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Narrative Review

Risk factors for undernutrition and poor growth during the first 6 months of life in sub-Saharan Africa: A scoping review

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SUMMARY

Background & aims: Early infant undernutrition and suboptimal growth represent significant public health challenges in many low- and middle-income countries, yet information regarding the risk factors for poor growth remains limited. A scoping review was conducted to map the existing evidence on indicators of undernutrition and poor growth and related risk factors among infants aged 0–6 months in sub-Saharan Africa.

Methods: This scoping review was conducted in accordance with the Joanna Briggs Institute framework and the Preferred Reporting Items for Systematic Reviews and Meta-Analyses Extension for Scoping Reviews. MEDLINE, Embase, and Scopus were systematically searched for eligible studies, with no restrictions on time or language.

Results: A total of 50 studies met the inclusion criteria for this review. The most frequently reported indicator of undernutrition was stunting, followed by underweight and wasting. Sex, feeding, illness, and birth size were the most studied infant risk factors for poor growth. The maternal risk factors most frequently investigated included age, education, human immunodeficiency virus infection, and occupation. Socioeconomic status and factors related to water, sanitation, and hygiene were the most studied household risk factors.

Conclusions: Several indicators of undernutrition and poor growth were identified, with stunting being the most frequently reported. Associated risk factors included multiple infant-, maternal-, and household factors, highlighting the need for complex multilayered interventions to address undernutrition and poor growth among these vulnerable infants.

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1. Introduction

Maternal and child undernutrition remain substantial public health challenges in many low- and middle-income countries (LMICs) [1]. Suboptimal physical growth is one consequence of undernutrition [2]. Indicators of undernutrition include stunting (low height-for-age), wasting (low weight-for-height) and underweight (low weight-for-age), which are defined as growth measurements more than two standard deviations (SD) below the World Health Organization (WHO) reference values [3]. Suboptimal growth due to undernutrition can increase the risk of morbidity and mortality [4] and may reduce learning abilities, school performance, and work capacity [5]. There is also an increased risk of obesity and chronic diseases later in life [5].

Despite several initiatives aimed at reducing the prevalence of undernutrition, such as the 2015 United Nations' Sustainable Development Goals, the world is off track when it comes to reaching these targets [6]. In sub-Saharan Africa, the absolute number of children affected has increased due to rapid population growth [2]. The determinants of undernutrition can be overlapping, hierarchical, and intergenerational, operating at

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immediate, underlying, and basic levels [7]. At the most proximate, or immediate level, determinants include factors such as inadequate dietary intake and infectious diseases, while more distal, or underlying and basic determinants include factors such as poverty, household food insecurity, education, and access to health services [8]. Knowledge of the determinants for undernutrition is increasing; however, studies have predominantly focused on older infants and children. Young infants have historically been excluded from nutrition and growth surveys or merged with other age groups thus being neglected as a distinct group [9]. However, there are important physiological differences between infants under 6 months and older children that may necessitate modified management strategies regarding nutrition and growth. These differences are recognized in the WHO guidelines, which highlight the importance of exclusive breastfeeding and the unique nutritional needs of infants in this age group [10]. Furthermore, early growth faltering is increasingly being documented, with recent studies from Africa showing that a significant proportion of infants are already stunted (19 %) and wasted (4 %) by 6 months. Notably, the incidence of stunting is highest before 6 months, emphasizing the critical period of early infancy for monitoring and intervention [11–13]. Younger infants also face a considerably higher risk of morbidity and mortality related to undernutrition than older children [14]. However, information about this age group is limited, and there is an ongoing discussion regarding the most appropriate anthropometric indicators to identify nutritionally at-risk infants and predict morbidity and mortality in this age group [15].

High incidence of undernutrition in early infancy in Africa, physiological differences compared to older children, and the critical nature of the early months justify a separate systematic assessment of this age group. To our knowledge, this is the first review to systematically map and examine the indicators used to describe poor growth related to undernutrition among infants aged 0–6 months in sub-Saharan Africa, along with the associated risk factors. A scoping review is an appropriate method to comprehensively explore the current evidence on indicators of undernutrition and their associated risk factors, while also identifying knowledge gaps. Such information is important to inform future research, and the development of effective interventions aimed at improving the identification and management of this vulnerable population.

2. Materials and methods

A protocol was developed based on the guidelines of Joanna Briggs Institute's (JBI) [16] and is available on Open Science Framework (DOI 10.17605/OSF.IO/FTK7Z). The methodology of this scoping review adheres to the JBI guidelines and follows the five-step approach suggested by Arksey and O'Malley [17,18]. The JBI Population, Concept and Context (PCC) strategy was utilized to define the title, objective, and inclusion criteria. The results are reported in accordance with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses extension for Scoping Reviews (PRISMA-sc) guidelines **(**Supplementary Material S1**)** [18].

