Factors Associated with Nurses' Adherence to WHO's Guidelines for Managing Severe Acute Malnutrition: A Cross-Sectional Study in Northern Ghana

Alexander Nyaaba Anafo,[1] Yaa Nyarko Adjeso[2]

[1]Specialist Pediatric Nurse, Tamale Teaching Hospital, Tamale, Ghana

[1]Faculty of Pediatric Nursing, Ghana College of Nurses and Midwives, Accra, Ghana

[2]Department of Population and Reproductive Health, School of Public Health, University for Development Studies, Tamale, Ghana

[2]Faculty of Pediatric Nursing, Ghana College of Nurses and Midwives, Accra, Ghana

Corresponding author's email: nyaaba220@gmail.com

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Abstract

Introduction

Severe acute malnutrition (SAM) contributes to approximately 400,000 child deaths annually worldwide, with sub-Saharan Africa bearing 70% of the global burden (Kellerhals, 2017). Despite evidence-based WHO guidelines for SAM management, poor adherence among healthcare providers, particularly nurses who provide direct patient care, remains a critical implementation challenge (Vaismoradi et al., 2020). This study assessed nurses' adherence to World Health Organization (WHO) guidelines for managing severe acute malnutrition (SAM) at Tamale Teaching Hospital in Ghana.

Methods

We conducted a cross-sectional study among 83 nurses providing paediatric care at Tamale Teaching Hospital, Northern Ghana's largest referral hospital (Saani, 2021). Data were collected using a validated questionnaire assessing knowledge of SAM protocols and self-reported adherence to the ten essential WHO management steps. Results were presented through frequency tables, bar charts, and statistical tests, including Pearson's and Fisher's exact Chi-square, T-test, and analysis of variance.

Results

Among participants, 91.6% (95% CI: 84.2-96.3%) provided direct SAM patient care, yet only 28.9% (95% CI: 19.8-39.4%) had received formal SAM management training. Knowledge assessment revealed that 59.0% of nurses scored ≥60% (adequate knowledge) while only 16.9% achieved ≥80% (good knowledge) on the standardized knowledge scale. Overall adherence was poor, with only 41.0% of nurses implementing ≥70% of the ten essential WHO protocol steps correctly. Nurses with SAM training were significantly more likely to adhere to the guidelines ($\chi 2$ =16.17, P<0.0001), as were those who frequently used the protocol ($\chi 2$=18.44, P<0.0001).

Conclusion

Poor guideline adherence highlights the urgent need for structured in-service training programs and system-level interventions to improve SAM management quality in resource-limited settings.

Keywords: Severe Acute Malnutrition, WHO Protocol, Nurses' Adherence, Training, Knowledge

INTRODUCTION

Severe acute malnutrition (SAM) is one of the most preventable yet persistent threats to child survival worldwide. Clinically, SAM is defined by weight-for-height Z-scores ≤-3 standard deviations, mid-upper arm circumference <11.5 cm in children aged 6-59 months, or bilateral pedal edema, indicating the most severe form of undernutrition that requires immediate medical intervention. Importantly, the diagnostic criterion of a mid-upper arm circumference of less than 11.5 cm in children aged 6-59 months serves as a practical screening tool for community-level identification (WHO, 2019).

SAM directly contributes to approximately 400,000 child deaths annually, with malnutrition underlying nearly half of all deaths in children under five years globally, making it the leading risk factor for childhood mortality. Current estimates indicate that 13.6 million children suffer from SAM globally, with case fatality rates ranging from 10-50% depending on healthcare access and quality of care (UNICEF, 2023). SAM threatens the health of approximately 14.3 million children under 5 years of age and contributes to a substantial number of child deaths globally per year (UNICEF, 2023; WORLD BANK, 2023). Sub-Saharan Africa accounts for 67% of global SAM cases, with Ghana reporting particularly high rates in northern regions. Protein-energy malnutrition (PEM) contributes to 54% of post-neonatal child deaths in Ghana, representing the single largest cause of preventable childhood mortality (Ghana Statistical Service, 2022). Recent national surveys indicate that 5.8% of Ghanaian children under five present with wasting, rising to 7.9% in the three northern regions where poverty and food insecurity are most prevalent (Ghana Demographic and Health Survey, 2022). The Northern Region of Ghana had the highest rate (3.9%) of severely malnourished children among all the regions of the country (Iddrisu & Gyabaah 2023). Thus, malnutrition remains a significant public health issue in Ghana, particularly in the Northern Regions.

