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Annals of Pediatrics & Child Health

Research Article

Prevalence and Associated Factors of Hypoglycemia among Sever Acute Malnourished Children who admitted in East Gojjam Zone Public Hospitals from 2018 to 2021, Northwest Ethiopia, 2022. Multi-Center Retrospective Cross Sectional Study

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Submitted: 16 June 2023
Accepted: 19 July 2023
Published: 21 July 2023
ISSN: 2373-9312

Keywords
- Severe acute malnutrition
- Hypoglycemia
- Under five children
- Ethiopia

Abstract

Background: Globally, severe acute malnutrition (SAM) remains a major killer of children under 5 years of age. The highest magnitude is seen in sub-Saharan Africa, including Ethiopia. Hypoglycemia is the most common complication of severe acute malnutrition (SAM) and the most life-threatening condition in pediatric society. However, there is limited evidence from Ethiopia to assess the prevalence of hypoglycemia and associated factors among severely malnourished children. The aim of this study was to assess the prevalence of hypoglycemia and its associated factors among under-five children with severe acute malnutrition who were admitted to public hospitals in the East Gojjam zone.

Methods: A cross-sectional retrospective study was conducted from August 01 to 30/2022 among 378 randomly selected samples who admitted public hospitals in East Gojjam zone from 2018 to 2021. Data was extracted from the medical records of the children and entered into SPSS version 26, which analyzed it. Model goodness-of-fit was checked by the Hosmer and lemesho test. Variables with a p-value<0.25 in the Bivariate analysis were a candidate for multivariable logistic regression and those with a p-value<0.05 in the multivariable analysis were considered as having statistically significant association with hypoglycemia among sever acute malnutrition.

Result: Out of 378 respondents, 50 (13.2%) had hypoglycemia with sever acute malnutrition patient. Children admitted between the ages of 0-6 month were 2.93 (AOR = 1.57-6.25, p=0.000), shock were 4.6 (AOR = 1.25-17.42, p=0.034) and fully immunized children were (AOR: 2.61 (1.01- 6.77, p=0.048) was significantly associated with hypoglycemia with sever acute malnutrition.

Conclusion: The prevalence of hypoglycemia with severe acute malnutrition was 13.2%. Age between 0-6 month, shock and children fully immunized were statistically significant factors for hypoglycemia in severe acute malnutrition. We also recommend a longitudinal study should be done among children's who develop hypoglycemia with sever acute malnutrition to determine the long-term consequences especially the neurodevelopmental sequelae associated with this condition.

ABBREVIATIONS

DMCSH: Debre Markos Compressive Specialized Hospital, MRN: Medical Registered Number, MG/DL: Milligram per deciliter, RBS: Random Blood Sugar, RCT: Randomize Control Trial, SAM: Sever Acute Malnutrition, SC: Stabilize Centre, SPSS: Statistical Package for Social Science, and WHO: World Health Organization

INTRODUCTION

At least one-third of all child fatalities worldwide are caused by malnutrition, which is a serious issue for global health. A state of abnormally low blood glucose levels is known as hypoglycemia [1]. The definition of hypoglycemia varies within the scientific literature and across clinical practice but is defined by the WHO as RBS<2.5 mmol/L (45 mg/dL) in an adequately nourished child, or <3.0 mmol/L (54 mg/dL) in a severely malnourished child [2]. Hypoglycemia is the most common complication of severe acute malnutrition (SAM) and a life-threatening threat to pediatric society. There is evidence that hypoglycemia is associated with higher mortality in children hospitalized with a severe illness [3]. Hypoglycemia has been found to have pro-inflammatory and prothrombotic effects and is associated with an increased risk of cardiovascular events [4,5]. It can also have severe neurological consequences, such as seizures and coma [2]. Globally, hypoglycemia with malnutrition increases the risk of morbidity and mortality, impairs cognitive development in children, and may also increase the risk of certain diseases throughout adulthood [6]. Worldwide trends show that malnutrition contributes to over half of all under-five child deaths due to hypoglycemia [7].

