 1.21)			1.13 (0.60– 2.13)
Vitamin A supplementation in the last six months					
No		1			1
Yes		1.00 (0.81– 1.24)			0.92 (0.68– 1.23)
Drugs for intestinal parasites (deworming drugs) in the last six months					
No					
Yes		0.77** (0.63–0.94)			0.76 (0.58– 1.00)
Fever in the last two weeks					
No		1			1
Yes		1.56*** (1.26–1.94)			1.64*** (1.25–2.17)

Underweight Status					
Normal		1			1
Underweight		1.64*** (1.25–2.17)			1.69** (1.13–2.54)
Stunting status					
Normal		1			1
Stunted		1.34** (1.11–1.62)			1.19 (0.93– 1.52)
Wasting status					
Normal					
Wasted		1.11 (0.64– 1.93)			0.80 (0.37– 1.73)
Maternal Age					
15 - 24			1		1
25 - 34			0.77* (0.60– 0.98)		0.81 (0.56– 1.15)
35 - 49			0.72* (0.53– 0.97)		0.75 (0.44– 1.28)
Maternal Educational Status					
No Education			1		1

Primary			1.10 (0.72– 1.66)		1.20 (0.77– 1.86)
Secondary			0.82 (0.55– 1.23)		0.98 (0.63– 1.52)
Higher			0.57 (0.30– 1.09)		0.78 (0.37– 1.65)
Maternal Anaemia Status (N = 3290)					
Not Anaemic			1		1
Anaemic			1.27 (0.97– 1.66)		1.26 (0.95– 1.67)
ANC visits during pregnancy (n=1775)					
<4			1		1
4+			0.96 (0.72– 1.27)		0.92 (0.68– 1.22)
Place of delivery (N = 1927)					
Home			1		1
Health Facility			1.18 (0.71– 1.97)		1.25 (0.75– 2.10)

Household Wealth Status					
Poorest				1	1
Poorer				0.72** (0.59–0.88)	0.66** (0.49–0.90)
Middle				0.70** (0.55–0.90)	0.72 (0.50– 1.03)
Richer				0.60** (0.43–0.84)	0.72 (0.46– 1.13)
Richest				0.44*** (0.29–0.66)	0.53* (0.29–0.97)
Household Size					
< 6				1	1
>= 6				0.99 (0.85– 1.16)	1.01 (0.78– 1.29)
Water source (N = 3254)					
Unimproved				1	1
Improved				1.02 (0.84– 1.23)	1.12 (0.86– 1.46)
Sanitation Facility (N = 3254)					
Improved				1	1
Unimproved				1.04 (0.87– 1.24)	0.93 (0.74– 1.19)

Residence					
Urban				1	1
Rural				0.83 (0.65–1.06)	0.71* (0.52–0.97)
Random effect analysis results					
Variance of random intercept	0.25 (0.14–0.44)	0.22 (0.11–0.43)	0.19 (0.06–0.54)	0.22 (0.12–0.41)	0.23 (0.09–0.6)
ICC (95% CI)	7.0 (4.1–11.9)	6.2 (3.3–11.5)	5.3 (1.9–14.1)	6.2 (3.4–11.0)	6.6 (2.7–15.4)
Median Odds Ratio (MOR)	1.61	1.56	1.51	1.56	1.59
Log pseudolikelihood	-2,270.48	-2138.152	-1,162.31	-2225.502	-1103.314
AIC	4544.965	4310.303	2344.61	4473.004	2274.629
BIC	4557.224	4414.499	2399.681	4540.275	2461.383

Table 5: Multilevel modelling of childhood anaemia among children aged 6–59 months in Zambia

** For level of significant, (eg; *P<0.05; **P<0.01; ***P<0.001; 1 = reference category)

4.5. Random Effects

4.5.1. Random intercept model

In the null model (Model 1) a significant clustering of childhood anaemia within enumeration areas was observed. The random intercept had a variance of 0.248 (95% CI: 0.139-0.443) which indicates significant unexplained variation in childhood anaemia between clusters. The ICC was

7.0% (95% CI: 4.1-11.9), suggesting that approximately 7% of the variation in childhood anaemia was due to differences between clusters rather than differences between children.