2.1. Eligibility criteria

2.1.1. Population, concept, and context

Studies involving infants aged 0–6 months were included. Reports focusing solely on birth anthropometric measurements (e.g., birth weight) were excluded. Although there are differences in breastfeeding recommendations and management of undernutrition between infants below 6 months and those at 6 months of age, this review included studies reporting on both infants below 6 months and those at 6 months. Due to the limited research on risk factors for poor growth related to undernutrition in this age group, and ongoing debates regarding the most appropriate indicators for this age group, the review aimed to capture the variation of dichotomous indicators of poor growth employed in this population and to investigate which indicators are most frequently used. Studies utilizing definitions other than the WHO standards were not excluded to ensure a comprehensive review of the available evidence. The term "risk factors" was broadly interpreted to encompass all types of factors associated with poor growth. Studies reporting evidence from sub-Saharan African countries were included.

2.1.2. Types of eligible studies

Observational cross-sectional or longitudinal quantitative or mixed-method studies (if quantitative data were reported) were eligible for inclusion. Only original, peer-reviewed sources were included. Sub-studies of intervention studies were included if the design was observational.

2.2. Search strategy for identification of relevant studies

The search strategy was developed in collaboration with a librarian at the University of Oslo. A pilot test was conducted to ensure the appropriateness of the eligibility criteria. The search terms included variations of "sub-Saharan Africa", "poor growth", and "infants", utilizing appropriate database-specific strategies. The following electronic databases were searched: Scopus, MEDLINE (PubMed), and Embase. The complete search strategy can be found in Supplementary Material S2. The search was conducted on November 27, 2023, and updated on January 7, 2025. No time or language restrictions were applied. The identified, deduplicated studies were imported into Covidence review software [19], where authors KH and RJ independently screened the studies based on title and/or abstract at the first level, followed by full-text examinations of relevant studies. Differences in study selection were resolved through discussion, following a consensus-based approach.

2.3. Data extraction, -analysis, and -presentation

A standardized data extraction form was developed by two authors (KH and RJ) in Microsoft Excel to chart relevant data from the included studies. The following data were extracted: First author, year of publication, country, study population, study setting, study design, sample size, risk factors for poor growth, and indicators of poor growth. Risk factors were considered significant when described as such by the authors of the included studies through logistic regression. One author (KH) extracted the data and double-checked the extracted data for accuracy, by cross-referencing with the original sources. As predetermined, another author (RJ) independently verified all data from 15 % of the studies, using random selection. Had any inaccuracies been identified, the author (RJ) would have increased the proportion of data reviewed to ensure accuracy. Data were summarized using descriptive statistics, including frequency counts and percentages. Analyses were conducted in Microsoft Excel. Additionally, narrative summaries accompany the descriptive data. Data on risk factors for poor growth were classified into three main conceptual categories: infant-, maternal-, and household risk factors, which were identified in the results.

3. Results

3.1. Search results

After deduplication, a total of 6025 studies were identified through the structured literature search. The abstract/title screening excluded 5182 studies, and 843 studies were assessed for eligibility through full-text screening. In total, 50 studies were included in the review. The selection process is described in the PRISMA flow diagram (Fig. 1).

3.2. Study characteristics

Detailed information from all 50 included studies is provided in Supplementary Material S3. Only 15 (31 %) of the countries in sub-Saharan Africa were represented among the included studies. These included Burkina Faso, the Democratic Republic of Congo (DRC), Ethiopia, Gabon, Gambia, Guinea, Kenya, Malawi, Nigeria, Somalia, South Africa, Tanzania, Uganda, Zambia, and Zimbabwe (Fig. 2). Half of the studies were conducted in South Africa, Kenya, Tanzania, or Ethiopia. Only one multi-country study was identified [20]. The included studies were published between 2005 and 2024 (Fig. 3). Study designs included prospective cohorts ($n = 27$), cross-sectional studies ($n = 18$), case–control studies ($n = 2$), and retrospective cohorts ($n = 3$). Some of the studies employed observational designs as part of an intervention study. Sample sizes ranged from 31 to 21,832 participants. Most studies included participants from the general population ($n = 31$), while some focused on specific target populations such as infants exposed to or infected with human immunodeficiency virus (HIV) ($n = 10$) and preterm or low birth weight (LBW) infants ($n = 9$). Study settings were urban ($n = 20$), peri-urban ($n = 5$), urban and rural combined ($n = 9$), and rural ($n = 11$), with five studies not describing the setting. Thirty-one studies provided measures of poor growth for infants <6 months [21–51], eleven studies for infants at 6 months [20,52–61], and eight studies for both <6 months and at 6 months [62–69].

3.3. Indicators of poor growth

Of the 50 included studies, 36 (72 %) reported stunting as an indicator of poor growth, 21 (42 %) reported wasting, and 24 (48 %) reported underweight. Some studies also reported “at least one adverse nutritional outcome” (stunting, wasting, or underweight) [36,37,39]. Severe stunting, wasting, and underweight were only investigated by one study [37]. Other indicators of poor growth included microcephaly [35,40,62], extrauterine/postnatal growth failure defined as growth measurement <10th percentile of the predicted value [24,32], postnatal growth failure defined as >1.28 decrease in weight z-score from birth to discharge among hospitalized neonates [49], failure to regain birth weight [33], early growth deficit/failure defined as <15 g/kg/day [34,42,45,50], and

