

Recorded Malnutrition and Associated Factors Among Children Under Five Attending ELWA Hospital, Liberia: A Cross-Sectional Analysis

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ABSTRACT

Child malnutrition remains an important public health concern in Liberia. This facility-based cross-sectional analysis examined recorded malnutrition among 272 children represented in the ELWA Hospital clinical and nutrition dataset. The source-recorded malnutrition variable was used as the primary outcome, while recorded WAZ, HAZ, WHZ and MUAC indicators were summarized descriptively. Modified Poisson regression with robust variance was used to estimate prevalence ratios, with a reduced adjusted model because only 14 children were recorded as not malnourished. Among 269 children with a recorded malnutrition status, 255 (94.8%) were classified as malnourished. Recorded WAZ below -2 SD was present in 255 of 271 children (94.1%), HAZ below -2 SD in 255 of 271 (94.1%), WHZ below -2 SD in 254 of 269 (94.4%), and MUAC below 12.5 cm in 51 of 262 children with valid MUAC (19.5%). None of the six factors in the reduced adjusted model showed clear evidence of association at the 5% level. Among 23 children with a recorded nutritional intervention, mean weight increased by 0.46 kg (paired Wilcoxon $p=0.010$), while mean height changed by 0.02 cm ($p=0.317$). Seventeen of 22 children with known treatment outcomes were recorded as improved. The findings describe a high recorded burden of malnutrition in this facility-based dataset, but the available records do not permit independent verification of WHO growth z-scores because exact age in months is unavailable.

Keywords: child malnutrition; underweight; stunting; wasting; MUAC; Liberia; ELWA Hospital

1.0 Introduction

Child malnutrition remains a major public health concern because poor growth is associated with illness, impaired development and adverse longer-term outcomes. Global estimates continue to show substantial levels of stunting and wasting among children under five years [1]. In Liberia, the 2019–20 Demographic and Health Survey documented a substantial burden of child undernutrition, while more recent national analysis continues to show differences in child health and nutrition across settings [2,3]. These national estimates provide an important picture of the population burden, but they do not describe the nutritional profile of children who present to an individual hospital for assessment or care.

Anthropometric indicators describe different aspects of child growth. Weight-for-age, height-for-age and weight-for-length or height are therefore interpreted as distinct measures rather than interchangeable indicators [4,5]. Their validity depends on accurate age information, standardized measurements and correct application of the relevant growth standards [4,5]. MUAC is also used to identify acute malnutrition when the applicable age criterion is met [6]. In clinical records, the usefulness of these measures depends on the quality of the measurements and the information available to support their interpretation.

Facility-based records describe children who reach health services and may provide information that is not captured in a national household survey. They do not, however, represent children who do not attend the facility, and recorded findings should therefore be interpreted within the context of health-service use and the quality of the clinical information. This study describes the recorded nutritional status of children under five years attending ELWA Hospital, examines selected socioeconomic, demographic, clinical, dietary and maternal factors associated with the recorded malnutrition outcome, and describes directly measured changes in weight and height among children with a documented nutritional intervention.

2.0 Literature Review

Child undernutrition is influenced by household resources, maternal characteristics, illness and the wider social environment. Global evidence describes these influences as interconnected rather than attributable to a single exposure [7,8]. In Liberia, national survey findings document persistent nutritional problems, but household surveys and facility records describe different populations and serve different purposes [2,3].

Maternal and parental education has been examined extensively in relation to child growth. Evidence from low- and middle-income countries indicates an association between parental education and childhood nutritional status, although the strength of the association varies across settings and between maternal and paternal education [9,10]. Household income and living

conditions may also affect nutrition through food access, caregiving resources, sanitation and exposure to infection [7,8]. These factors are relevant to the socioeconomic information available in the ELWA Hospital records.

Water, sanitation and hygiene are also linked to child nutritional outcomes. Systematic reviews have reported associations between WASH conditions and childhood stunting, while findings concerning acute malnutrition are less consistent [11,12]. Clinical illness may occur alongside poor nutritional status, and malaria among children under five varies with age and household and environmental conditions [13]. In a facility-based cross-sectional study, illness recorded at the time of care is therefore better treated as a clinical characteristic than as evidence of a causal relationship with malnutrition.

Evidence on nutritional treatment provides a separate context for interpreting follow-up measurements. Systematic reviews have reported weight gain among children receiving treatment for acute malnutrition, but outcomes vary with treatment approach, severity and programme setting [14,15]. Changes observed in facility records can describe what occurred among children receiving care, but they cannot by themselves establish treatment effectiveness when there is no untreated comparison group.