The hippocampus is particularly sensitive to hypoglycemia and can lead to deficits in cognitive development, particularly with regard to working memory [8]. Severe acute malnutrition (SAM) is thought to predispose children to develop either hypoglycemia [9]. Low glycogen stores and wasting with reduced lean mass and adipose tissue reserves have been linked to hypoglycemia in SAM [10]. In addition, hepatic glucose production has been found to be lower, especially in children with edematous SAM [11]. The WHO guidelines on the inpatient treatment of SAM at nutritional rehabilitation units recommend small, 2–3 hourly feeds in the early stages of treatment to prevent episodes of hypoglycemia [12].

It is believed that children with severe acute malnutrition (SAM) are more likely to experience either hypo or hyperglycemia. Low glycogen stores and wasting with reduced lean mass and adipose tissue reserves have been linked to hypoglycemia in SAM. Hormonal changes with impaired insulin responses as well as impaired glucose clearance could potentially increase the risk of hyperglycemia in SAM [4]. When compared to developed countries, hypoglycemia with SAM is a common health problem in developing countries [13]. This is evident when visiting almost any hospital in a developing country, where severely malnourished children and hypoglycemia are likely to account for a significant proportion of pediatric mortality [14]. Hypoglycemia with severe acute malnutrition is a common and serious condition that increases the mortality rate of children. Hypoglycemia in children with severe acute malnutrition can be easily treated and managed at a low cost, but there is a lack of awareness and materials in developing countries to assess hypoglycemia early in children with severe acute malnutrition. This study is intended to provide information and data on the prevalence of hypoglycemia among malnourished children admitted to health facilities. Such data is important for reassessing, evaluating, and reforming the policy. Reviewing previous studies on hypoglycemia in the malnourished yielded no clear and adequate data. The gap was addressed in this study. The goal of this study is to reduce morbidity and mortality associated with hypoglycemia caused by malnutrition and its risk factors.

METHODS AND MATERIALS

Study design, area and period

A retrospective institutional-based cross-sectional study was conducted at public hospitals in the East Gojjam Zone from August 1 to August 30, 2022. This study was conducted at East Gojjam Zone public hospitals, Amara Region, Ethiopia. Debre Markos Town is the capital of the East Gojjam Zone, which is 254 kilometers away from Bahirdar, the capital of the Amhara National Regional State, and 304 kilometers away from Addis Ababa, the capital of Ethiopia. The study areas are Debre Markos Comprehensive Specialized Hospital, Lumamie Primary Hospital, and Bichena Primary Hospital. Debre Markos Comprehensive Specialized Hospital has a catchment area and five primary hospitals. The hospital provides care for around 5,000,000 of the population of Debre Markos town and its neighboring catchment area, and most of its patients come from the lower socioeconomic area; it admits 14 SAM patients per month [15]. Lumamie primary hospital provides care for 154,612 of the population of Lumama town and has 3 SAM patients per month admitted to it [16]. Bichena primary hospital provides care for around 522,000 of the population of Bichena town, including its catchment area, and had 5 SAM patients per month flow through it [17].

Eligible criteriaand Inclusion criteria

Under-five children admitted with SAM at the public hospital in East Gojjam Zone from 2018 to 2021 were included in this study. Children with incomplete data were excluded (i.e., outcome variable, age, sex, residence, routine medication, unknown admission and discharge date).

Sample size determination and Sampling technique

Sample size determination: The sample size was determined using the single population proportion formula. The following assumptions were made: that the marginal error (d) on either side of the true proportion was 5%, that a 95% confidence level was used, and that $n = \frac{(Za/2)^2 * P(1-p)}{d^2}$

Where, n = minimum sample size required

d = Desired degree of error

z = standard normal distribution value at 95% confidence level

$(Za/2)$ = 1.96 for 95% confidence interval

P= In an Ethiopian study of children with SAM, hypoglycemia was found to be the most common comorbidity and complication on admission, affecting 8.8% of children admitted to the stabilize center at Gedo zone [18]. In order to maximize precision in our study, we used the lowest possible margin of error (d) of 3%, or 0.03.

$$n = \frac{(Za/2)^2 * P(1-p)}{d^2} = \frac{(1.96)^2 * 0.088(1-0.088)}{0.03^2}$$

$$= \frac{3.8416 * 0.088(0.912)}{0.0009} = \frac{3.8416 * 0.0802256}{0.0009} = \frac{0.3093114496}{0.0009} = 342.5683 \approx 343$$

Using a 10% non-response rate so, the final sample size was 378.