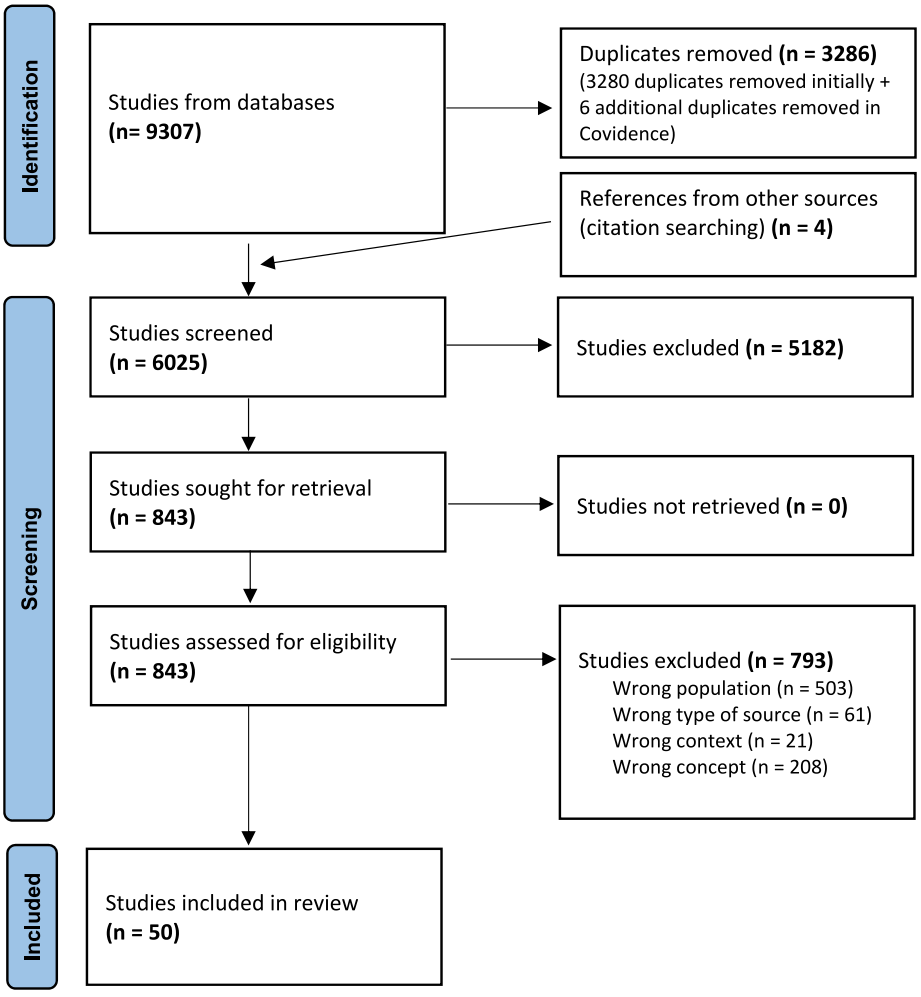

Fig. 1. PRISMA flow diagram describing the search and screening process. Source: Adapted from *Page MJ*, et al. *BMJ 2021;372:n71. doi: 10.1136/bmj.n71.*

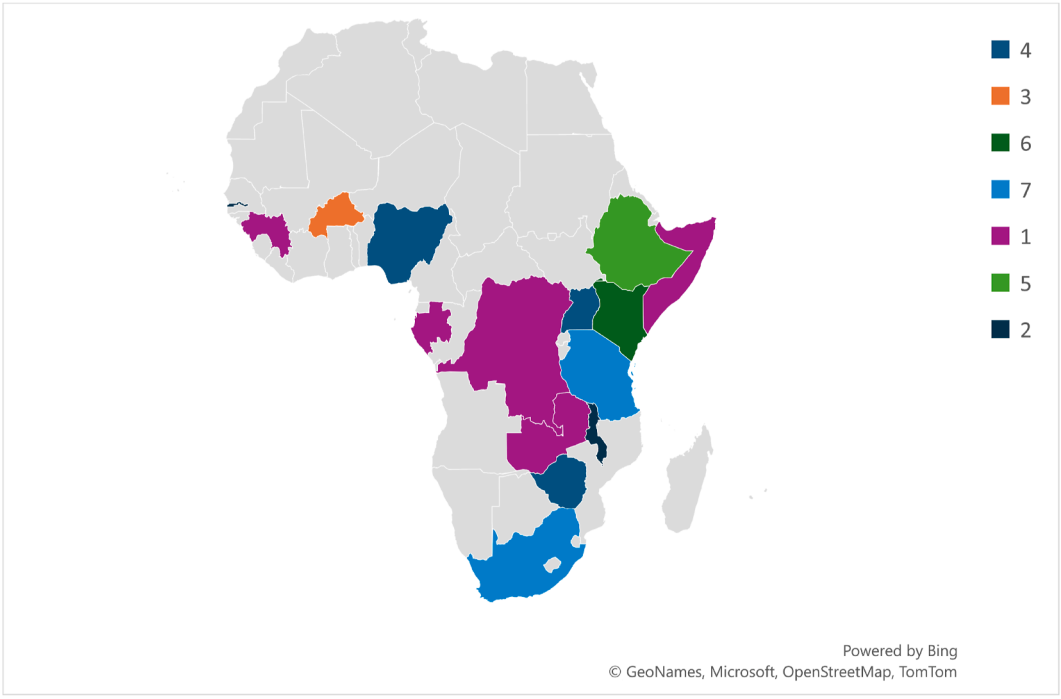

Fig. 2. Geographical distribution of included studies. The colored boxes on the right side indicate the number of included studies for each country. The countries represented are Burkina Faso, the Democratic Republic of the Congo, Ethiopia, Gabon, Gambia, Guinea, Kenya, Malawi, Nigeria, Somalia, South Africa, Tanzania, Uganda, Zambia, and Zimbabwe.