The likelihood ratio test, which compared the random intercept model to the standard logistic regression model, was significant in the null model and confirmed that the multilevel model was better than the single-level logistic regression model.

4.5.2. Effect of adding explanatory variables on cluster-level variation.

When child-level factors were added (Model 2), the cluster-level variance was relatively reduced from 0.248 to 0.218, with the ICC falling from 7.0% to 6.2%. This suggests that some variability between clusters was due to differences in child characteristics (age, morbidity status, nutritional status etc.). When maternal characteristics were included (Model 3), the variance was reduced further to 0.186 and the ICC reduced to 5.3%, suggesting that maternal characteristics were responsible for some additional contextual variation in childhood anaemia risk.

The household/community model (Model 4) showed a cluster-level variance of 0.218 (95% CI: 0.117-0.406) and ICC of 6.2%, indicating persistent geographic variation, once we include socio-economic and environmental variables. The final model was very well fitted compared to the null and the intermediate model, as was observed by the decrease in the Akaike Information Criterion (AIC) and Bayesian Information Criterion (BIC).

The null model with only the random intercept and no explanatory variables had an AIC of 4544.97 and a BIC of 4557.22 at the start of the study, which shows the extent of unexplained variation of childhood anaemia from enumeration to enumeration. Once the background of child-level characteristics, maternal and household/community variables were included, the information criteria values significantly decreased, with the fully adjusted model having an AIC of 2271.30 and a BIC of 2447.07.

In this model, the BIC was much more accurate and the AIC was lower than the null model by approximately 2274 points, indicating that we could explain the variation of childhood anaemia from one enumeration to the next. Since AIC balances model fit with model complexity by penalizing unnecessary parameters, the significantly lower AIC suggests that the added predictors in the final model provided valuable information and improved prediction of childhood anaemia beyond what could be explained by cluster-level differences alone.

The fact that BIC was reduced from 4557.22 to 2447.07 also indicates that the model was more parsimonious including the additional predictors. Since BIC has a higher penalty for model complexity than AIC, a lower BIC in the final model points to better explanatory power when more variables are added without the model complexity becoming too high. The improved model fit indicates that childhood anaemia is determined by multiple factors that all contribute to the process of development. The null model showed that there was significant variation in prevalence of anaemia in enumeration areas, indicating how different situations play a role in childhood anaemia risk.

However, the significant improvement obtained when child characteristics, maternal characteristics and household/community characteristics were included indicates that most of the variation in children could be explained by the measurable factors that are associated with child health status, parenting, socioeconomic status and the environment of the household.

While incorporating covariates improved the model performance, clustering is still present in the final model as shown by the remaining random intercept variance and ICC. This means that there are other unmeasured community-level factors, such as access to health services, local nutrition environments, community practices, and the availability of preventive health care, that still affect childhood anaemia risk. Therefore, the final multilevel model was a more appropriate analytical framework than a conventional logistic regression model that included individual-level determinants and child clustering within the community.

4.6. Model 2: Child-level factors associated with childhood anaemia.

Child age, recent fever, deworming status, underweight status, household wealth status, and residence were highly correlated with childhood anaemia in the fully adjusted multilevel logistic regression model. Children aged 24-59 months had significantly lower odds of anaemia compared with children aged 6-23 months (adjusted odds ratio [AOR]=0.56; 95% CI: 0.43-0.71; $p<0.001$). It is clear that younger children aged 6-23 months had higher odds of anaemia compared to older children when controlling for other variables in the model. Female kids had lower odds of anaemia than male children but it is not statistically significant (AOR=0.81; 95% CI: 0.65-1.01; $p=0.057$). The birth order was not significantly associated with childhood anaemia. Children with birth order 2-3 (AOR=0.98, 95% CI: 0.72-1.35), 4-5 (AOR=1.26, 95% CI: 0.80-2.00) and 6 or more

(AOR=1.13, 95% CI: 0.60-2.12) did not significantly have significantly different odds of anaemia from first-born children.

