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Article

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Determinants of Health-Related Quality of Life and the Role of Stunting Among Children Aged 5–9 Years in Amhara Region, Ethiopia: A Cross-Sectional Path Analysis

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Abstract

Introduction: Stunting has substantial short- and long-term consequences for children's health and well-being. However, evidence on the link between stunting and health-related quality of life (HRQoL) remains limited. This study aimed to identify factors associated with HRQoL and examine the mediating role of stunting in linking its determinants to HRQoL among children aged 5–9 years in the Amhara Region, Ethiopia."

Methods: A cross-sectional study was conducted among 835 children aged 5-9 years in the North Gojjam and South Gondar Zones of the Amhara Region, Ethiopia, between June and October 2025. A multistage sampling technique was used to recruit participants. Children's health-related quality of life (HRQoL) was assessed using a modified 18-item version of the Pediatric Quality of Life Inventory (PedsQL™) 4.0 Generic Core Scales. HRQoL scores were categorized into low tertiles (<25th percentile) medium (25th to <75th percentile), and high (≥75th percentile) categories. Generalized Structural Equation Modelling (GSEM) was used to evaluate the direct and indirect associations of potential determinants, as well as the mediating role of stunting, with total HRQoL. Statistical significance was set at $p < 0.05$.

Result: Overall, children with high HRQoL score accounted for 36.0% and 38.6%, according to child and parent reports, respectively. Living closer to a health facility (<10 km), adequate dietary diversity score (DDS) and household food security showed direct positive associations with both child-reported and parent-reported HRQoL. However, child stunting, maternal common mental disorders (CMDs), and small birth size showed direct negative associations with total HRQoL in both reports. In the indirect pathways for both reporters, household food security positively influenced total HRQoL through DDS, whereas maternal CMDs negatively influenced total HRQoL through DDS and stunting.

Conclusion: Approximately one-third of children had high total HRQoL. Stunting, DDS, birth size, household food security, maternal CMDs, and health facility proximity were directly associated with child HRQoL. Stunting served as a key mediating pathway linking DDS and maternal CMD to HRQoL. Integrated interventions targeting stunting alongside its underlying dietary, maternal mental health, household, and health-service determinants are essential to optimize children aged 5–9-year total HRQoL.

Keywords: Health-related quality of life, stunting, path analysis, middle childhood, Amhara, Ethiopia

Introduction

Adequate and quality food provides the energy and nutrients essential for growth, health and reproduction from infancy to adolescence[1, 2]. Poor nutrition can lead to stunting, a chronic condition linked to both short- and long-term adverse health and developmental consequences [3, 4]. Stunting was defined as a height-for-age Z-score (HAZ) < -2 SD according to the WHO growth reference 2007 for school-aged children and adolescents (aged 5-19 years) [5]. It often begins with inadequate weight gain, and if left unaddressed, it leads to impaired height growth [6]. Stunting remains a major global public health challenge, affecting about 23.2% (150.2 million) children under five in 2024, most of whom live in low- and middle-income countries [7]. In Ethiopia, the 2024–25 Demographic and Health Survey shows that 40% of children under five are stunted [8]. This nutritional challenge persists beyond early childhood and is highly prevalent among children in middle childhood, aged 5-9 years [9, 10].

Middle childhood (ages 5-9 years) is a critical period for growth, development, and well-being. Stunting during this period can impair physical, cognitive, and psychosocial well-being,

potentially limit children's physical and social participation and reduce their health-related quality of life (HRQoL)[2, 11, 12]. HRQoL is a multidimensional measure of how health influences an individual's functioning and overall well-being. It reflects a person's perception of their life within the context of their culture, values, goals, expectations, and concerns. In children, the HRQoL encompasses key physical, social, cognitive, and emotional domains. These dimensions provide crucial insight into how health conditions affect child development over time [13-16].

Poor HRQoL in children is characterized by poorer physical health, learning ability, cognitive functioning, emotional health, and peer relationships [13, 14]. A complex interplay of individual and environmental factors shapes HRQoL. These include sociodemographic characteristics (age, sex, household socioeconomic status, and family structure), lifestyle behaviour (physical activity, dietary patterns, and sedentary habits), and school-related dynamics (academic stress and performance)[12, 13, 15]. From the domains, emotional health is particularly sensitive to stressors such as sadness and anxiety, which are key determinants of emotional well-being among both primary and secondary school children [14, 17]. In addition, broader environmental conditions, including ecosystem characteristics and living environments, contribute significantly to children's psychosocial well-being [12-15].

Stunting is an understudied determinant of child health-related quality of life (HRQoL). Beyond impaired physical growth, stunting is associated with cognitive, psychological, and social consequences [4, 16-19] that potentially reduce a child's overall HRQoL. However, research has largely focused on children under five years of age, whereas evidence among children in middle childhood (5-9 years) remains limited and has predominantly emphasized physical growth rather than broader HRQoL [20, 21]. Although some studies have assessed HRQoL among adults and adolescents with chronic diseases [22, 23], evidence on HRQoL among stunted children aged 5-9

years is scarce in Ethiopia, including the study area. This is particularly important because middle childhood is marked by school entry, expanding peer relationships, and rapid cognitive and emotional development. Stunted children may therefore experience bullying, poorer academic performance, low self-esteem, and emotional difficulties, potentially compromising their HRQoL [19, 24-26]. Furthermore, in high-stunting settings such as Ethiopia and the study region [8, 27] the relationship between stunting and HRQoL may be less apparent. Evidence on the contextual and cultural factors shaping this relationship among children aged 5–9 years remains limited.

To address these gaps, this study identified factors associated with HRQoL and evaluated the direct and mediating pathways linking stunting and its underlying determinants to total HRQoL among children aged 5–9 years in North Gojjam and South Gondar Zones, Amhara Region, Ethiopia, using Generalized Structural Equation Modeling (GSEM). By understanding these pathways, the study may inform the development of integrated, context-specific strategies to improve children's nutrition, health and overall quality of health. The findings also provide baseline evidence for future longitudinal research.

Methods and materials

Study area and setting: The study was conducted in the North Gojjam and South Gondar administrative zones of the Amhara Region, northwestern Ethiopia. North Gojjam Zone comprises ten districts and had an estimated population of 1,561,460 in 2025, with Bahir Dar serving as its

administrative centre. South Gondar Zone consists of fourteen districts and had an estimated population of 2,702,398 in 2025, with Debre Tabor as its administrative centre. Data were collected from 29 June 2025 to 02 October 2025.

Study design and population: A community-based cross-sectional study was conducted. The source population comprised all children aged 5–9 years residing in two zonal administrations. The study population comprised all children aged 5–9 years residing in selected kebeles.

Sample size calculation: The minimum required sample size was initially estimated using the single-population proportion formula based on an assumed 50% prevalence of good HRQoL, a 95% confidence level (Z = 1.96), and a 5% margin of error, yielding a baseline requirement of 384 participants. Adjusting for a design effect of 1.5 (due to multistage sampling) and an anticipated 10% non-response rate yielded a minimum target of 633 dyads. However, to satisfy the broader primary objectives of the parent project and ensure adequate statistical power for Generalized Structural Equation Modeling (GSEM), a total of 835 child-parent dyads were successfully recruited.

Sampling technique and procedure: A multistage sampling technique was employed. First, five districts (two from North Gojjam and three from South Gondar) were selected using a simple random sampling technique (SRS) from the 23 districts in the North Gojjam and South Gondar zones. Second, 16 kebeles were selected from the five selected districts using SRS. Third, eligible children were selected from the selected kebeles using a systematic random sampling technique (SyRS). The sample size was allocated to each selected kebele using probability proportional to size (PPS) methods. Before data collection, a house-to-house census was conducted with the support of health extension workers to identify all eligible children. The sampling interval (k) was calculated by dividing the total number of eligible children in the selected kebeles (12,441) by the

required sample size (835), yielding (k = 14.9≈15). A random starting point between 1 and 15 was generated using Microsoft Excel, after which every 15th eligible child was selected through systematic random sampling. If a selected household contained more than one eligible child, one child was randomly selected.