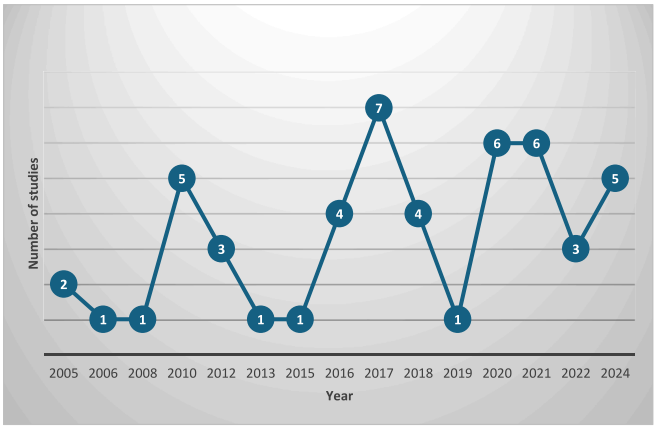

Fig. 3. Number of included studies according to publication year.

growth failure defined as >0.67 SD decrease in weight z-score during the study period [56].

3.4. Risk factors of poor growth

Supplementary Material S3 contains detailed information on risk factors investigated by the included studies. Risk factors are also presented as frequencies and categorized into infant-, maternal-, and household factors in Fig. 4.

3.4.1. Infant sex and age

Twenty-four (48 %) of the included studies examined infant sex as a risk factor for poor growth. Seven of these (29 %) reported statistically significant associations between male sex and increased odds of growth failure [56], postnatal growth failure [32], stunting [38,55,58,69], wasting [38], and underweight [38,41,58]. Age was examined by four studies [22,35,38,50]. In Nigeria, older age (>30 days) was associated with stunting, wasting, and underweight among infants aged 0–3 months [38].

3.4.2. Infant birth size and birth-related factors

Birth weight or size at birth was examined in 16 (32 %) of the studies, of which 75 % reported significant associations with poor growth. Lower birth weight or smaller size increased odds of postnatal growth failure [24,49], stunting, wasting, and/or underweight [28,39,47,48,53,54,58,61], while larger birth weight or size reduced odds of stunting [55] and postnatal growth failure [32]. Intrauterine growth restriction (IUGR) was examined in three studies [45,53,56]. IUGR increased the odds of underweight among infants at 6 months in Malawi [53], while a study from the DRC reported reduced odds of growth failure among those with symmetric IUGR [56]. Preterm birth or gestational age was examined in 10 studies [27,32–34,42,48,53,56,60,69], of which five studies reported increased odds of stunting and/or underweight at different infant ages [27,48,53,60,69]. In contrast, a study from Kenya reported an increased risk of early growth deficit among premature infants with gestation ages of 33–36 compared to 28–32 [42]. Seven studies investigated type of pregnancy (single or multiple) [24,32,33,37,38,47,69]. Multiple pregnancies were associated with several indicators of poor growth [32,37,38,47,69]. Among the studies investigating mode of delivery [34,38,41,42], one study found increased odds of underweight at 6 weeks when the infant was delivered by cesarean section [41]. Birth during the rainy season reduced odds of wasting at 6 months in Malawi [53].

3.4.3. Infant feeding and nutrition

Infant feeding was examined in 24 (48 %) of the included studies, with 58 % of these reporting significant findings. Breastfeeding was examined in 21 studies. Studies found that breastfeeding reduced the odds of poor growth [35,41], while various aspects of suboptimal breastfeeding practices increased the odds

