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DEPARTMENT OF PAEDIATRICS AND CHILD HEALTH

Burden of infants at risk of poor growth and development among children under six months of age in selected health facilities within Kampala.

BY

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DECLARATION

I hereby declare that, to the best of my knowledge, this is my original work and has never been submitted to this university or any other institution of higher learning for an academic award or publication.

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DEDICATION.

I dedicate this work to my Guardian and mentor Mariam the Nazarene Gumkom.

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LIST OF ACRONYMS AND ABBREVIATIONS.

ANC-Antenatal Care.

GDG-The Guideline Development Group.

LBW-Low Birth Weight.

LMIC -low-income and middle-income countries.

MUAC-Mid-upper arm circumference.

NDD- Neurodevelopmental Disorders.

PHQ-Patient Health Questionnaire.

PNC-Postnatal Care.

SD -standard deviations.

SDG-Sustainable Development Goals.

SGA- small for gestational age.

SSA-Sub-Saharan Africa.

UDHS- Uganda Demographic Health Survey.

UNICEF-United Nations International Children's Emergency Fund.

WAZ -Weight-for-age z-score.

WHO-World Health Organization.

WLZ-Weight-for-length z-score.

aPR- Adjusted prevalence ratio

OPERATIONAL DEFINITIONS;

1. **Infants at risk of poor growth and development WHO 2023:**

This was defined as infants with low weight-for-age, low weight-for-length, or mid-upper arm circumference (MUAC) below 110 mm, or growth faltering, born preterm/low birth weight/small for gestational age as well as those with known risk factors for poor growth and development (1).

2. **Infants with Poor Growth patterns:** This was defined as infants under 6 months with poor growth based on sequential measurements, that is; no weight gain or weight loss (1)..

3. **Infants with Poor Anthropometry:** This was defined as infants under 6 months with poor anthropometry based on a single measure, including weight-for-age z-score below -2 standard deviations, weight-for-length z-score below -2 standard deviations, nutritional edema, or mid-upper arm circumference less than 110 mm (1).

4. **Infants with Known Risk Factors:** This was defined as infants under 6 months with known risk factors for poor growth and development, such as neurodevelopmental concerns, infant feeding concerns, maternal risk factors, or history of hospitalization (1).

5. **Infants with Poor Birth Outcomes:** This was defined as infants under 6 months with poor birth outcomes, including preterm birth, low birth weight, or being small for gestational age (1).

6. **Low Birth Weight (LBW):** This was defined as a birth weight of less than 2500 grams (or 5.5 pounds) (1).

7. **Small for Gestational Age (SGA):** This was defined as a birth weight that is less than the 10th percentile or more than 2 standard deviations below the mean for a given gestational age, based on a reference population (1).

8. **Gestational Age:** This was defined as the number of completed weeks of pregnancy, calculated from the first day of the woman's last menstrual period (LMP) or by ultrasound measurement (2).

ABSTRACT.

Background: Globally, infants under six months face a high burden of morbidity and mortality driven by complications of poor growth and development, yet previous research and nutrition programs have focused predominantly on children aged 6-59 months. However, infants under six months are not a homogenous group they include those with poor birth outcomes, known risk factors, poor growth patterns, or poor anthropometry each requiring different management. The World Health Organization's 2023 revised guidelines introduced the categorization of infants under six months "at risk of poor growth and development" to enable early detection and intervention. However, data on the prevalence and factors associated with this at-risk population in Uganda remain limited.

Objectives: To determine the prevalence of "infants at risk of poor growth and development (PGD)" and associated factors among infants under six months of age attending outpatient clinics in selected health facilities within Kampala, Uganda.

Methods: A cross-sectional study was conducted among 832 infants aged 6 weeks to under 6 months attending outpatient clinics at Kawempe National Referral Hospital, Kisenyi HC IV, and Kisugu HC III in Kampala. Consecutive sampling was used. A semi-structured questionnaire collected data on infant, maternal, and household factors. Infants at risk were defined using WHO 2023 criteria (poor birth outcomes, known risk factors or poor anthropometry). Data were analyzed using STATA 17.0 with modified Poisson regression to estimate adjusted prevalence ratios (aPR)

Results: The prevalence of infants at risk of poor growth and development was 46.2% (95%CI 42.8-49.6%). Factors significantly associated with increased risk were: non-maternal caregiving (aPR 1.77, 95%CI 1.25-2.52, p-value 0.001), maternal illness during pregnancy (aPR 1.43, 95%CI 1.17-1.76, p-value 0.001), and household history of loss of a child under five years (aPR 1.52, 95%CI 1.09-2.13, p-value 0.014). Protective factors included adequate antenatal care visits (4-7 visits: aPR 0.73, 95%CI 0.60-0.89, p-value 0.002; ≥8visits: aPR 0.71, 95%CI 0.51-0.99, p-value 0.042) and mosquito net use (aPR 0.70, 95%CI 0.55-0.88, p-value 0.002).

Conclusion: The high prevalence (nearly 1 in 2 infants) suggests that risk begins very early in life and may be under-ascertained by current surveillance systems focusing on older children. The

findings highlight the need for broader screening criteria and targeted interventions addressing maternal health and caregiving environments to ensure infants reach their developmental potential.

CHAPTER ONE.

1. INTRODUCTION.

1.1 Background.

Infants under six months of age still experience a high burden of morbidity and mortality globally, driven by complications related to poor growth and development, including stunting, wasting, premature birth, low birth weight, delayed cognitive and motor skills, birth asphyxia, congenital abnormalities, and infectious diseases (3). These challenges are worsened with systemic risks, including conflict, climate change, and declining immunization rates, which disproportionately affect low- and middle-income countries (LMICs) (4). Malnutrition worsens these vulnerabilities, weakening immune systems and increasing susceptibility to developmental delays, disease, and death (5).

The first 1,000 days of life, spanning conception to age two, are foundational for growth and development, with linear growth during the first two years strongly linked to cognitive and motor outcomes (6). However, before 2023, global guidelines lacked specific recommendations for infants under six months showing early signs of poor growth but not yet meeting criteria for acute malnutrition (1, 7).

Recognizing this gap, WHO updated its guidelines to ensure early detection and timely intervention for vulnerable infants at risk of poor growth and development (1). The 2023 guidelines introduce the “At-Risk Infants Under 6 Months” category, focusing on those with poor growth patterns, suboptimal anthropometric measurements, known risk factors, or adverse birth outcomes (1). These revisions aim to identify and support at-risk infants before they develop severe conditions such as wasting or nutritional oedema (1).

Key recommendations include exclusive breastfeeding for the first six months, early breastfeeding initiation, continuity of respectful, high-quality care, and a comprehensive approach addressing the interconnected health and nutrition needs of mothers and infants (1).

This initiative aligns with WHO's broader focus on early childhood development, emphasizing the importance of early intervention in preventing severe health outcomes (8).

This focus is crucial given the alarming global malnutrition trends: in 2022, 149 million children under five were stunted, 45 million were wasted, and 37 million were overweight or obese (9, 10). There are still high rates of malnutrition in sub-Saharan Africa with studies indicating 20.1% of infants under six months are underweight, 21.3% wasted, and 17.6% stunted in 54 low- and middle-income countries (11), and specifically in Ethiopia, 21.7% of infants under six months experience concurrent anthropometric deficits (CIAF), with 10.7% having multiple deficits (12). Ugandan studies show 12.5% of infants (1-6 months) suffer from moderate acute malnutrition (13), while 44.9% of children (6-59 months) experience stunting (14).

Despite high immunization (96.5%), exclusive breastfeeding rates in some regions (15), and high national breastfeeding rates (66%) (16), developmental disabilities are also highly prevalent, with 12.7% of Ugandan infants aged 9-12 months exhibiting neurodevelopmental delays, higher than the global average (15, 17). Key risk factors associated with the neurodevelopmental delays and poor growth among children under six months include being SGA, preterm birth, short birth length, and maternal MUAC below 23.5 cm (18). Additionally, female infants are also at a higher risk. (18).

The World Health Organization's (WHO, 2023) newly updated guidelines emphasize the need for new evidence on the prevalence and factors associated with infants at risk of poor growth and development among infants under six months. Additionally, the scarcity of existing research on infants under six months is particularly concerning for developing countries like Uganda. To inform evidence-based interventions and policies, new studies are urgently needed. Currently, even national surveys, such as the Uganda Demographic and Health Survey (UDHS), lack detailed data on this age group, limiting the development of targeted interventions.

Addressing these gaps is essential to achieving Sustainable Development Goals (SDGs) 2 (Zero Hunger) and 3 (Good Health and Well-being), highlighting the urgent need for research to inform context-specific strategies for early detection and management of at-risk infants. Therefore, this study aimed to determine the prevalence and factors associated with “infants at risk of poor growth and development” among infants under six months of age attending outpatient clinics in selected health facilities in Kampala, Uganda.

1.2 Problem statement.

Infants under six months face several global challenges, including 21% wasting, 20% underweight, and 17% stunted, worsened by inadequate breastfeeding with less than 50% of the infants being breastfed worldwide (19, 20), which, under the WHO 2023 framework, now encompasses four distinct risk categories: poor birth outcomes, known risk factors (feeding difficulties, neurodevelopmental concerns, maternal illness), poor growth patterns, and poor anthropometry (WHO, 2023). Nearly half of deaths under five occur during the neonatal period, and 18% of newborns have low birth weight (21, 22). Specifically, no Ugandan study has quantified the proportion of infants under six months meeting the expanded WHO 2023 'at-risk' criteria, which captures vulnerability beyond traditional anthropometric malnutrition.

Despite various efforts to improve infant health such as UNICEF’s Family Connect program and World Vision Uganda's Baby-Friendly Health Facility Initiative(23, 24, 25), Uganda still faces significant challenges, with 16.1% of infants under five years being underdeveloped and 29.8% being severely underweight. (26).

This is for reasons such as poor maternal nutrition before and during pregnancy, leading to underweight babies with growth challenges (27). Additionally, poor access to basic healthcare, maternal ignorance and resource limitations affecting nutrients’ availability and care practices for their babies, making it even harder for them to thrive (28).

If left unaddressed, this issue can have severe and long-lasting consequences, including increased risk of illness and death, delayed cognitive and physical development, and reduced economic productivity later in life (29, 30).

The implementation of revised World Health Organization (WHO, 2023) guidelines on infant growth and development presents an opportunity to address these issues (1). Currently, there is limited data on the prevalence of infants at risk of poor growth and development among infants under six months. Most research has focused on children under five, frequently overlooking the crucial period of infancy under six months, a particularly vulnerable group with unique nutritional and developmental needs. We also lack a clear understanding of the factors contributing to the infants at risk of poor growth and development which knowledge is essential in improving infant health outcomes.

To bridge this knowledge gap, this study sought to determine the prevalence and factors associated with "infants at risk of poor growth and development" among infants under six months of age.

1.3 Justification and significance of the study.

Although the burden of acute malnutrition/or child wasting and nutrition edema has been well characterized in 6 – 59 months old children in Uganda and other resource-limited income countries and in diverse context situations, a reciprocal description is limited for infants less than six months to enable targeted interventions. The high prevalence of underdevelopment and being underweight among Ugandan infants, despite ongoing efforts, highlights the urgency of this study. Moreover, the recent revision of WHO 2023 guideline recommendations on prevention and management of child wasting and nutrition edema recognized four categories of infants less than six months that deserve customized interventions. The scarcity of research focusing on children under six months in Uganda, under this category adds to the urgency for this study. This research aims to provide valuable insights into the burden of infants at risk of poor growth and development among those less than six months of age in Kampala, Uganda,

including the prevalence and factors associated with infants at risk of poor growth and development. Understanding these factors associated with underdevelopment and underweight is essential. This knowledge can enable targeted interventions, risk assessments, and prevention strategies, including public health campaigns and policy changes. Healthcare providers can be able to deliver more effective care, with early identification and appropriate intervention to prevent long-term consequences. Furthermore, the findings will inform policies and interventions aimed at improving the management of infants at risk of poor growth and development and addressing associated aspects like healthcare delivery systems and food insecurity in the Ugandan context, aligning with the Sustainable Development Goals (SDGs) 2 and 3.

1.4 Research Questions.

1. What is the prevalence of infants at risk of poor growth and development among infants less than six months of age attending outpatient clinics in selected health facilities in Kampala, Uganda?

2. What factors are associated with infants at risk of poor growth and development among infants under six months of age attending outpatient clinics in selected health facilities in Kampala, Uganda?

1.5 Objectives.

1.5.1 General Objective.

To determine the burden of infants at risk of poor growth and development among infants under six months of age attending outpatient clinics in selected health facilities within Kampala, Uganda.

1.5.2 Specific Objectives:

2. To determine the prevalence of infants at risk of poor growth and development among infants under six months of age attending outpatient clinics in selected health facilities in Kampala City, Uganda.

3. To describe the factors associated with infants at risk of poor growth and development among infants under six months of age attending outpatient clinics in selected health facilities in Kampala, Uganda.

1.6 The conceptual framework:

1.6.1 Scope of study.

This study focused on the prevalence and factors associated with infants at risk of poor growth and development among infants below 6 months of age attending outpatient clinics at selected health facilities in Kampala City, Uganda. These included Kawempe National referral hospital, Kisenyi HCIV, and Kisugu HC III.

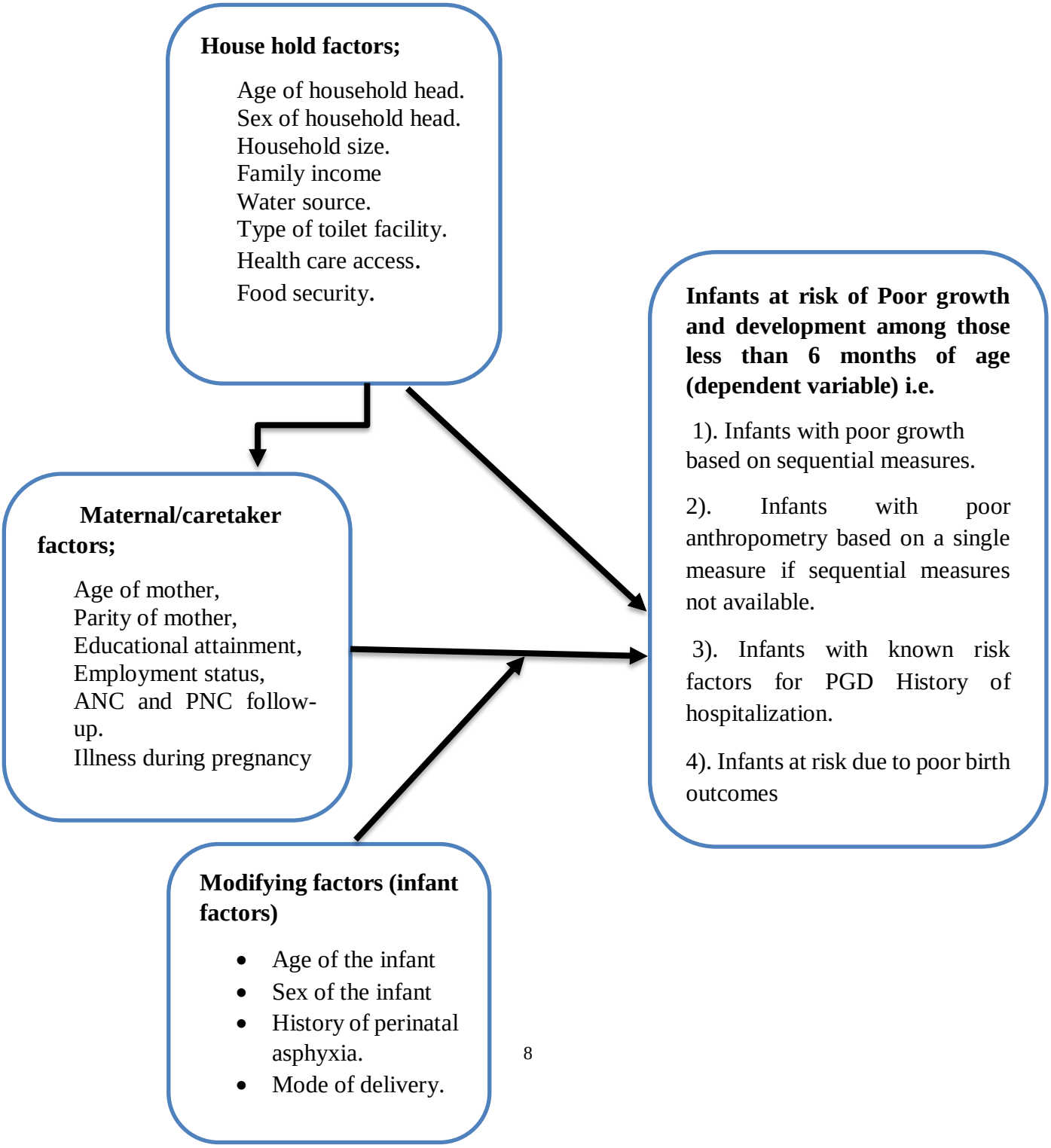
The factors studied included household factors such as the age and sex of the household head, household size, estimated income, water source, sanitation facilities, healthcare access, and food security. Maternal/caretaker factors, such as age, educational attainment, employment status, parity. Modifying factors such as the infant's age, sex, mode of delivery and any history of perinatal asphyxia, immunization status, mosquito net use and any medical condition.