Children who had received deworming medication in the last six months were significantly less likely to be anaemic than children with no deworming treatment (AOR=0.75, 95% CI: 0.57-0.99, $p=0.043$). These findings suggest that deworming intervention may reduce the risk of childhood anaemia by deworming. Recent fever was significantly associated with increased incidence of childhood anaemia. Children who had fever two weeks before the survey had more chances of getting anaemia compared to children who did not have fever (AOR=1.64; 95% CI: 1.24-2.16; $p<0.001$).

Cough and recent diarrhoea were not significantly related to anaemia after adjustment for other factors. Nutritional status was also linked to childhood anaemia. The children who were underweight had much greater odds of getting anaemia than children of normal weight for age (AOR=1.69; 95% CI: 1.13-2.54; $p=0.011$). Although stunting was associated with increased risk of anaemia in the child-level model, this association was reduced after adjusting for maternal and household factors and was not significant in the final model (AOR=1.19; 95% CI: 0.93-1.52; $p=0.164$).

Wasting status and vitamin A supplementation were not significantly associated with the anaemia in the final model.

4.7. Model 3 Maternal factors related to childhood anaemia.

Maternal characteristics were measured such as maternal age, education, maternal anaemia status, antenatal care attendance and the time of birth and where the mother gave birth. Maternal age was not significantly associated with childhood anaemia in the fully adjusted model. For children born when their mother was between 15 and 24 years old, children born to a mother aged 25-34 years had lower odds of anaemia (AOR=0.81; 95% CI: 0.57-1.15), and children born to a mother between 35 and 49 years old had lower odds (AOR=0.75; 95% CI: 0.44-1.28), but neither association was statistically significant. A maternal educational attainment was not significantly associated with childhood anaemia. Children of mothers with no education did not have higher odds of anaemia than children whose mothers had primary education (AOR=1.19; 95% CI: 0.77-1.85), secondary education (AOR=0.97; 95% CI: 0.63-1.51) or higher education (AOR=0.77; 95% CI: 0.36-1.64).

Children whose mothers had anaemia had higher odds of childhood anaemia compared to children who did not have anaemia but not so much that it was statistically significant (AOR=1.26; 95% CI: 0.95-1.67; $p=0.106$). Antenatal care attended and locations of delivery were not significantly related to childhood anaemia. Children whose mothers had attended four or more antenatal visits had similar probability of anaemia to those who were not attended more than four (AOR=0.92; 95% CI: 0.69-1.23). Delivery at a health centre was not significantly related to childhood anaemia compared to home delivery (AOR=1.25; 95% CI: 0.75–2.10).

4.8. Model 4 Household and community-level factors associated with childhood anaemia.

The wealth status in a household was related to childhood anaemia significantly more strongly than in the poorest household (AOR=0.66; 95% CI: 0.49–0.91; $p=0.010$). Children from the richest households also had significantly lower odds of anaemia (AOR=0.53; 95% CI: 0.29-0.97; $p=0.040$). The associations between middle-income and richer households were in the protective direction but not statistically significant.

Childhood anaemia was not associated with household size. Children who were in six or more families had similar odds of anaemia compared to children in smaller and medium-sized households (AOR=1.01; 95% CI: 0.78-1.29). Water source and sanitation were not significantly associated with childhood anaemia. The children from the better and cleaner water sources had similar likelihood of anaemia to children from the poor water sources (AOR = 1.11; 95% CI: 0.85-1.45).

Improved sanitation facilities and open defecation were not significantly associated with anaemia as opposed to poor sanitation facilities. Residence type was significantly associated with childhood anaemia. Children living in rural areas were less likely to have anaemia than children living in urban areas (AOR=0.71; 95% CI: 0.52-0.97; $p=0.030$).

4.9. Full Model

After controlling for child, maternal, household and community-level factors, the most significant predictors of child anaemia were child age, recent fever, receipt of deworming medication, underweight status, household wealth and residence type.

Younger children aged 6 to 23 months, children with recent fever and children who were underweight had higher chances of anaemia. On the other hand, receiving deworming medication,

higher household wealth and more rural residence were associated with lower odds of childhood anaemia. Such large cluster-level variation after adjustment indicates that interventions that are focused on childhood anaemia need to consider context as well as individual characteristics when they are implemented in Zambia. This indicates that prevention of childhood anaemia needs to be made up of child health and nutrition management, infection prevention and control and social welfare strategies to help vulnerable families.