The World Health Organization established a benchmark mortality rate of <10% for inpatient SAM management, yet many facilities in low-resource settings report case fatality rates exceeding 20%, indicating substantial gaps in care quality. Evidence-based protocols are therefore essential to reduce preventable complications, including hypoglycemia, dehydration, and electrolyte imbalances that account for the majority of SAM-related deaths during hospitalization. However, the rate can be lowered if guideline-based inpatient care protocols are followed. Global studies revealed that poor hospital management of children with severe acute malnutrition has been associated with high case fatality rates (Abate et al. 2019; Ashworth et al. 2004; Ketha & Kenyatta 2018). Evidence from studies has shown care improvement and a reduction in case fatality following the WHO guidelines (Ashworth et al. 2004; Bhutta et al. 2013). A study found that case fatality decreased from 20% to 5% through the implementation of SAM management protocol (Munthali, 2015, Ashworth, Huttly, & Khanum 1994). Considering the success, the WHO recommended a guideline for facility-based inpatient management of severely malnourished children. To reduce the case fatality rates and improves the quality of care given to severely malnourished children (World Health Organization, 2013). Following that, Ghana has integrated a national SAM management guideline that should be followed by doctors, nurses, and other healthcare professionals involved in inpatient management of children with SAM. However, Mambulu-Chikankheni (2023) reported deficiencies in managing children with SAM, such as diagnosis discrepancies demonstrated by incomplete anthropometric assessments; non-compliance with SAM management guidelines was noted through

skipping some critical steps, including therapeutic feeding at the clinic level.

There is limited information in Ghana, particularly in the northern region, regarding adherence to the WHO guidelines for managing SAM. This study assessed nurses' adherence to WHO treatment guidelines towards severe acute malnutrition management among children under five, to inform policies and strategies for curtailing the disease burden in the population.

Primary Objective:

To assess the level of adherence to WHO guidelines for SAM management among nurses in Northern Ghana and identify associated factors.

Secondary Objectives:

1. To evaluate nurses' knowledge of SAM management protocols using validated assessment tools.
2. To explore the relationship between training, experience, and guideline adherence.
3. Identify organizational and individual barriers to protocol implementation.

THEORY OF PLANNED BEHAVIOR

Nurses' adherence to the World Health Organization's guidelines for managing Severe Acute Malnutrition (SAM) is essential for effective patient care. The Theory of Planned Behavior provides a framework to understand and improve adherence by focusing on attitudes, subjective norms, and perceived control (Ajzen, 1991). However, the challenges faced in adhering to WHO guidelines can be attributed to the lack of structured training programs and varied educational backgrounds among nurses. This discrepancy affects the overall quality of care provided to malnourished children, creating a need for targeted capacity-building interventions (Bilal et al., 2018)

The beliefs of nurses about following WHO guidelines for SAM management improved patient outcomes and reduced workload. Their evaluation of these consequences, whether positive or negative, will influence the nurses' attitude towards adhering to the guidelines (Yakubu et al., 2025). For instance, suppose nurses believe that following the guidelines will lead to better outcomes for severely malnourished children, but perceive the workload to be too high. In that case, their attitude will be a combination of these two beliefs.