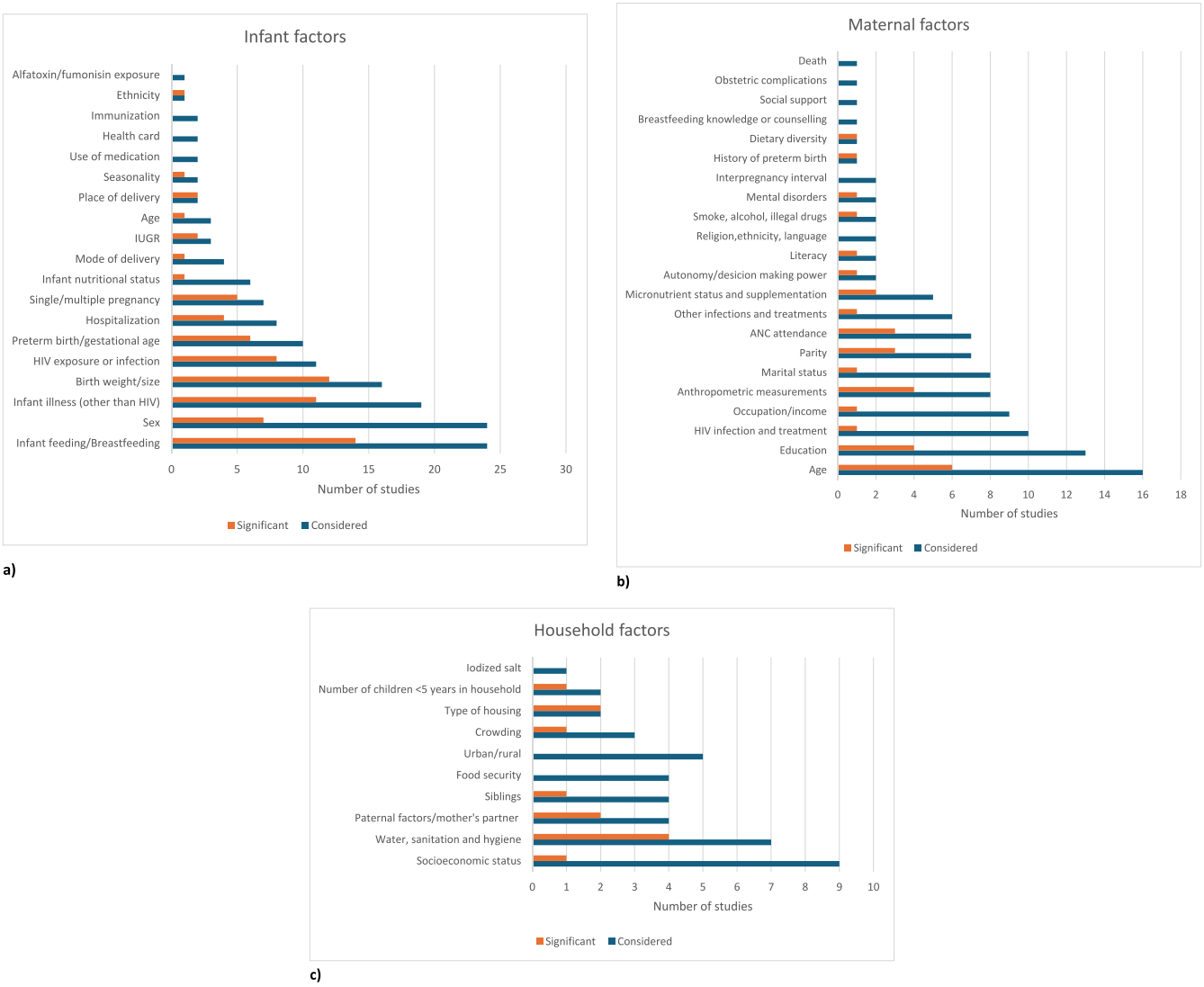

Fig. 4. Considered (blue) and significant (orange) infant **(a)**, maternal **(b)**, and household **(c)** risk factors for poor growth reported by the included studies. Abbreviations- ANC, antenatal care; HIV, human immunodeficiency virus; IUGR, intrauterine growth restriction.

of poor growth, including underweight, stunting, wasting, failure to regain birthweight, and poor weight gain [22,33,34,36,60]. However, a multi-country study from Burkina Faso, Kenya, and South Africa found reduced odds of stunting at 6 months for infants who were never breastfed [20]. In Malawi, exclusive breastfeeding (EBF) increased the odds of stunting but decreased the odds of wasting and underweight among infants aged 0–5 months [28]. One study also reported increased risk of early growth failure among very low birth weight (VLBW) infants with early use of breastmilk [45]. Delayed enteral feeding or delayed time to full feeding among hospitalized premature or LBW neonates were identified as risk factors for postnatal growth failure in Uganda [32,49] and Ethiopia [50].

Infant iron status or anemia was investigated in four studies [32,47,54,55]. One of these reported a significant association between infant iron deficiency and stunting at 6 months in South Africa [55]. Wasting or underweight was not found to be associated with stunting [47,55], nor was infant mid-upper arm circumference (MUAC) associated with stunting, underweight, or microcephaly [35].

3.4.4. Infant HIV status, illness, and hospitalization

Infant HIV infection or exposure was examined in 11 (22 %) of the studies [26,27,32,35,41,44,46,60,62,64,65], with significant findings reported in 73 % of these studies. HIV exposure and/or infection increased the odds of microcephaly [62], stunting [26,27,35,64], wasting [26,60,64,65] and underweight [26,41] in infants at different ages from 6 weeks to 6 months. In contrast, one study from South Africa found reduced odds of stunting among HIV-exposed infants at 3 and 6 months [65].

Infant illness or symptoms of illness (excluding HIV) were examined in 19 (38 %) of the studies [21,22,24,32,34,35,37–39,41,45,47,49,53,54,58,60,67], with 58 % reporting significant findings. Malaria [54], hyperbilirubinemia [37,38], number of disease episodes [53], higher levels of biomarkers for systemic inflammation [67], diarrhea [21,41], sepsis [32,49], respiratory distress syndrome [49], and neonatal illness [45] were associated with various indicators of poor growth. In contrast, one study reported reduced odds of wasting associated with respiratory infection at 6 months [60]. Infant mycotoxin exposure (aflatoxin and fumonisin) was examined in one study

among 5-month-old infants in Tanzania, but no significant association with stunting or underweight was found [30]. Use of medication (antibiotics or HIV prophylaxis) was not associated with poor growth in the two studies examining this risk factor [35,60]. Infant immunization was examined but showed no significant association with poor growth in infants <6 months in Uganda [22] or in 6-month-old infants in Ethiopia [58].