4.10. Interpretation of adjusted associations

Age: Children aged 24–59 months had 45% lower odds of anaemia than children aged 6–23 months (AOR=0.55). This is calculated as $1 - 0.55 = 0.45$. The 95% CI did not include 1, providing statistical evidence of an association.

Fever: Children with fever in the two weeks preceding the survey had 64% higher odds of anaemia than children without recent fever (AOR=1.64). The 95% CI excluded 1.

Underweight: Underweight children had 69% higher odds of anaemia than children with normal weight-for-age (AOR=1.69). The 95% CI excluded 1.

Deworming: Children who received deworming medication had lower odds of anaemia (AOR=0.76), equivalent to approximately 24% lower odds. The upper CI was approximately 1.00, so the evidence is borderline and should be interpreted cautiously.

Household wealth: Compared with the poorest households, children in poorer households had 34% lower odds of anaemia and children in the richest households had 47% lower odds. The middle and richer categories were also below 1 but their confidence intervals included 1, so evidence of an independent association was insufficient at the 5% level.

Residence: Rural residence was associated with 29% lower odds of anaemia compared with urban residence (AOR=0.71; 95% CI: 0.52–0.97). This association should not be interpreted as evidence that rural residence itself is protective; residence is a proxy for a combination of contextual characteristics that were not fully measured in this dataset.

5. CHAPTER 5: DISCUSSION

In this study the prevalence and determinants of anaemia among children aged 6–59 months in Zambia were investigated using data from 2024 Zambia Demographic and Health Survey (ZDHS).

Using a multilevel mixed-effects logistic regression model, it examined factors at the child level, maternal level, household level and community level associated with childhood anaemia.

5.1. Prevalence of childhood Anaemia

This study demonstrates that childhood anaemia remains a significant public health issue in Zambia and that important determinants at different levels of influence are played out. Childhood anaemia prevalence among children 6 to 59 months of age in Zambia. 52% of children aged 6 to 59 months were anaemic in the study, which shows that Zambia has a high level of anaemia in young children. This finding suggests that childhood anaemia is still a significant public health concern despite the need for nutrition and child health interventions, such as vitamin A supplementation, deworming programs, malaria prevention and maternal and child health care services. The prevalence of childhood anaemia is in good agreement with previous research in Zambia. Nawa et al. (2024) reported 53.8% childhood anaemia prevalence among 6-59 months children in a nationally representative analysis, with a high prevalence (Zambia Statistics Agency et al., 2024).

The comparison between the current study and previous evidence indicates that despite the increase in access to preventive health services, Zambia's children continue to have significant incidence of childhood anaemia. The high prevalence, due to multifactorial reasons (i.e., nutritional deficit, infectious disease and poor diet and background of health and poverty), may be associated with childhood anaemia.

In Zambia, current food insecurity, lack of variety in diets, malaria transmission and insufficient access to health services may have led to continued anaemia burden (Zambia Statistics Agency et al., 2024). From a policy perspective, the findings indicate that reducing childhood anaemia is not about supplements but rather integrated intervention. We would need to strengthen coordination between nutrition programs, malaria prevention programs, infection control and poverty reduction interventions in national anaemia management.

5.2. Child-level factors of childhood anaemia.

Child age was significantly associated with anaemia. Children aged 24-59 months had lower likelihood of anaemia compared to those aged 6-23 months (AOR=0.56; 95% CI: 0.43–0.71) and

younger children were at higher risk of the disease. This finding is in line with earlier research that suggests that younger children are more vulnerable to anaemia. Moschovis et al. (2018) also found that younger age is a significant determinant of anaemia in children in sub-Saharan Africa, and UNICEF (2020) noted that the complementary feeding period is a particularly important stage due to increased nutritional requirements and low iron intake. In fact, Nawa et al. (2024) found higher risk of anaemia in younger children in Zambia, and Chakulya et al. (2025) identified younger age as a strong predictor of childhood anaemia. The reason for this higher risk among younger children is that during the first 2 years of the child's life they are developing and growing rapidly, increasing their requirements for iron. At the same time, many children are transitioned from breast milk exclusively to additional food sources which may lack iron content or dietary diversity. Young children are also more susceptible to infections that can lead to anaemia because of inflammation and lack of iron (White, 2018). Prevention of anaemia at the first 24 months of life should be made to include children. Strengthening infant and young child feeding programmes, promoting iron-rich complementary foods, and ensuring timely micronutrient supplementation should be part of child nutrition policies.