The literature provides the context for examining nutritional status together with socioeconomic, clinical, dietary and maternal characteristics and for interpreting treatment follow-up separately from cross-sectional associations. The present study applies this approach to children attending ELWA Hospital in Liberia, using the available clinical records to describe recorded nutritional indicators, examine selected factors associated with the recorded malnutrition outcome, and report directly measured weight and height changes among children with a documented nutritional intervention.

3.0 Study Objectives

1. To describe the recorded frequency of MUAC below 12.5 cm among children with a valid MUAC measurement and assessable age information.
2. To assess associations between selected socioeconomic and demographic characteristics and recorded malnutrition among children attending ELWA Hospital.
3. To assess associations between selected clinical, dietary and maternal health factors and recorded malnutrition.

4. Among children with a recorded nutritional intervention, to describe changes in directly measured weight and height and summarize treatment outcomes and caregiver satisfaction.

4.0 Research Methodology

4.1 Study design and setting

This was a retrospective cross-sectional analysis of 272 children under five years represented in the supplied ELWA Hospital clinical and nutrition dataset. The analysis used the complete available facility dataset rather than a newly recruited sample.

4.2 Data source and variables

The dataset contained 38 source variables covering child age group and sex, caregiver and maternal characteristics, household conditions, feeding practices, recent illness, immunization, nutrition knowledge, supplementation, anthropometric measurements, nutritional interventions, treatment follow-up, treatment outcomes and caregiver satisfaction.

4.3 Anthropometric data and definitions

The supplied dataset contained recorded initial WAZ, HAZ and WHZ fields and a MUAC field. Recorded underweight was defined as WAZ below -2 SD, recorded stunting as HAZ below -2 SD, and recorded WHZ-defined wasting as WHZ below -2 SD. MUAC below 12.5 cm was summarized among children with a valid recorded MUAC, using the assessment criterion recorded in the source dataset [6]. Because exact age was unavailable, eligibility for applying the MUAC criterion could not be fully verified. These indicators are described as recorded measures because the dataset provides only broad age groups rather than exact age in months or date of birth; independent recalculation of WHO growth z-scores was therefore not possible [4,5]. The age-group label 25–34 months was retained as supplied and flagged for verification because the supplied coding contains a gap before the 37–48-month category.

4.4 Data cleaning and quality assessment

The dataset was reviewed for missing, invalid and implausible values before analysis. Four MUAC values recorded as 0.0 cm were treated as invalid and excluded from the MUAC analysis. An undefined maternal-illness category and an invalid treatment-outcome entry were treated as missing. Implausible measurements, including a recorded current weight of 69 kg and a post-treatment height of -3 cm, were flagged but were not corrected or imputed.

The initial z-score fields showed extensive duplication, and the treatment WAZ, HAZ and WHZ fields were systematically identical across the intervention records. These variables were therefore retained as source fields but were not independently interpreted as validated WHO z-scores. The source-recorded malnutrition variable was used as the primary binary outcome for regression.

4.5 Outcome definition

For inferential analysis, recorded malnutrition was defined from the source malnutrition field, coded as malnourished or not malnourished. This decision avoided constructing an inferential outcome from duplicated and unverified z-score fields. The anthropometric indicators were summarized descriptively.

4.6 Statistical analysis

Categorical variables were summarized using frequencies and percentages. Crude associations with recorded malnutrition were examined using modified Poisson regression with robust variance to estimate prevalence ratios [16]. Several sparse multi-level predictors contained categories with no outcome-negative observations. Where necessary, these predictors were collapsed into clinically interpretable binary contrasts before modeling. The adjusted model was intentionally reduced to six conceptually central predictors: child sex, parent/guardian age 30 years or older, maternal secondary/tertiary education, household income of at least 18,000 LRD per month, non-flush sanitation, and malaria versus other recorded illness. Only 14 children were classified as not malnourished, so the adjusted model was treated as exploratory rather than a stable predictive model.

Among children with a recorded nutritional intervention, paired weight and height measurements were summarized and compared using paired Wilcoxon tests. Recorded WAZ, HAZ and WHZ changes were not included in the main treatment analysis because the source fields were systematically duplicated and exact age was unavailable. Treatment outcomes and caregiver satisfaction were summarized descriptively. No causal treatment effect was estimated because there was no untreated comparison group.

4.7 Ethical considerations

Permission to collect and use the clinical and nutrition data was obtained from ELWA Hospital. The study involved analysis of existing clinical records and did not involve direct recruitment or interaction with participants. The analysis was conducted using the authorized data provided for the study, with appropriate attention to confidentiality and protection of patient information.

4.8 Reporting and software

The data were analyzed using R, with descriptive statistics and modified Poisson regression with robust variance used to summarize the findings and estimate prevalence ratios. The manuscript was prepared in accordance with relevant observational reporting principles [17].