Furthermore, nurses' perceptions of significant others, such as supervisors, colleagues, and family, regarding what they should do about SAM management, and their motivation to meet these expectations, will shape the subjective norm. If nurses believe that their supervisors and colleagues expect them to strictly follow the guidelines and are motivated to meet these expectations, it will create a positive subjective norm. High perceived control can motivate nurses to overcome obstacles and improve compliance (Adem et al. 2023). Again, nurses' beliefs that factors that may influence their ability to follow the guidelines and perception of the power of these factors, such as availability of resources, training, time constraints, and workload intensity, can influence their perceived behavioral control (Adema et al. 2023). For

example, if nurses believe that they lack adequate training on SAM management or face significant time pressures, their perceived behavioral control will be low.

These three components, attitude, subjective norm, and perceived behavioral control, together influence nurses' behavioral intention to adhere to the WHO SAM guidelines. Stronger intentions are more likely to translate into actual behavior; however, other factors, like environmental conditions and workload intensity, may also play a role in observed adherence.

Methods

We conducted a cross-sectional study to assess current practices and associated factors regarding adherence to the SAM management guideline among nurses at Tamale Teaching Hospital between March 15 and June 30, 2023. The cross-sectional design was selected to provide a snapshot of current practice patterns and identify modifiable factors for the development of interventions. A questionnaire adapted from WHO SAM management guidelines (WHO, 2016) was used, and data were collected from March to June 2023.

Tamale Teaching Hospital serves as the primary referral center for Ghana's five northern regions, with 800 beds, including 120 pediatric beds. The hospital manages approximately 350 SAM cases annually, with peak admissions occurring during the lean season (May-August). The pediatric department includes specialized nutrition rehabilitation units, with dedicated SAM management protocols implemented since 2018. The hospital offers a range of services, including specialized care for malnutrition. Most inhabitants are Muslims, though traditional beliefs also influence perceptions of disease causation and management (Ghana Statistical Service, 2012).

The target population comprised 100 registered nurses working in pediatric units. Sample size calculation was based on detecting a 20% difference in adherence rates between trained and untrained nurses, assuming 50% baseline adherence, with 80% power, 95% confidence level, and 5% non-response rate, yielding a minimum sample of 84 participants:

According to Yammane (1967), the formula for calculating the sample size when the population is known is;

$\mathbf{n}=N/(1+N(e)^2)$

Where **n** is the desired sample size, **e** is the level of precision (0.05), and **N** is the population size.

Therefore;

$\mathbf{n} = 100/(1+100(0.05)^2)$ $\mathbf{n} = 80$

A non-respondent rate of 5% of **n** was calculated as (4)

The total sample size was then 84 participants.

Proportions for paediatric ward (65 nurses) and paediatric emergency ward (35 nurses) were calculated

using Israel's (1992) formula;

f*= n/N**, where **n** is the sample size (84), **N** is the size of the population (100), and ***f is the constant proportion.

Therefore, ***f***=84/100 =0.84

Pediatric ward = 65 x 0.84 = 54.6, rounded to 55 nurses/midwives.

Pediatric Emergency Ward estimated staff = 35 x 0.84 = 29.4, rounded to 29 nurses/midwives.

This reflects their relative staffing ratios. Within each stratum, systematic random sampling was used, with every second eligible nurse selected from duty rosters until target sample sizes were achieved. A simple random sampling method and a lottery technique were employed for participant selection. Nurses on sick, annual, and maternity leave were excluded.

We developed a structured questionnaire based on the WHO Severe Acute Malnutrition Management Guidelines (WHO, 2013; updated 2019). The instrument comprised four sections: (1) demographic characteristics (8 items), (2) knowledge of SAM management (15 multiple-choice questions), (3) self-reported adherence to ten WHO protocol steps (using 5-point Likert scales), and (4) organizational factors (12 items). It covered demographic characteristics, factors influencing malnutrition management, knowledge of SAM, and adherence to protocols. Four trained research assistants administered questionnaires during nurses' break times to minimize work disruption. Each participant provided written informed consent before completing the 20-minute self-administered questionnaire. Data quality was monitored through daily completeness checks, with clarifications sought within 24 hours when necessary.