1.6.2 Description of the conceptual framework.

The Conceptual frame work shows the dependent variable. i.e. Infants less than six months at risk of poor growth and development, defined as an infant meeting the criteria for any of the four categories as defined by World Health Organization (WHO) 2023 guidelines.

And the independent variables i.e. the household and maternal / caretaker factors as well as the modifying factors explored in the study. This conceptual framework is adapted from the WHO framework for determinants of child undernutrition, which categorizes influences into proximal, underlying, and basic determinants. Proximal factors, which are the immediate influences on child health, include Household Factors and Maternal/Caretaker Factors. Household factors such as the age and sex of the household head, household size, and wealth status, water source, sanitation facilities, healthcare access, and food security shape the living environment and availability of resources essential for child health. Maternal/caretaker factors, including age, educational attainment, employment status, parity etc. directly affect the caregiving capacity and health-seeking behavior for the infant. Modifying factors such as the infant's age, sex, mode of delivery and any history of perinatal asphyxia set the baseline susceptibility and determine how external stresses translate into faltering growth. These interconnected factors contribute to the outcome of infants at risk of poor growth and development among infants less than six months of age, highlighting critical intervention points for improving child health outcomes.

Figure 1: Conceptual framework adapted from WHO's determinants of child undernutrition framework.



CHAPTER 2:

2 LITERATURE REVIEW.

2.1 Definition and groups of infants at risk of poor growth and development.

Infants at risk of poor growth and development is defined as infants who lack proper nutrition in their first six months (31). Low birth weight, preterm birth, insufficient breastfeeding, maternal health challenges and financial problems can all raise this risk (32). These babies might develop Failure to Thrive (FTT) as a result, which means slow physical growth due to not getting enough nutrients (33). Proper nutrition and care play a key role in baby growth, setting the stage for physical, mental, and social skills (34). Brain growth starts before birth and needs good food and fun experiences to grow well. Babies who get enough food and care have a better chance to grow and do well (34). Conversely, babies who don't get enough food and care might face long-term issues, like trouble learning and being less productive later on (34).

The World Health Organization (WHO) 2023 guidelines categorize these infants into four groups for targeted intervention (1). The first group includes infants with poor growth based on sequential measurements, such as no weight gain or weight loss from one measurement to the next, downward crossing of weight-for-age centile lines, or insufficient weight gain (velocity standards or grams per specific period) (1). The second group comprises infants with poor anthropometry based on a single measure, including those with a weight-for-age z-score (WAZ) below -2 standard deviations of the WHO child growth standards median, a weight-for-length z-score (WLZ) below -2 standard deviations of the WHO child growth standards median, nutritional edema, or a mid-upper arm circumference (MUAC) less than 110 mm for infants between 6 weeks to less than 6 months of age (1).

The third group of infants at risk includes those with known risk factors for poor growth and development, such as neurodevelopmental concerns or infant feeding concerns, maternal risk factors (physical or mental health problems affecting caring practices), or a history of hospitalization (1). Neurodevelopmental disorders are a group of congenital or acquired

conditions attributed to disturbances of the brain and/or neuromuscular system, resulting in functional limitations (1). Co-occurrence with cerebral palsy and epilepsy is prevalent, and these conditions are together under the broader framework of pediatric neuro-disability. (1).

Finally, the fourth group consists of infants at risk due to poor birth outcomes, including preterm birth, low birth weight (LBW), or being small for gestational age (SGA) (1). Preterm birth refers to babies born alive before 37 completed weeks of pregnancy (1). Low birth weight is defined by the WHO as weight at birth less than 2500 grams (1). Small for gestational age is defined as birth weight less than the 10th percentile or less than -2 standard deviations by reference population (1).

Table 1: Identification and Classification Criteria of Infants at Risk of Poor Growth and Development into Four Categories

A. Infants at risk due to poor birth outcomes	B. Infants with known risk factors for poor growth and development	C. Infants with poor growth based on sequential measures	D. Infants with poor anthropometry based on a single measure
• Preterm birth1or • Low birth weight2 or • Small for gestational age.	•Neurodevelopmental concerns or • Infant feeding concerns or • Maternal risk (physical or mental health problem(s) affecting caring practices) or • History of hospitalization.	• No weight gain or weight loss from one measurement to the next or • Downward crossing of weight-for-age centile lines4 or • Insufficient weight gain (velocity standards or grams/per specific time period.	• Weight-for-age z-score (WAZ) below -2 SD of the WHO child growth standards median; or • Weight-for-length z-score (WLZ) below -2 SD of the WHO child growth standards median; or • Nutritional edema; or • MUAC less than 110 mm for infants between 6 weeks to less than 6 months of age.

1Defined as babies born alive before 37 weeks of pregnancy are completed.

2Defined as weight at birth of < 2500 grams.

2.2 Epidemiology of infants at risk of poor growth and development.

2.2.1 Infants with poor anthropometry and under nutrition.

Globally, undernutrition is responsible for about half of all deaths among children under the age of 5. These occur primarily in low- and middle-income countries (WHO, 2024c).By 2022, 45 million infants and children under the age of five were estimated to be wasted worldwide. (9). The developmental, economic, social and medical impacts of the global burden of malnutrition are serious and lasting, for individuals, their families, communities and countries (9).

The pooled prevalence of malnutrition among the under 5 children from 2006 to 2016, in SSA was 33.2% for stunting, 7.1% for wasting, and 16.3% for underweight. (35). Although the prevalence of stunting decreased from 38.3% in 2000 to 22.3% in 2022, the numbers of children affected increased from 50.6 million to 58.7 million due to population growth (36).

In Uganda, The infant and neonatal mortality rate was 36 and 22 deaths, per 1,000 live births respectively for the 5-year period before the 2022 UDHS (16). Neonatal deaths now account for 61% of infant deaths (37). The prevalence of Stunting was reported at 24% among children 0-59 months in 2022 although there is no data specific to the under 6 months (37). The proportion of underweight children has gradually decreased, from 18% in 2001 to 10% in 2022 while that of wasting has remained steady since 2001 (37). Additionally, 3.6% of children under 5 years of age are affected by wasting, which is lower than the average for the Africa region (6.0%) (17).

The prevalence for severe and mild to moderate stunting was 29% and 1% respectively among the children under-five (38). Also, 3% and 1% of children in the same age category experience mild-to-moderate and severe wasting respectively (38).

2.2.2 Infants at risk due to poor birth outcomes.

Globally, Low birth weight was estimated to be at 15% to 20% of all births i.e. more than 20 million births a year (39). Low birth weight can result from; preterm birth and fetal growth restriction (FGR), with the FGR pathway resulting in the baby being small for gestational age (SGA) (1). Global estimates for 2020 suggest 23·4 million live births were SGA (1). In 2020, an estimated 13.4 million babies were born preterm i.e. more than 1 in 10 babies with a static trend over the previous decade. Approximately 900 000 children died in 2019 of complications of preterm birth (1).

Preterm births mostly occur in LMIC including sub-Saharan Africa where over 90% of extremely preterm babies die within the first few days of life, compared to 10% that die in high-income settings (1). An estimated 5.6 million infants born in sub-Saharan Africa were born SGA in 2012, with a prevalence of 17% (40).

In Uganda, 49% of live births had a reported birth weight and 4% of these had LBW (37). From the mother's estimate of size, four percent of births were reported as very small, 10% as smaller than average, and 83% as average as or larger than average (37).

2.2.3 Known risk factors for poor growth and development.

Globally, 52·9 million children younger than 5 years had developmental disabilities in 2016 and about 95% of these lived in LMIC. However, there are conflicting prevalence rates worldwide, due to differences in study methodology and definitions used (17). According to WHO-2O23, congenital disorders cause an estimated 240 000 newborns deaths worldwide within 28 days of birth every year and 170 000 deaths of children between the ages of 1 month and 5 years (1).

A study done in 2 districts of eastern Uganda found a high NDD burden among infants 9-12 months with a prevalence of 12.7% (15).

The 2016 UDHS report indicates that only 66 per cent of children under the age of 6 months are exclusively breastfed, while two per cent are not breastfed at all (16). In addition, the

percentage of children exclusively breastfed decreases sharply with age from 83 per cent of infants age 0-1 month to 69 per cent of infants age 2-3 months and, further, to 43 per cent of infants age 4-5 months (38).

2.3 Factors associated with infants at risk of poor growth and development.

2.3.1 Household factors associated with infants at risk of poor growth and development.

The age and sex of the household head are some of the factors associated with risk of poor growth and development. However, there isn't much research that directly explores these connections. Studies have shown that younger household leaders might struggle with limited finances, less access to healthcare, and less experience in caring for children (41, 42, 43). This can negatively impact the nutrition and care that infants receive (43). On the other hand, older household leaders tend to have more stable incomes and greater living experience, which can lead to better care for children (41, 44). However, they may also have health issues or traditional beliefs that could negatively impact infant care (41, 42, 43). Research has also shown that when mothers are undernourished, often linked to younger maternal age, their children are at a higher risk of stunting by age two. This can lead to poor growth and development outcomes (41, 42, 43).

The sex of the household leader can also play a role. Households led by women often face economic challenges, which can limit access to nutritious food and healthcare services (45). This can increase the risk of under nutrition in infants (45). However, some studies suggest that women may prioritize child health and nutrition more than men, which can help mitigate some risks (46). On the other hand, households led by men might have better economic standing, but may not allocate resources as effectively toward child health (45, 47). The impact of the household leader's sex on child nutrition and development is complex and influenced by cultural norms, economic status, and support systems (48).

The size of a household is also another significant factor. This can impact the allocation of resources, care-giving attention, and overall infant well-being (49). Larger households may

experience resource dilution, where limited resources are spread thinly across more individuals, potentially compromising infant care (49, 50). However, larger households can also provide a supportive network for care-giving, benefiting infant development (49, 50). A study in Uganda found that household size was significantly associated with child undernourishment. As household size increases, the risk of under nutrition among children also rises (51).

Wealth status is also a significant determinant of infant growth and development. Wealthier households typically have better access to nutritious foods, healthcare services, and improved living conditions, contributing to healthier growth patterns in infants (52). In Tanzania, a study revealed that children from the poorest households were nearly three times more likely to be stunted and two times more likely to be underweight compared to those from the richest households (53). This highlights the essential role of economic status in influencing nutritional outcomes. Similarly, research in Bangladesh demonstrated that the prevalence of childhood growth-stunting declined as household wealth status increased (54).

Access to electricity is often linked to improved living standards, better healthcare access, and enhanced educational opportunities, which can indirectly benefit infant health (55, 56). Households with electricity can store perishable nutritious foods, access health information, and maintain better hygiene practices, contributing to improved infant growth and development (55, 56, 57). A study in Uganda highlighted that energy poverty is widespread, with about 26% of children living in households experiencing acute multidimensional energy poverty (58). This lack of access to clean energy sources was associated with higher rates of under nutrition among children (58). Research in India found that households without electricity had higher incidences of child stunting, underweight, and mortality, emphasizing the importance of electrification in promoting child health (59).

The growth and development of infants under six months old is closely associated with environment and household conditions. Access to safe drinking water, proper toilet facilities,

and clean cooking fuels are essential for preventing diseases that can hinder infant growth and development (60).

Access to safe drinking water is important for preventing waterborne diseases that can impair infant growth and development (60). In 2022, approximately 115 million people globally still relied on surface water for drinking, highlighting the ongoing challenge of providing safe water access (60). Contaminated drinking water can lead to diarrheal diseases, which are a leading cause of malnutrition and stunted growth in infants (60).

Proper toilet facilities are also vital for reducing environmental contamination and preventing the spread of pathogens that cause infections (61). The absence of proper sanitation facilities leads to open defecation, which contaminates water sources and the environment, increasing the risk of diarrheal diseases (62). Implementing improved sanitation facilities can significantly decrease the incidence of infections that adversely affect infant health (61, 62).

The type of cooking fuel used in households also affects indoor air quality, which impacts respiratory health, particularly in infants (63). The use of solid fuels like wood, charcoal, and dung for cooking leads to indoor air pollution, which is associated with acute respiratory infections, a significant cause of morbidity and mortality in children under five (63, 64). Infants exposed to indoor air pollution may experience reduced lung function and increased susceptibility to respiratory illnesses, hindering their overall growth and development (63, 64).

Food security is another important factor, defined as consistent access to sufficient, safe, and nutritious food, is essential for the health of both mothers and infants. Recent discussions emphasize the urgency of addressing childhood malnutrition (65). Bill Gates, in the 2024 Goalkeepers Report, highlighted the need for interventions such as fortifying staple foods with essential nutrients and providing micro-nutrient supplements to pregnant women (66). These measures aim to prevent anemia, enhance maternal and newborn health, and reduce stillbirth rates (66).

Access to quality healthcare is essential for the growth and development of infants under six months old. Research has shown that having access to healthcare services can significantly impact infant health outcomes. Studies found that expanding Medicaid coverage led to a decrease in infant mortality rates (67, 68). States that implemented Medicaid expansions under the Affordable Care Act saw a decline in infant mortality, while states that did not expand Medicaid experienced an increase in infant mortality rates (67, 68). This suggests that having access to healthcare services through Medicaid can improve infant survival and health. Another healthcare practice that has been shown to have numerous benefits for infants is kangaroo care (69). This involves skin-to-skin contact between infants and caregivers, which has been associated with normalized vital signs, increased weight gain, reduced hospital-acquired infections, and improved cognitive development (69). These findings highlight the importance of healthcare practices that promote close physical contact in supporting infant growth and development (69).

2.3.2 Infant factors associated with infants at risk of poor growth and development.

Age is an essential factor in infant growth and development, with the first six months of life being particularly essential (70). During this period, infants undergo rapid physical and cognitive changes, making them vulnerable to factors that can hinder growth, such as inadequate nutrition and infections (70). Research shows that growth faltering often begins within the first two years of life, with the most significant impact observed in the first six months, especially among infants with low birth weight, preterm birth, or inadequate breastfeeding practices (70, 71).