5.0 Results

5.1 Participant characteristics

The dataset included 272 children. Females represented 52.0% and males 48.0%, with one missing sex value. Nearly half of the children were aged 7–12 months and 34.6% were aged 13–24 months. Secondary education was the most common maternal education category. Almost half of households reported monthly income below 18,000 LRD, while most were classified as concrete/plaster housing. Pit latrine use and open defecation were recorded in a smaller proportion of households. Malaria was the most frequently recorded recent illness. Only 27.2% of children were recorded as fully immunized.

Table 1. Socioeconomic, demographic, clinical and dietary characteristics of the study sample

Characteristic	Category	N	Percent
Age group	0–6 months	29	10.7
Age group	7–12 months	128	47.1
Age group	13–24 months	94	34.6
Age group	25–34 months (source label; verify)	16	5.9
Age group	37–48 months	4	1.5
Age group	49–60 months	1	0.4
Sex	Male	130	47.8
Sex	Female	141	51.8
Sex	Missing	1	0.4
Mother education	No formal education	61	22.4
Mother education	Primary school	28	10.3
Mother education	Secondary school	163	59.9
Mother education	Tertiary education	20	7.4
Household income	Below 18,000 LRD	134	49.3
Household income	18,000–54,000 LRD	137	50.4
Household income	More than 54,000 LRD	1	0.4

Characteristic	Category	N	Percent
Housing type	Zinc	62	22.8
Housing type	Mud to mud	20	7.4
Housing type	Concrete/plaster	190	69.9
Sanitation	Flush toilet	165	60.7
Sanitation	Pit latrine	95	34.9
Sanitation	Open defecation	12	4.4
Caregiver occupation	Business	129	47.4
Caregiver occupation	Farming	5	1.8
Caregiver occupation	Civil servant	7	2.6
Caregiver occupation	Private institution	17	6.2
Caregiver occupation	Not working	114	41.9
Exclusive breastfeeding	No	142	52.2
Exclusive breastfeeding	Yes	129	47.4
Exclusive breastfeeding	Missing	1	0.4
Recent illness	Diarrhea	19	7.0
Recent illness	Respiratory infection	45	16.5
Recent illness	Malaria	116	42.6
Recent illness	Malaria and diarrhea	39	14.3
Recent illness	None reported	53	19.5
Maternal illness during pregnancy	No	155	57.0
Maternal illness during pregnancy	Yes	112	41.2
Maternal illness during pregnancy	Missing	5	1.8
Immunization	Complete	74	27.2
Immunization	Incomplete	198	72.8
Nutrition knowledge	No	184	67.6

Characteristic	Category	N	Percent
Nutrition knowledge	Yes	88	32.4
Supplementation	No	60	22.1
Supplementation	Yes	211	77.6
Supplementation	Missing	1	0.4

Note. Percentages are calculated from all 272 records. Missing responses are shown where applicable. The 25–34-month age label is retained from the supplied source coding and should be verified against the original questionnaire/codebook.

5.2 Recorded anthropometric indicators

Among 269 children with a source-recorded malnutrition status, 255 were recorded as malnourished. Recorded WAZ below -2 SD was present in 255 of 271 children, HAZ below -2 SD in 255 of 271, and WHZ below -2 SD in 254 of 269. Among 262 children with valid MUAC measurements after removal of four zero values, 51 had MUAC below 12.5 cm. These values are descriptive of the supplied records and should not be interpreted as independently validated WHO prevalence estimates.

Table 2. Recorded anthropometric indicators and source-recorded malnutrition status

Indicator	Assessed	Positive	Percent
Underweight (recorded WAZ < -2 SD)	271	255	94.1
Stunting (recorded HAZ < -2 SD)	271	255	94.1
WHZ below -2 SD (recorded)	269	254	94.4
MUAC < 12.5 cm (valid recorded MUAC)	262	51	19.5
Recorded malnutrition status: Yes	269	255	94.8

Note. WAZ, HAZ and WHZ are recorded source fields and were not independently recalculated because exact age in months is unavailable [4,5]. MUAC=0.0 cm was treated as invalid/missing. MUAC eligibility cannot be fully resolved from the broad age groups supplied.

5.3 Socioeconomic and demographic associations

Crude modified Poisson analyses based on the source-recorded malnutrition outcome showed modest associations for selected collapsed contrasts. Children with a parent/guardian aged 30 years or older had a PR of 0.94 (95% CI 0.88–1.00) compared with those under 30 years, and households with income of at least 18,000 LRD had a PR of 0.94 (95% CI 0.89–1.00). Female sex, housing type, non-flush sanitation and caregiver occupation were not clearly associated with

the recorded outcome. Sparse categories in the original coding were collapsed before analysis to avoid empty outcome-negative cells.