Sampling procedure and technique: Under-five children with SAM admitted to public hospitals in East Gojjam Zone from 2018 to 2021 were obtained. Each year, the number of admitted children was counted. The medical record was extracted within the defined period, and a unique number was assigned. The samples were proportionally allocated for each year. Each year, the final sample size was determined using a simple random sampling method.

Variable of the study

Dependent variable: Hypoglycemia with SAM

Independent variable: socio-demographic and admission status (age, sex, residence, history of TB contact and presence of edema, appetite test, admission criteria). Comorbidity (diarrhea, cough/pneumonia, malaria, sepsis, superficial infection (skin or ear infection), severe anemia, fever, HIV/AIDS, vomiting, hypothermia, hyperthermia)

Operational definition

Hypoglycemia: occurs when the random blood sugar level falls below 54 mg/dL.

SAM: the presence of nutritional edema (bilateral pitting edema) or severe wasting (MUAC < 11.5 cm or a WFH < -3 z-score [WHO standards]) in children > 6 months old.

New admission: patients who are directly admitted to inpatient care to start the nutritional treatment.

Defaulted: SAM cases that are signed (by parents on behalf of their child) against treatment to leave treatment before cure or lost for 2 consecutive days with unknown status

Relapse: If that patient has ever been severely malnourished before and cured [19].

Marasmic-Kwash: SAM cases with both edema and severe wasting [19].

Data collection tool and procedure

Data collection has been done using a structured data extraction format accomplished by reviewing children's medical record charts and the HMIS log book. After carefully observing the medical records of the children an appropriate data extraction checklist was made. The questionnaire was developed in English and used to collect data after being pre-tested before the study period. A modification of the questionnaire was made based on the pre-test. Socio-demographic characteristics, medical comorbidities, and treatment are given and follow-up characteristics of the study subject in the course of treatment of hypoglycemia with SAM. The data collection tools were adapted from several different related studies of hypoglycemia with SAM(20). Four BSc nurses working in the malnutrition center were collected for the data by reviewing children's medical record charts and the HMIS log book.

Data quality control

The data was extracted by staff nurses working in malnutrition centers who were familiar with the malnutrition follow-up form. Two days of introductions about the objectives, significance, and variables of the research, and how to extract the data by using the data extraction tools were given to four data collectors and two supervisors. To assess the consistency of the data extraction tools, a pretest was performed on approximately 5% of the charts at Dejen Primary Hospital. The data collection process was closely monitored by the supervisors and the principal investigator for its completeness and consistency.

Data analysis technique

Data was checked for its completeness and consistency, then entered into SPSS and analyzed. SPSS 25 version statistical software was used for cleaning, coding, and analysis. Descriptive statistics were computed for categorical variables. The primary outcome variable was categorized as "0" for without hypoglycemia individuals and "1" for hypoglycemia with SAM individuals. The goodness-of-fit of the model was checked by the Hosmer–Lemeshow test. After checking the multi-collinearity and interaction terms, each independent variable with a p-value <0.25 in the bivariate analysis was included in binary and multivariate logistic regression to control confounders. Finally, adjusted odds ratios (AOR) with p-values of 0.05 were used to determine statistical significance and measure the strength of the association. Finally, the result was presented in the form of text, tables, figures, and a chart.

RESULT

Socio-demographic characteristics

From 2018 to 2021, 378 under-five patients with severe acute malnutrition were admitted to East Gojjam zone Public Hospitals, with a 100% response rate. Out of 378 children, 240 were male (63.5%). In total, 308 (81.5%) of the respondents were aged 6-59 months; additionally, the majority of the children came from 250 rural (66.1%) homes, and half of the Marasmus respondents, 192 (50.8%), were 131 (34.7%). The 378 SAM children had a mean weight of 6.21 kg (SD = 4.61) and a mean height or length of 72.28 cm (SD = 13.8) at admission (Table 1).