Child sex

In this study, female children had slightly lower prevalence of anaemia than male children, but the difference was not statistically significant in the final model (AOR=0.81; 95% CI: 0.65-1.01). This is in contrast to Tesema et al. (2021), who reported that male children had an increased risk of anaemia in a large multi-country analysis in sub-Saharan Africa. However, Chakulya et al. (2025) also noted that sex differences may vary with context and the distribution of other risk factors. The differences between studies may be caused by differences in biological factors, dietary habits, infection exposure and cultural practices that affect boys and girls. Sex was not an independent predictor after adjustment, so the other factors like nutrition, infection, and household socioeconomic conditions may play a larger role in determining childhood anaemia. The policy implication is that such interventions for anaemia should not be limited to sex-based targeting and should focus on children based on nutritional vulnerability, age, illness exposure and socioeconomic status.

Recent fever illness

Children who had fever in the two weeks before the survey had significantly higher odds of anemia compared to children without fever (AOR=1.64; 95% CI: 1.24-2.16). This result is in line with previous evidence that infectious diseases, particularly malaria, are associated with childhood anaemia. Tesema et al. (2021) reported that children with recent fever had increased anaemia risk, while Eisele et al. (2011) found a very strong association between malaria infection and anaemia in the Luangwa District in Zambia. Konkola et al. (2023) also found that anaemia was more common in areas with malaria transmission and febrile illnesses.

The association of the disease and illness could be explained by the biological effects of infection. Malaria and other febrile diseases lead to anaemia, with red blood cells destroyed in the body, haemoglobin production reduced, inflammation, and iron metabolism impaired. Many illness episodes may also reduce appetite and diet so nutritional deficiencies are further worsened by frequent illness episodes. The findings also underscore the need for better integration between malaria control and anaemia prevention measures. Screening children with febrile illnesses for anaemia, improving malaria prevention coverage and strengthening early diagnosis and treatment should be the priority.

Nutritional status.

Underweight children had dramatically higher risk of anaemia than children with normal nutritional status (AOR=1.69; 95% CI: 1.13–2.54). This conclusion is in line with the Tesema et al. (2021) study, who found increased risks of anaemia for children with undernutrition, including underweight, wasting, and stunting. Moschovis et al. (2018) also identified nutritional status as a determinant of childhood anaemia in sub-Saharan Africa. Because a lack of these nutrients in children are essential for haemoglobin production (iron, folate, etc.). Undernourished children may also have weakened immunity and be more susceptible to infections that contribute to anaemia. The policy implication is that prevention of anaemia should now be integrated into existing child nutrition programmes. Prevention of growth, nutrition screening and management of undernutrition should be part of routine child health services.

5.3. Maternal factors associated with childhood anaemia.

Maternal age and education. In our study, maternal age and education were not independently associated with childhood anaemia after controlling for other factors. Although maternal age and

education were associated in the descriptive and intermediate analyses, these were attenuated in the final model. This is unlike Moschovis et al. (2018) who reported that maternal education and maternal traits were important predictors of childhood anaemia in sub-Saharan Africa. Nawa et al. (2024) also identified household educational characteristics as an important factor in anaemia in Zambia.

The lack of association in this study may be that maternal education has a direct influence on childhood anaemia through household wealth, dietary practices, and healthcare use. If these had been controlled for, then education would have been less relevant. As such, we believe that maternal education is still important, but it should be combined with household poverty, food security and access to quality health care.

Maternal anaemia.