Table 3. Crude associations between socioeconomic and demographic characteristics and recorded malnutrition

Variable	Comparison	PR (95% CI)	P value	N
Child sex	Female vs Male	1.04 (0.98–1.10)	0.226	269
Parent/guardian age	30 years or older vs under 30 years	0.94 (0.88–1.00)	0.041	269
Mother education	Secondary/tertiary formal/primary vs no	0.97 (0.92–1.03)	0.295	269
Household income	18,000 LRD or more vs below 18,000 LRD	0.94 (0.89–1.00)	0.033	269
Housing type	Mud-to-mud vs Zinc	0.98 (0.88–1.10)	0.742	269
Housing type	Concrete/plaster vs Zinc	0.97 (0.92–1.03)	0.346	269
Sanitation	Pit latrine/open defecation vs flush toilet	1.03 (0.97–1.08)	0.356	269
Caregiver occupation	Not business vs business	0.99 (0.94–1.05)	0.736	269

Note. PR, prevalence ratio; CI, confidence interval. Sparse multi-level variables were collapsed into binary contrasts where necessary because some original categories contained no outcome-negative observations. Reference categories are stated in the comparison column. Modified Poisson regression with robust variance was used [16].

5.4 Clinical, dietary and maternal factors

Most crude clinical and dietary associations were weak or imprecise. Nutrition knowledge was associated with a modestly lower prevalence ratio (PR 0.92, 95% CI 0.86–0.99). Exclusive breastfeeding, feeding frequency, food type, recent illness, immunization and supplementation did not show clear associations at the 5% level in the reconstructed crude models. The previously reported statistically supported malaria association was not reproduced when the source-recorded outcome was used.

Table 4. Crude associations between clinical, dietary and maternal factors and recorded malnutrition

Variable	Comparison	PR (95% CI)	P value	N
Exclusive breastfeeding	Yes vs No	1.03 (0.97–1.09)	0.336	268
Feeding frequency	3 or more times/day vs less than 3 times/day	1.00 (0.93–1.08)	0.927	269
Food type	Non-carbohydrate category vs mostly carbohydrates	0.99 (0.93–1.06)	0.810	269
Recent childhood illness	Respiratory infection vs diarrhea	0.96 (0.83–1.11)	0.626	269
Recent childhood illness	Malaria vs diarrhea	1.02 (0.91–1.15)	0.716	269
Recent childhood illness	Malaria and diarrhea vs diarrhea	1.03 (0.91–1.17)	0.629	269
Recent childhood illness	None reported vs diarrhea	0.98 (0.85–1.12)	0.759	269
Immunization	Incomplete vs complete	1.02 (0.96–1.10)	0.499	269
Nutrition knowledge	Yes vs No	0.92 (0.86–0.99)	0.036	269
Supplementation	Yes vs No	1.05 (0.96–1.14)	0.292	268

Note. PR, prevalence ratio; CI, confidence interval. Sparse feeding and food-type categories were collapsed into binary contrasts. An undefined maternal illness category was treated as missing. Modified Poisson regression with robust variance was used [16].

5.5 Exploratory adjusted analysis

The reduced adjusted model included 269 complete records and six conceptually selected predictors. None of the adjusted associations met the 5% significance threshold. Parent/guardian age 30 years or older had an adjusted PR of 0.94 (95% CI 0.89–1.00), while household income of at least 18,000 LRD had an adjusted PR of 0.96 (95% CI 0.91–1.01). Malaria versus other recorded illness had an adjusted PR of 1.03 (95% CI 0.98–1.08). Because only 14 children were classified as not malnourished, these estimates should be regarded as exploratory.

Table 5. Exploratory adjusted prevalence ratios for recorded malnutrition

Variable	Comparison	Adjusted PR (95% CI)	P value	N
Child sex	Female vs Male	1.04 (0.98–1.10)	0.190	269
Parent/guardian age	30 years or older vs under 30 years	0.94 (0.89–1.00)	0.055	269
Mother education	Secondary/tertiary vs no formal/primary	0.97 (0.92–1.03)	0.300	269
Household income	18,000 LRD or more vs below 18,000 LRD	0.96 (0.91–1.01)	0.085	269
Sanitation	Pit latrine/open defecation vs flush toilet	1.02 (0.97–1.08)	0.413	269
Recent childhood illness	Malaria vs other recorded illness	1.03 (0.98–1.08)	0.302	269

Note. PR, prevalence ratio; CI, confidence interval. The reduced model included sex, parent/guardian age group, maternal education, household income, sanitation and recent malaria. The model is exploratory because only 14 records were classified as not malnourished.