Inclusion and Exclusion Procedure: Children aged 5-9 years who had been permanent residents of the two zones for at least six months were eligible for the study. Children with physical, mental, hearing, or visual impairments, as well as those whose parents or caregivers did not provide consent, were excluded.

Variables: Health-related quality of life (HRQoL) was the outcome variable. Independent variables were community, household/family, and child-level factors.

Data collection tool and procedure: Data were collected via an interviewer-administered semi-structured questionnaire adapted from EDHS and other relevant literature [19, 27, 28], using the Kobo Toolbox. Community-level data were collected through interviews with kebele leaders or health extension workers. children's dietary diversity was evaluated using the 24-hour Minimum Dietary Diversity Score (MDDS) based on ten standard food groups [29]. Household food insecurity was assessed using the Food Insecurity Experience Scale Survey Module (FIES-SM). Food insecurity status was determined by summing responses to the eight items and categorizing households into two levels: food secure (scores 0–3) and food insecure (scores 4-8) [30]. Child hygiene was assessed by spot check of hands, clothing, face, and hair. Each item scored 0 (dirty) or 1 (clean) by the data collector. Scores were summed (0–4) and categorized: 0=Very poor, 1=Poor, 2=Fair, 3=Good, 4=Excellent [31]. Household water sources were classified as improved (piped water, boreholes, protected wells/springs, rainwater, and packaged/delivered water) or unimproved (rivers and unprotected springs)[31].

Health-related quality of life (HRQoL) was measured using a modified 18-item generic Pediatric Quality of Life Inventory (PedsQL 4.0), completed by both children and their parents. Due to conflict-related school closures in the study area, the school functioning domain was excluded, and only the physical, emotional, and social functioning domains were assessed. Participants were asked how much of a problem each item had been during the past month before the interview. For child self-reports (ages 5-7), a simplified 3-point scale was used, supported by visual aids (happy-to-sad faces) to aid comprehension. Responses were coded as 0 = not at all, 2 = sometimes, and 4 = a lot, then reverse-scored and linearly transformed to a 0–100 scale (0 = 100, 2 = 50, 4 = 0). For children aged 8-9 and parents' proxy-reports, a 5-point scale was used: 0 = never, 1 = rarely, 2 = sometimes, 3 = often, and 4 = almost always. These items were also reverse-scored and transformed to a 0-100 scale (0 = 100, 1 = 75, 2 = 50, 3 = 25, 4 = 0). Scale scores were calculated as the mean of completed items; however, they were not computed when more than 50% of responses were missing. HRQoL was assessed using the Physical Health Summary Score, the Psychosocial Health Summary Score (emotional and social functioning domains), and the overall HRQoL score [16] (Table 1).

Anthropometric measurements were taken using standard procedures. Height was measured to the nearest 0.1 cm using a portable board, with children standing without shoes and with heels, buttocks, and shoulders aligned. Weight was measured to the nearest 0.1 kg using a beam balance. Children's age in months was obtained from parents. Stunting was defined as a height-for-age z-score (HAZ) below -2 standard deviations from the WHO growth reference [5]. Height-for-age Z-scores were calculated using WHO AnthroPlus software[32]. Maternal nutritional status was assessed using body mass index (BMI, kg/m²) and classified: chronic energy deficiency (BMI <18.5 kg/m²), normal weight (18.5–24.9 kg/m²), overweight (25.0–29.9 kg/m²), and obesity (≥30.0

kg/m²)[33]. Child birth size was assessed based on the parent's report of whether the child was very large, larger than average, average, smaller than average, or very small at birth, as per the EDHS questionnaire [27].

The wealth index was constructed using Principal Component Analysis (PCA) based on household assets (e.g., television, bicycle), housing materials, and water/sanitation facilities. Each item was scored 0 (absent) or 1 (present). Household scores were assigned to members, ranked, and divided into quintiles (20% each). Rural and urban households were assessed separately and then combined[27]. Women's decision-making autonomy was assessed using three items: (1) her own health care, (2) major household purchases, and (3) visits to family/relatives. For each, she received a score of 1 if she decided alone or jointly, and 0 otherwise. An aggregate score was created; women were classified as autonomous if they participated in decision-making across all three domains, and non-autonomous if not[34]. The maternal/caregiver mental health assessment was conducted using the World Health Organisation (WHO) Self-Reporting Questionnaire (SRQ-20). This 20-item tool evaluates depressive, anxiety, panic, and somatic symptoms experienced in the past four weeks, with each item scored as 1 for presence or 0 for absence of symptoms. The total score ranges from 0 to 20, with scores above 8 indicating mental distress [35]. It has been used in previous studies in Ethiopia[36, 37].

Operational Definitions: Social support services were available if the kebele had the Productive Safety Net Programme (PSNP) or non-governmental organizations (NGOs) working on food security or disaster response. A kebele was classified as open defecation-free (ODF) if it had a valid certification from health extension workers, verified through district records and spot checks; certifications older than two years were excluded.

Quality improvement: Data collectors and supervisors received three days of training on study objectives, data collection tools, interviewing techniques, and anthropometric measurements. The questionnaire was translated into Amharic and pre-tested on 5% of the sample. Based on pre-test findings, necessary revisions were made before the main data collection. The anthropometric training included proper positioning, calibration, and standardization. Before data collection began, the competency of all measurers was assessed by comparing their results with those of an experienced measurer to ensure accuracy and consistency. Height and weight were measured twice for each child, and the average was taken. The weighing scale was calibrated every five measurements using a standard 5 kg weight. HRQoL was assessed using the validated PedsQL™ 4.0 Generic Core Scales for both child self-reports and parent proxy-reports, with parents and children completing their questionnaires independently. For children aged 5–7 years, visual aids with three facial expressions facilitated response selection (Annex I). The principal investigator closely supervised fieldwork, checked questionnaires daily, and provided immediate feedback. Finally, data were cleaned, coded, and exported to Stata version 17 for analysis.

Data processing and analysis: The data were cleaned, coded and analyzed using STATA version 17 statistical software[38]. Frequencies, percentages, medians, and interquartile ranges (IQRs) were used to summarize the findings. Height-for-age Z-scores (HAZ) were calculated with WHO AnthroPlus version 1.0.1[32]. Following the PedsQL 4.0 guidelines, children's HRQoL was summarized into physical health, psychosocial health (social and emotional functioning), and total HRQoL (physical, social, and emotional functional domains). HRQoL was assessed using different response scales for children aged 5–7 years (three-point Likert scale) and 8-9 years (five-point Likert scale). Thus, age-specific tertile were used to classify HRQoL as low ($<25^{th}$ percentile), medium (25th -$<75^{th}$ percentile), and high ($\geq 75^{th}$ percentile). These age-specific

categories were then combined to create a total HRQoL classification for children aged 5–9 years, following the approach used in a previous study [39].

Generalized Structural Equation Modeling (GSEM) was employed to evaluate direct and indirect associations across community, household-, and child-level factors within a sequential framework. Because total HRQoL was modeled as an ordinal outcome (low, medium, and high), candidate GSEM specifications were compared using the Bayesian Information Criterion (BIC), where lower values indicated superior fit. The final GSEM model specified an ordered logit link function for HRQoL, which yielded the lowest BIC. Indirect pathways and the mediating role of stunting were estimated as the product of path coefficients along each hypothesized mediating route using the nlcom post-estimation command in Stata. Total associations were calculated as the sum of corresponding direct and indirect path coefficients. Unstandardized path coefficients, along with 95% confidence intervals, were reported for all direct, indirect, and total associations. Statistical significance was set at $p < 0.05$.