Hospitalization was considered in eight studies [24,32–35,37,39,49] and was significantly associated with poor growth in four of these [24,33,35,49]. Place of delivery (residential homes or privately owned hospitals compared to public hospitals, and out-of-hospital compared to in-hospital delivery) was associated with poor growth, while the type of delivery attendant was not associated [37,38].

3.4.5. Maternal age, marital status, living situation, and religion

Maternal age was considered in 16 (32 %) of the included studies [22,25,28,34,35,37–39,41,42,47,48,50,54,58,60]. Of these, 37 % reported significant associations. Studies indicated that both younger (<20 years) and older maternal age (>30 or >35 years) increased the odds of stunting, wasting, underweight, or poor weight gain [37–39,41,50,60]. Of the eight studies (16 %) examining marital status [22,27,35,38,42,47,54,58], only one study reported a significant association with a decreased risk of wasting when mothers were single or divorced [27]. Only two studies examined maternal autonomy and decision-making power [47,58], and one of these found increased odds of stunting with higher scores on the maternal autonomy scale [58]. Of the two studies examining maternal literacy [48,53], one found a significant association between wasting and illiteracy [53]. Level of social support [58] and religion or ethnicity [38] were not associated with poor growth.

3.4.6. Maternal anthropometric measurements

Maternal anthropometric indicators were investigated in eight (16 %) of the studies. These included maternal body mass index (BMI), based on weight measurements collected at various time points between 0 and 6 months postpartum across the included studies [20,35,47,54]; maternal height [20,28,35,39,47,53,55,58]; maternal weight measured prior to 18 weeks of gestation [53]; and maternal MUAC during pregnancy [53,58]. In the four studies reporting significant findings, lower BMI [20,54] and height [20,55] increased the odds of stunting, whereas a larger MUAC reduced the odds of underweight [58].

3.4.7. Maternal education, occupation, and income

Maternal occupation and/or income were investigated in nine (18 %) of the included studies [22,25,27,34,37–39,47,54]. One study from Tanzania reported increased odds of stunting with lower maternal income [54], but no other studies reported significant findings. Of the 13 studies (26 %) considering maternal education [22,27,28,34,35,37–39,41,42,47,54,55], four studies reported increased odds of poor growth (stunting, wasting, underweight, or poor weight gain) related to no or lower education [28,34,38,41]. One study found that primary and secondary education increased odds of stunting compared to no education [28]. Knowledge of breastfeeding practices or receiving counselling on breastfeeding was not found to be a significant risk factor for poor growth [34,50].

3.4.8. Maternal health factors

Maternal HIV infection [27,39,47,52,53,60] and treatment [25,27,35,40,41,52] were investigated by five and six studies, respectively. The only significant finding was reported by a study from South Africa, which found an increased risk of stunting and underweight at 6 months if maternal CD4 cell counts were low [60]. Other maternal infections investigated included malaria [53,68], urogenital schistosomiasis [31], tuberculosis [41], and syphilis [41]. One study found an increased risk of underweight infants at 6 weeks when the mother had tuberculosis during pregnancy [41]. Maternal death was not found to be a significant risk factor for poor growth [60]. Antenatal care (ANC) visits were investigated in seven (14 %) of the studies [25,37–39,41,47,50]. One study reported a decreased risk of stunting with no ANC attendance [38], whereas others reported a positive effect of ANC on growth [41,50]. Mental health issues were examined by two studies; one found an association between postpartum depression and increased risk of underweight among infants 6–14 weeks in Kenya, and the other found no associations between maternal mental disorders and poor growth [29,57]. Two studies examined the effect of smoking, alcohol, and illegal drug use on poor growth [25,58]. A study from South Africa found increased odds of stunting at 6 weeks when the mother smoked, snuffed, drank alcohol, or used cannabis, amphetamines, or heroin during pregnancy [25].

3.4.9. Maternal nutrition and birth history

Maternal iron status and anemia were examined in two studies; one found increased odds of stunting and underweight at 6 months when the mother had iron deficiency anemia [53], while the other did not find significant associations [47]. Use of micronutrient supplementation and fortified food during pregnancy was examined in three studies without any significant findings [25,28,47]. Infants born to mothers who did not take vitamin A supplements within two months of delivery had higher odds of stunting and wasting in Guinea [47]. The only study investigating maternal dietary diversity score concluded that a higher score reduced the risk of underweight at 3 and 6 months [63]. Parity was considered in seven of the included studies [37–39,41,47,53,54]. Multiparity was associated with reduced odds of poor growth among 3-month-old infants in Nigeria [37–39]. Maternal history of preterm birth was associated with reduced odds of poor weight gain in Tanzanian infants [34]. Interpregnancy interval was examined by two studies, but no significant findings were reported [47,56].