5.6 Anthropometric changes among children with a recorded intervention

Twenty-three children had a recorded nutritional intervention. Mean weight changed from 6.89 kg before the intervention to 7.35 kg after the intervention, a mean change of 0.46 kg (paired Wilcoxon $p=0.010$). Mean height changed from 70.89 cm to 70.91 cm, a mean change of 0.02 cm ($p=0.317$). Recorded WAZ, HAZ and WHZ changes were excluded from the main treatment analysis because those fields were systematically duplicated in the source data and could not be independently validated.

Table 6. Directly measured anthropometric changes among children with a recorded nutritional intervention

Measure	N	Pre_mean	Post_mean	Mean_change	Pre_median	Post_median	Wilcoxon_p
Weight (kg)	23	6.89	7.35	0.46	6.8	7.3	0.01
Height (cm)	23	70.89	70.91	0.02	71.0	71.0	0.317

Note. Analysis is restricted to 23 intervention records. Weight and height are directly measured fields. No causal treatment effect is estimated.

5.7 Treatment outcomes and caregiver satisfaction

Among the 22 children with a known treatment outcome, 17 were recorded as improved and five as unchanged. One intervention record had an invalid or missing treatment-outcome code. Among all 23 intervention records with satisfaction information, 22 caregivers were recorded as very satisfied and one as very dissatisfied.

Table 7. Recorded treatment outcomes among children with known outcomes

Outcome	N	Percent
Improved	17	77.3
Unchanged	5	22.7

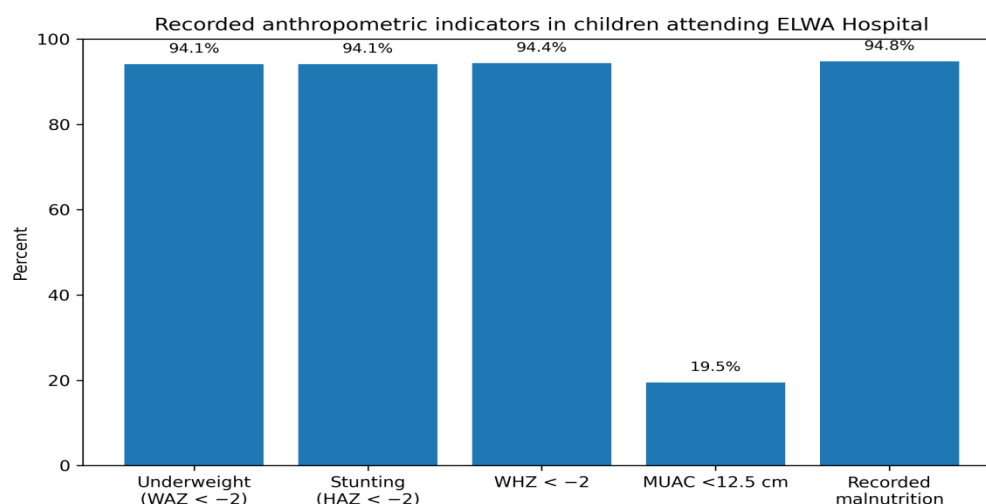
Note. Percentages are based on 22 children with known treatment outcomes. One invalid or missing treatment-outcome entry was excluded.

Table 8. Recorded caregiver satisfaction among children with a nutritional intervention

Satisfaction	N	Percent
Very satisfied	22	95.7
Very dissatisfied	1	4.3

Note. Percentages are based on 23 intervention records with recorded satisfaction.