Ethics approval and consent to participate: Ethical approval was obtained from the Ethical Review Board of Bahir Dar University, College of Medicine and Health Sciences (Protocol No. 4026/2025). Permission to conduct the study was also obtained from the Amhara Public Health Institute. Informed consent was obtained from all the parents or their legal guardian(s) of the minor participants involved in the study. All methods were performed in accordance with the Declaration of Helsinki[40].

Result

Child characteristics

From the total sample of 835 children aged 5–9 years, 808 were included in the analysis, making a response rate of 96.77%. Of these, 55.69% of children were male, and 69.31% were aged 5–7 years. Only 28.47% of children met the minimum dietary diversity (MDDS), while most children

(79.08%) consumed ≥ 3 meals/day. More than one-third of the children, 38.37%, were stunted, while 10.15% were thin (Table 2).

Community and household/paternal characteristics

More than half of the children (55.94%) lived in rural areas, and the vast majority (95.4%) resided in kebeles located within 10 km of a health facility. Only 13.49% of households had small family sizes. About 23.51% of the children's mothers had a common mental disorder. Almost all children (97.15%) came from food-secure households. Nearly half of the mothers (49.38%) and 37.87% of the fathers were illiterate. The majority (95.4%) resided within 10 km of a health facility. Approximately one-third of children (29.5%) required more than 30 minutes of walking to reach the nearest health facility. Only 10.4% of children lived in kebeles with social support systems, and 19.8% lived in kebeles that were open defecation-free (Table 3).

Internal consistency reliability of the HRQoL

The total HRQoL scale demonstrated internal consistency, with Cronbach's alpha of 0.73 for child self-reports and 0.84 for parental proxy reports. Agreement between child self-reported and parental proxy-reported HRQoL categories was 89.45%, with a weighted kappa of 0.649 (SE = 0.035, $p < 0.001$). Bland–Altman analysis showed a mean difference of 3.58 points, with 95% limits of agreement ranging from −14.27 to 21.43.

HRQoL status of children aged 5-9 years

Overall, children with high HRQoL score accounted for 36.0% and 38.6%, according to child and parent reports, respectively, compared with 38.61% based on parent proxy reports (Figure *1*). There was no statistically significant difference in the distribution of total HRQoL categories

between child self-reports and parent proxy reports (Stuart–Maxwell test: $\chi^2 = 2.76$, df = 2, p = 0.252).

Direct and indirect association of factors on HRQoL among children aged 5-9 years based on children's self-reports

Physical health quality of life

Proximity to a health facility within 10 km (β = 0.97; 95% CI: 0.28, 1.67), food security (β = 1.36; 95% CI: 0.50, 2.22), and adequate DDS (β = 0.93; 95% CI: 0.62, 1.25) showed significant positive direct association. However, Stunting (β = -0.71; 95% CI: -1.04, -0.38), living with animals in the same room (β= -0.32; 95% CI: -0.63, -0.02), maternal common mental disorder (CMD) (β = -0.47; 95% CI: -0.84, -0.11), and small/very small birth size (β= -0.91; 95% CI: -1.38, -0.44) had significant negative direct association on physical health. Regarding indirect paths, significant positive indirect association were observed for absence open defecation through stunting (β=0.14, 95% CI: 0.06, 0.22), food security through DDS (β = 0.17, 95% CI: 0.05, 0.29), meal frequency through stunting (β=0.10, 95% CI: 0.03,0.17) and adequate DDS through stunting (β =0.17, 95% CI: 0.08,0.26). However, significant negative indirect association were observed for living in the same room with animals through stunting (β = -0.09, 95% CI: -0.15,-0.03), maternal with CMD through DDS (β = -0.11, 95% CI: -0.18, -0.04) and maternal CMD through stunting (β = -0.27, 95% CI: -0.42, -0.13) (Table 4) and (Figure 2).

Psychosocial health quality of life

Proximity to a health facility within 10 km (β = 1.03, 95% CI: 0.28, 1.78) and adequate DDS (β = 0.70, 95% CI: 0.35, 1.05) showed significant positive direct association. However, stunting (β = -0.41, 95% CI: -0.76, -0.06), maternal CMD (β =-0.70, 95% CI: -1.09, -0.32) and small/very small

birth weight (β =-0.75, 95% CI: -1.23, -0.28) showed significant direct negative association. Regarding the indirect paths, adequate DDS through reduced stunting (β = 0.10, 95% CI: 0.01, 0.19) and food security through improved DDS (β = 0.12, 95% CI: 0.01, 0.22) showed significant positive indirect association. However, maternal CMD had significant negative indirect association through reducing DDS (β = -0.08, 95% CI: -0.14, -0.02) and through stunting (β = -0.16, 95% CI: -0.30, -0.02) (Table 4) and (Figure 2).

Total health-related quality of life

Proximity to a health facility within 10 km (β = 1.10, 95% CI: 0.44, 1.75), food security (β = 1.34, 95% CI: 0.61, 2.07) and adequate DDS (β = 0.97, 95% CI: 0.63, 1.30) showed a significant positive direct association on the total HRQoL. However, stunting (β = -0.75, 95% CI: -1.08, -0.42), living with livestock in the same room (β= -0.34, 95% CI: -0.64, -0.03), maternal CMD (β= -0.54, 95% CI: -0.89, -0.19), and small/ very small birth size (β=-0.72, 95% CI: -1.19, -0.25) had significant negative direct association. Interims of indirect paths, significant positive indirect association were observed for meal frequency(≥3/day) through reducing stunting (β = 0.11, 95% CI: 0.04,0.18), absence of open defecation through stunting (β = 0.15, 95% CI: 0.07, 0.24), food secure through DDS (β = 0.18, 95% CI: 0.05, 0.30), and adequate DDS through stunting (β = 0.18, 95% CI: 0.09, 0.27). But significant negative indirect association were observed for maternal CMD through stunting (β = -0.29, 95% CI: -0.43, -0.15), maternal CMD through DDS (β = -0.12, 95% CI: -0.19, -0.04) and living with animals in the same room through stunting (β = -0.09, 95% CI: -0.15, -0.03), (Table 4) and (Figure 3).

Direct and indirect association of factors on HRQoL among children aged 5- 9 years based on paternal proxy report

Physical health quality of life

Food security (β = 1.32, 95% CI: 0.45, 2.19) and adequate DDS (β = 0.97, 95% CI: 0.65, 1.28) showed significant positive direct association. However, stunting (β = -0.39, 95% CI: -0.72, -0.06) absence of social support (β = -1.19, 95% CI: -1.65, -0.73), maternal CMD (β = -0.55, 95% CI: -0.91, -0.19), and small/ very small birth size (β = -0.94, 95% CI: -1.36, -0.52) showed significant negative direct association on physical health. Regarding indirect paths, positive indirect association were observed for adequate DDS through stunting (β = 0.10, 95% CI: 0.01, 0.18), and food security through adequate DDS (β = 0.17, 95% CI: 0.05, 0.30). However, maternal CMD showed significant negative indirect association through adequate DDS (β = -0.14, 95% CI: -0.21, -0.04) and through stunting (β = -0.17, 95% CI: -0.31, -0.02) (Table *5*) and (Figure 4).