Sex is another significant factor in infant growth and development, with research indicating that male infants are biologically more vulnerable to undernutrition and developmental delays compared to female infants (72). This vulnerability is attributed to higher energy requirements in boys during periods of rapid growth, which may not be met in resource-limited settings, leading to a higher risk of neonatal and infant mortality (72). Girls tend to outperform boys in

early developmental milestones, particularly in language and socio-emotional skills, with these differences consistent across various cultural and socioeconomic contexts (72, 73).

Perinatal asphyxia, or oxygen deprivation during birth, has a significant impact on infant development, increasing the risk of poor neurodevelopmental outcomes (74). This condition can lead to severe consequences, including cerebral palsy, cognitive delays, and motor impairments (74). Research emphasizes the importance of early intervention, such as physical therapy, to improve developmental outcomes in affected infants (74, 75). Long-term follow-up is crucial to identify and address potential neurological and developmental issues, ensuring timely and effective support for these vulnerable infants (76).

Neurodevelopmental concerns and congenital abnormalities also pose significant risks to the growth and development of infants under six months old(77). Neurodevelopmental concerns, including disorders affecting the nervous system, can lead to impaired brain function, motor skills, cognitive abilities, and behavior, manifesting as delayed milestones, hypotonia, or feeding difficulties (77). Congenital infections, such as cytomegalovirus, can cause structural brain abnormalities, resulting in severe neurodevelopmental impairments, cerebral palsy, epilepsy, and neurosensory deficits (78). Additionally, congenital heart disease (CHD) increases the risk of neurodevelopmental disabilities, with approximately 20% of affected children exhibiting cognitive impairments, attention deficits, motor dysfunction, and social interaction challenges that can persist into later childhood and adulthood (79).

Infants born with congenital anomalies face increased risks of poor growth and developmental outcomes, including neurodevelopmental impairment, growth retardation, and post-surgical complications (80, 81). Studies have shown that infants with major congenital anomalies have double the risk of neurodevelopmental impairment, lower scores on developmental indexes, and higher rates of cerebral palsy (81). Additionally, these infants often experience growth delays and may require surgical intervention, which can lead to initial growth failure but potential catch-up growth over time (81).

Infant feeding concerns can significantly impact growth and development, particularly in the first six months of life (82). Difficulties with breastfeeding or formula feeding can lead to inadequate nutrient intake, which is critical for growth and brain development (83). Common challenges include poor latch, low milk supply, or feeding aversion (83). Research emphasizes the importance of exclusive breastfeeding for the first six months, which is associated with optimal growth and reduced risk of infections (82). However, significant barriers exist, with only 44% of infants globally being exclusively breastfed (84).

A history of hospitalization during infancy can also hinder growth and development. Hospitalization, especially for chronic conditions or severe illnesses, can disrupt feeding routines, limit physical activity, and expose infants to stress (85, 86). Studies have shown that frequent or prolonged hospitalizations significantly increase the risk of developmental vulnerabilities, particularly in physical, social, and emotional domains (85). Furthermore, infants hospitalized early in life are at greater risk of long-term developmental delays, emphasizing the need for supportive care during and after hospitalization (86).

2.3.3 Maternal factors associated with infants at risk of poor growth and development.

The age of the mother is an essential factor in determining infant health outcomes. Adolescent mothers are more likely to experience preterm births, low birth weight infants, and higher neonatal mortality rates. In contrast, older mothers (above 35 years) face risks such as chromosomal abnormalities and complications during delivery (87). Research has consistently shown that infants born to adolescent mothers have lower birth weights and higher mortality rates compared to those born to mothers aged 20-40 years (88).

Maternal education significantly influences infant health, with higher educational attainment associated with better knowledge of nutrition, healthcare practices, and access to resources. This, in turn, leads to improved growth and development outcomes (89). The Healthy People 2030 initiative emphasizes that maternal education improves early childhood development by fostering better care-giving practices and access to healthcare (90). Furthermore, research has

shown that maternal education enables informed decision-making and creates a conducive environment for development (90).

Maternal employment can have both positive and negative effects on infant growth. While employment provides financial stability, it can limit the time available for care-giving, potentially affecting feeding practices and emotional bonding (91, 92). Research has found that the quality of mother-infant interaction varies with maternal employment status, with employed mothers showing different patterns of interaction compared to non-employed mothers (92). However, supportive workplace policies, such as maternity leave, can mitigate the negative impacts of maternal employment on infant growth (91).

The mode of delivery, particularly cesarean section (CS), has been linked to variations in infant growth and development. A systematic review highlighted that infants born via CS exhibited altered gut microbiota composition up to six months of age, characterized by reduced abundance of beneficial bacteria such as Bifidobacterium and Bacteroides species (93). These microbial differences may have implications for nutrient absorption and immune system development, potentially influencing growth trajectories (93).

Furthermore, a study from India reported that elective CS deliveries were associated with higher body mass index (BMI) z-scores and an increased risk of overweight status at one year of age (94). Conversely, these infants also demonstrated reduced linear growth, indicating a complex relationship between CS delivery and growth patterns (95). Additionally, CS deliveries have been associated with suboptimal breastfeeding practices, including delayed initiation and increased likelihood of prelacteal feeding, which can adversely affect early nutrition and growth (95).

Parity of a mother is also a significant factor. Research indicates that nulliparous women (those who have not previously given birth) are more likely to deliver infants with low birth weight (LBW) and small for gestational age (SGA) compared to multiparous women (96). A study in Malawi found that women with previous childbirth experience were less likely to have LBW

infants (96). Similarly, a large-scale study across five countries reported that infants born to nulliparous women had lower mean birth weights and higher neonatal mortality rates than those born to multiparous women (97). Parity also affects infant feeding behaviors (98). In Ethiopia, primiparous mothers were found to initiate complementary feeding earlier than recommended, with a median initiation time of five months compared to six months among multiparous mothers (98). This early initiation may be as a result of lack of experience and confidence in breastfeeding among first-time mothers (98).

Regular antenatal care (ANC) and postnatal care (PNC) visits are crucial for ensuring early detection and management of complications, promoting breastfeeding, and providing essential health education to mothers (99, 100). Studies have shown that ANC and PNC follow-up significantly improve growth monitoring and promotion service utilization, facility delivery, and early PNC utilization, all of which positively impact infant health (99, 100). In Ethiopia and Uganda, research has highlighted the importance of regular ANC visits and PNC follow-up in promoting healthy infant growth and development (99, 100).

The death of a mother has big implications for an infant's survival and development, often leading to inadequate care-giving, poor nutrition, and increased mortality risk (101). Research from Harvard's FXB Center shows that maternal death disrupts household stability, leading to long-term social and economic challenges (102). Infants whose mothers die during childbirth are significantly less likely to survive their first year, emphasizing the need for targeted support and interventions to mitigate the effects of maternal mortality on infant health and development (88).

Maternal health during pregnancy plays a pivotal role in shaping the growth and developmental outcomes of infants, particularly in the first six months of life. Various maternal illnesses, including infectious diseases, and metabolic conditions, have been associated with adverse infant health outcomes (103). In regions where malaria is endemic, such as Uganda, maternal malaria during pregnancy has been linked to significant growth impairments in infants (103).

A cohort study conducted in Uganda found that infants born to mothers who experienced malaria during pregnancy had reduced weight and height gains at 12 months compared to those whose mothers did not have malaria (103). The risk was particularly high when maternal malaria occurred in the 12 weeks preceding delivery (103). Additionally, these infants exhibited increased susceptibility to malaria infections, acute respiratory infections, and diarrheal diseases during infancy (103). Other infectious diseases, such as rubella, syphilis, toxoplasmosis, and varicella, have also been implicated in adverse prenatal outcomes (104). These infections can cross the placental barrier, leading to complications like low birth weight, prematurity, physical malformations, and intellectual disabilities in infants (104).

2.4 Health service utilization among study population.

Health service utilization is an important aspect of improving maternal and child health outcomes, particularly in infants under six months of age (105). Effective utilization of health services, including antenatal care (ANC), postnatal care (PNC), immunizations, and growth monitoring, ensures timely interventions, promotes exclusive breastfeeding, and helps in the early detection and management of potential health issues (105, 106). However, health service utilization is often influenced by various factors, including socioeconomic conditions, cultural practices, accessibility, and the quality of healthcare services (107, 108).

In low-resource settings, challenges such as poverty, lack of awareness, and poorly equipped healthcare systems often hinder optimal utilization (109, 110, 111). Studies from around the world highlight these dynamics. For instance, research in Uganda, China, and Ethiopia has consistently shown that financial constraints, limited accessibility, and negative attitudes of healthcare personnel are significant barriers to health service utilization (109, 110, 111). These issues lead to poor usage of available services, particularly among marginalized communities (109, 110, 111).

A study conducted in the Jimma Zone of Southwest Ethiopia found that the health service utilization rate was 45.6%, indicating that almost half of the population had visited a healthcare

facility in the previous 12 months (111). The study identified various factors that influence health service utilization, including age, sex, marital status, household income, socioeconomic status, and perceived health status (111). The findings highlighted the importance of addressing issues of accessibility, affordability, and perceived health status to improve health service utilization (111).

The collective evidence from these studies highlights the need for targeted interventions to address socioeconomic, cultural, and systemic barriers to health service utilization. By improving accessibility, affordability, and the quality of healthcare services, policymakers and healthcare providers can enhance health service utilization, particularly among vulnerable populations. This, in turn, can lead to improved maternal and child health outcomes, reduced morbidity and mortality, and enhanced overall well-being.

2.5 Efforts to address the risk of poor growth and developments among infants.

Efforts to address the risk of poor growth and development among infants are multi-faceted and involve a combination of global and localized interventions aimed at ensuring better health outcomes for children. Key initiatives emphasize the importance of early and consistent healthcare services, adequate nutrition, and holistic care-giving practices. International frameworks such as the World Health Organization's Nurturing Care Framework promote healthy growth and development through a focus on adequate nutrition, responsive care-giving, early learning opportunities, and creating safe environments for children (112). These principles are often implemented through integrated programs that combine health, nutrition, and early education interventions (112, 113). For example, promoting exclusive breastfeeding for the first six months has been shown to significantly enhance cognitive and physical growth while reducing the risk of infections (112, 113).

Globally, organizations such as UNICEF and WHO advocate for policies prioritizing maternal and child health, including expanding antenatal and postnatal care services, tackling malnutrition, and ensuring access to clean water and sanitation (8, 114). These efforts are

supported by innovative approaches like mobile health tools, which help to educate parents, schedule immunizations, and improve adherence to healthcare interventions (115). In Uganda, these global strategies are adapted to the local context through community health worker programs, improved healthcare infrastructure, and digital health solutions (116).

In addition to the other initiatives, the Ugandan government, through the Ministry of Health, has implemented strategies such as the Sharpen Plan 2, which focuses on reducing maternal and newborn mortality (117, 118). This plan includes initiatives like Maternal Perinatal and Death Surveillance and Response, as well as the establishment of high-risk pregnancy clinics across the country (117, 118). These interventions aim to improve antenatal and postnatal care services, which are essential for monitoring infant growth and development.

CHAPTER 3:

3 METHODS.

3.1 Study Design:

A cross-sectional study design was conducted in selected health facilities in Kampala, Uganda to assess the prevalence and factors associated with development of infants at risk of poor growth and development among the under six infants.

3.2 Study setting.

The study was conducted in selected health facilities in Kampala, Uganda's capital and largest city. Kampala consists of five political divisions: Central, Kawempe, Makindye, Nakawa, and Rubaga. The city has a night population of approximately 1,875,834 people. According to USAID (2017), Kampala Capital City Authority (KCCA) divisions had a total of 1,554 health facilities. Their distribution was as follows: 26% in Makindye, 21% in Kawempe, 20% in Lubaga, 19% in Nakawa, and 15% in the Central Division. Of these, 94% are private for-profit, 4% are private not-for-profit, and 2% are government-owned. The government hospitals are categorized based on the level of care provided into Health Centre (HC) II, III, IV, general hospitals as well as national referral hospitals. Kampala has 13 HC II, 5 HC III, 2 HC IV, and 7 hospitals, of which 4 are national referral hospitals. Kawempe Division hosts two national referral hospitals that offer general and specialized pediatric care, Mulago and Kawempe National Referral Hospitals.

The study was conducted at outpatient clinics and immunization clinics at government health facilities, which included Kisenyi HCIV (Central division), Kisugu HCIII (Makindye division), and Kawempe National Referral Hospital (KNRH) (Kawempe division). Kisenyi HCIV receives about 500 children under five years monthly, Kisugu HCIII receives 250 children below five years monthly run by two clinical officers, one nurse and two nursing assistants, Kawempe National Referral Hospital (NRH) general outpatient Children's Clinic, which is a high-volume outpatient clinic that provides essential pediatric services receives about 700

children monthly. It is run by pediatrics senior house officers, junior house officers, pediatricians and nurses. The immunization clinic in Kawempe N.R.H is run by two nurses and nursing students.

These facilities were purposively selected to represent three KCCA administrative divisions. (Kawempe, Central and Makindye) out of the five, their capacity to provide extensive pediatric care, to reflect the levels of care (tertiary, HCIV/district, and HCIII) in Kampala City. Kawempe N.R.H and Kisenyi HC IV were additionally selected based on their high patient volumes. Kisenyi HC IV was also purposively selected because of its unique population that includes refugees who may have differences in their determinants of health in comparison with the other population.

3.3 Study Population.

3.3.1 Target population.

Infants less than 6 months of age in Kampala attending/or receiving outpatient services in public health facilities, Uganda.

3.3.2 Accessible population.

Infants less than six months of age and their caretakers attending outpatient clinics in one national referral hospital and two health centers in Kampala, Uganda during the study period.

3.3.3 Reference population.

Infants less than six months of age attending outpatient clinics in health facilities in urban city level areas of Uganda.

3.4 Eligibility criteria.

3.4.1 Inclusion criteria.

Infants six weeks to less than 6 months of age attending the outpatient clinics (immunization and OPD) at Kawempe National Referral Hospitals, Kisenyi health center IV, and Kisugu HCIII during the study period. (Below 6 weeks is neonatal period and at 6th week is first

immunization visit. Also 6 weeks is the starting eligible age to use MUAC essential for identifying infants at risk of PGD).

Infants whose caretakers gave informed written consent to participate in the study.

3.4.2 Exclusion criteria.

Infants under 6 months of age attending the outpatient clinics in the selected health facilities who had danger signs or emergency signs based on the Emergency Triage Assessment and Treatment (ETAT).

3.5 Sampling:

This involved consecutive sampling to enroll all eligible participants who visits the outpatient clinic during the study period until the desired sample size was reached for all the sites.

3.6 Sample size estimation.

Objective 1:

The sample size for objective 1 was determined using the Kish Leslie formula (1965) for estimating single proportions using 50% prevalence as there is no prior data about prevalence of infants less than 6 months of age at risk of poor growth and development among outpatients available.

$$n = \frac{z^2 p(1-p)}{e^2}$$ Were,

n is required sample size.

z is Z score corresponding to 95% confidence level, which is 1.96

p is estimated prevalence of infants less than 6 months of age at risk of poor growth and development from previous outpatient clinic studies, at 50%; p=0.5

e is the desired margin of error or precision= 0.05

n is 384.16, therefore =385.

To account for 10% non-response; *n*adjusted=*n*/ (1- non response rate).

A total of 428 participants were needed.

Objective 2:

Sample size estimation was done using the Fleiss formula (Fleiss, Statistical Methods for Rates and Proportions, formulas 3.18 &3.19), based on Lat et al. (2023) prevalence rates (35% unexposed primiparous mothers, 45% exposed multiparous mothers), with 95% confidence and 5% margin of error.