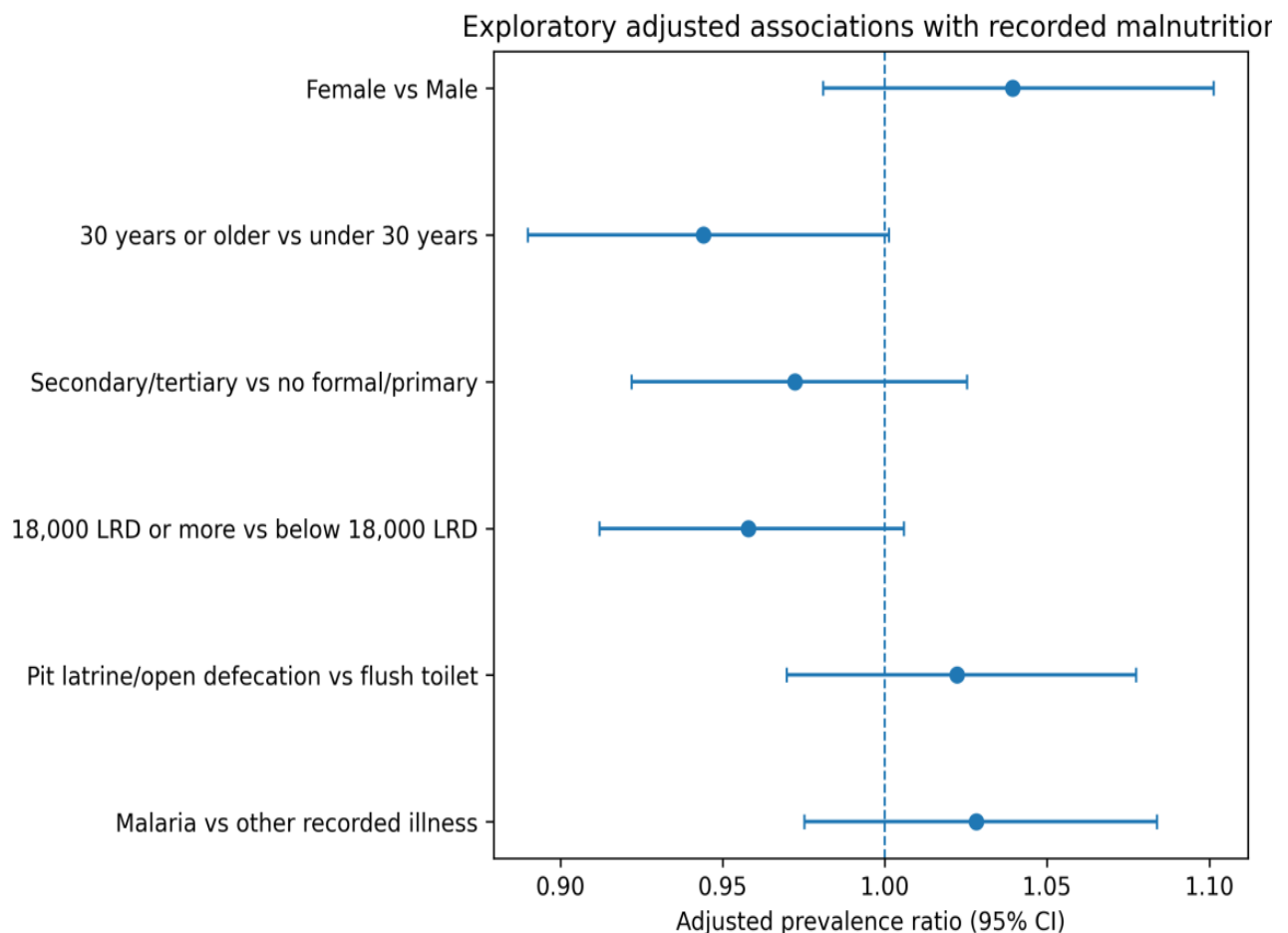
Figure 1. Recorded anthropometric indicators in children attending ELWA Hospital.



Note. WAZ, HAZ and WHZ are recorded source indicators and were not independently recalculated as WHO z-scores. MUAC=0.0 cm was treated as invalid/missing.

Figure 1 shows that the recorded WAZ, HAZ and WHZ indicators fall below the specified cutoff in most assessed records, whereas the MUAC criterion identifies a smaller group. The contrast describes the supplied clinical records because the recorded z-scores were not independently recalculated.

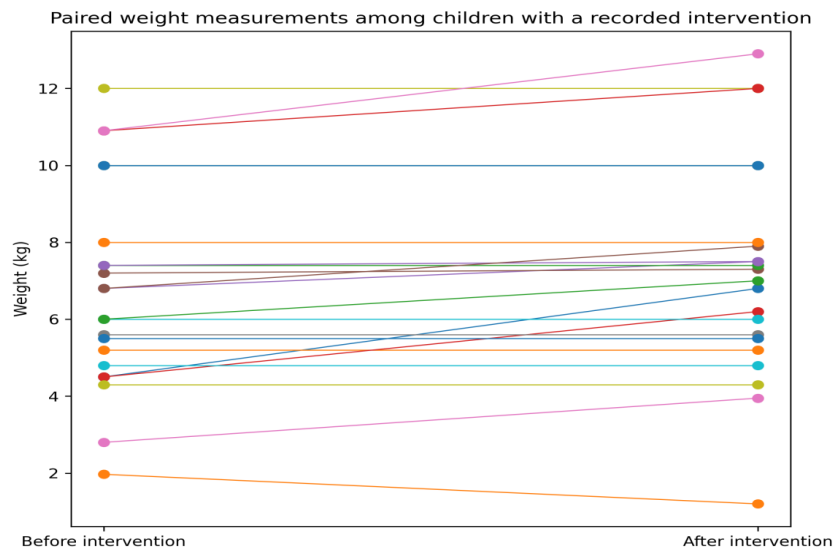
Figure 2. Exploratory adjusted associations with source-recorded malnutrition.



Note. Points show adjusted prevalence ratios and horizontal lines show 95% confidence intervals. The model is exploratory because only 14 children were recorded as not malnourished.