Maternal anaemia was associated with increased odds of childhood anaemia, but the association was not statistically significant (AOR=1.26; 95% CI: 0.95-1.67). Moschovis et al. (2018) identified maternal anaemia as a significant risk factor for childhood anaemia, which is related to different nutritional and socioeconomic challenges of mothers and children. This association might be explained by common household dietary habits, nutritional deficiencies of maternal children, and biological pathways of maternal and child health. The lack of statistical significance could be an indication that maternal anaemia is distributed across household and nutritional pathways that are not impacted by other variables. We should continue to strengthen maternal nutrition programmes to prevent maternal health and to screen for anaemia and to treat it during pregnancy, as better maternal health can be related to better child health outcomes.

5.4. Household and community-level determinants.

Household wealth. Higher household wealth was strongly associated with childhood anaemia. Children of poorer and richest households had lower incidence of anaemia compared to children from the poorest families. This is in line with Moschovis et al. (2018), whose findings showed strong socioeconomic gradients in childhood anaemia across sub-Saharan Africa. Nawa et al. (2024) also found household socioeconomic conditions to be important determinants of childhood anaemia in Zambia.

The association could be attributable to food security, dietary diversity, access to healthcare as well as ability to obtain preventive care. Poor households may be unable to access iron-rich foods and health care services and that in turn makes them more vulnerable to anaemia. The policy implications are that reducing childhood anaemia requires tackling structural drivers such as poverty and food insecurity. Social protection programs, livelihood enhancement and nutrition-sensitive interventions must complement health-sector interventions.

Water, sanitation and residence.

Water source and sanitation were not significantly associated with childhood anaemia in the final model. This is in contrast to findings suggesting that better WASH conditions lower anaemia risk because of reduced exposure to enteric infections (Kothari et al., 2019). The lack of association may be because of the complicated pathways between WASH and anaemia. Water and sanitation may indirectly affect infection reduction, household hygiene practices and nutritional pathways. Household wealth and other socioeconomic factors may also play an important role in these relationships.

Rural residence was associated with lower risk of anaemia in this study, but this finding was not consistent with the rest of the world. Konkola et al. (2023) have shown that there is geographic clustering of anaemia in Zambia and thus local disease ecology, malaria transmission, and service availability may affect the risk for anaemia at the community level. This suggests that interventions to manage anaemia should take local context into account rather than just urban-rural.

Community surveillance and targeted interventions in high-risk areas may improve programme performance. Community-level variation in childhood anaemia. The multilevel analysis showed that the clustering of anaemia is significant among children living in the same enumeration areas. The ICC found that differences of childhood anaemia are still seen even when individual and household characteristics are adjusted for. This result is consistent with previous evidence that childhood anaemia is influenced by context outside of individual quality. Konkola et al. (2023) found geographical variations in anaemia prevalence in Zambia, and Eisele et al. (2011) also showed that transmission intensity of malaria is a community-level driver.

The remaining community-level variation could be a function of non-measured factors including local food environment, health services and malaria exposure as well as nutrition of communities.

The policy implication is that national anaemia strategies should incorporate community-based approaches, including strengthening community health workers, improving local nutrition programmes, and tailoring interventions according to community-specific risks

Random effects and clustering of childhood anaemia

The multilevel analysis demonstrated significant clustering of childhood anaemia within enumeration areas. The null model showed an intraclass correlation coefficient (ICC) of approximately 7.0%, indicating that variation between communities accounted for a measurable proportion of differences in childhood anaemia prevalence.

After inclusion of child, maternal, household, and community-level variables, the ICC reduced slightly to approximately 6.6% in the final model. This indicates that although individual and household characteristics explained part of the variation, residual differences between communities remained. The persistence of cluster-level variation suggests that contextual factors not captured in the dataset, such as local food environments, malaria transmission intensity, availability of health services, and community-level nutrition practices, may influence childhood anaemia risk. The use of multilevel modelling was therefore appropriate because a conventional logistic regression model would have ignored the hierarchical structure of the data and potentially underestimated uncertainty in the estimates.

5.5. Strengths and limits of the Study.

Strengths: This study had several strengths: Firstly, it used data from the 2024 Zambia Demographic and Health Survey (ZDHS), which is a nationally representative sample and therefore, the findings can be applied to children aged 6-59 months in Zambia. Additionally, the multilevel logistic regression analysis of the DHS data was used to examine the hierarchical structure of the data, which allowed for the assessment of the factors at the child, household and community level.