Statistical analysis followed a pre-specified plan using Stata 16.1. Missing data (<5% overall) were addressed through multiple imputation with chained equations. Continuous variables were assessed for normality using Shapiro-Wilk tests and described using means ± standard deviations or medians [interquartile ranges]. Categorical variables were described using frequencies and percentages with 95% confidence intervals. Bivariate associations were assessed using chi-square tests for categorical variables and t-tests or Mann-Whitney U tests for continuous variables. Multivariable logistic regression was performed to identify independent factors associated with good adherence (defined as implementing ≥7 of 10 protocol steps). Variables with $p<0.20$ in bivariate analysis were included in the multivariable model. Model assumptions were verified through residual analysis and goodness-of-fit testing using the Hosmer-Lemeshow test. A p-value of less than 0.05 was considered statistically significant.

Content validity was established through expert review by five pediatric nutrition specialists and three nurse educators, achieving a content validity index of 0.89. The instrument was pretested among 20 nurses at the Seventh Day Adventist Hospital, Tamale. Test-retest reliability over 14 days yielded correlation coefficients of 0.82 for knowledge scores and 0.76 for adherence scales. Internal consistency was acceptable (Cronbach's $\alpha = 0.78$ for knowledge, $\alpha = 0.84$ for adherence). Double negatives, ambiguous, and leading questions were avoided to maintain question quality.

Inclusion and Exclusion Criteria

All the professional nurses working in the paediatric department who were physically present during the data collection period were included. However, Nurses with less than one year of working experience, those on annual leave, study leave, and maternity leave were excluded from the study

The WHO Guidelines for Inpatient Treatment of Severely Acute Malnourished Children

This is a practical guideline for treating severely malnourished children, intended for the healthcare team, including nurses, doctors, nutritionists/dietitians, and other healthcare workers responsible for the medical and nutritional care of these children, as well as for trainers and supervisors. The guidelines are divided into two main phases: the stabilization phase and the rehabilitation phase. The stabilization phase highlights frequent therapeutic feeding, both day and night, rehydration with a low-sodium rehydration solution for SAM (Resomal), careful monitoring for signs of fluid overload, correction of electrolyte and micronutrient deficiencies, and the administration of broad-spectrum antibiotics, even if there are no signs of infection (WHO, 2013). The focus of the rehabilitation phase is on rebuilding lost body tissues, providing psychosocial stimulation, and preparing for discharge and ongoing follow-up care. Overall, the guidelines are implemented in 10 essential steps.

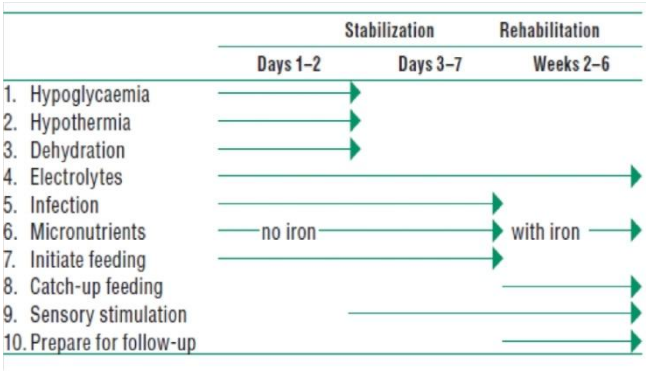

Figure 1: Time frame for management of children with SAM (Adapted from the WHO guidelines, 2013)

Ethical Considerations

Ethical approval was obtained from the Research Unit of the Tamale Teaching Hospital and the Ethical Review Committee on Human Research and Publication Ethics (CHRPE/AP/167/22) of Kwame Nkrumah University of Science and Technology. All ethical protocols were followed, including privacy, confidentiality, voluntary participation, and informed consent.