The formula is given by:

$$\text{N Fleiss} = \frac{\left[z_{\alpha/2}\sqrt{(r+1)p(1-p)} + z_{\beta}\sqrt{rp_0(1-p_0) + p_1(1-p_1)}\right]^2}{r(p_0-p_1)^2}$$

$$\text{P} = \frac{p_0 + rp_1}{r+1}$$

Where;

α = 0.05, the probability of type I error (significance level) is the probability of rejecting the true null hypothesis

β = 0.2, the probability of type II error (1 - power of the test) is the probability of failing to reject the false null hypothesis.

P0 = 35% of the primiparous mothers (Lat et al., 2023)

P1 = 45% of multiparous mothers (Lat et al., 2023)

r = 1, the ratio of multiparous mothers to primiparous mothers to be 1; N1Fleiss-cc =395. The required sample size for the population 1 group using the Fleiss formula with continuity correction.

N2 = r x N1Fleiss-cc= 395

Required Sample size = N1 + N2=790

To account for 5% non-response; n adjusted=n/ (1- non-response rate).

A total of 832 participants was needed.

The final sample size was determined to be 832 participants, as this was the larger of the two options considered.

Distribution of sample size across the different health facilities was given by:

$$\frac{number\ of\ infants\ below\ six\ months\ \ in\ a\ given\ Health\ facility}{Total\ number\ of\ infants\ below\ six\ months\ in\ all\ facilities} *\text{Estimated sample size}$$

Table 2:Showing the distribution of sample size across the different health facilities.

Health Facility	**Approximated number of children (2 months period)**	**Estimated sample size**
Kisugu HCIII	500	143
Kisenyi HCIV	1,000	287
Kawempe Outpatient Clinic	1,400	402
Total	**2900**	**832**

3.7Study variables.

3.7.1 Dependent/ Outcome variable.

The primary outcome was the proportion of infants less than six that are at risk of PGD. Infants less than six months at risk of poor growth and development, was defined as an infant meeting the following criteria for any of the four categories as defined by World Health Organization (WHO) 2023 guidelines. In each of the four groups, infants were classified as "Yes" if they met any of the criteria within that group, and "No" if they met none of the criteria.

The first group included infants with poor growth based on sequential measurements, such as no weight gain or weight loss from one measurement to the next, downward crossing of weight-for-age centile lines, or insufficient weight gain (velocity standards or grams per specific period). This was assessed using plotted weight on the growth curves from the child health cards or any other medical records availed.

The second group comprised infants with poor anthropometry based on a single measure, including those with a WAZ below -2 SD of the WHO child growth standards median, nutritional edema, or a MUAC less than 110 mm for infants between 6 weeks to less than 6 months of age. Weight was measured using a 2 in 1 digital weighing scale (SECCA) and the length measured using SECCA stadiometer. For both, two readings were taken and an average recorded.

The third group of infants at risk included those with known risk factors for poor growth and development, such as neurodevelopmental concerns or infant feeding concerns, maternal risk factors (physical or mental health problems affecting caring practices), or a history of hospitalization. The fourth group consisted of infants at risk due to poor birth outcomes, including preterm birth, LBW, or SGA.

Infant feeding concerns were categorized into; those related to; 1). Infant (Ineffective attachment/ suck or oral thrush, refusal to breast feed, mixed feeding, difficulty suckling,

swallowing/ coughing / chocking while feeding, cleft lip/ palate, tongue tie. 2). Mother. (Inadequate breast milk, not confident about feeding baby, breast or nipples; cracked/sore/inverted/ flat/ large, thrush, mastitis). 3). Others e.g. mother working away from infant, twins, whether received breast feeding counselling, and whether mother is confident about her ability to adequately feed infant.

Maternal mental health screening was done using the questions from the Mental Health and Psychosocial Support (MHPSS) from UNHCR, which is an integrated part of programs in several sectors with emphasis of several levels of complementary support, targeted interventions and referral. Questions and observations about excessive worry/ sadness, anhedonia, thoughts/ acts of harm to self or infant, experiencing gender-based violence, whether caregiver is out of touch with reality and if infant is at risk due to caregiver's behavior, whether caregiver experiences so much pain to the extent of interfering with care practices, were used to screen for mental and physical health concerns.

Concerns about neurodevelopment of infants were screened using questions relating to the various domains from several sources like Nelson's text book of pediatrics. These included whether infant had abnormal tone/ posture, floppy neck, poor head/ trunk control, stiff body, abnormal hand use/ clenched hands, occasional fits/ rigidity or loss of consciousness, difficulty hearing, or any other neurological/ physical disability.

Infants below 6 months at risk of PGD was further categorized as having no SAM and with SAM, prospect to be maternally breastfed and no prospect for maternal breastfeeding.

3.7.2 Independent variables.

The independent variables were categorized as follows: Male/ Female (sex), Yes/ No (history of perinatal asphyxia, death of mother), No follow-up/ 1-3 follow-ups/ ≥4follow-ups (ANC and PNC follow-up) Present/ Absent (congenital abnormalities), Stay-at-home mum or none/ private business/ formal employment. (employment status), Single/ Married or cohabiting / separated (marital status), Kampala/ other e.g. wakiso (District of residence), Private/ Public (healthcare access), Secured/ Unsecured (food security), Categorized during analysis (family

income, age of both infants and caregiver), None/ Primary/ Secondary/ Tertiary (educational attainment), Private/ community owned/ Other (type of toilet facility), Tap/ others e.g. well. (water source), mode of delivery (caesarean section and vaginal delivery), parity (Primiparous, Multiparous), Illness during pregnancy (malaria, diabetes, hypertension, Depression or anxiety, other, none).

3.8 Study procedure:

3.8.1 Data collection Tools.

A standard structured and semi structured questionnaire was used to collect data. It was sectioned into six categories; infant factors, maternal factors, household factors and infant growth and development.

3.8.2 Study team.

The study team consisted the principal investigator and 3 research assistants at every site. The principal investigator trained the research assistants about the research protocol, informed consent, data collection procedures and tools for a period of 3 days.

The principal investigator and research assistants obtained informed consent from the participants and data collection. The PI was responsible for cleaning data and oversaw and supervised all research activities.

3.8.3 Enrollment of study participants.

The PI and research assistants were positioned at outpatient clinics of selected health facilities in Kampala. They chose participants as infants less than 6 months at the outpatient clinics. The PI or research assistant introduced themselves to the mother/caretaker and provided information about the study in order to obtain informed consent to participate in the study. After informed consent participants were assessed for eligibility. The sociodemographic information for participant such as age, sex, residence, tribe, birth order and caretaker information such as age, marital status, employment status, household income, educational level, family size were

obtained. Patient anthropometry was assessed and infant, household, and maternal factors were obtained. The face-to-face interviews took about 30minutes.

3.8.4 Data management and analysis.

3.9.1 Data management.

The data for each participant was checked for completeness prior to enrollment of the next participant. Completed questionnaires were then entered into a computer using epidata 14.0 using the double data entry technique to minimize errors during entry. The PI performed data quality checks on uploaded data for completeness and accuracy. The data was backed up on google drive only accessible to the study team. To ensure accuracy, data cleaning, data coding and data validation were done. Completed consent forms and questionnaires were kept in a secure lockable cabinet for at least 3 years after study completion only accessible to the study team.

3.8.2 Data analysis.

The data were imported into STATA 17.0 (Stata Corporation, Texas, USA) from Epidata for cleaning and analysis. Descriptive statistics were used to describe the study population. Continuous variables were summarized using the mean for normally distributed data, and the measure of dispersion, the standard deviation, was computed. Skewed data were summarized using the median, and the interquartile range was computed as the measure of dispersion. Categorical variables were summarized using frequencies and proportions, e.g., percentages displayed in graphical summaries, e.g. graphs or pie charts.

Objective 1.

To determine the prevalence of infants at risk of poor growth and development among infants less than six months of age attending outpatient clinics in selected health facilities in Kampala, Uganda. The prevalence of infants at risk of poor growth and development among children less than six months of age was expressed as a proportion of infants less than 6 months who meet

the criteria for the 4 categories, divided by the total number of infants enrolled in the study multiplied by 100, and presented with its confidence interval.

Objective 2.

To determine the factors associated with infants at risk of poor growth and development among infants less than six months of age attending outpatient clinics in selected health facilities in Kampala, Uganda. A bivariate analysis was performed to assess the association between each independent variable and the infants at risk of poor growth and development. Variables with a p-value of ≤ 0.2 were considered for multivariate analysis. Prevalence ratios, their confidence intervals, and p-values were reported. Variables with a p-value ($p < 0.05$) were considered as statistically significant. Modified Poisson regression was used. The PI worked with a biostatistician for data management and analysis.

3.10 Quality control.

The data collection tools were subjected to testing for validity and reliability before actual data collection. The PI trained research assistants regarding the study procedures and tools prior to study commencement to ensure the collection of correct and quality data.

3.11 Ethical considerations.

Permission to carry out the study was sought from the Department of Paediatrics and Child Health at Makerere University College of Health Sciences. Ethical approval was sought from the School of Medicine Research and Ethics Committee (SOMREC). Administrative permission was sought from the different health facilities.

Informed written consent was sought from the caretakers because infants are unable to provide consent or assent. Participation was voluntary without coercion and a participant were free to withdraw from the study at any time without any impact on his/ her medical care. The consent

forms were translated into the local language, and written informed consent was obtained before performing any study assessments/ procedures.

Informed consent and filled questionnaires were under lock and key and only accessible to the study team to maintain confidentiality. The questionnaires did not bear names of the participants to maintain anonymity. The research ensured that there was no harm to the participants.

The infants that were found to be at risk of poor growth and development accessed the standard care as per the hospital management guidelines and any necessary referrals to the any specialized care were done appropriately.

3.12 Dissemination of results.

The results of this study will be widely disseminated via different platforms. The results of this study will be submitted as a dissertation for the award of Master of Medicine in Pediatrics and Child Health. A report will be prepared and presented to Albert Cook Library, Makerere University College of Health Sciences, Makerere University Directorate of Research and Graduate Training for archival and future reference. Abstracts will be prepared and presented at relevant local and international conferences. Manuscripts will be developed and published in a peer-reviewed journal.

Additionally, results will be presented at the Nutrition Technical Working- IMAM group hosted by the Ministry of Health, Nutrition Division. This Forum attracts a diverse group of policymakers and practitioners that are charged with revising the IMAM guideline.

The findings of this study shall also be presented to the Management of small & nutritionally at-risk infants under six months & their mothers (MAMI) Global Network. The MAMI Global Network is a group of established and early-career programmers, researchers, and policymakers from across the globe who are working towards realizing that collaborators work together to improve policy, programs and practice for small and nutritionally at-risk infants under six months and their mothers.

CHAPTER FOUR: RESULTS.

This study enrolled 832 infants aged 6 weeks to under 6 months attending outpatient clinics at three health facilities in Kampala, Uganda, between December-2025 to January-2026.

4.1 Study profile.

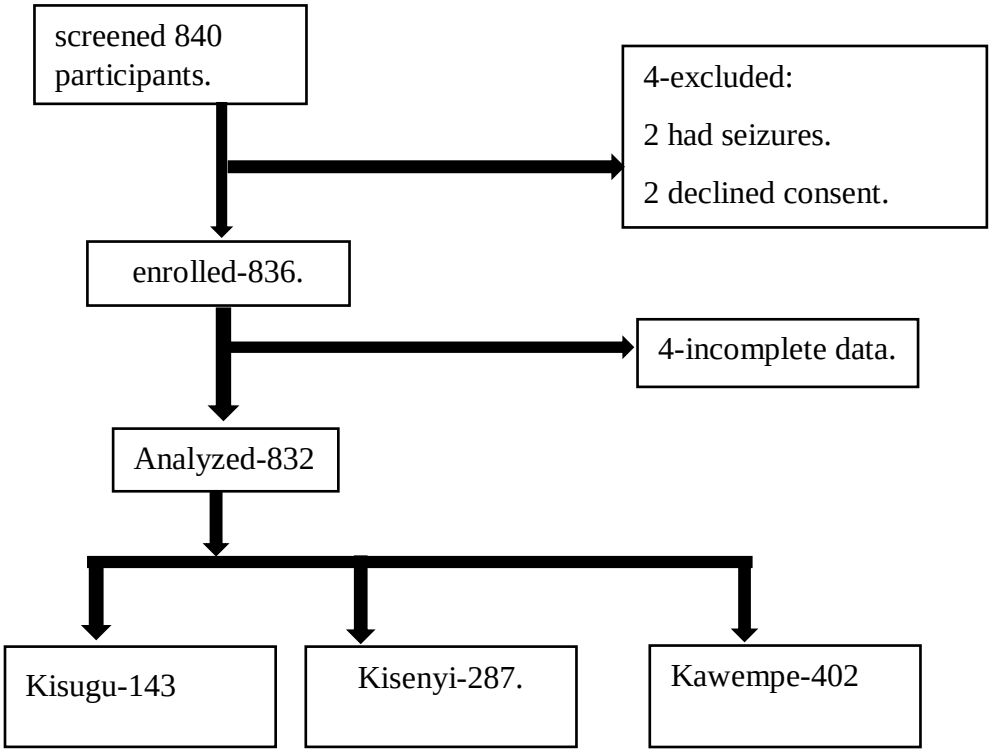


Figure 2: Participants' study chart for the infants at risk of poor growth and development.

4.2 Socio-Demographic Characteristics of Caregivers of infants.

Most primary caregivers were mothers (99.6%, n=829) indicating their central role in child care. There was a large proportion of young mothers aged 15–24 years (40.0%, n=333), although majority care givers were aged 25–34 years (51.9%, n=432), while only 8.1% (n=67) were aged 35 years and above. A significant proportion of caregivers i.e. 25.8% (n=215) had

no or only primary education which impacts care practices although more than half had attained secondary education (58.1%, n=483), and 16.1% (n=134) had attained tertiary education. Regarding employment status, the majority of caregivers were full-time house wives/stay-at-home mothers (59.3%, n=493), followed by those engaged in private business (32.9%, n=274), while only 7.8% (n=65) were formally employed. (Table 3).

Table 3: Socio-Demographic characteristics of 832 caregivers of infants under 6 Months in the Study at the selected health facilities.

Variable/ category.	Frequency (n=832)	Percent (%)
Relationship of the primary Caregivers with the involved infant.		
Mother	829	99.6
Father	3	0.4
Age of Caregiver in Complete Years.		
15-24 years	333	40.0
25-34 years	432	51.9
35 & Above	67	8.1
Mothers' age in completed years (n=699).		
19-24 years	276	39.5
25-34 years	368	52.6
35 & Above	55	7.9
Nationality of the Caregiver.		
Ugandan	827	99.4
Non-Uganda	5	0.6
Level of Education.		
None/ Primary level	215	25.8
Secondary Level	483	58.1
Vocational diploma, cert, & Degree plus	134	16.1
Caregivers' status of employment for source of income.		
Full-time housewife or stay-at-home mum	493	59.3
Private business	274	32.9
Formal employment in government or a private organization	65	7.8
Nearby VHT known by caregivers.		
No	634	76.2
Yes	198	23.8

4.3 Household and Maternal Health Characteristics.

Table 4 summarizes the household and maternal health characteristics of participants. Most households were male-headed (90.3%), with household heads predominantly aged 25–34 years (56.7%). The majority were cohabiting (57.5%) and living in monogamous households (87.1%). Most participants resided in Kampala (77.0%), mainly in Central Division (47.9%). Households were generally small, with 69.1% having four or fewer members, and most (67.7%) had one child under five years. Over half (52.4%) reported a monthly income of ≥500,000 UGX, and 76.2% were within 30 minutes of a health facility. Regarding living conditions, most households used tap water (81.2%) and community sanitation facilities (63.3%). Maternal health indicators showed that the majority attended 4–7 antenatal care visits (75.2%) and were HIV negative (92.6%). Few mothers reported chronic illness (1.7%) or illness during pregnancy (13.3%).