Figure 2 shows the adjusted prevalence-ratio estimates from the reduced exploratory model. The confidence intervals cross the null value for all six predictors, consistent with the limited number of children recorded as not malnourished.

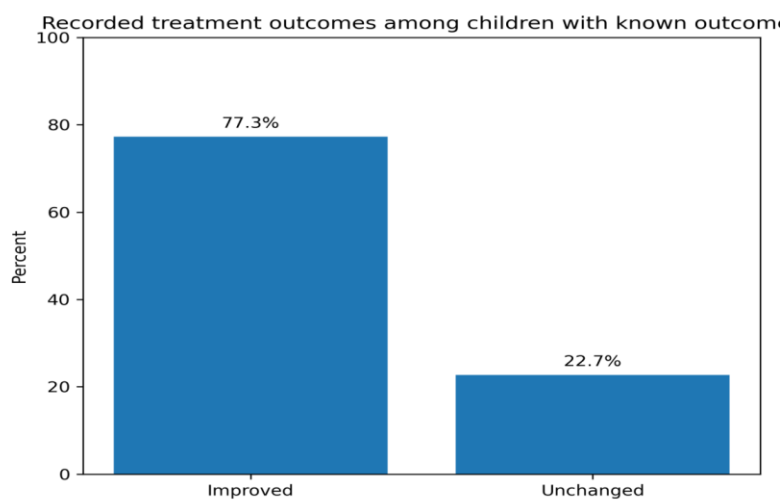
Figure 3. Weight before and after a recorded nutritional intervention.



Note. Lines connect the paired measurements for the 23 children with a recorded nutritional intervention.

Figure 3 displays the paired weight measurements for the 23 children with a recorded nutritional intervention. The lines show the direction and size of change for each child and do not establish that the intervention caused the observed changes.

Figure 4. Recorded treatment outcomes among children with known outcomes



Note. Percentages are based on 22 children with known treatment outcomes.

Figure 4 summarizes the recorded treatment outcomes among the 22 children with known outcome status. The figure describes the available follow-up records and should not be interpreted as a program-level treatment success rate.

6.0 Discussion

The analysis provides a description of recorded malnutrition among children represented in the ELWA Hospital dataset while taking into account important limitations in the available clinical records. The use of the source-recorded malnutrition outcome avoided constructing a new outcome from duplicated and unverified anthropometric fields. Modified Poisson regression with robust variance was used to estimate prevalence ratios for the recorded outcome [16]. Observational reporting principles were also considered in organizing the analysis and reporting [17].

The treatment-outcome and caregiver-satisfaction records are descriptive. They summarize the available follow-up records and should not be interpreted as a hospital-wide recovery rate, treatment-effect estimate or general measure of caregiver satisfaction. The subgroup was small, one treatment outcome was invalid or missing, and the dataset did not contain sufficient information on intervention intensity, clinical severity or reasons for dissatisfaction. These limitations are consistent with the broader need to interpret facility-based clinical records in relation to the completeness and quality of the underlying data.

The treatment records provide a limited follow-up view of children who received a recorded nutritional intervention. Directly measured weight increased between the pre- and post-intervention assessments, whereas the change in height was small and not statistically supported. Because there was no untreated comparison group, the observed weight change cannot be attributed to the intervention. Evidence from systematic reviews shows that children receiving treatment for acute malnutrition can gain weight, but outcomes vary according to treatment modality, severity and programme context [14,15]. The duplicated treatment WAZ, HAZ and WHZ fields were therefore not used to claim improvement in standardized nutritional status.

Sanitation did not show a clear adjusted association in this analysis. This finding differs from evidence that improved water, sanitation and hygiene conditions can be associated with lower risk of childhood stunting, while evidence for acute malnutrition is more heterogeneous [11,12]. The absence of a clear association here may reflect limited measurement detail, the facility-based sample and the very high frequency of the recorded outcome. Similarly, the corrected analysis did not reproduce the previously reported inverse association between malaria and malnutrition. The exploratory adjusted estimate for malaria versus other recorded illness was close to the null, and the cross-sectional design does not support a causal interpretation. Evidence from sub-

Saharan Africa indicates that malaria risk and clinical presentation among children under five vary with age, household and environmental conditions [13].

In the crude analyses, parent or guardian age and household income showed modest associations with the recorded outcome, but these associations were not clearly supported in the reduced adjusted model. Maternal education was also not clearly associated after sparse categories were collapsed. This differs from systematic evidence linking parental or maternal education with child growth and undernutrition in low- and middle-income countries [9,10]. The difference may reflect the highly selected facility population, the small number of children classified as not malnourished, and the limited socioeconomic information available in the dataset. The present results therefore should not be interpreted as evidence against the broader relationship between parental education and child nutrition [9,10].