Psychosocial health quality of life

Significant positive direct association were observed for proximity to a health facility <10 km (β = 1.14, 95% CI: 0.33, 1.95), food security (β = 1.23, 95% CI: 0.34, 2.13) and adequate DDs (β = 1.03, 95% CI: 0.70, 1.35). However, stunting (β = -0.33, 95% CI: - 0.63, -0.02), farmer fathers' occupation (β = -0.34, 95% CI: -0.66, -0.02), maternal CMD (β = -0.63, 95% CI: -0.96, -0.29), and small/very small birth size (β = -1.19, 95% CI: -1.58, -0.80) had significant negative direct association. Regarding the indirect paths, positive indirect association were observed for adequate DDS through stunting (β = 0.08, 95% CI: 0.0015, 0.16) and food security through adequate DDS (β = 0.18, 95% CI: 0.04, 0.31). However, maternal CMD showed a significant negative indirect association both through adequate DDS (β = -0.12, 95% CI: -0.20, -0.04) and stunting (β = -0.14, 95% CI: -0.28, -0.01) (Table *5)* and *(*Figure 4*).*

Total health-related quality of life

Regarding total HRQoL, significant positive direct associations were observed for proximity to a health facility <10 km (β = 1.23, 95% CI: 0.47,1.99), food security (β = 1.29, 95% CI: 0.45,2.13), and adequate DDS (β = 1.04, 95% CI: 0.71,1.36). However, stunting (β = -0.31, 95% CI: -0.61, -0.01), maternal CMD (β = -0.74, 95% CI: -1.07, -0.40) and small/ very small birth size (β = -1.21, 95% CI: -1.65, -0.77) had significant negative direct association. Regarding the indirect paths, food security through adequate DDS (β = 0.19, 95% CI: 0.05–0.33) and adequate DDS through stunting (β = 0.08, 95% CI: 0.15, 2.79) had significant positive indirect association. But maternal CMD exerted significant negative indirect association through both stunting (β = -0.13, 95% CI: -0.25, -0.01) and DDS (β = -0.12, 95% CI: -0.20,-0.04) (Table *5*) and (Figure *5*).

Discussion

The study assessed factors directly and indirectly associated with HRQoL among children aged 5–9 years using both child self-reports and parental proxy reports. The total HRQoL scale demonstrated acceptable internal consistency for both child self-reports and parent proxy reports. Bland–Altman analysis showed a small average difference but some variability between the two reporting methods. There was no statistically significant difference in the distribution of total HRQoL categories between child self-reports and parent proxy reports. This variability may reflect differences in how children and parents perceive and report child well-being. Parents may place greater emphasis on observable and behaviour-based aspects of functioning, whereas children may be more likely to report subjective experiences, including feelings and emotional states[41, 42]. Differences in response formats may also have contributed, as children aged 5-7 years used a three-point scale, whereas parental proxy respondents used a five-point scale [16].

High HRQoL was reported by 36.01% of children and 38.61% of parents proxy report, indicating that more than one-third of children aged 5-9 years had high total HRQoL. There was no statistically significant difference in the distribution of total HRQoL categories between child self-reports and parent proxy reports. The proportion of children with high HRQoL in the present study was lower than that reported in studies from Eastern Ethiopia[43] and in Addis Ababa [44]. This difference may reflect variations in study settings, population characteristics, and methods used to categorize HRQoL. For example, the present study categorized HRQoL into three levels (low, medium, and high), whereas the study from Eastern Ethiopia classified HRQoL into two categories (poor and good). Such differences in categorization may have influenced the distribution of participants across HRQoL groups. Furthermore, nearly two-thirds of children were classified in the low or medium HRQoL categories, suggesting that many children in the study setting may

experience interconnected challenges, including undernutrition, household food insecurity, limited access to healthcare, and psychosocial stressors, which may adversely affect their HRQoL.

In both child and parental proxy reports, stunting, DDS, proximity to a health facility, household food security, maternal CMD, and birth size had significant direct association on total HRQoL. DDS, household food security, and maternal CMD also had significant indirect association. Stunting was identified as a mediating pathway for the associations of DDS and maternal CMD with HRQoL. DDS was identified as a linking pathway for the associations of maternal CMD and household food security with HRQoL.

Stunting was directly associated with lower total HRQoL. This finding is consistent with previous studies showing that stunted children have lower HRQoL than their non-stunted peers [24, 45]. Possible explanations include psychosocial consequences such as negative perceptions of body size, social difficulties, and reduced participation in activities reported in previous studies [24-26]. Stunted children often feel alienated from their social community, hold negative self-perceptions, become socially withdrawn, and suffer from low self-esteem, which reduces their psychosocial and overall HRQoL[25]. Stunting is also associated with reduced physical endurance, lower muscle mass, and limited mobility, which can impair daily functioning [18]. Given the high burden of stunting in the Amhara region[8], addressing this condition is essential to improving children's physical, psychosocial, and total HRQoL.

In the present study, adequate DDS was positively associated with children's total HRQoL, both directly and indirectly through stunting. The positive direct association is consistent with findings from previous studies conducted outside Ethiopia [46, 47]. One possible explanation is that a diverse diet provides a wider range of essential nutrients needed for healthy growth and psychosocial well-being [48, 49]. This is particularly relevant during the ages of 5-9 years, when

adequate nutrition supports continued physical and developmental needs[50]. Dietary diversity may also reflect favourable household conditions, including supportive family environments and better socioeconomic circumstances, which may contribute to better overall HRQoL [48, 51]. Furthermore, adequate DDS also showed a positive indirect association on total HRQoL through its association with stunting. A plausible explanation for this pathway is that adequate DDS practice is associated with nutrient adequacy needed for sustained linear growth and development [49]. Stunting may subsequently be associated with poorer physical functioning and limitations in children's participation in everyday activities, psychosocial and social difficulties[19, 25]. Thus, adequate DDS may be associated with better nutritional adequacy and linear growth, while lower levels of stunting may, in turn, be associated with better physical, psychosocial, and total HRQoL.

Household food security was significantly and positively associated with children's total HRQoL, both directly and indirectly through DDS. The direct association is consistent with findings from Ethiopia [52] and abroad [53-55], which have reported better total HRQoL among children living in food-secure households. One possible explanation is that food-secure households are more likely to provide adequate diverse diets, supporting optimal nutritional status and, consequently, children's physical and psychosocial well-being. Household food security may also reduce parental stress and emotional distress, potentially enabling caregivers to provide better care and emotional support. In contrast, food insecurity may increase stress and anxiety among caregivers and children, which can adversely affect children's emotional and behavioural well-being and, ultimately, their HRQoL [56].

Food security had a positive indirect association with children's total HRQoL through adequate DDS. This finding is consistent with previous studies conducted outside Ethiopia [55]. A possible explanation is that food-secure households are more likely to provide children with diverse diets

that supply the nutrients necessary for healthy growth and development. Adequate DDS promotes optimal physical functioning and strengthens immunity, reducing susceptibility to illness and supporting total HRQoL. These benefits can enhance children's vitality, mobility, and daily functioning, thereby improving their physical health and total HRQoL[26, 50].

The current study found that maternal CMD was significantly directly associated with poorer total HRQoL among children and indirectly through stunting and dietary diversity. The direct association is consistent with previous evidence showing that maternal depression and anxiety can adversely affect children's cognitive, emotional, and physical development, as well as their psychosocial functioning[57-59]. Maternal psychological distress may reduce the capacity to provide consistent emotional support, responsive care, and appropriate attention to children's nutrition and healthcare needs. These challenges may contribute to emotional and behavioural difficulties, poorer physical well-being, and ultimately lower HRQoL[57].

Maternal CMD was also indirectly associated with poorer total HRQoL through stunting. Psychological distress may be associated with poor feeding, caregiving, hygiene, and healthcare-seeking practices, which may increase children's vulnerability to illness and inadequate growth[55, 57, 59, 60]. Stunting may impair physical functioning and overall well-being, contributing to poorer HRQoL. This finding suggests that stunting may represent an important pathway linking maternal CMD with children's HRQoL.

In addition, maternal CMD showed an indirect association with poorer HRQoL through dietary diversity. Maternal psychological distress may make it more difficult to provide a varied and nutritious diet, potentially limiting children's intake of essential nutrients needed for healthy growth and development. Inadequate DDS may, in turn, contribute to poorer nutritional status and well-being, thereby reducing HRQoL [58, 60]. Overall, these findings indicate that maternal CMD

may be related to children's HRQoL through interconnected psychosocial, dietary, and growth-related pathways, with stunting representing an important mediating pathway.