Results

Participant Flow and Response Rate of 100 eligible nurses, 84 participated (response rate: 84%). One incomplete questionnaire was excluded, yielding 83 complete responses for analysis. Non-participants (n=16) included nurses on leave (n=8), those who declined participation (n=5), and nurses transferred during data collection (n=3). No significant differences were observed between participants and

non-participants regarding age, gender, or years of experience (all p>0.05).

Demographic Characteristics of the Study Participants

Most of them were aged less than 30 years (51.3%), with an average age of 31 years, and 50.6% were males. Almost half of the participants (49.4%) had attained a diploma-level education (Table 1). Most of the nurses (91.6%) were directly involved in the management of SAM patients. Only 28.9% of participants affirmed that they have been trained in SAM management. Just above half (51.8%) of the participants had not used the WHO SAM protocol for the management of SAM patients (Table 2).

Knowledge of the SAM management protocol among participants

Knowledge Assessment Results among 83 participants showed significant variation in correct responses across different domains. Basic definitions were well understood: 77.1% (95% CI: 66.9-85.4%) correctly defined malnutrition as energy imbalance, and 89.2% (95% CI: 81.0-94.7%) identified undernutrition as the most common form of malnutrition in Ghana. Additionally, 62.7% and 81.9% correctly stated that wasting resulted from energy deficiency and defined "Weight for height -3 z scores below 70% and or edema on both feet and MUAC below 11.5cm" as the accurate case definition, respectively. Furthermore, only 18.1% of the participants identified the correct causes of death in malnourished children (Table 3). Figure 1 illustrates the overall knowledge levels of the SAM management protocol among participants. Approximately 17.0% had good knowledge of the SAM management protocol.

Determinants of adherence to WHO SAM management protocol

Regarding the observance of the WHO's ten (10) SAM protocol steps; Step 2 (hypothermia) had high adherence (74.7%), Step 5 (infections) had 58.7%, and Step 10 (prepare for follow-up after recovery) had 71.1%. However, only 15.7% followed Step 1 (hypoglycemia), 3.6% followed Step 4 (electrolyte correction), and 6.0% followed Step 6 (correct micronutrient deficiencies) (Table 4).

Overall Protocol Adherence Using the pre-defined threshold of implementing ≥7 of 10 protocol steps correctly, only 4 nurses (4.8%, 95% CI: 1.3-11.9%) demonstrated good adherence. Moderate adherence (implementing 4-6 steps correctly) was observed in 34 nurses (41.0%), while 45 nurses (54.2%) showed poor adherence (≤3 steps implemented correctly). The observed differences in levels of adherence to SAM protocol across participants' age groups (p =0.536), gender (p =0.591), education level (p =0.728), and years of experience working (p =0.687) were not statistically significant. However, 51% of nurses who adhered poorly were 31 years and above (Table 5). Factors Associated with Good Adherence among the 24 trained nurses, 18 (75.0%) demonstrated good adherence compared to 16 of 59 untrained nurses (27.1%). This difference was statistically significant (χ^2 = 16.17, p<0.001, OR = 8.1, 95% CI: 2.8-23.4). Similarly, nurses who regularly used the protocol showed significantly higher adherence rates (76.5% vs 23.5%, p<0.0001). Also, participants who used the SAM management protocol were more (76.5%) than those who

had no use (23.5%) in terms of good adherence to the protocol, and observed differences were statistically significant ($p<0.0001$). However, the observed frequencies of the levels of adherence to SAM protocols across SAM management involvement and display awareness were not statistically different $p = 0.607$ and $p=0.176$ respectively (Table 6). Furthermore, participants who had good knowledge of SAM management protocol were more (32.4%) than those who had poor knowledge (6.1%) in terms of good adherence to the protocol, and observed differences were statistically significant ($p<0.005$) (figure 3).