The quality of the source measurements is important when interpreting the anthropometric results. Four MUAC values recorded as zero were treated as invalid rather than retained as measurements, and the source-recorded malnutrition variable was used for regression instead of constructing a new outcome from duplicated and unverified z-score fields. This approach follows the principle that anthropometric indicators require valid measurements and appropriate age information before they can be interpreted as standardized growth outcomes [4,5]. The correction also illustrates why routine clinical datasets require explicit quality assessment before statistical modelling. The remaining implausible raw values, including the recorded current weight of 69 kg and post-treatment height of -3 cm, require verification against the original clinical records before they are used for further anthropometric calculations.

The concentration of the study population in the first two years of life is relevant because this is a period of rapid growth and changing nutritional requirements. Child undernutrition is shaped by interacting immediate, household and structural determinants rather than by a single exposure [7,8]. The distribution of maternal education, household income and sanitation in the dataset therefore provides useful descriptive context, but the facility-based design and limited measurement detail prevent the present analysis from separating these pathways reliably. More recent evidence also supports the importance of maternal and parental education for child growth and nutritional status, although the magnitude and consistency of these associations vary across settings [9,10].

This facility-based analysis found a high recorded burden of malnutrition among children represented in the ELWA Hospital dataset. The recorded malnutrition outcome and the recorded WAZ, HAZ and WHZ fields produced substantially higher values than those reported in the 2019–20 Liberia Demographic and Health Survey [2] and than global estimates summarized by UNICEF, WHO and the World Bank [1]. These differences should not be interpreted as evidence

of a corresponding population-level burden because the present study is facility-based, the dataset represents children who reached the hospital, and the supplied z-score fields could not be independently recalculated. WHO guidance emphasizes accurate age determination, standardized anthropometry and appropriate construction of growth indicators [4,5]. Accordingly, the findings are best described as recorded clinical observations rather than independently validated population prevalence estimates [4,5].

The audited ELWA Hospital dataset shows a high recorded burden of malnutrition among children represented in the available clinical records. The source-recorded malnutrition prevalence was 94.8%, while recorded WAZ, HAZ and WHZ fields each classified approximately 94% of assessed children below the specified cutoff and valid recorded MUAC below 12.5 cm was 19.5%. The regression analysis identified only modest crude associations, and the reduced adjusted model did not provide clear evidence of independent associations at the 5% level. Children with a recorded nutritional intervention experienced an average weight increase of 0.46 kg during follow-up, but the absence of an untreated comparison group prevents causal interpretation. Verification of exact age and original anthropometric measurements remains essential before the recorded z-score estimates are presented as definitive WHO-defined prevalence.

7.0 Policy Implications

The findings have practical implications for nutrition services at ELWA Hospital. Routine assessment of children should continue to use reliable anthropometric measurements with accurate age information, and records should be checked before standardized growth indicators are used for reporting or clinical follow-up. The hospital and other facilities using similar records would benefit from complete documentation of age, weight, height or length, MUAC, nutritional interventions and follow-up outcomes. Strengthening the recording of these variables would improve the quality of routine nutrition data and make subsequent analysis more useful for clinical monitoring and programme planning. The findings also support careful interpretation of facility-based malnutrition records alongside population-based nutrition surveys rather than treating the two sources as interchangeable.

8.0 Limitations of the Study

The study has several limitations. It is facility-based and therefore does not provide population-representative prevalence estimates. Exact age in months is unavailable, preventing independent recalculation of WHO growth standards from the supplied data, and several anthropometric fields require verification. Only 14 children were recorded as not malnourished, making the adjusted model exploratory and limiting the stability of the association estimates. The cross-

sectional design limits causal interpretation of the socioeconomic, clinical, dietary and maternal associations. The treatment subgroup was small and had no untreated comparison group, so observed changes cannot be attributed to the intervention. One treatment outcome was invalid or missing, and the records do not provide sufficient information on intervention intensity, clinical severity or reasons for dissatisfaction. The flagged raw measurements and source age coding also require verification against the original questionnaire or clinical records before any revised anthropometric analysis is undertaken.

9.0 Conclusion

The findings show a high recorded burden of malnutrition among children included in the ELWA Hospital dataset. The clinical records and available anthropometric measures indicate that malnutrition was common among children attending the facility. Although some demographic, socioeconomic and clinical factors were associated with malnutrition in the crude analysis, none showed a clear independent association in the adjusted analysis. Children with recorded nutritional interventions gained weight during follow-up, but the study design does not allow this change to be attributed to the intervention. These findings support the continued assessment, treatment and follow-up of children with nutritional problems at ELWA Hospital. Prospective studies with accurate age information, reliable anthropometric measurements and complete follow-up data are needed to better understand the factors associated with malnutrition and changes in nutritional status over time.

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