Table 3: Household and maternal clinical characteristics of participants in the study from selected facilities (n = 832).

Variable/ category	Frequency	Percent (%)
Sex of the Household head.		
Male	751	90.3
Female	81	9.7
Age of the Household head in Complete Years.		
19-24 years	66	7.9
25-34 years	471	56.7
35 & Above	294	35.4
Marital status of the household head.		
Married	270	32.5
Partner/ Cohabiting	478	57.5
Divorced/ Living apart, not divorced	45	5.3
Widow/ widower/Never married	39	4.7
Type of household.		
Monogamous	725	87.1
Polygamous	107	12.9
District of Residents.		
Kampala	641	77.0
Others	191	23.0
For Kampala Residents (n=641).		
Central	307	47.9
Kawempe	197	30.7
Makindye	137	21.4
Total number of people in the Household.		
≤ 4	575	69.1
> 4	257	30.9
Total number of children < 5 years in the household.		
1 child	563	67.7
≥2 children	269	32.3
Estimated Household monthly income.		
None	115	13.8
Less than 500,000 UGX (135.5 US Dollars)	281	33.8
500,000 & above UGX	436	52.4
Time taken from the residence to health facility (mins).		

Variable/ category	Frequency	Percent (%)
30 minutes & less	634	76.2
Above 30 minutes	198	23.8
The main water source.		
Tap	676	81.2
Other	156	18.8
Type of toilet facility used.		
Community owned	527	63.3
Private	305	36.7
Number of antenatal care visits for the current infant.		
Less than 4 ANC	112	13.7
4 to 7 ANCs	614	75.2
8 or more	91	11.1
Mother's HIV status.		
Negative	770	92.6
Positive	55	6.6
Unknown	7	0.8
Any other chronic illness of concern.		
Yes	14	1.7
No	818	98.3
Mother had an illness during pregnancy for the current infant.		
Yes	111	13.3
No	721	86.7

4.4 Sociodemographic and clinical characteristics of infants.

Of the 832 infants, a female to male ratio of nearly 1:1 was found (51.0%, n=424) and a median age of 75 days (IQR45–105). Nearly half were first-born (44.1%, n=367), and the mean birth weight was 3.1(0.76) kg. Preventive health coverage was high with most children sleeping under mosquito nets (92.9%, n=773) and up to date with immunization (86.9%, n=712). Morbidity was low, with very few tuberculosis related cases, congenital heart disease or other chronic illnesses. Majority were HIV negative (92.8%, n=772), although 6.5% (n=54) were HIV-exposed consistent with national estimates. The majority lived with both parents (89.8%, n=748), and prior household under-five mortality was rare (1.1%, n=9). (Table 5)

Table 4: Sociodemographic and clinical characteristics of infants under 6 months in the selected health facilities (n = 832).

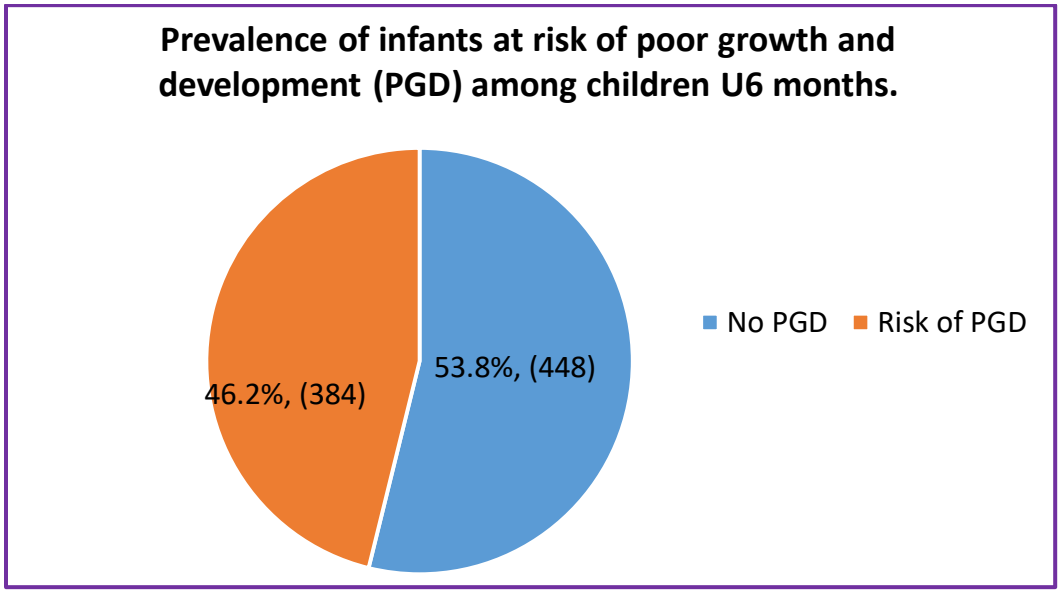
Variables/ Category.	Frequency(n)	Percent (%)	Median(IQR) Mean(SD)
Sex.			
Male	408	49.0	
Female	424	51.0	
Median age of child (days)			75 (45- 105)
Birth order.			
1	367	44.1	
2	227	27.3	
≥ 3	238	28.6	
Mean Birth weight (Kgs)			3.1(0.76)
Birth weight.			
< 1	6	0.7	
1 to 1.49	24	2.9	
1.5 to 2.49	91	10.9	
2.5 to 3.1	296	35.6	
Above 3.1	415	49.9	
Nationality.			
Ugandan	821	98.7	
Non-Uganda	11	1.3	
Child refugee (788).			
Yes	7	0.9	
No	781	99.1	
Mosquito net use by the Index child.			
Yes	773	92.9	
No	59	7.1	
Child immunization status based on age (n=819).			
Up to date	712	86.9	
Not up to date	107	13.1	
Households lost a child <5 years (n=821).			
Yes	9	1.1	
No	806	98.9	
Child's HIV/AIDS Status.			
Negative	772	92.8	
Sero exposed	54	6.5	
Positive	2	0.2	

Variables/ Category.	Frequency(n)	Percent (%)	Median(IQR) Mean(SD)
Unknown	4	0.5	
Child's TB treatment history.			
Yes	3	0.4	
No	829	99.6	
Has the child ever been diagnosed with congenital heart disease.			
Yes	3	0.4	
No	829	99.6	
The child has other chronic illnesses.			
Yes	1	0.1	
No	831	99.9	
Child's current living arrangement.			
Lives with both parents	748	89.8	
Lives with only the mother	79	9.5	
Lives with other extended family members	4	0.5	
Other, specify	1	0.2	
The child is a total orphan.			
Yes	2	0.2	
No	830	99.8	

4.5 Objective 1: Prevalence of infants at risk of poor growth and development among those under six months of age.

Nearly half of infants under six months of age were at risk of PGD 46.2% (384/832) (95%CI 42.8-49.6%). (Figure 3)

Figure 3: Prevalence of infants at risk of poor growth and development among those under 6 months of age.



4.6 Categorization of infants with risk of PGD.

Overall, 14.5% had poor birth outcomes. Additionally, more than a quarter (26.6%) had known risk factors for PGD, and 20.7% exhibited poor anthropometry based on a single measure. (table 6).

The category of Infants with poor growth based on sequential measures i.e. (no weight gain or weight loss from one measurement to the next or downward crossing of weight-for-age centile

lines or insufficient weight gain.) was not included in the analysis due to missing data from the child health charts for a significant proportion of infants.

Table 5: Categorization of the infant at risk of PGD among 832 infants under six months in Kampala city.

Variable/Category.	Frequency, n=832	Percentage, %
Infants with Poor birth outcomes.		
No	711	85.5
Yes	121	14.5
Infants with known risk factors for PGD.		
No	611	73.4
Yes	221	26.6
Infants with poor Anthropometry based on single measure.		
No	660	79.3
Yes	172	20.7

4.6 Objective 2: Factors associated with infants at risk of poor growth and development among infants under six months.

4.6.1 Bivariable analysis of the association between caregivers' sociodemographic factors and risk of poor growth and development.

Maternal age ≥35years (cPR=1.34; p=0.029), and divorced/ never married household heads were significantly associated with increased risk of PGD (cPR=1.24; p=0.039), whereas care giver age, education, nationality, employment status and VHT awareness were not significantly associated. Therefore, caregiving and household social structures were key determinants of PGD in this population. (Table 7).

Table 6: Bivariable analysis of caregiver socio-demographic factors associated with risk of poor growth and development among 832 infants under six months in Kampala city.

Variable / Category	Risk of PGD		P-Value	cPR (95% CI)
	No	Yes		
	n (%)	n (%)		
Age of Caregiver (years).				
15–24 years	181(40.4)	152 (39.6)		1
25–34 years	237 (52.9)	195 (50.8)	0.889	0.99 (0.85–1.16)
35 & Above	30 (6.7)	37 (9.6)	**0.123**	1.21 (0.95–1.55)
Mothers' age (years) (n=699).				
19–24 years	156 (40.7)	120 (40.0)		1
25–34 years	204 (53.3)	164 (51.9)	0.784	1.03 (0.86–1.22)
35 & Above	23 (6.0)	32 (10.1)	0.029	1.34 (1.03–1.74)
Level of Education.				
None / Primary	107 (23.9)	108 (28.1)		1
Secondary	269 (60.0)	214 (55.7)	**0.140**	0.88 (0.75–1.04)
Tertiary	72 (16.1)	62 (16.2)	0.476	0.92 (0.73–1.15)
Caregiver's nationality.				
Ugandan	445 (99.3)	382 (99.5)		1
Non-Ugandan	3 (0.7)	2 (0.5)	0.793	1.15 (0.39–3.39)
Marital status of the household head.				
Married / Cohabiting	411 (91.7)	337 (87.8)		1
Divorced /Never married	37 (8.3)	47 (12.2)	**0.039**	1.24 (1.01–1.53)
Caregivers' status of employment.				
Housewife/stay-at-home mum	270 (60.3)	223 (58.1)		1
Private business	137 (30.6)	137 (35.7)	0.200	1.11 (0.95–1.29)
Formal employment	41 (9.2)	24 (6.3)	0.231	0.82 (0.59–1.14)
Nearby VHT known by caregivers.				
Yes	105 (23.4%)	93 (24.2%)		1
No	343 (76.6%)	291 (75.8%)	0.971	1.01 (0.86–1.21)

4.6.2 Bivariable analysis of the association between household and maternal factors and infants at risk of poor growth and development.

Four or more ANC visits (p=0.003) was a strong protective factor whereas maternal illness during pregnancy (p=0.002), polygamous house hold(p=0.008), house hold size of ≥4 persons (p=0.011) and having more than 2 children under five in home were associated with significant risk for PGD. (Table 8).

Table 7: Bivariable analysis of household and maternal factors associated with risk of poor growth and development among infants under six months in Kampala City.

Variable / Category	Risk of PGD		P-Value	cPR (95%CI)
	No	Yes		
	n (%)	n (%)		
Sex of the Household head.				
Male	412 (92.0)	339 (88.3)		1
Female	36 (8.0)	45 (11.7)	**0.053**	0.81 (0.66-1.00)
Age of the Household head in Complete Years.				
19–24 years	35 (7.8)	31 (8.1)		1
25–34 years	265 (59.3)	206 (53.6)	0.613	0.93 (0.71-1.23)
35 & Above	147 (32.9)	147 (38.3)	0.663	1.06 (0.80-1.41)
Type of household.				
Monogamous	402 (89.7)	323 (84.1)		1
Polygamous	46 (10.3)	61 (15.9)	**0.008**	1.28 (1.06-1.54)
Place of Residence (n=832)				
Outside Kampala (Wakiso, other.	98 (21.88)	93 (24.22)		1
Kampala Central	174 (38.84)	133 (34.64)	**0.238**	0.89 (0.73-1.08)
Kampala Kawempe	111 (24.78)	86 (22.4)	0.321	0.90 (072–1.11)
Kampala Makindye	65 (14.51)	72 (18.75)	0.488	1.08 (0.87-1.34)
Total number of people in the Household.				
≤ 4	326 (72.8)	249 (64.8)		1
≥ 4	122 (27.2)	135 (35.2)	**0.011**	1.21 (1.04-1.41)
Total number of children < 5 years in the household.				
1 child	318 (71.0)	245 (63.8)		1
≥ 2 children	130 (29.0)	139 (36.2)	**0.024**	1.19 (1.02-1.38)

Variable / Category	Risk of PGD		P-Value	cPR (95%CI)
	No	Yes		
	n (%)	n (%)		
Estimated Household monthly income (UGX).				
None	64 (14.3)	51 (13.3)		1
Less than 500,000 UGX	151 (33.7)	130 (33.9)	0.730	1.04 (0.82-1.33)
500,000 & above	233 (52.0)	203 (52.4)	0.676	1.05 (0.84-1.32)
Time taken from the residence to health facility (mins).				
30 minutes & less	349 (77.9)	285 (74.2)		1
Above 30 minutes	99 (22.1)	99 (25.8)	**0.203**	1.11 (0.94-1.31)
The main water source.				
Tap	377 (84.2)	299 (77.9)		1
Others	71 (15.8)	85 (22.1)	**0.014**	1.23 (1.04-1.46)
Type of toilet used.				
Private	163 (36.4)	142 (37.0)		1
Community owned	285 (63.6)	242 (63.0)	0.859	1.01 (0.87-1.18)
Number of antenatal care visits for the current infant.				
None / Less than 4	44 (9.9)	68 (18.2)		1
4 to 7 ANCs	343 (77.4)	271 (72.5)	**P<0.001**	0.73 (0.61-0.86)
8 or more	56 (12.6)	35 (9.4)	**0.003**	0.63 (0.47-0.85)
Mother had an illness during pregnancy for the current infant.				
Yes	46 (10.3)	65 (16.9)		1
No	402 (89.7)	319 (83.1)	**0.002**	1.32 (1.11-1.50)

4.6.3 Bivariable analysis of the association between Sociodemographic and clinical characteristics of infants and infants at risk of poor growth and development.

Mosquito net use (p<0.001) was a key protective factor, while prior house hold loss of a child <5 years (p=0.004), incomplete immunization status (p=0.004), not residing with both parents (p=0.009) and a higher Birth order (p=0.021) were associated with increased risk.. (Table 9).

Table 9: Bivariable analysis of the association between Sociodemographic and clinical characteristics of participant infants and infants at risk of poor growth and development (n = 832).