Discussion

This study revealed critically low adherence to WHO SAM management protocols among nurses in Northern Ghana, with fewer than 5% of participants demonstrating good adherence despite nearly all being involved in SAM patient care. These findings highlight substantial implementation gaps that may contribute to preventable childhood mortality in this resource-limited setting. It revealed that while a majority of nurses (91.6%) were involved in SAM management, only a small fraction (28.9%) had received formal training. Our adherence rate of 4.8% is substantially lower than reported in similar settings: 34% in Kenya (Mbugua et al., 2015), 28% in Ethiopia (Tefera et al., 2014), and 41% in Bangladesh (Islam et al., 2022). This marked difference may reflect variations in training intensity, supervision quality, or resource availability between study sites. More than half (51.8%) of respondents were unaware of WHO protocols displayed in the ward, indicating inadequate sensitization efforts. Knowledge assessment revealed a concerning pattern: while most nurses (77.1%) understood basic malnutrition definitions, only 18.1% correctly identified the primary causes of death in SAM children. This knowledge-practice gap aligns with implementation science theory suggesting that knowledge alone is insufficient for behavior change without supportive organizational structures and adequate resources.

The finding that only 28.9% of nurses received SAM-specific training reflects broader healthcare capacity challenges in sub-Saharan Africa. Our results demonstrate that formal training significantly increased odds of good adherence (OR = 8.1, 95% CI: 2.8-23.4), supporting evidence from randomized trials showing that structured training programs can improve clinical outcomes when combined with supportive supervision (Rahman et al., 2020). These gaps suggest the need for refresher training to enhance capacity in SAM care, as proper training directly correlates with adherence to protocols. Most respondents (81.9%) incorrectly identified the causes of death in SAM cases, misattributing them to infections and heart failure instead of the correct WHO-listed causes like hypoglycemia, dehydration, and electrolyte imbalance. These findings are consistent with a study conducted by (Briend and Collins 2010). This highlights a critical knowledge gap that could impact patient outcomes.

Nurses demonstrated a reasonable understanding of SAM definitions, with 81.9% identifying the correct case definition and 89.2% recognizing undernutrition as the most common form of malnutrition in Ghana, as reported by WHO (2017). The high results could have been influenced by observation from the ward, similar to the findings reported from low—and middle-income countries (Trehan *et al.,* 2016).

Additionally, 72.3% correctly identified the two main components of the SAM management protocol—stabilization and rehabilitation, which is in contrast to a study conducted in selected hospitals in northern Ghana which reported 45.5% knowledge of nurses on both stabilization and rehabilitation phases

of the protocol (Mogre et al. 2017). However, only 42.2% correctly articulated all ten essential steps of the protocol. The findings of Mogre et al. (2017) are comparable.

Hypoglycemia treatment and prevention in SAM are critical due to the increased risk of hypoglycemia in children with SAM due to decreased glucose reserves, a random blood sugar (RBS) should be checked on admission, and if this is not possible, intravenous 10% glucose should be given as a bolus or fed as soon as possible. The study found poor adherence to the ten essential steps outlined in the WHO guidelines, with low compliance in hypoglycemia management (15.7%). SAM is thought to predispose children to develop either hypo- or hyperglycemia and meta-analysis results showed that hypoglycemia was associated with a higher chance of mortality during hospitalization in children with SAM (Ledger et al. 2021). This is consistent with the findings at Kalakla Turkish Hospital in Khartoum, Sudan (Salih 2018).

Respondents, that have good knowledge of SAM and WHO guidelines were more likely to follow these protocols. Poor diagnosis, treatment, and prevention of hypoglycemia could be attributed to a lack of essential supplies, unavailability of the WHO protocol in the patients' records and also in the wards, lack of training on the protocol, or due to staff reluctance, or both, could explain inadequate adherence for hypoglycaemia. However, 15.7% of respondents followed this step, which is comparable to a finding in a comparable Bangladesh (Islam et al. 2022). Malnourished children are prone to hypothermia, therefore, routine temperature monitoring, keeping warm, and nursing in specialized rooms are recommended (WHO, 2013). This step of the study was well followed by the attendant nurses. This is consistent with the findings at Mbagathi District Hospital in Kenya, where good adherence to hypothermia was reported (Wangechi et al, 2013). In contrast to the findings in Garissa from Warfa et al., (2013) study there were low adherence reported in the ward. The difference could as a result of different methodologies. Their study was designed as a prospective study in a district hospital, whereas our study was conducted in a tertiary health facility, which could have influenced the disparity. Effective measures such as extra blankets, hot water bottles, especially at night, and their availability might have contributed to the high adherence to this step (Bilal et al., 2018).