Medical Comorbidities

There was no found hypoglycemia in 261 (69%) of the

Table 1: Socio-demographic and admission information on enrolment of children with SAM treated by therapeutic center under-five children admitted East Gojjam Zone Public Hospitals from 2018 to 2021, Ethiopia, 2022. (n=378)

Characteristics	Category	Frequency n=378	Percentage (%)
Sex	Male	240	63.5
	Female	138	36.5
Age	0-6 month	70	18.5
	6-59 month	308	81.5
Residence	Urban	128	33.9
	Rural	250	66.1
Clinical Classification of SAM	Only edema (kwashiokor)	131	34.7
	Only wasting (weight for height) or marasmus	192	50.8
	Both edema & wasting (marasmus-kwashiokor)	55	24.3
Admission criteria	Bilateral pitting edema (any grade)	92	24.3
	WFH<-3Z SCORE	156	41.3
	Severe wasting (MUAC <11.5CM OR Z SCORE <-3)	71	18.8
	Edema + severe Wasting + complication	59	15.6
Grade of nutritional edema	no edema	164	43.4
	Grade 1 or +	106	28.0
	Grade 2 or ++	74	19.6
	Grade 3 or +++	34	9.0
MUAC at admission in mm	<115	308	81.5
	Not indicated	70	18.5
Admission status	New	268	70.9
	Repeated	43	11.4
	Return after defaulter	67	17.7
Appetite test at admission	Pass	48	12.7
	Fail	330	87.3
Exclusive breast Feeding	No	139	36.8
	Yes	239	63.2

378 SAM patients who presented, and 50 (13.2%) had found hypoglycemia with SAM. During admission, all but one of the respondents (346 out of 91.5) had comorbidity (Table 2).

Table 2: Distribution of hypoglycemia and other medical comorbidities under-five children with SAM admitted East Gojjam Zone Public Hospitals from 2018 to 2021, Ethiopia, 2022. (n=378)

Characteristics	Category	Frequency n=378	Percentage (%)
Had the child comorbidities?	No	32	8.5
	Yes	346	91.5
Different comorbidity	No comorbidity	32	8.5
	Hyperthermia (temp >37.5 °c)	20	5.3
	Hypothermia (temp<35.5 °c)	100	26.5
	Diarrhoea	90	23.8
	Cough or pneumonia	35	9.3
	Malaria	5	1.3
	Vomiting	62	16.4
	Sepsis	11	2.9
	superficial infection (skin or ear)	4	1.1
	Severe anaemia	10	2.6
	HIV/AIDS	3	0.8
	Others	6	1.6
Types of diarrhoea	No diarrhoea	302	79.9
	Watery diarrhoea	60	15.9
	Dysentery	10	2.6
	Other	6	1.6
Degree of dehydration	no dehydration	300	79.4
	some dehydration	70	18.5
	severe dehydration	8	2.1
Level of consciousness	Normal	105	27.8
	Altered	273	72.2
Shock	No	359	95.0
	Yes	19	5.0
Failure to treatment	No	335	88.6
	Yes	43	11.4
TB	No	368	97.4
	Yes	10	2.6
Types of TB	has no TB	368	97.4
	Pulmonary TB	6	1.6
	Other	4	1.1

Treatment given and follow up characteristics

East Gojjam Zone Public Hospitals used the national guideline for SAM Ethiopia inpatient treatment protocol for treatment given and follow-up characteristics of under-five children with SAM. Due to that, those under-five children admitted to the SAM room took different types of routine medication at admission, such as ampicillin and gentamicin (41.8%), amoxicillin (22.7%), and Albendazole or Mebendazole (8.7%) (Table 3).

About 66.1% of under five children were fully immunized (Figure 1).

In terms of the prevalence of hypoglycemia among 378 patients studied, 50 (13.2%) were SAM patients (Figure 2).

Factors Associated with Hypoglycemic among Severe Acute Malnutrition

In the bivariate analysis, sex, age, residence, admission status, MUAC at admission, Appetite test at admission, shock, failure to treatment, TB, child who had given ReSoMal, type of IV medication and immunization status were associated with significant variables. In contrast, age, shock and children fully immunized were significantly associated with hypoglycemia among SAM in multivariate logistic regression analysis (P-value less than 0.05).