Variable / Category	Risk of PGD		P-value	cPR (95% CI)
	No	Yes		
	n (%)	n (%)		
Sex.				
Male	225 (50.2)	183 (47.7)		1
Female	223 (49.8)	201 (52.3)	0.461	0.95 (0.82–1.10)
Birth order.				
1	209 (46.7)	158 (41.2)		1
2	126 (28.1)	101 (26.3)	0.730	1.03 (0.86–1.25)
≥ 3	113 (25.2)	125 (32.5)	**0.021**	1.22 (1.03–1.44)
Nationality.				
Ugandan	442 (98.7)	379 (98.7)		1
Non-Uganda	6 (1.3)	5 (1.3)	0.963	1.02 (0.53–1.95)
Child refugee.				
No	421 (99.5)	360 (98.6)		1
Yes	2 (0.5)	5 (1.4)	**0.071**	1.55 (0.96–2.49)
Mosquito net use by the Index child.				
No	19 (4.2)	40 (10.4)		1
Yes	429 (95.8)	344 (89.6)	**P<0.001**	0.66 (0.54–0.80)
Child immunization status (n=825).				
Not up to date	45 (10.2)	62 (16.4)		1
Up to date	395 (89.8)	317 (83.6)	**0.004**	0.77 (0.64–0.92)
Households lost a child <5 years (n=821).				
No	437 (99.5)	369 (98.1)		1
Yes	2 (0.5)	7 (1.9)	**0.004**	1.70 (1.19–2.43)
Child TB treatment history.				
No	447 (99.8)	382 (99.5)		1
Yes	1 (0.2)	2 (0.5)	0.368	1.45 (0.65–3.23)
Child's current living arrangements.				
Both parents	413 (92.2)	335 (87.2)		1
Others	35 (7.8)	49 (12.8)	**0.009**	1.30 (1.07–1.59)

4.6.4 Multivariable analysis of factors associated with infants at risk of poor growth and development.

Factors significantly associated with risk of poor growth and development at multivariable analysis were: not being cared for by mother (aPR 1.77, 95%CI 1.25-2.52, p-value 0.001), adequate ANC visits (4-7 ANC visits: aPR 0.73, 95% CI 0.6-0.89, p-value 0.002; ≥8 ANC visits: Apr0.71, 95%CI 0.51-0.99, p-value 0.042), maternal illness during pregnancy (aPR1.43, 95%CI 1.17-1.76, p-value 0.001), use of mosquito nets (aPR 0.70, 95%CI 0.55-0.88, p-value 0.002) and history of child loss (aPR1.52, 95%CI 1.09-2.13, p-value 0.014) (Table 10)

Inadequate ANC visits (<4) remained a significant risk factor, whereas >4 visits (4-7 ANC visits: aPR 0.73, 95% CI 0.6-0.89, p-value 0.002; ≥8 ANC visits: Apr0.71, 95%CI 0.51-0.99, p-value 0.042) were protective. An infant not cared for by the mother (aPR 1.77, 95%CI 1.25-2.52, p-value 0.001), maternal illness during pregnancy (aPR1.43, 95%CI 1.17-1.76, p-value 0.001), history of an under 5 child loss in household (aPR1.52, 95%CI 1.09-2.13, p-value 0.014) remained independent risk factors. Mosquito net use (aPR 0.70, 95%CI 0.55-0.88, p-value 0.002) was noted as a significant protective factor against PGD. (Table 10).

Table 8: Multivariable analysis for the factors associated with risk of poor growth and development among 832 Infants below 6 months in selected health facilities in Kampala city.

Variable	Category	Apr	95% CI	P-value
Caregiver relationship.	Mother	1		
	Others	1.77	1.25 – 2.52	**0.001**
ANC visits.	< 4 visits	1		
	4–7 visits	0.73	0.60 – 0.89	**0.002**
	≥ 8 visits	0.71	0.51 – 0.99	**0.042**
Illness during pregnancy.	No	1.00		
	Yes	1.43	1.17 – 1.76	**0.001**
Mosquito net use.	No	1.00		
	Yes	0.70	0.55 – 0.88	**0.002**
History of child loss.	No	1.00		
	Yes	1.52	1.09 – 2.13	**0.014**

CHAPTER FIVE: DISCUSSION.

5.1 Introduction.

This facility-based cross-sectional study was conducted to determine the prevalence and factors associated with "infants at risk of poor growth and development" among infants under six months of age attending outpatient clinics in selected health facilities in Kampala, Uganda. The study was guided by the newly updated 2023 World Health Organization (WHO) guidelines, which expand the criteria for identifying vulnerable infants in this critical age group. This study is to the best of my knowledge, the first in Uganda to investigate the burden of infants under six months at risk of poor growth and development basing on the newly revised WHO definition, filling a critical evidence gap.

5.2 Prevalence of infants at risk of PGD.

Nearly half 46.2% (95% CI: 42.8-49.6%) of infants under six months attending outpatient clinics in selected Kampala health facilities were at risk of poor growth and development according to the WHO 2023 criteria. This indicates that approximately 1 in every 2 infants under six months of age in this urban Ugandan outpatient population meets at least one of the (excluding those with poor growth based on sequential measures) WHO criteria for being at risk of PGD. The fourth category with poor growth based on sequential measures was not included in the analysis because of missing data from the availed child health charts highlighting a documentation gap and some participants did not have their child health charts.

This prevalence is higher than that reported in the Uganda Demographic and Health Survey. The UDHS reported that 24% of children were stunted, 10% were underweight, and 3.6% were wasted(119). The difference observed could be due to the fact that UDHS prevalence includes children aged 0-59 months and does not provide disaggregated data for infants under six months specifically. However, the magnitude of the difference suggests that risk begins very early in life and may be under-ascertained by current surveillance systems that focus on children 6-59 months.

The prevalence observed in this study is higher than previously reported estimates for malnutrition among infants under six months in similar settings. Kerac et al. (2025), analyzing 54 low- and middle-income countries, found that 20.1% of infants under six months were underweight, 21.3% were wasted, and 17.6% were stunted(120). A hospital-based cross-sectional study in India by Verma and colleagues (2023) found that 36.8% of infants under six months were underweight (WAZ<-2) and 20.2% were wasted(121). The high prevalence in this study compared to previous studies suggests that the expanded WHO 2023 definition which includes not only poor anthropometry but also poor birth outcomes, known risk factors, and poor growth patterns, captures a significantly larger population of vulnerable infants than traditional malnutrition definitions alone. This study's prevalence is more consistent with the concept of nutritional, subsequent risk for poor growth and development rather than acute

malnutrition in isolation. This aligns with the WHO's strategic shift toward early identification and preventive intervention before infants develop severe wasting or nutritional edema. Therefore, health systems will need to develop tiered approaches to manage this larger population efficiently, reserving intensive interventions for those at the highest risk while providing basic support to the broader at-risk group.

5.3 Factors significantly associated with infants at risk of PGD.

5.3.1 Care-giver/Maternal related factors.

Non-maternal caregiving.

Infants whose primary caregiver was not their mother had 77% higher risk of PGD compared to those cared for by their mothers. The strong association suggests that maternal presence and caregiving are important protective factors for infant growth and development during the first six months of life. Mothers are biologically equipped to breastfeed, and exclusive breastfeeding for the first six months is the WHO's strongest recommendation for infant nutrition. Fathers or other caregivers may face practical challenges in ensuring exclusive breastfeeding, including facilitating frequent feeding sessions or managing expressed breast milk.

This is firmly supported by Brugaletta et al. (2021), who assert that feeding practices are largely dictated by the caregiver's knowledge and skills, with maternal involvement directly linked to improved outcomes(122). Furthermore, Odera (2020) in Kenya clearly demonstrated that complementary feeding practices fell short when caregivers other than mothers took on the feeding responsibility, primarily due to a significant lack of understanding regarding appropriate timing, frequency, and diversity of foods(123). Therefore, interventions should support working mothers through policies like extended maternity leave and workplace lactation support to ensure they can remain the primary caregivers during the first six months.

Maternal illness during pregnancy.

Infants whose mothers reported illness during pregnancy (for the current infant) had a 43% higher risk of poor growth and development compared to those whose mothers had no illness. This finding is consistent with previous research. Findings from a Ugandan cohort study showed that various maternal illnesses, including infectious diseases, and metabolic conditions, have been associated with adverse infant health outcomes (103). A systematic review in Australia found an association between maternal health and child health (physical and mental)(124) and another study by Teta et al. (2024) revealed that maternal health, both physical and mental, is closely linked to a child´s development and can affect their quality of life in the future(125).

This could be attributed to the fact that Maternal illness during pregnancy can disrupt the placenta's ability to transfer essential nutrients and oxygen, directly hindering fetal weight gain and organ maturation. Systemic infections or chronic conditions often trigger an inflammatory response in the mother, which can lead to preterm birth or low birth weight, both of which are primary precursors to stunted growth. Postnatally, a mother's ongoing illness can impair her physical and mental capacity to provide optimal care, potentially leading to inconsistent feeding practices or reduced emotional stimulation for the infant. These combined biological and care-related disruptions create a cumulative deficit that significantly increases the risk of long-term developmental delays. Therefore, there is need to strengthen prenatal care and integration of maternal mental health assessments into routine ANC.

Antenatal care visits.

Children whose mothers attended 4-7 visits and eight or more visits had a 27% and 29% lower risk of PGD, respectively compared to those whose mothers attended less than 4 visits. These findings align with those of Mwebesa et al. (2022) in Uganda, who found that having four or more ANC visits increased facility delivery and early PNC utilization(100). Similarly, Simegn et al. (2024) in Ethiopia reported that ANC attendance significantly improved growth

monitoring and promotion service utilization(126). Similar findings are reported by a study in Ghana which reported that high-quality antenatal care during pregnancy was associated with a reduced risk of premature birth or low birth weight babies(127).

This is because ANC provides a platform for nutritional counseling, iron-folate supplementation, deworming, immunization, and the management of pregnancy-related complications that directly impact fetal and neonatal growth(128). Furthermore, Women with adequate ANC are more likely to deliver in health facilities with skilled attendance, reducing risks of birth asphyxia, preterm birth, and low birth weight. Rahman and colleagues reported that women who had 4 or more ANC visits were 5.7 times more likely to use delivery care at a health facility and 6.5 times more likely to have a delivery assisted by a skilled birth attendant compared to women who had no ANC visit(129). Therefore, efforts should focus on removing barriers to ANC, such as transport costs or long wait times, to ensure all mothers complete the recommended number of visits.

5.3.2 Household-related factors.

Use of mosquito nets.

Infants who slept under mosquito nets had a 30% lower risk of poor growth and development than those who did not. Sleeping under a mosquito net is typically associated with malaria prevention(130), which is a primary driver of growth faltering and developmental delays in endemic regions. By preventing mosquito bites, these nets reduce the incidence of clinical malaria and chronic parasitemia, both of which deplete an infant's nutritional reserves and trigger systemic inflammation that stalls physical growth. Furthermore, ITNs protect the mother during pregnancy, reducing the risk of placental malaria, which often leads to low birth weight and intrauterine growth restriction.

This finding is supported by previous research, which reported that malaria is associated with risk of growth and developmental complications(131). Uganda has achieved high mosquito net coverage (92.9% of this study’s sample reported net use), which is commendable. However,

the 7.1% of infants not using nets had substantially higher risk. Targeted distribution to pregnant women and new mothers through ANC and immunization clinics could reach this remaining population.

Household history of child loss under five years.

Infants in households that had previously lost a child under five years had a 52% higher risk of poor growth and development than those who in households that had never lost a child under five years. This could be attributed to the following reasons; child loss may be a marker of ongoing poverty, food insecurity, poor sanitation, limited healthcare access, or other structural factors that affect all children in the household. Lwiza. (2019) reported that the poorest households were nearly three times more likely to be underweight compared to those from richer households(132). The same maternal conditions that contributed to a previous child's death may affect subsequent pregnancies and infants, and bereaved mothers may experience depression, anxiety, or complicated grief that impairs their ability to provide optimal care for subsequent infants. This is consistent with previous research which showed that loss of a child contributes to maternal depression(133), and maternal depression negatively impacts child nutrition and development(134).

5.4 Study strengths and limitations.

This study is, to my knowledge, the first in Uganda to investigate the burden of infants under six months at risk of poor growth and development using the newly revised WHO definition, filling a critical evidence gap identified by the Guideline Development Group. However, the study has limitations. Firstly, the study's focus on one district, particularly the capital city, limits its generalizability to other areas like rural Uganda. However, we compared participant characteristics with regional and national child health indicators to assess representativeness of the study population.

Additionally, the hospital-based design may have introduced selection bias as infants attending health facilities may have better health care seeking behavior or have existing health concerns.

This therefore may not be a direct representation of the community prevalence. Facility-based sampling was appropriate for the study's objective of informing outpatient clinical practice, where the at-risk classification was applied, rather than estimating community prevalence.

Since it is a cross-sectional design, the temporal relationship between associated factors and at-risk status cannot be definitively established, and reverse causality cannot be ruled out. The cross-sectional design is appropriate for this foundational prevalence study, and the significant associations identified provide strong justification for longitudinal cohort studies to establish causality and validate the WHO classification system.

Furthermore, consecutive sampling could have introduced selection bias. This was minimized by applying standardized inclusion criteria and encouraging broad participation.

Maternal reports of birth weight, gestational age, illness during pregnancy, and previous child loss may be inaccurate due to poor recall, lack of documentation, or limited access to ultrasound for gestational age confirmation. Recall bias was minimized by cross-referencing maternal reports with available health cards and immunization records.

CHAPTER SIX: CONCLUSIONS AND RECOMMENDATIONS.

6.1 Conclusions.

This study found that nearly one in every two infants (46.2%) is at risk of poor growth and development in Kampala according to the WHO 2023 criteria, a substantially higher burden than previously reported disaggregated data using traditional undernutrition indicators alone. 14.5% were at risk due to poor birth outcomes, more than a quarter (26.6%) had known risk factors for PGD, and 20.7% exhibited poor anthropometry based on a single measure.

Factors significantly associated with risk of PGD were: maternal-related factors like non-maternal caregiving, inadequate antenatal care visits and, maternal illness during pregnancy, house hold- related factors like failure to use mosquito nets, and household history of a child loss under five years.. The high prevalence and identification of modifiable risk factors support

the WHO's shift toward early identification and preventive intervention in the first six months of life.

6.2 Recommendations.

Policy.

Ministry of Health should:

- Ensure institutionalization of the newly updated National IMAM guidelines to re-organize the different care points like the immunization and outpatient clinics to have targeted interventions aimed at screening, early identification and linkage to appropriate services.
- Integrate at-risk infant screening into the routine immunization schedule. The 6-week immunization visit is an ideal entry point for assessing all four WHO risk categories using a simple checklist.
- Establish a fast-track or intensive follow-up protocol for infants identified with high-risk markers, such as those not cared for by their biological mothers or those whose mothers have a history of child loss.
- Strengthen antenatal care to achieve universal coverage of four or more visits.
- Ensure 100% coverage of Insecticide-Treated Nets (ITNs) specifically targeting pregnant women during ANC visits to prevent placental malaria and subsequent infant growth faltering.

Practice.

Health workers should:

- Ensure intensive follow-up of those infants identified to be at risk of poor growth and development at the different care points.

- Enhance Antenatal Care (ANC) sessions to focus not just on attendance but on high-quality counseling regarding the long-term impact of maternal health on infant neurodevelopment and physical growth.
- Ensure complete documentation of the relevant tools like the child health cards to enhance availability of adequate data for identifying several risk categories including those with poor growth patterns based on sequential measures.

Future research.

- Repeat studies in a rural Ugandan setting to compare the prevalence and drivers of PGD.
- Conduct longitudinal cohort studies to validate the WHO at-risk criteria against long-term outcomes.
- Future studies to involve the category with poor growth patterns based on sequential anthropometry measurements to fully establish burden in the different settings.

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APPENDICES.

APPENDIX I: CONSENT FORM.

Title of the Proposed Study: Burden of Infants at Risk of Poor Growth and Development among infants under six Months of Age in selected health facilities within Kampala.

Investigator: The principal investigator is Dr. Mayanja Charles who is affiliated to the Department of Pediatrics and Child Health at Makerere University College of Health Sciences.