Access to nearby health services was an important predictor of child HRQoL. Living within 10 km of a health facility showed a significant direct positive association with total HRQoL. The positive association between proximity to health facilities and better HRQoL may be explained by improved access to preventive and curative healthcare, timely treatment, and regular health monitoring. Children living closer to health facilities are more likely to experience better physical and psychosocial well-being due to easier access to healthcare services. This can also make healthcare visits less stressful and more familiar, reducing fear and anxiety associated with seeking medical care, particularly among young children [61, 62].

The present study found that small/ very small birth size was significantly and directly associated with lower total HRQoL. This finding is consistent with previous studies showing that children born with very low birth size tend to have poorer emotional, physical, and social functioning, which may contribute to lower HRQoL [63-65]. However, another study found no significant differences in HRQoL between children with low and normal birth weights [66]. The observed association between low birth weight and poorer HRQoL may be explained by its long-lasting association on physical health and neurodevelopment. Children born with low birth size are at increased risk of stunting, chronic health conditions, and neonatal complications. These challenges can limit participation in daily activities and negatively affect overall well-being, resulting in lower HRQoL during childhood and later life [63, 67]. However, another study has found no significant differences in HRQoL, physical health, and psychosocial outcomes between children born with low birth weight and those born with normal birth weight. This inconsistency may be due to the association of low birth size on HRQoL shaped by other contextual, maternal characteristics and

child factors. For instance, poor maternal health and poor parenting practices negatively affected the children's physical and developmental outcomes, reducing their quality of life [68].

Strengths and Limitations

The strengths of this study include the use of advanced statistical methods to examine the mediating role of stunting and the inclusion of both child self-reports and maternal proxy reports of HRQoL. However, the cross-sectional design limits causal inference, and cognitive function could not be assessed because of school closures during data collection. Some variables, including birth size were based on caregiver-reported information and may be subject to recall or reporting bias. Differences in response formats between younger and older children may also have contributed to variation in child-reported HRQoL.

Conclusion and recommendation

Both child self-reports and maternal proxy reports indicated that more than one-third of children aged 5-9 years had high total HRQoL. Stunting, dietary diversity, birth size, household food security, maternal common mental disorders, and proximity to a health facility were directly associated with total HRQoL. DDS, household food security, and maternal common mental disorders also showed indirect associations with total HRQoL. Stunting was identified as a linking pathway for the indirect associations of DDS and maternal CMD with total HRQoL. DDS also served as a linking pathway for the indirect associations of household food security and maternal common mental disorders with total HRQoL. Integrated interventions addressing stunting and its underlying dietary, household, maternal, and healthcare-related determinants may contribute to improving children's HRQoL.

Declaration

Ethics approval and consent to participate: Ethical approval was obtained from the Ethical Review Board of Bahir Dar University, College of Medicine and Health Sciences (Protocol No. 4026/2025). Permission to conduct the study was also obtained from the Amhara Public Health Institute. Informed consent was obtained from all the parents or their legal guardian(s) of the minor participants involved in the study. All methods were performed in accordance with the Declaration of Helsinki.

Consent for publication: Not applicable because the manuscript does not include, images, or videos relating to individual participants

Availability of data and materials: The minimal anonymize dataset is available from the corresponding author upon reasonable request at seoumer@yahoo.com.

Competing interests: The authors declare no competing interests.

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Authors' contributions: OS, YM, DB, and TG contributed to the proposal and tool development. All authors (OS, YM, DB, TG, EW, and AWM) participated in data collection, analysis, drafting, and critical revision of the manuscript. All authors read and approved the final manuscript.

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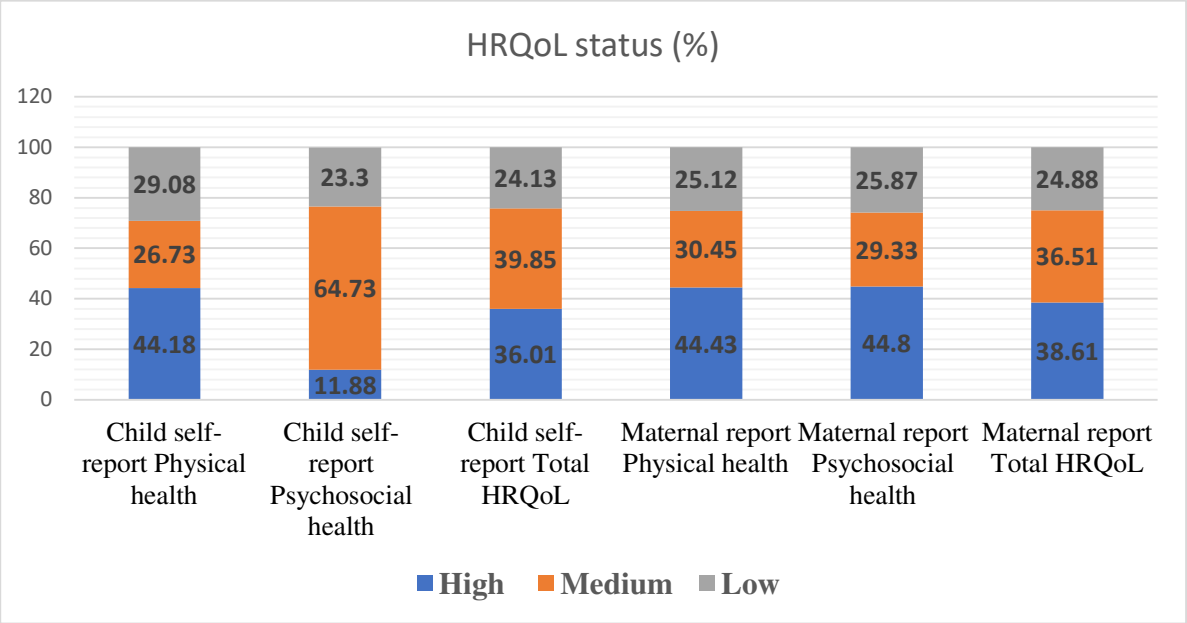
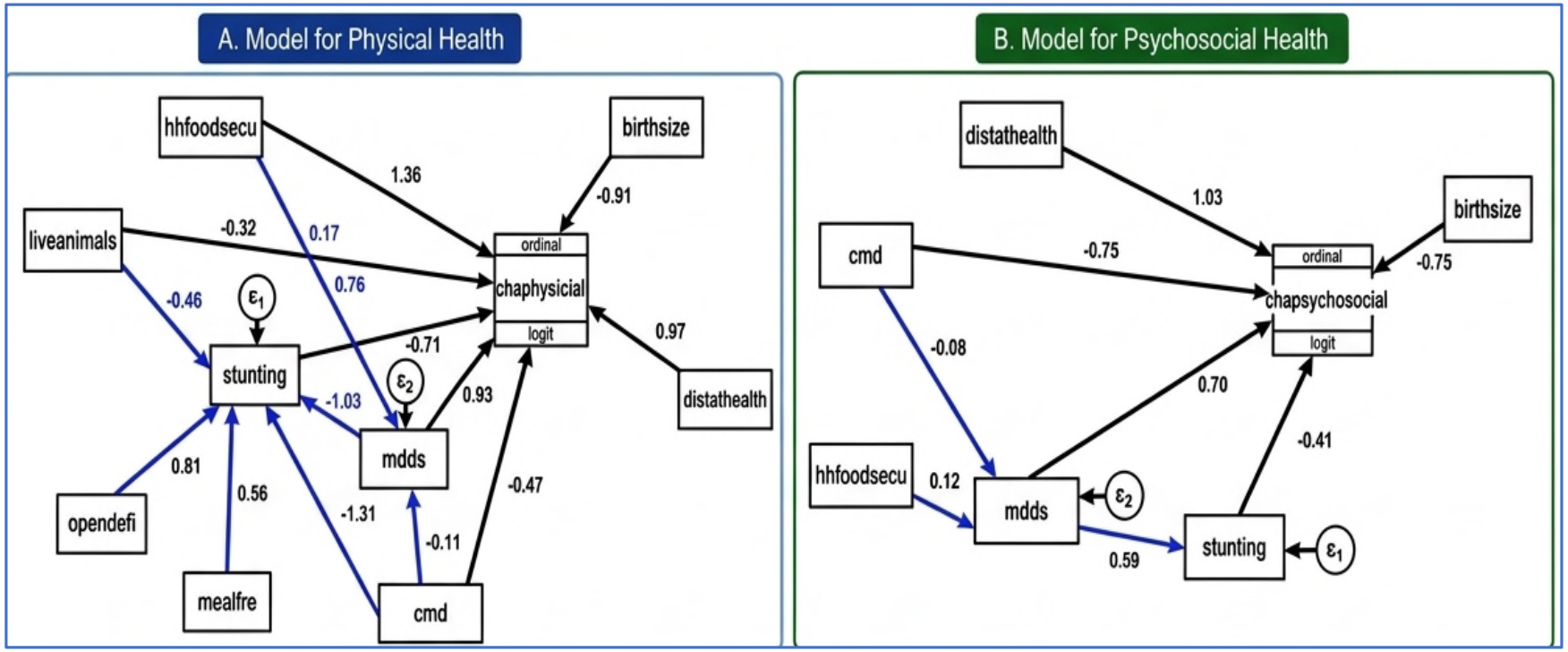
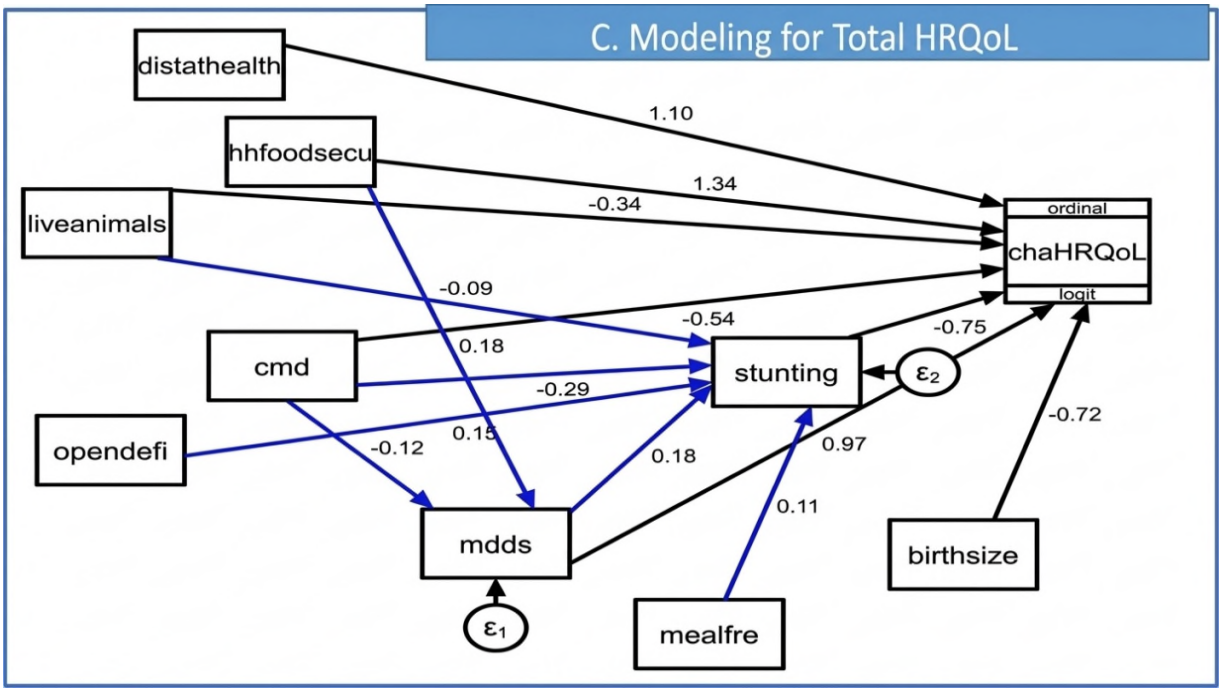