Age was significantly associated with hypoglycemia with SAM; children admitted between the ages of 0-6 months were 5.9 times more likely than those admitted between the ages of 6 and 59 months to develop hypoglycemia [AOR: 5.92 (2.41–14.52, p=0.000)]. Children who had shock were 4.4 times more likely than those who did not have shock to develop hypoglycemia among SAM [AOR: 4.35 (1.12–16.91, p = 0.034)]. Children who had fully immunized were 2.6 times more likely than those who did not have yet immunized to develop hypoglycemia among SAM (AOR: 2.61 (1.01- 6.77, p=0.048**)** (Table 4).

Table 3: Distribution of treatment given and follow up characteristic under-five children with SAM admitted East Gojjam Zone Public Hospitals from 2018 to 2021, Ethiopia, 2022. (n=378)

Characteristics	Category	Frequency	Percentage (%)
does the child had given routine medication	No	7	1.9
	Yes	361	95.5
	Not indicated	10	2.6
Type of routine medication	not indicated for medication	10	1.1
	Amoxicillin	84	22.2
	Ampicillin & Gentamicin	158	41.8
	Vitamin A	5	1.3
	Albendazole/mebendazole	33	8.7
	folic acid	30	7.9
	Anti-malaria	3	0.8
	measles vaccination	24	6.3
	Others	37	9.8
child who had given zinc tab	No	320	84.7
	Yes	20	5.3
	Not indicated	38	10.1
Immunization status	fully immunized	250	66.1
	up to date	70	18.5
	not yet immunized	58	15.3
Child had fever	No	20	5.3
	Yes	358	94.5
Child had given special IV medication	No	25	6.6
	Yes	353	93.4
Child had given special IV medication	No	0	0.0
	Yes	353	93.4
Types of IV medication	had not taken special IV medication	0	0.0
	Blood	10	2.6
	IV fluid	70	18.5
	IV anti-biotic	293	77.5
	Others	5	1.3

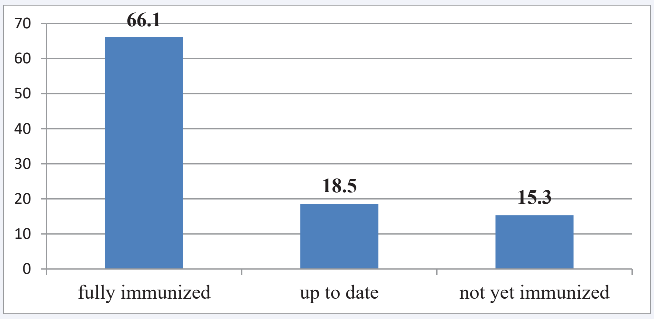

Figure 1 Immunization status of under-five children with SAM admitted east Gojjam zone public hospitals from 2018 to 2021, Ethiopia, 2022. (n=378).

DISCUSSION

In this study, a total of 378 sampled retrospective data records were reviewed, and the prevalence of hypoglycemia was 13.2% (95% CI: 0.1-0.17)). The study is lower than the study conducted in India (21.9%)(21). Again, there was retrospective bias, and only 27% of patients had a blood glucose recorded in this system within 4 hours of admission WHO standards (22). In our study, 50 of 378 (13.2%) SAM patients were admitted to three hospitals, including the East Gojjam Zone Public Hospital, for a retrospective study. A study conducted in Kenya examined the utility of the WHO protocol for a retrospective study of children with SAM and discovered a prevalence of hypoglycemia of 13.6% [23, This might be due to differences, in hospital facilities; skills of professionals, adherence to management protocol, the severity of cases, and comorbidity attributed to these variations.

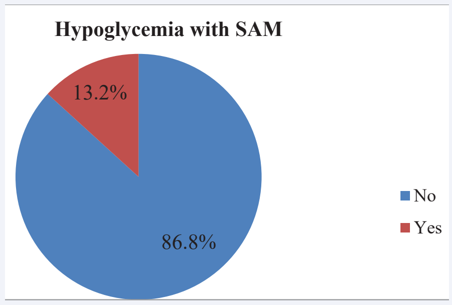

Figure 2 Prevalence of hypoglycemia with severe acute mal nutrition among under-five children who admitted East Gojjam public hospitals from 2018 to 2021, Ethiopia, 2022. (n=378).