Tel. number 0776833221. Email: charlesmnj@gmail.com

Background of the study: Infants under six months face high risks of poor growth and development globally, worsened by malnutrition, conflict, and climate change. Early detection and intervention are crucial to prevent severe health outcomes. The World Health Organization (WHO) has updated its guidelines to enhance early detection and intervention for vulnerable infants. However, research is scarce on infants under six months, particularly in developing countries like Uganda. This study aims to determine the prevalence and factors associated with poor growth and development among infants under six months in Kampala, Uganda, to inform evidence-based interventions and policies.

Sponsor: In-kind Funding support from NAWTREAT Project at CHDC MakCHS Funded by

Eleanor Crook Foundation and The ELMA Relief Foundation.

Purpose of the study: This study aims to determine the prevalence of infants at risk of poor growth and development and associated factors among infants under six months of age.

The estimated duration the research participant will take in the research project: The study

is estimated to take about 20-40 minutes of your time.

Study procedures: If you agree for your child to participate in this study, a member of the study

team will interview you, during which a questionnaire will be completed regarding you, your family, and your child. Additionally, anthropometric measurements, including the child's height/length, weight, and mid-upper arm circumference (MUAC) for all those above three months, will be taken.

Who will participate in the study? A total of 832 children under six months attending outpatient clinics at selected health facilities in Kampala City will be eligible to participate i.e. Infants 6 weeks to less than 6 months of age attending the outpatient clinics at Kawempe National Referral Hospitals, Kisenyi health center IV, and Kisugu HCIII during the study period, provided their caregivers give informed consent and are willing for both themselves and the child to undergo all study procedures.

Risks/Discomforts: This study involves minimal risks. Some questions may be personal or sensitive, which could cause slight discomfort. However, participation is voluntary, and you may

choose not to answer any question you find uncomfortable. The anthropometric measurements,

including height/length, weight, and Mid Upper Arm Circumference (MUAC), are part of routine

care and do not pose any additional risks.

Benefits: There are no direct medical, financial, or other personal benefits for you or your child

as a result of participating in this study. However, the findings will contribute to improving the

care and support of children with poor growth and development and will aid the Ministry of Health in implementing Integrated Management of Acute Malnutrition (IMAM) guidelines more effectively.

The infants that will be found to be at risk of poor growth and development will access the standard care as per the hospital management guidelines and any necessary referrals to the any specialized care will be done appropriately.

Confidentiality: All information collected about you and your child during this study will be kept strictly confidential and will only be accessible to the research team. Completed consent forms and questionnaires will be securely stored in a lockable cabinet for at least three years after study completion, with access restricted to the study team. While the study results may be published, your child's identity will not be disclosed. Additionally, the Makerere

University School of Medicine Research and Ethics Committee and Uganda National Council for Science and Technology may request access to identifying information for ethical review purposes, but this information will not be made public.

Alternatives and Voluntariness: Participation in this study is completely voluntary for both you

and your child. You are free to join of your own free will and have the right to withdraw at any

time without any penalty. Choosing not to participate or withdrawing from the study will not affect your child's access to care at the health facility in any way.

Cost: There are no direct costs associated with participation in this study.

Compensation for Participation: As a participant, you will receive UGX 10, 000 as time compensation.

Questions about the study: For any inquiries regarding this research, you may contact the Principal Investigator now or later, Dr. Mayanja Charles, at Tel. number 0776833221 or via Email: charlesmnj@gmail.com.

Questions About Participants' Rights: If you have any concerns about your rights as a research participant, you may contact the Chairperson of the School of Medicine Research and

Ethics Committee, Assoc. Prof. Ponsiano Ocama, at +256 772 421190.

Statement of Voluntariness: Your decision to participate is entirely voluntary, and you are free

to decline or withdraw at any stage. Choosing not to participate will not affect the medical treatment you or your child receives in any way.

Dissemination of Results: You will receive feedback on the study findings from the Principal Investigator through the different facilities where the study will be conducted. The findings of this study will also be disseminated in form of a report that will be submitted to the department

of pediatrics and child health of Makerere University. The findings will also be disseminated in

conferences, abstract presentations and a peer-reviewed journal.

Ethical Approval: This study has been reviewed and approved by the Makerere University School of Medicine Research and Ethics Committee (SOMREC).

STATEMENT OF CONSENT.

……

Has described to me what is going to be done, the risks, the benefits involved, and my rights regarding this study. I understand that my decision to participate in this study will not alter my usual medical care. In the use of this information, my child's identity will be concealed. I am aware that I may withdraw from the study at any time. I understand that by signing this form, I

do not waive off my child's legal rights but merely indicate that I have been informed about the

research study in which I am voluntarily agreeing for my child to participate. A copy of this form

will be provided to me.

Name of Caregiver;

Signature/Thumb print:

Date ……. …… ……. …..
……

Name of study team member; Signature:

Date …….. …… ……. …..
……

Name of Witness; Signature:

Date …….. …… ……. ….. ……

APPENDIX II: TRANSLATED CONSENT FORM

ENKOZESA Y'OKUKIRIZA

Omutwe gw'okunoonyereza: Omugugu gw'abaana abawere abali mu bulabe bw'okukula obubi n'okukulaakulana mu baana abawere abali wansi w'emyezi mukaaga mu malwaliro agalondeddwa mu Kampala, Uganda.

Omunoonyereza: Omunoonyereza omukulu ye Dr. Mayanja Charles alina akakwate ku kitongole ky'abasawo b'abaana n'ebyobulamu by'abaana mu Yunivaste ya Makerere, Kolegi yo bwobulamu. Essimu. Number 0776833221. Email: charlesmnj@gmail.com

Ensibuko y'okunoonyereza: Abaana abawere abali wansi w'emyezi mukaaga bayina omikisa mingi okuba n'obulabe obw'amaanyi obw'okukula obubi n'okukulaakulana mu nsi yonna, nga beyongedde olw'endya embi, entalo, n'enkyukakyuka y'obudde. Okuzuula amangu n'okuyingira mu nsonga kikulu nnyo okuziyiza ebiva mu kukonziba. Ekitongole ky'ebyobulamu mu nsi yonna kizzeemu okutereeza enkola yaakyo okutumbula okuzuula amangu n'okuyingira mu nsonga z'abaana abawere abali mu mbeera embi. Wabula okunoonyereza kutono ku baana abawere abali wansi w'emyezi mukaaga naddala mu nsi ezikyakula nga Uganda. Okunoonyereza kuno kugenderera okuzuula obungi n'ensonga ezikwatagana n'okukula obubi n'okukulaakulana mu baana abawere abali wansi w'emyezi mukaaga mu Kampala, Uganda, okumanyisa enkola n'enkola ezesigamiziddwa ku bujulizi.

Obuyambi bwe nsimbi: Okunonyereza kuno kufunye obuyambi bwe'nsimbi okuva mu Pulojekiti ya NAWTREAT ku CHDC MakCHS ewaniriddwa ekitongole kya Eleanor Crook n'ekitongole kya The ELMA Relief Foundation.

Ekigendererwa ky'okunoonyereza: Okunoonyereza kuno kugenderera okuzuula obungi bw'abaana abawere abali mu bulabe bw'okukula obubi n'okukula n'ensonga ezikwatagana nabyo mu baana abawere abali wansi w'emyezi mukaaga.

Ekiseera ekibalirirwamu agenda okwetaba mu kunoonyereza kuno kw'agenda okutwala: Okunoonyereza kuteeberezebwa okutwala eddakiika nga 20-40 ez'obudde bwo.

Enkola z'okunoonyereza: Bw'oba okkirizza omwana wo okwetaba mu kunoonyereza kuno, omuntu wa ttiimu y'okunoonyereza ajja kukubuuza ebibuuzo, mu kiseera ekyo ekibuuzo kijja kumalibwa ku bikwata ku ggwe, amaka go, n'omwana wo. Okugatta ku ekyo, ebipimo by'omuntu, omuli obuwanvu bw'omwana, obuzito, n'okwetooloola kw'omukono ogwa wakati okumala emyezi egyo gyonna egyali gisukka mu esatu, bijja kutwalibwa.

Ani agenda okwetaba mu kunoonyereza kuno? Abaana abawera lunaana mu asatu mu basatu(832) nga bali wansi w'emyezi mukaaga abagenda mu malwaliro ag'ebweru mu bifo ebirondeddwamu eby'obulamu mu kibuga Kampala abajja okuba n'ebisaanyizo okwetabamu nga ; Abaana abawere abaweza n'okudda wagulu wa wiiki 6 okutuuka ku myezi egiri wansi wa 6 nga bagenda mu malwaliro g'abalwadde abatali balwadde bayyi mu malwaliro ga Kawempe National Referral Hospitals, Kisenyi health centre IV, ne Kisugu HCIII mu kiseera ky'okunoonyereza kasita ababalabirira bawa okukkiriza okutegeerekeka era nga beetegefu ku bombi bo bennyini n'omwana okuyita mu nkola zonna ez'okusoma.

Obulabe/Obutabeera bulungi: Okunoonyereza kuno kuzingiramu akabi akatono. Ebibuuzo ebimu biyinza okuba eby'obuntu, ekiyinza okuleetawo obuzibu obutonotono. Naye, okwetabamu kwa kyeyagalire, era oyinza okusalawo obutaddamu kibuuzo kyonna ky'osanga nga tekinyuma. Ebipimo by'omuntu, omuli obuwanvu, obuzito, ne okwetooloola kw'omukono ogwa wakati, kitundu kya kulabirira kwa bulijjo era tebirina bulabe bwonna obw'enjawulo.

Emigaso: Tewali migaso gya bujjanjabi, egy'ensimbi, oba emirala egy'obuntu gy'oli oba omwana wo olw'okwetaba mu kunoonyereza kuno. Wabula ebizuuliddwa bijja kuyamba okutumbula okulabirira n'okuwagira abaana abakula obubi n'okukulaakulana era bijja kuyamba minisitule y'ebyobulamu mu kuteeka mu nkola enkola y'okujanjaba obulwadde bw'obutaba na mmere obw'amaanyi mu ngeri ennungi.

Abaana abawere abagenda okusangibwa nga bali mu bulabe bw'okukula n'okukula obubi bajja kufuna obujjanjabi obw'omutindo nga bwe kiri mu ndagiriro y'okuddukanya eddwaaliro era

okusindikibwa kwonna okwetaagisa mu kulabirirwa kwonna okw'enjawulo kujja kukolebwa mu ngeri esaanidde.

Ebyama: Amawulire gonna agakung'aanyiziddwa ku ggwe n'omwana wo mu kunoonyereza kuno gajja kukuumibwa nga ga kyama nnyo era gajja kutuukirirwa ttiimu y'abanoonyereza yokka.

Okukkiriza okumaliriziddwa n'ebibuuzo ebididwaamu bijja kuterekebwa bulungi mu kabadda eriko kkufulu okumala waakiri emyaka esatu oluvannyuma lw'okumaliriza, ng'okuyingira kukoma ku ttiimu y'okunonyereza.

Wadde ng'ebinava mu kunoonyereza biyinza okufulumizibwa, amanya g'omwana wo tegajja kufulumizibwa. Okugatta ku ekyo, obukiiko okuli akakola ku kunoonyereza ku Yunivasite y'e Makerere mu ssomero lyebyobulamu n'olukiiko lw'eggwanga olwa ssaayansi ne tekinologiya buyinza okusaba okufuna amawulire agalaga okusobola okwekenneenya empisa, naye amawulire gano tegajja kufulumizibwa mu lujjudde.

Ebirala n'obwannakyewa: Okwetaba mu kunoonyereza kuno kwa kyeyagalire ddala eri ggwe n'omwana wo. Oli wa ddembe okwegatta ku ddembe lyo ery'okwesalirawo era olina eddembe okuva mu kunonyereza ekiseera kyonna nga tolina kibonerezo kyonna. Okusalawo obuteetaba oba okuva mu kunoonyereza tekijja kukosa mwana wo okufuna obujjanjabi mu kifo ky'ebyobulamu mu ngeri yonna.

Ebisale: Tewali nsaasaanya ya butereevu ekwatagana n'okwetaba mu kunoonyereza kuno.

liyirira okwetabamu: Olwo'budde bwo, ojja kuliyirirwa ne siringi za Uganda 10,000.

Ebibuuzo ebikwata ku kunoonyereza: Obuzibu bwona oba ebibuuzo ebikwatagana ku kunoonyereza kuno osobola okubuuza oba okutuukirira Dr. Mayanja Charles kati oba obudde obulala, ku namba y'essimu 0776833221 oba ku Email: charlesmnj@gmail.com.

Ebibuuzo ebikwata ku ddembe ly'omwetabizi: Bw'oba olina okusoberwa oba okweraliikirira ku ddembe lyo ng'oyo eyetabye mu kunoonyereza, osobola okukwatagana ne ssentebe w'akakiiko akavunaanyizibwa ku kunoonyereza n'obulamu mu ttendekero Ly'e Makerere, Assoc. Prof. Ponsiano Ocama, ku +256 772 421190

Sitetimenti y'obwannakyewa: Okusalawo okwetabamu kunonyereza kwa kyeyagalire ddala, era oli wa ddembe okugaana oba okuvamu ku mutendera gwonna. Okusalawo obuteetabamu tekijja kukosa bujjanjabi eri ggwe oba omwana wo bwe mufuna mu ngeri yonna.

Okusaasaanya ebivudde mu kunoonyereza: Ojja kufuna endowooza ku bizuuliddwa mu kunoonyereza okuva eri omunoonyereza omukulu ng'oyita mu bifo eby'enjawulo okunoonyereza we kunaakolebwa. Ebizuuliddwa mu kunoonyereza kuno era bijja kusaasaanyizibwa mu ngeri y'alipoota egenda okuweebwa ekitongole ky'abasawo b'abaana n'obulamu bw'abaana mu yunivasite ya Makerere. Ebizuuliddwa era bijja kusaasaanyizibwa mu nkuŋŋaana, ennyanjula n'ekitabo ekigenda okukeberebwa bannaabwe.

Okukkirizibwa mu ngeri ey'obwannannyini: Okunoonyereza kuno kwakebereddwa era kwakkiriziddwa akakiiko akavunaanyizibwa ku by'obulamu n'ennono z'obuntu mu ttendekero ly'e Makerere.

EKITABO KY'OKUKKIRIZIGANYA

..... annyonnyodde ekigenda okukolebwa, akabi, emigaso, n'eddembe lyange erikwata ku kunoonyereza kuno. Ntegedde nti okusalawo kwange okwetaba mu kunoonyereza kuno tekijja kukyusa bujjanjabi bwange obwa bulijjo. Mu nkozesa y'amawulire gano, amanya gomwana wange gajja kukwekebwa. Nkimanyi nti nnyinza okuva mu kunonyereza kuno ekiseera kyonna. Ntegedde nti nga nzisa omukono ku ffoomu eno,

siwayo ddembe ly’omwana wange mu mateeka wabula ndaga nti ntegeezeddwa ku kunoonyereza era nzikiriza n’omwana wange okwetabamu. Kopi ya foomu eno ejja kumpebwa.

Erinnya ly'omuzadde…….

Omukono oba ekinkumu: ……

Ennaku z‘omwezi:

…….

Erinya lya’buza ebibuzo……

Omukono gw'oyo abuuza ebibuuzo…….

Erinnya ly’omujjuluzi……..

Omukono oba ekinkumu: ……

Ennaku z‘omwezi:…….

APPENDIX III: QUESTIONNAIRE.