3.4.10. Household size and paternal characteristics

Of the four studies examining the effect of siblings on poor growth [22,34,35,47], one found increased odds of stunting among infants <6 months who had siblings [22]. Two studies investigated the effect of the number of children <5 years in the household. One found reduced odds of underweight when there was one child <5 years in the household compared to none [58], while the other did not find any association with stunting [47]. Household crowding was associated with underweight among infants aged 6 weeks in Kenya [35], but not with stunting or wasting in Uganda [22] or Guinea [47]. Age [34,47,58], education [22,34,47], and occupation [34,47] of the infant's father or of the mother's partner were examined in four studies. Higher age was associated with increased odds of underweight in Ethiopia [58], and formal education was associated with increased odds of wasting in Guinea [47].

3.4.11. Household factors related to water, sanitation, and hygiene

Factors related to water, sanitation, and hygiene were investigated in seven studies (14 %) [21,25,28,37,38,47,58]. Infants from households with shared sanitation had higher odds of poor growth in Nigeria [37,38], and infants from households with poor sanitation conditions had higher odds of underweight in Ethiopia [58]. Non-appropriate disposal of child stool increased odds of stunting in infants <6 months in Guinea [47].

3.4.12. Household socioeconomic status, type of housing, and food security

Household socioeconomic status was examined in nine studies (18 %) [20–23,38,41,47,56,58]. One study found a significant association with underweight at 6 weeks among infants in South Africa [41]. Neither urban nor rural residency was reported as a significant risk factor for poor growth [21,22,47,50,58], but formal housing was associated with reduced odds of stunting at 6 weeks among infants in South Africa [25]. In Nigeria, rented accommodation was associated with reduced odds of wasting and underweight [38]. Household food security was examined in four studies, but none reported it as a significant risk factor for poor growth [21,25,41,46]. A study from Burkina Faso created latent variables for maternal-, paternal-, household-, access to health care-, and pregnancy characteristics using confirmatory factor analysis, and found several direct and indirect associations with stunting at 3 and 6 months [69].

4. Discussion

Although the 1000 days from conception to a child's second birthday is widely recognized as a critical period for interventions to secure healthy growth and development, the first months of an infant's life have not received sufficient attention [1,70]. This scoping review maps existing evidence on dichotomous indicators used to describe poor growth among infants aged 0–6 months in sub-Saharan Africa and the associated risk factors. The findings suggest that evidence is unevenly distributed across the region. Stunting was the most used indicator, followed by underweight and wasting. Multiple risk factors were reported at the infant, maternal, and household levels.

4.1. Discussion of main findings

A total of 50 studies met the inclusion criteria. However, the majority of sub-Saharan African countries were not represented, with half of the studies originating from only four countries. This presents a challenge, as the prevalence of undernutrition and poor child growth varies across sub-regions, and determinants have shown heterogeneity between countries in the region [71,72]. The lack of both clinical health data and health research in Africa has been identified as a significant barrier to evidence-based care aimed at improving health outcomes in the region [73,74].

There is an ongoing debate on which growth indicators should be used to identify nutritionally at-risk infants during the first months of life [75]. Most studies in this review reported risk factors for stunting (72 %), followed by underweight (48 %) and wasting (42 %). Measuring length in young infants is particularly challenging compared to older children. Newborns and young infants tend to adopt a fetal position with bent knees, complicating length measurements in a stretched position. Additionally, infant activity might disrupt the measurement process, making length measurement prone to errors and reducing the reliability of results [15]. Other indicators, such as underweight or MUAC, have been proposed as more appropriate for this age group due to fewer measurement errors and better prediction of morbidity and mortality risk [15]. However, no studies investigating risk factors related to low MUAC were identified in this review. Weight-related indicators such as extrauterine/postnatal growth failure, failure to regain birth weight, and early growth deficit, were used for preterm or LBW/VLBW infants. Other indicators of poor growth included microcephaly, which was used for ages ranging from 6 weeks to 6 months, and growth failure (>0.67 SD decrease in weight z-score) used at 6 months.

The risk factors identified in this review were categorized into infant, maternal, and household factors. More studies reported significant findings for infant risk factors than for maternal and household factors, with infant factors being more commonly examined. The most frequently studied infant risk factors included infant feeding, sex, illness, and birth weight. Regarding infant feeding, most studies reporting significant findings indicated that deviations from WHO breastfeeding recommendations increased the odds of poor growth. However, a few studies also reported increased odds of poor growth among breastfed infants. Inconclusive findings on the relationship between breastfeeding and child growth have been documented elsewhere [76] and may result from study design limitations, confounding factors, or insufficient data on variables such as breastfeeding frequency and quality [77,78]. Reverse causality, where early discontinuation of exclusive breastfeeding occurs due to a perception of poor infant growth, has been proposed as one explanation [77]. Promoting breastfeeding must remain a priority, given its substantial benefits for both child and maternal health, especially in LMICs [76].

Male sex was identified by several studies as a risk factor for several indicators of poor growth at different ages. Similar findings have been reported in both global and regional reviews of children <5 years [79,80], and the observed differences between sexes are likely due to complex genetic, environmental, and social mechanisms [81,82]. However, the majority of included studies found no association between sex and growth, a finding also reported by Kerac et al. when examining risk factors for acute wasting among infants aged <6 months [83]. This may suggest that sex differences in growth are more pronounced at other ages.