Limitations: This study did show different determinants of childhood anaemia from single-level assessment. We also have limitations for this study. The cross-sectional design of the ZDHS makes it difficult to establish causal links between identified factors and childhood anaemia. Additionally, some of the variables are based on caregiver self-report, which may be affected by recall bias. We also did not include the data from the ZDHS, so some of the most important variables are not known (diet, iron status, genetic causes). While there are limitations of using national data and methods it can be seen that, as long as they are used and data is used, the findings are valid.

6. CHAPTER 6: CONCLUSION

In this study we discovered that childhood anaemia is still a public health concern for children aged 6-59 months in Zambia and more than half of children are treated as anaemic. The study revealed that childhood anaemia is associated with a range of interconnected factors in the child, household, maternal and community level and that there are several factors involved in the child-child relationship and the children are affected as well. Children aged 6-23 months, fever and children who were underweight significantly increased the risk of anaemia.

Socioeconomic status is also significant but not the only important factor in children with poor parents being more prone to anaemia than children from richer parents. Childhood anaemia was also associated with motherhood and maternal characteristics although we found that there were several associations that were not significant after controlling for child and household factors.

This indicates that maternal influences may be mediated through more socioeconomic and nutritional factors as well. Community clustering and large community clustering suggest that childhood anaemia is not an individual problem but a social and economic issue relating to the context in which children grow up. Prevention of anaemia requires integrated interventions in nutrition, infection control and poverty and community, health and poverty.

7. CHAPTER 7: RECOMMENDATIONS.

1. Enhance nutrition interventions for children aged 6-23 months: The Ministry of Health and partners should enhance interventions for children in the first two years of life: Providing appropriate complementary feeding strategies, more iron-rich food and micronutrient

supplementation and growth monitoring and early identification of nutritional deficiencies should be emphasized.

2. Integrate anaemia prevention into child illness management: Given the high correlation between fever and anaemia, childhood illness programmes should be designed to identify and treat malaria and other infections early and raise awareness among the children in terms of early healthcare seeking behaviour.
3. Enhance interventions for child undernutrition: Prevention programs and nutrition interventions to treat childhood anaemia need to be integrated with the interventions for underweight and growth-deteriorating children, including increased screening for malnutrition in the community and facility level and nutrition counselling for the parents and caregivers.
4. Address socioeconomic disparities in childhood nutrition: The association between household wealth and anaemia highlights a need for wider multisectoral approaches to the problem.
5. Expand studies to longitudinal study for the temporal relationship between determinants and childhood anaemia. There should be more research into community-level factors not included in the DHS datasets, such as the malaria transmission intensity, dietary diversity, household food security and access to iron supplementation.

REFERENCES

1. Wh M, Lc C. An analytical framework for the study of child survival in developing countries. 1984. PubMed.
2. World Health Organization. Anaemia. 10 February 2025. Accessed 8 January 2026. https://www.who.int/news-room/fact-sheets/detail/anaemia?utm_source=chatgpt.com.
3. White NJ. Anaemia and malaria. *Malar J*. 2018;17:371.
4. Balarajan Y, Ramakrishnan U, Özaltın E, Shankar AH, Subramanian S. Anaemia in low-income and middle-income countries. *The Lancet*. 2011;378:2123–35.
5. Corsi DJ, Neuman M, Finlay JE, Subramanian S. Demographic and health surveys: a profile. *Int J Epidemiol*. 2012;41:1602–13.
6. Elkasabi M, Ren R, Pullum TW. *DHS Methodological Reports No. 27 Multilevel Modeling Using DHS Surveys: A Framework to Approximate Level-Weights*. August 2020.
7. Kothari MT, Coile A, Huestis A, et al. Exploring associations between water, sanitation, and anemia through 47 nationally representative demographic and health surveys. *Annals of the New York Academy of Sciences*. 2019;1450:249–67.
8. Nawa M, Konkola G, Sialubanje C. Factors Associated with Anaemia in Under-five Children in Zambia; Secondary Analysis of the 2021 Malaria Indicator Survey Data. *mjz*. 2024;50:307–19.