Figure 1: HRQoL status of children aged 5–9 years based on child self-reports and parental proxy reports in North Gojjam and South Gondar Zones, Amhara Region, Ethiopia, 2025 (n = 808).



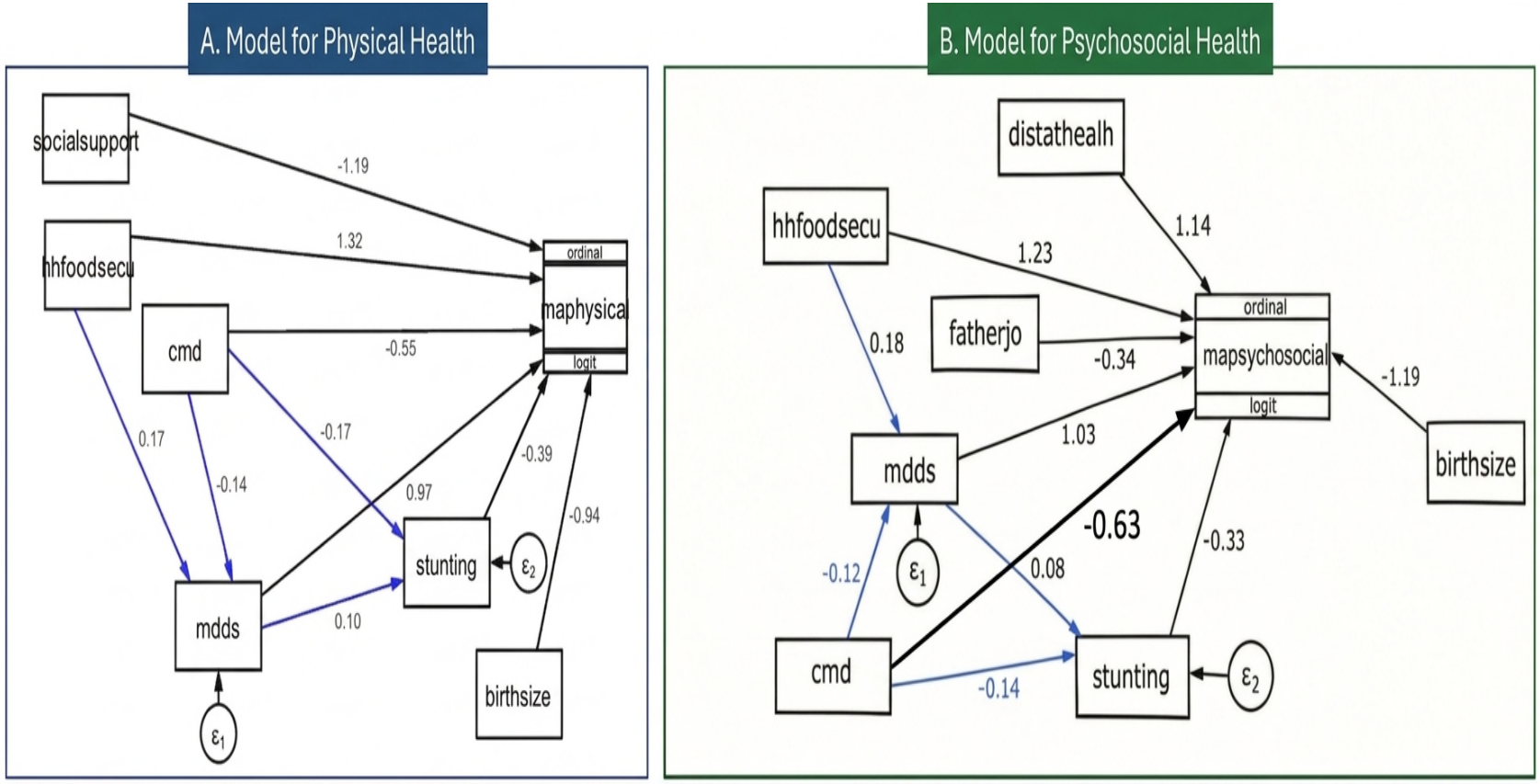
Abbreviations: *chaphyscial = physical health quality of life from child report;* chapsychosocial = *psychosocial health quality of life from child report; opendefi = open defecation; distathealth = distance from Kebele to nearest health facility; hhfoodsecu = household food security; liveanimals = living in the same room with animals; cmd = maternal common mental disorder; birthsize = child birth size; mealfre = meal frequency per day; mdds = minimum dietary diversity score. Black arrows indicate direct associations, whereas blue arrows indicate indirect associations.*

Figure 2: Path analysis of direct and indirect factors significantly associated with physical and psychological health-related quality of life among children aged 5–9 years based on child self-reports (n = 808).