The magnitude of hypoglycemia with SAM in our study was 13.2%, which is higher than the previous study in Ethiopia, Children with SAM who had hypoglycemia made up 8.8% of those admitted to the Gedo Zone [24]. The prevalence of hypoglycemia in SAM patients with comorbid pneumonia was 35 (9.3%) in this study, 14.3% in the previous study in Ethiopia [18], and in Malawi [25], 7 out of 176 (4%) SAM patients were recorded to have hypoglycemia in the first 24 hours of admission based on an electronic medical records database. The other study showed a retrospective analysis of case notes, relying on hypoglycemia being recognized and tested for; the prevalence of hypoglycemia was therefore likely underestimated based on observational data ranging from 1.3% to31% [25].

Children admitted between the ages of 0 and 6 months were 3 times more likely than those admitted between the ages of 6 and 59 months to develop hypoglycemia. This might be because the ages of 0 and 6 months of life are extremely important for the growth and development of children. And it is a time when most malnutrition cases occur because it is a transition time from exclusive breastfeeding to complementary feeding.

Children who had shock were 5 times more likely than those who did not have shock to develop hypoglycemia among SAM. This finding was similar with previously conducted studies in Ethiopia Gedeon Zone [24], and Mozambique [20], of which shock was identified as the main determinant of death. This is because children with SAM are highly at risk of shock secondary to severe infections and diarrheal diseases, which can cause either hypovolemic or septic shocks. Besides, severe sepsis and diarrheal diseases in malnourished children might be associated with low cardiac reserves, leading to shock, which leads to death. Another possible explanation for the high fatality rate among children who got IV fluids is that the IV fluids prescribed to the children throughout the research period may not have

Table 4: Factors associated with hypoglycemia under five SAM children who was admitted East Gojjam public hospitals from 2018 to 2021, Ethiopia, 2022. (n=378)

Variable (n=378)	Category	Hypoglycemia with SAM(n=50)		Binary regression	p- value	Multivariate regression	P- value
		Yes	No	COR (95%CI)		AOR (95%CI)	
Sex	Male Female	143(59.8%) 118(84.9%)	96(40.2%) 21(15.1%)	3.77(2.22-6.42) 1	0.000	1.71(0.78-3.75) 1	0.185
Age	0-6 month 6-59 month	21(30.0%) 240(77.9%)	49(70.0%) 68(22.1%)	8.24(4.62-14.68) 1	0.000	**5.92(2.41-14.52)** 1	0.000
Residence	Urban Rural	77(60.2%) 184(73.6%)	51(39.8%) 66(26.4%)	1.85(1.18-2.90) 1	0.008	1.61(0.79-3.28) 1	0.193
MUAC at admission in mm	<115 Not indicated	233(75.6%) 28(40.0%)	75(24.4% 42(60.0%)	0.22(0.13-0.37) 1	0.000	0.69(0.25-1.87) 1	0.462
Admission status	New Repeat Return P defaulter	191(71.3%) 31(72.1%) 39(58.2%)	77(28.7%) 12(27.9%) 28(41.8%)	0.56(0.32-0.98) 0.54(0.24-1.23) 1	0.041 0.142	0.77(0.32-1.84) 0.71(0.21-2.36) 1	0.550 0.573
Appetite test at admission	Pass Fail	24(50.0%) 237(71.8%)	24(50.0%) 93(28.2%)	2.55(1.38-4.71) 1	0.003	0.72(0.28-1.87) 1	0.497
Shock	Yes No	256(71.3%) 5(26.3%)	103(28.7%) 14(73.7%)	6.96(2.44-19.82) 1	0.000	4.35(1.12-16.91) 1	0.034
Immunization status	fully immunized up to date not yet immunized	168(65.6%) 60(85.7%) 33(63.5%)	88(34.4.4%) 10(14.3%) 19(36.5%)	0.91(0.49-1.69) 0.29(0.12-0.69) 1	0.765 0.006	2.61(1.01- 6.77) 0.55(0.17-1.75) 1	0.048 0.313
Child who had given ReSoMal	No Yes	186(64.6%) 75(83.3%)	102(35.4%) 152(16.7%)	2.74 (1.49-5.02) 1	0.001	1.19(0.56-2.59) 1	0.644
Failure to treatment	No Yes	14(3.7%) 36(9.5%)	86(22.8%) 242(64.0%)	0.58 (0.30-1.12) 1	0.103	0.69(0.25-1.92) 1	0.480
TB	No Yes	252(68.5%) 9(90.0%)	116(31.5%) 1(10.0%)	4.14 (0.52-33.08) 1	0.180	2.14(0.24-18.72) 1	0.492
Types of IV medication	Blood Iv fluid IV antibio Others	8(80.0%) 52(74.3%) 200(68.3%) 1(20.0%)	2(20.0%) 18(25.7%) 93(31.7%) 4(80.0%)	0.06(0.00-0.92) 0.09(0.00-0.83) 0.12(0.01-1.05) 1	0.043 0.033 0.056	0.06(0.00- 1.15) 0.29(0.02-3.88) 0.13(0.01-1.58) 1	0.062 0.348 0.109