SECTION A: IDENTIFICATION & CONSENT

Q No.	**Question**	**Response Options / Codes**
A1	Questionnaire ID	
A2	Date of interview (DD/MM/YYYY). Time of interview.	____/____/____. ____/____.
A3	Facility name/ Level.	
A4	Consent obtained	1=Yes 0=No (if no stop.)
A6	Ask and look: Does infant have any danger sign based on ETAT guidelines as below?	1=yes, 2=no. And stop here if yes to any below.
A6a	Ask caregiver, is the infant **able to drink or breastfeed**? [1] =Yes, able to feed [2] =Unable to feed.	
A6b	Ask caregiver, does the infant **vomit everything**? [1] =Yes, vomiting everything [2] =No, not vomiting everything.	
A6c	Ask caregiver, has the infant **had convulsions**? [1] =Yes, had fits (Convulsions) [2] =No, no fits or convulsions.	
A6d	Look, is the infant **convulsing now**? [1] =Yes, convulsing or fitting now [2] =No, not fitting or not convulsing now.	
A6e	Look, is the infant **lethargic or unconscious**? [1] =Movement only when stimulated (lethargic) [2] =No movement (unconscious).	

SECTION B: CAREGIVER DEMOGRAPHICS

Q No.	Question	Response Options / Codes
B1	Relationship to infant.	1=Mother 2=Father 3=Grandmother/ Other, If other specify……
B2	Age of caregiver (years).	
B3	National/ Refugee.	1=National 2=Refugee. If 2, specify Country of origin? .....
B4	Highest education level attained,	1=None 2=Primary 3=Secondary 4=Tertiary
B5	Marital status.	1=Single 2=Married/ partner/ cohabiting. 3=Divorced/ separated. 4=Widowed
B6	Employment Status.	1=full time house wife or stay at home mum. 2=farming. 3=private business. 4=formal employment in government or private institution. 6=Other specify……..

SECTION C: HOUSE HOLD FACTORS.

Q No.	Question	Response option/ codes.
C1	Address.	
C2	District of Residence.	1=Kampala., if Kampala: which division…….. 2= Wakiso district and others……
C3	Household size.	
C4	Number of children under 5 years in household.	
C5	Has household lost a child under 5years in last 12 months?	1= yes. 2= no.
C6	Type of house hold	1=Monogamous. 2=Polygamous.
C7	Age/ Sex of house hold head.	……...years. 1=male, 2=female.
C8	Infant's current living status;	Lives with1= both parents, 2=only the mother, 3=only father, 4= other extended family members, 5=others specify……..
C9	Estimated Household monthly income.	
C10	Health care access type.	1=Public 2=Private Not for Profit 3=Private for Profit. 4=Other, specify……

C11	How for is nearby health facility from residence? (Km/ minutes.)	……km ……minutes.
C12	Food security.	1=Secured 2=Unsecured
C13	Is nearby VHT known by caregivers?	1= yes. 2= no.

SECTION D: ENVIRONMENT & WASH

Q No.	Question	Response Options / Codes
D1	Main source of water.	1=Tap. 2=Borehole 3=Well. 4=Spring. 5=others……
D2	Toilet facility type used.	1=private 2=community owned. 3=None 4=Others specify…….

SECTION E: MATERNAL HEALTH

Q No.	Question	Response Options / Codes
E1	Maternal age	
E2	Parity	
E3a	Antenatal Care visits/ follow up	1=None 2=1-4 3=4-7 4= ≥8
E3b	Post-natal follow up.	1=No 2=Yes.

E4	Maternal HIV status	1=Positive 2=Negative 3=Unknown
E5	Maternal Chronic illness.	1=No 2=Yes If yes specify; …….
E6	Illness/ medical condition during pregnancy for current participant infant.	1=No 2=Yes If yes specify. e.g. Malaria, Hypertension, Diabetes, Depression / Anxiety. ……
E7	Nutritional status; mother's MUAC.	1-Normal: >/=22cm. 2-Abnormal: Underweight. <22 cm.

SECTION F: INFANT BIRTH DETAILS

Q No.	**Question**	**Response Options / Codes**
F1	Infant sex	1=Male 2=Female
F2	Date of birth / age in months.	…./……../…….. ……months.
F3	Birth weight (kg). (check child health chart if available).	……
F4	Birth order of participating infant.	
F5	Place of delivery	1=Facility 2=Home 3=Other

F6	Mode of delivery	1=Vaginal 2=Assisted 3=CS If 3, Elective or Emergency and what was the indication? .....
F7	History of perinatal asphyxia (did baby cry immediately after birth, admission to NICU, Oxygen therapy?)	1=No 2=Yes
F8	Any Congenital abnormalities.	1=No 2=Yes If yes specify……
F9	Poor Birth outcomes e.g. Was your infant born too early (preterm) or too small (Low birth weight) or small for gestational age.	1=Yes 2=No

SECTION G: FEEDING ASSESSMENT.

Q No.	**Question**	**Response Options / Codes**
G1	Ever breastfed	1=Yes 2=No
G2	If no, is mother dead or alive?	1=dead 2=alive If 2, is she main caregiver? 3= yes

		4=No
G3	Is mother interested in relactating?	1=yes 2=No
G4	Is Exclusive breastfeeding current?	1=Yes 2=No
G5	Any breast milk substitute (BMS) used?	1=Cow's milk 2=Commercial infant formula 3=Cereal-based porridge 4=Other, specify:
G6	Prelacteal feeds given.	1=No 2=Yes
G7	Bottle feeding in last 24h	1=No 2=Yes
G8	Number of breastfeeds in 24h	
G9	Any breast-feeding concerns related to; • Infant. (Ineffective attachment/ suck or oral thrush, refusal to breast feed, difficulty suckling, swallowing/ coughing / chocking while feeding, cleft lip/ palate, tongue tie. • Mother. (Inadequate breast milk, not confident about feeding baby, breast or nipples; cracked/sore/inverted/ flat/ large, thrush, mastitis. • Other. E.g. mother working away from infant, twins,	1=infant 2=mother 3=other. Specify……

G10	Has care taker received breast feeding counselling before?	1=Yes. when?..... 2=No

SECTION H: INFANT HEALTH

Q No.	Question	Response Options / Codes
H1	Infant ill in last 2 weeks?	1=No 2=Yes
H2	Immunization up to date? (Check child health chart if available).	1=No 2=Yes 3=No card
H3	Hospital admissions since birth?	1=No 2=Yes If yes, why? .....
H4	Does infant use a mosquito net?	1=yes. 2= no.
H5	Infant's HIV status.	1=negative 2=positive. 3=exposed 4=unknown.
H6	Does infant have other chronic condition e.g. congenital heart disease, Tuberculosis treatment history?	1= yes. Specify……. 2=no.

SECTION I: MATERNAL MENTAL HEALTH

Q No.	Question	Response Options / Codes
I1	Is Mother apparently out of touch with reality or what is happening in the assessment (e.g. not responding appropriately during the assessment)?	1=Yes 2=No
I2	Is infant apparently at risk from the mother's behavior? (E.g. mother shows no concern for infant, or willful neglect of infant, such as prolonged period of no eye contact or no physical contact with infant).	1=Yes 2=No
I3	Sometimes a mother finds it difficult to do daily tasks because she is feels sad or worried. ASK & LISTEN, In the last two weeks, have you been feeling Sad?	1=Yes 2=No If yes 1=Little 2 =Some 3 =Much 4=Most of the time?
I4	ASK & LISTEN, In the last two weeks, have you been feeling Worried?	1=Yes 2=No If Yes: 1=Little 2=Some 3=Much 4=Most of the time?
I5	If mother answers yes to either of questions above, then ask:	

	ASK & LISTEN: What are the problems that you are feeling sad or worried about?	
I6	Sometimes when a person feels sad or worried she may have thoughts of harming herself or her infant. ASK & LISTEN: Do you have any thoughts like that?	1=Yes 2=No
I7	Sometimes a person feels very sad or worried because her husband/ partner (or someone else in the family) is hitting or beating her. ASK & LISTEN: Is that happening to you?	1=Yes 2=No
I8	ASK AND LISTEN: are there times you experience so much pain that it interferes with your ability to carry out daily tasks?	1=Yes 2=No If Yes: 1=Little 2=Some 3=Much 4=Most of the time?

SECTION J: INFANT ANTHROPOMETRY/ NUTRITIONAL ASSESSMENT.

Q No.	**Question**	**Response Options / Codes**
J1	Infant weight (kg)	
J2	Infant length (cm)	

J3	Weight for length	1=<-3SD 2=<-2SD but >-3SD 3=Normal.
J4	MUAC.	1=normal 2=abnormal.
J5	Nutritional edema (Bilateral Pitting Pedal edema)	1=Yes 2=No
J6	Check immunization card for sharp drop across growth chart centile line.	1= yes. 2= no. 3 =no chart/ missing data.

SECTION K: NEURODEVELOPMENTAL CONCERNS SCREEN.

Q No.	**Question**	**Response Options / Codes**
K1	ASK AND LOOK; Does caregiver have concern about infant's development? abnormal tone or posture, neck feels floppy, poor head/ trunk control, stiff body, keeps hands closed all the time/ uses hands differently or any known neurological / physical disability.	1=No 2=yes. (If yes to any)
K2	ASK AND LOOK: Is infant able to respond to voice/sound? (hearing).	1=Yes 2=No 3=Not sure

K3	ASK AND LOOK: Follows objects e.g. Stares momentarily at spot where object disappeared (by about 2 months), Stares at own hand (by about 4 months).	1=Yes 2=No 3=Not sure
K4	ASK AND LOOK: Is the baby able smile in response to face, voice. (By about 2 months). Makes Monosyllabic babble (by about 6 months).	1=Yes 2=No 3=Not sure
K5	ASK AND LOOK: Is baby able to use all limbs adequately for his age, Lifts head on tummy? Pulls to sit, with no head lag, Brings hands together in midline. (By about 3 months). Grasps and reaches for objects. (By about 4 months). Transfers object hand to hand (By about 5 and 1/2 months.)	1=Yes 2=No 3=Not sure
K6	Does child sometimes become rigid, have fits or lose consciousness?	1=yes 2=No.

APPENDIX IV: SOMREC APPROVAL.

MAKERERE UNIVERSITY
P.O. Box 7072 Kampala, Uganda
E-mail: rresearch9@gmail.com
Phone: 256 414 533541
Fax: 256 414 541036/0414 532204
COLLEGE OF HEALTH SCIENCES
SCHOOL OF MEDICINE
RESEARCH ETHICS COMMITTEE

15/10/2025
To: CHARLES MAYANJA
MAKERERE UNIVERSITY

Review Type: Initial Review

Re:Mak-SOMREC-2025-585: Burden of infants at risk of poor growth and development among infants under 6 months of age in selected health facilities within kampala, Uganda.

I am pleased to inform you that at the **206** convened meeting on **22/07/2025**, the MAK School of Medicine REC (Mak-SOMREC) meeting voted to approve the above referenced application.
Approval of the research is for the period of **15/10/2025** to **15/10/2026.**

As Principal Investigator of the research, you are responsible for fulfilling the following requirements of approval:

1. All co-investigators must be kept informed of the status of the research.
2. Changes, amendments, and addenda to the protocol or the consent form must be submitted to the REC for re-review and approval **prior** to the activation of the changes.
3. Reports of unanticipated problems involving risks to participants or any new information which could change the risk benefit: ratio must be submitted to the REC.
4. Only approved consent forms are to be used in the enrollment of participants. All consent forms signed by participants and/or witnesses should be retained on file. The REC may conduct audits of all study records, and consent documentation may be part of such audits.
5. Continuing review application must be submitted to the REC **eight weeks** prior to the expiration date of **15/10/2026** in order to continue the study beyond the approved period. Failure to submit a continuing review application in a timely fashion may result in suspension or termination of the study.
6. The REC application number assigned to the research should be cited in any correspondence with the REC of record.
7. You are required to register the research protocol with the Uganda National Council for Science and Technology (UNCST) for final clearance to undertake the study in Uganda.

The following is the list of all documents approved in this application by MAK School of Medicine REC (Mak-SOMREC):

No.	Document Title	Language	Version Number	Version Date
1	Translated consent form clean copy	Luganda	2	2025-09-24
2	Consent form clean copy	English	2	2025-09-24
3	Protocol clean copy	English	2	2025-09-24

4	COVID-19 & EBOLA risk management plan	English	pdf	2025-06-13
5	Community Engagement plan	English	pdf	2025-06-03
6	Data collection tools	English	pdf	2025-06-03
7	Data collection tools	English	pdf	2025-06-03
8	Data collection tools	English	pdf	2025-06-03

Yours sincerely,

Prof. Ponsiano Ocama
For: MAK School of Medicine REC (Mak-SOMREC)

APPENDIX V: KAWEMPE N.R.H ADMINISTRATIVE CLEARANCE.

Tele : 0414 672552
Email :
kawemperefhosp18@gmail.com

FOR ANY CORRESPONDENCE ON THIS
SUBJECT PLEASE QUOTE NO: **KNRH/REC:017**

Office of the Executive Director
Kawempe National Referral Hospital
Plot 1035/3883 Kawempe, Bombo Road
P. o. Box 3253 Kampala, Uganda

THE REPUBLIC OF UGANDA

KAWEMPE NATIONAL REFERRAL HOSPITAL
RESEARCH ETHICS COMMITTEE

26th November 2025

The In-Charge
Immunisation Clinic, Early Infant Diagnosis Clinic,
Preterm Clinic, Acute Clinic
Kawempe NRH

RE: Administrative Clearance to Conduct Research at Kawempe National Referral Hospital

This is to confirm that Dr Mayanja Charles has been granted administrative clearance to conduct his research project titled:

"Burden of infants at risk of poor growth and development among infants under 6 months of age in selected health facilities within Kampala, Uganda".

Kawempe National Referral Hospital acknowledges receipt and review of the following documents:

- The research protocol and study documents submitted by Dr Mayanja Charles;
- Ethical approval letters issued by Makerere University school of Medicine research and ethics committee

Having reviewed and found the study in line with institutional policies and ethical standards, the Hospital hereby grants administrative clearance to proceed with the research within our facility.

KAWEMPE NATIONAL REFERRAL HOSPITAL
★ 26 NOV 2025 ★
EXECUTIVE DIRECTOR
KAWEMPE NATIONAL REFERRAL HOSPITAL

Dr. Byaruhanga Kayogoza Emmanuel
Executive Director

APPENDIX VI: KCCA ADMINISTRATIVE CLEARANCE.

KCCA
KAMPALA CAPITAL CITY AUTHORITY
For a better City

DIRECTOR PUBLIC HEALTH AND ENVIRONMENT

REF: DPHE/KCCA/1302/01

12th November 2025
Dr. Mayanja Charles
Makerere University
Kampala, Uganda
0776833221

ADMINISTRATIVE CLEARANCE

Reference is made to your letter dated 10th November 2025 on the above subject matter.

This is to inform you that permission has been granted to you to conduct research entitled **"BURDEN OF INFANTS AT RISK OF POOR GROWTH AND DEVELOPMENT AMONG CHILDREN UNDER SIX MONTHS OF AGE IN SELECTED HEALTH FACILITIES WITHIN KAMPALA"** for a period of two months (02) from 13th November, 2025 to 13th January, 2026.The above permission is granted to you on the following conditions:

1. Participation in your study is voluntary and the informed consent process should be observed at all times.
2. You will provide a report to the office of the Director Public Health and Environment of your findings.
3. You will strictly adhere to the study protocol and make no changes without informing the Director Public Health and Environment.

By copy of this letter, the In charges of Kisugu and Kisenyi HCs are requested to render you all the necessary support.

DIRECTORATE OF PUBLIC HEALTH AND ENVIRONMENT
KAMPALA CAPITAL CITY AUTHORITY

Dr. Alex Ndyabakira
FOR: DIRECTOR PUBLIC HEALTH AND ENVIRONMENT
Copy: In- Charge Kisenyi HC IV and Kisugu HC III

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