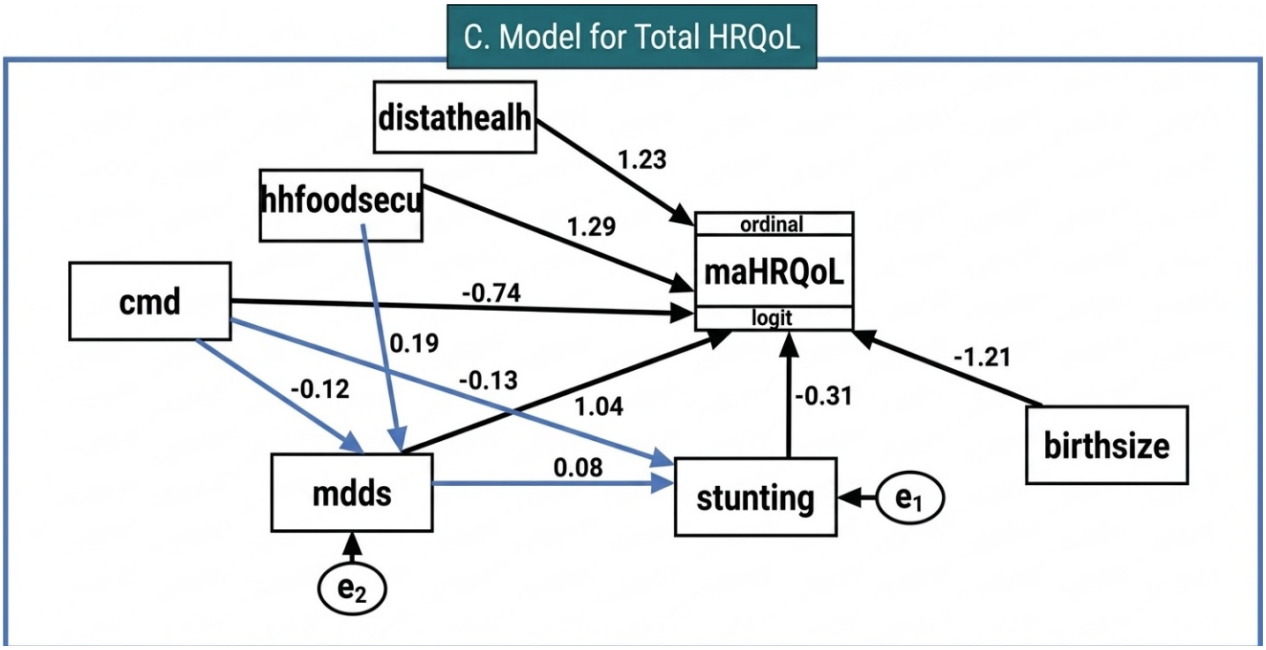
Abbreviation: chaHRQoL, children's total health-related quality of life * Other abbreviations are mentioned in Figure 3.

Figure 3: Path analysis of direct and indirect factors significantly associated with total HRQoL among children aged 5–9 years based on child self-reports (n = 808).



Abbreviations: *mapphysical=physical health quality from maternal report, mapsychosocial=psychosocial health quality from maternal report, fatheredu = fathers' education and socialsupport = a social support system in the kebele. * Other abbreviations are mentioned in Figure 3.*

Figure 4: Path analysis of direct and indirect factors significantly associated with physical and psychosocial health quality of life among children aged 5–9 years based on parental proxy (n = 808)



Abbreviation: *chaHRQoL = total HRQoL from maternal report. * Other abbreviations are mentioned in Figure 3.*

Figure 5: Path analysis of direct and indirect factors significantly associated with total HRQoL among children aged 5–9 years based on parental proxy report (n = 808).

List of tables

Table 1: PedsQLTM [4.0] Generic Core Scales for Children and parental proxy Report Summary

	Dimensions (Items)	**Summery score**
Children	• Physical functioning (8 items) • Emotional functioning (5 items) • Social functioning (5 items)	• Physical health summary (8 items) • Psychosocial health summary score (10 items) • Overall score =18
Parents	• Physical functioning (8 items) • Emotional functioning (5 items) • Social functioning (5 items)	• Physical health summary (8 items) • Psychosocial health summary score (10 items) • Overall score =18

Table 2: Child-related characteristics among children aged 5–9 years in North Gojjam and South Gondar Zones, Amhara Region, Ethiopia, 2025 (n = 808).

Characteristics		**Frequency**	**Percent**
Child sex	Female	358	44.31
	Male	450	55.69
Child age	5-7 Years	560	69.31
	8-9 Years	248	30.69
Twin birth	Yes	20	2.48
	No	788	97.52
Child's birth size	Very small/small	73	9.03
	Average/large	735	90.97
Child hygiene status	Poor and below	219	27.10

	Fair and above	589	72.90
Minimum dietary diversity score of the child	Adequate	230	28.47
	Inadequate	578	71.53
Meal frequency per day	<3	169	20.93
	≥3	639	79.08
Thinness	Not thin	726	89.85
	Thin	82	10.15
Stunting statues	Stunted	310	38.37
	Non-stunted	498	61.63

Table 3: Community and household/paternal-related characteristics among children aged 5–9 years in the North Gojjam and South Gondar zones, Amhara Region, Ethiopia, 2025 (n = 808).

Characteristics		**Frequency**	**Percent**
Districts	Bahir Dar Zuria	141	17.45
	Yilmana ena Denssa	214	26.49
	Fogera	219	27.10
	Dera	148	18.32
	Guna Begemidr	86	10.64
Residency	Rural	452	55.94
	Urban	356	44.06
Average distance of kebele to the nearest health facility	< 10 Km	771	95.4
	≥10 Km	37	4.6
	No	724	89.60

Social support system in the kebele	Yes	84	10.40
Open defecation free kebele	No	648	80.20
	Yes	160	19.80
Family size	Small (<4)	109	13.49
	Medium and above (≥4)	699	86.51
Household water source	Improved	731	90.47
	Not improved	77	9.53
Toilet availability	No toilet	267	33.04
	Have toilet	541	66.96
Wealth index	Poorest	161	19.93
	Poor	161	19.93
	Middle	164	20.30
	Rich	162	20.05
	Richest	160	19.80
Mothers/caregiver decision-making power	Yes	187	23.14
	No	621	76.86
Separate room for livestock	Kept in a separate room	296	36.63
	Kept in the same dwelling	512	63.37
Household food security status	Food secure	785	97.15
	Food insecure	23	2.85
Respondent age (years)	≤30	296	36.63
	≥31	512	63.37
	Married	766	94.80

Marital status of respondents	Single/Divorced	42	5.20
Maternal education	Illiterate	399	49.38
	Primary school	180	22.28
	Secondary school	108	13.39
	College and above	121	14.98
Father's education	Illiterate	306	37.87
	Primary school	173	21.41
	Secondary school	137	16.96
	College and above	192	23.76
Maternal job	Housewife	438	54.21
	Government employed	138	17.08
	Agriculture	134	16.58
	Business	98	12.13
Father job	Agriculture	578	71.53
	Government employed	141	17.45
	Business	89	11.01
Maternal BMI	Chronic energy deficiency	107	13.24
	Normal weight	609	75.37
	Overweight/Obese	92	11.39
Maternal CMD	Distressed	190	23.51
	Good	618	76.49

Table 4: Direct, indirect, and total association of factors associated with HRQoL among children aged 5–9 years based on child self-reports using a generalised structural equation model (n = 808).