Key : 1 = Reference; *Statistically significant by COR at p-value ≤0.25; **Statistically significant by AOR at p-value <0.05

adequately corrected their shock. This would be consistent with a study that compared the use of half-strength Darrow's solution with the use of the isotonic solution in children with SAM and reported inadequate shock correction in all study arms, leading to a decision to end the trial early [4,5].

Children who had been fully immunized were 3 times more likely than those who did not have yet been immunized to develop hypoglycemia among SAM. Malnourished children consequently stand to gain a great deal from vaccination, but given that it is the most prevalent immunodeficiency in the world, they may not be able to respond to immunizations as well as they could. Given that recurrent infections contribute to the pathophysiology of the illness, immunization may be essential for preventing malnutrition. The 10 greatest evidence-based nutrition-specific interventions are thought to minimize stunting by just 20%, highlighting the necessity for additional strategies, including as infection control, to prevent growth failure in infancy. However, it is difficult to pinpoint the specific contribution of vaccination. Multi-sectoral interventions have proven the most successful in lowering the prevalence of stunting. Immunizations against one disease are unlikely to have a large impact on growth; rather, it is becomingmore and more obvious that a combination of therapies is required to combat malnutrition [4].

This study revealed that children with SAM are at risk of hypo- or hyperglycemia, and hypoglycemia relates to clinical outcomes like mortality. Give emphasis to screening hypoglycemia in SAM patients with regard to treating and preventing hypoglycemia. As this is a hospital-based secondary data analysis, further prospective studies are needed to identify the prevalence of hypoglycemia and risk factors for severe acute malnutrition in children.

AVAILABILITY OF DATA AND MATERIALS

The data and other documents used in this study are available from the corresponding author.

Funding

This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

Author's Contribution

YG, AT, YG , EM and DB: conceptualization, methodology, data entry, data cleaning, data analysis, writing the original draft, validation, tool evaluation, methodology, reviewing, and editing. Finally, all authors approved the manuscript.

ACKNOWLEDGMENT

We would like to thank Debre Markos University, the College of Health Science, and the Department of Pediatrics and Child Health Nursing for their support in the preparation of this study. Hospital employees who allow any data collection from the hospitals recorded review. Finally, thank you, data collectors and supervisors.

ETHICAL CONSIDERATION

The study was conducted after receiving ethical approval from the research and ethics committee of the Debre Markos University Department of Pediatrics and Child Health Nursing. Before actual data collection, permission was taken from Debre Markos Referral Hospital, Lumamie Primary Hospital, and Bichena Primary Hospital's chief executive officer. In addition to that, written informed consent was obtained from the study participant. Finally, the outcome was communicated to the clinician so that the patient could be treated. They were given the chance to ask any questions about the study and were free to refuse or stop the questionnaire at any time they wanted.

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