Birth weight or size at birth was found to be significant in 75 % of the studies examining this risk factor. All these studies reported increased odds of poor growth when infants had smaller birth weights or sizes compared to those with larger birth weight or sizes. This finding is consistent with existing literature and underscores the importance of addressing maternal and pregnancy-related factors to improve growth during infancy [8]. Several studies identified infant illness as a risk factor for poor growth across different indicators and ages. HIV exposure or infection was significantly associated with poor growth in 73 % of the studies examining these factors, with all but one study reporting poorer growth in HIV-exposed or -infected infants. In a global review, Isanaka et al. observed growth disturbances in both length and weight from 3 months of age among infants infected by HIV, but not among HIV-exposed uninfected and HIV-unexposed infants [84]. In the current review, several studies reported the effects of both HIV exposure and infection on poor growth from as early as 6 weeks of age.

Among maternal factors, age was the most frequently studied variable. Studies reported that both younger and older maternal ages could negatively impact growth. These effects may be mediated by multiple biological and social factors [85]. Sub-Saharan Africa continues to face high rates of adolescent pregnancies, which are associated with negative outcomes for both mother and child [86]. Of the studies investigating maternal education, one-third found significant associations with poor growth. The direction of these associations largely supports previous evidence linking lower or no education to poor growth [87]. Possible mechanisms underlying these associations may include factors such as health literacy, health care utilization, health decisions, income, living conditions, and pregnancy age [72,86,88]. Intergenerational cycles of undernutrition are known to impact fetal and infant growth in many LMICs [89]. However, this review identified only eight studies (15 %) that examined maternal anthropometric measurements as risk factors for poor growth, of

which four reported significant associations between suboptimal maternal anthropometric measurements and poor infant growth.

Lower socioeconomic status has previously been linked to undernutrition and poor growth in children <5 years old in sub-Saharan Africa [87]. In the present review, only one of the nine studies investigating this issue reported significant findings. This could suggest that household socioeconomic status may have a greater impact on growth at later stages. Among other household factors, poor sanitation conditions were reported as risk factors for poor growth in several studies, starting from an early age.

4.2. Implications of findings

This review found that indicators involving measurements of length were most frequently used, although they are prone to larger measurement errors. This overview of current indicator use could contribute to the ongoing discussion about which indicators are most appropriate for this age group. Identifying risk factors for poor growth related to undernutrition among the youngest infants is crucial for the successful design of interventions aimed at addressing this public health challenge. However, there appears to be a paucity of such information in most countries across the sub-Saharan African region, highlighting the need for increased focus and prioritization of this population. This review provides an overview of both the risk factors considered and those identified as significant in relation to poor growth. Given the exploratory, rather than explanatory, nature of scoping reviews, clear policy recommendations are not warranted. However, the findings emphasize the importance of multifactored and multilayered interventions to improve growth, as significant factors at the infant, maternal-, and household levels were reported, encompassing both immediate and distal risk factors. Although the findings suggest that the infant and pregnancy-related factors are particularly important for growth during the first months of life, sustainable improvements in these factors cannot be achieved without addressing the basic climatic, economic, social and political determinants [90].

4.3. Strengths and limitations

One strength of this study is the inclusion of multiple indicators for poor growth, which offers a comprehensive understanding of how poor growth is defined within this age group. To our knowledge, this is the first review to provide an overview of risk factors for multiple indicators of poor growth among 0–6-month-old infants in this region. Another strength of this study is the adherence to recommended guidelines for planning, conducting, and reporting scoping reviews, thereby enhancing the quality and transparency of the review. Several limitations of this study should be considered. Although two authors independently screened sources throughout the process and collaboratively developed the data extraction form, data extraction was conducted by only one author, which may increase the potential for inaccuracies. To mitigate this risk, the extracted data was subsequently double-checked, and a second author verified 15 % of the extracted data to ensure accuracy. Additionally, the possibility that not all relevant studies have been included cannot be ruled out. Furthermore, non-English studies were excluded. A risk of bias assessment or evaluation of the methodological quality of the included studies was not conducted, as this is not recommended for scoping reviews [18]. Effect estimates and clinical relevance of the findings are not assessed in this review. Combined with the absence of critical appraisal, this limits the ability to draw definite conclusions regarding the impact of different risk factors on growth. Therefore, interpretation of the findings should be approached with caution. Findings indicate key research gaps and patterns in existing literature, providing a foundation for future high-quality studies.

5. Conclusion

The critical role of the first months of life in promoting healthy growth and nutrition in infants is increasingly recognized. However, the findings from this review indicate that information on risk factors for poor growth in this age group is unevenly distributed across the sub-Saharan region. This review broadly examined various indicators of poor growth among infants aged 0–6 months in sub-Saharan Africa, along with their associated risk factors. These findings contribute to a deeper understanding of infant-, maternal-, and household factors affecting growth in early infancy and may inform future research and policy efforts aimed at addressing these risk factors and ensuring healthy growth for young infants.

Author contributions

Katrine Hjertholm: Conceptualization, methodology, formal analysis, investigation, writing-original draft, visualization, project administration. **Per Ole Iversen:** Conceptualization, methodology, writing-review and editing. **Gerd Holmboe-Ottesen:** Conceptualization, methodology, writing-review and editing. **Randi Jepsen:** Conceptualization, methodology, formal analysis, investigation, writing-review and editing.

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Declaration of competing interest

The authors declare no potential conflicts of interest.

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Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.clnesp.2025.05.019.

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