Predictor	**Effect type/paths**	**Physical health**	**Psychosocial health**	**Total HRQoL**
		β (95% CI)	**β (95% CI)**	**β (95% CI)**
Distance from Kebele to nearest health facility (<10 km)	Direct	0.97 (0.28, 1.67) **	1.03 (0.28, 1.78) **	1.10(0.44, 1.75) **
Open defecation free kebele (No)	Direct	- 0.28 (-0.68, 0.12)	-	-0.21(-0.58, 0.15)
	→ Stunting	0.14(0.06, 0.22) **	-	0.15(0.07, 0.24) **
	Total effect	-0.14(-0.56, 0.28)	-	-0.06(-0.46, 0.32)
Social support in the kebele (No)	Direct	-0.36 (- 0.80, 0.08)	-0.01 (- 0.41, 0.39)	-0.30(-0.72, 0.13)
Live in the same room with livestock's (Yes)	Direct	-0.32(- 0.63, -0.02) *	-0.28(- 0.61, 0.06)	-0.34(-0.64, -0.03) *
	→ Stunting	-0.09(-0.15, -0.03) *	-0.05(-0.10, -0.001) *	-0.09(-0.15, -0.03) *
	Total effect	-0.41(-0.73, -0.10) *	-0.33(-0.67, 0.01)	-0.43(-0.73, -0.12) *
Household food security (Food secure)	Direct	1.36 (0.50, 2.22) *	0.30 (-0.43, 1.03)	1.34(0.61, 2.07) *
	→ DDS	0.17(0.05, 0.29) *	0.12(0.01, 0.22) *	0.18(0.05, 0.30) **
	Total effect	1.53(0.64, 2.40) **	0.42(-0.34, 1.19)	1.51(0.66, 2.36) **

Maternal common mental disorder (Distressed)	Direct	-0.47 (-0.84, -0.11) *	-0.70(-1.09, -0.32) **	-0.54(-0.89, -0.19) *
	→Stunting	-0.27 (-0.42, -0.13) **	-0.16(- 0.30, -0.02) *	-0.29(-0.43, -0.15) **
	→ DDS	-0.11(-0.18, -0.04) *	-0.08(-0.14, -0.02) *	-0.12(-0.19, -0.04) **
	Total indirect	-0.36(-0.41, -0.01) *	-0.24(-0.32, -0.08) *	-0.41(-0.73, -0.02) *
	Total effect	-0.83(-0.96, 0.15)	-0.94 (-1.10, -0.17) *	-0.95(-0.99, -0.07) *
Childbirth size (small/very small)	Direct	-0.91(-1.38, -0.44) **	-0.75 (-1.23, -0.28) *	-0.72(-1.19, -0.25) *
Minimum Dietary Diversity score (Adequate)	Direct	0.93(0.62, 1.25) **	0.70 (0.35, 1.05) **	0.97(0.63, 1.30) **
	→Stunting	0.17 (0.08,0.26) **	0.10(0.01, 0.19) *	0.18(0.09, 0.27) **
	Total effect	1.10(0.75, 1.46) **	0.80(0.43, 1.17) *	1.15(0.78, 1.51) **
Meal frequency (≥3/day/day)	Direct	0.26 (-0.10, 0.62)	0.27 (-0.09, 0.64)	0.18(-0.15, 0.55)
	→Stunting	0.10(0.03, 0.17) *	0.06(-0.001, 0.12)	0.11 (0.04, 0.18) *
	Total effect	0.36(-0.21, 0.52)	0.33(-0.16, 0.59)	0.29(-0.28, 0.42)
Child stunting (Yes)	Direct	-0.71 (-1.04, -0.38) **	-0.41 (-0.76, -0.06) *	-0.75(-1.08, -0.42) **
Fathers' Job (Agriculture)	Direct	-	0.21 (-0.11, 0.52)	-
Maternal education (Illiterate)	Direct	-	-	0.09(-0.36, 0.18)
	Total effect	-	-	0.09(-0.36, 0.18)

Note: *Significant at *P < 0.05; **P <0. 001. For indirect effects, we included only paths with statistically significant indirect effects. A hyphen ("-") indicates that the variable was not included in the final analytical model. Variables evaluated solely for direct pathways do not display separate indirect or total effect rows.*

Table 5: Direct, indirect and total association of factors associated with HRQoL among children aged 5–9 years based on parental proxy reports using a generalised structural equation (n = 808)

Factor	**Effect type/paths**	**Physical health**	**Psychosocial health**	**Total HRQoL**
		β (95% CI)	β (95% CI)	β (95% CI)
Distance from Kebele to nearest health facility (<10 km)	Direct	0.71 (-0.09, 1.50)	1.14(0.33,1.95) **	1.23(0.47, 1.99) *
Social support in the kebele (No)	Direct	-1.19 (-1.65, -0.73) **	-	-
Household food security (Food secured)	Direct	1.32 (0.45, 2.19) *	1.23 (0.34, 2.13) **	1.29(0.45, 2.13) *
	→ MDDS	0.17(0.05, 0.30) *	0.18 (0.04, 0.31) *	0.19(0.05, 0.33) *
	Total effect	1.49(0.59,2.39) *	1.41(0.48, 2.35) *	1.48(0.59, 2.35) **
Maternal common mental health status (Distressed)	Direct	-0.55 (-0.91, -0.19)	-0.63(-0.96, -0.29)	-0.74(-1.07, -0.40) *
	→Stunting	-0.17 (-0.31, -0.02) *	-0.14(-0.28, -0.01)0*	-0.13(-0.25, -0.01) *
	→ MDDS	-0.14 (-0.21, -0.04) *	- 0.12(-0.20, -0.04) **	-0.12(-0.20, -0.04) *
	Indirect total	-0.31(-0.61, 0.10)	-0.26(-0.56, 0.13)	-0.17(-0.46, 0.14)

	Total effect	-0.86 (-0.95, -0.04) *	-0.89(-1.03, -0.20)	-0.91(-1.14, -0.33) **
Childbirth size (Very small/small)	Direct	-0.94 (-1.36, -0.52) **	-1.19(-1.58, -0.80)	-1.21(-1.65, -0.77)
Minimum Dietary diversity score (Adequate)	Direct	0.97(0.65, 1.28) **	1.03 (0.70, 1.35)	1.04(0.71,1.36) **
	→Stunting	0.10 (0.01, 0.18) *	0.08(0.0015, 0.16)	0.08 (0.001, 0.16) *
	Total effect	1.07(0.72, 1.40) **	1.11(0.75,1.46) **	1.12 (0.77, 1.46) **
Child stunting (Yes)	Direct	-0.39(-0.72, -0.06) *	-0.33(-0.63, -0.02,)	-0.31(-0.61, -0.01)
Thinness (thin)	Direct	-	-	0.43(-0.01, 0.86)
Mother's Job (housewife)	Direct	-	-0.23(-0.51, 0.06)	-
Fathers' Job (Agriculture)	Direct	-0.25 (-0.56, 0.73)	-0.34(-0.66, -0.02) *	-0.28(-0.58, 0.02)
Father's education (Illiterate)	Direct	-	-0.10(-0.38, 0.19)	-

Note: *Significant at *P < 0.05; **P <0. 001. For indirect* association*, we included only paths with statistically significant indirect* association*. A hyphen ("-") indicates that the variable was not included in the final analytical model. Variables evaluated solely for direct pathways do not display separate indirect or total effect rows.*