9. Croft, Trevor N, Allen, et al. Guide to DHS Statistics (English). 2023. Accessed 26 June 2026. <https://dhsprogram.com/publications/publication-dhsg1-dhs-questionnaires-and-manuals.cfm>.
10. United Nations Children's Fund (UNICEF). *Improving Young Children's Diets During the Complementary Feeding Period*. 2020.
11. Moschovis PP, Wiens MO, Arlington L, et al. Individual, maternal and household risk factors for anaemia among young children in sub-Saharan Africa: a cross-sectional study. *BMJ Open*. 2018;8:e019654.
12. World Health Organization. Intermittent iron supplementation in preschool and school-age children in malaria-endemic areas. 9 August 2023. Accessed 8 January 2026. https://www.who.int/tools/elena/interventions/iron-intermittent-children-malaria?utm_source=chatgpt.com.
13. Eisele TP, Miller JM, Moonga HB, et al. Malaria Infection and Anemia Prevalence in Zambia's Luangwa District: An Area of Near-Universal Insecticide-Treated Mosquito Net Coverage. *The American Society of Tropical Medicine and Hygiene*. 2011;84:152–7.
14. Hill K. SciELO - Public Health - Frameworks for studying the determinants of child survival Frameworks for studying the determinants of child survival.
15. Kobayashi E, Negi B, Nakazawa M. The association between food groups and childhood anemia in Zambia, based on the analysis of Zambia Demographic and Health Survey 2018. *J Public Health Afr*. 2022;13:6.
16. Asgedom YS, Habte A, Woldegeorgis BZ, et al. The prevalence of anemia and the factors associated with its severity among children aged 6–59 months in Ghana: A multi-level ordinal logistic regression. *PLoS ONE*. 2024;19:e0315232.

17. Zambia Statistics Agency, Ministry of Health (MoH) Zambia, ICF. *Zambia Demographic and Health Survey 2024: Key Indicators Report*. 2024.

APPENDICES

1. NHRA Clearance

	NATIONAL HEALTH RESEARCH AUTHORITY Lot No. 18961/M, off Kasama Road, Chalala, P.O. Box 30075, LUSAKA Tell: +260211 250309 Email: znhrasec@nhra.org.zm www.nhra.org.zm
NHRA-3514/21/04/2026	22nd April 2026
The Principal Investigator, Mr. Gabriel Mwila, University of Lusaka Zambia,	
Dear Mr. Gabriel Mwila,	
Re: Request for Authority to Conduct Research	
The National Health Research Authority Is in Receipt of Your Request for Authority to Conduct Research Titled “Determinants of Anaemia Among Children Aged 6–59 Months in Zambia: A Multilevel Analysis of the 2024 ZDHS.”	
I wish to inform you that following submission of your request to the Authority, our review of the same and in view of the ethical clearance, this study has been approved on condition that:	
1. The relevant Provincial and District Medical Officers where the study is being conducted are fully appraised. 2. Progress updates are provided to NHRA bi-annually from the date of commencement of the study. 3. The final study report is cleared by the NHRA before any publication or dissemination within or outside the country. 4. After clearance for publication or dissemination by the NHRA, the final study report is shared with all relevant Provincial and District Directors of Health where the study was being conducted, University leadership, and all key respondents.	
Yours sincerely,	
National Health Research Authority	
	
Prof Victor Chalwe, Director and Chief Executive Officer	
All correspondences should be addressed to the Director/CEO National Health Research Authority	

2. DHS Dataset Approval



Apr 21, 2026

Gabriel Mwila
University of Lusaka
Zambia
Request Date: 04/21/2026

Dear Gabriel Mwila:

This is to confirm that you are approved to use the following SPA Datasets for your registered research project titled: "Determinants of Anaemia Among Children Aged 6–59 Months in Zambia: A Multilevel Analysis of the 2024 ZDHS":

Zambia

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. Also, be aware that re-distribution of any DHS micro-level data, either directly or within any tool/dashboard, is not permitted. 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,

Olsen Hanner

Olsen Hanner
Data Archivist
The Demographic and Health Surveys (DHS) Program