It is difficult to diagnose dehydration and also challenging to estimate the severity of dehydration among children with SAM. Therefore, intravenous fluids should be restricted only to those children in shock and oral ReSoMal should be used to rehydrate the children who are not in shock to reduce the risk of cardiac overload (WHO, 2013). In this study, the majority 55.4% poorly adhered to this step. Similarly, Bilal et al (2018) judged inadequate adherence in this step even though dehydration is a known complication in malnourished children. Lack of training and therefore lack of knowledge on the dangers of poor monitoring of patients as well as shortage of nurses, may have contributed to our findings.

Children with SAM have electrolyte deficiencies including potassium and magnesium, the correction of these deficiencies may take up to ≥ 2 weeks. In this study, the majority 96.4% were not adhering to this step. A similar finding in Kenya referral Hospitals (Mbugua et al, 2015). However, in contrast to the finding in Pakistan where adherence was high (Younas et al, 2012). The study differed from our study in that was a prospective study in Pakistan unlike ours which was a cross-sectional study in a tertiary teaching and referral Hospital. The difference could also be due to geographical location. The doctor's reluctance to

prescribe the electrolytes, the nurse's reluctance to serve, or even the lack of training on the protocol could explain the poor adherence to the step.

Malnourished children present commonly with the infection without the typical signs such as fever. It is therefore assumed that children with SAM have infections and should be routinely initiated on antibiotics for presumed infection (WHO, 2013). In this study, the majority of respondents adhered to first-line antibiotics which is in line with the WHO protocol. Similar to the findings in Parkistan (Younas *et al*., 2012). However, in contrast to findings in South Africa (Ashworth *et al*., 2013) where it was attributed to reluctance by doctors to prescribe antibiotics. The good adherence to this step could have been that the nurses understood the importance of antibiotics in SAM and were ready to serve with the doctor's order.

Children with SAM have vitamin and mineral deficiencies contributed by dietary insufficiency. Anemia is also common among malnourished children and iron should be supplemented in the rehabilitation phase of management (WHO, 2013). In this study, there was low adherence compared to the recommendation of the WHO protocol. However, there sharp contrast in the findings in the Mbagathi district hospital (Wangechi et al, 2013) where adherence was high among participants at this step. In the Mbagathi study, an inventory of supplies of micronutrients was done which showed available in the hospital but in our study, the inventory of the supplies was not done. Hence the poor adherence to this step could been the unavailability of supplies or inadequate relevant knowledge among nurses.

Initiate feeding: Due to the fragile physiological state of malnourished children, initiating refeeding should be done with caution by using a low osmolality recipe such as F75 at the stabilization phase, to continue 2-3 hourly day and night, and to encourage continue breastfeeding if the child is breastfeeding (WHO, 2013). In this study, there was low adherence (28.9) to initiating feeding, similar to findings at Mbagathi Hospital (Wangechi et al, 2013), however, in contrast to findings in Kenya (Mbuguaet al, 2015). The low adherence in initiating feeds could be due to the lack of feeding charts with clear prescriptions on the amount to give and the frequency of feeding and also inadequate communication from the clinicians and nutritionists to the nurses and the caregivers.

In the rehabilitation phase of treatment, a high-caloric feed should be introduced based on the reduction of edema and or improvement of appetite (WHO, 2013). There was high none adherence in this study in contrast to the WHO protocol (WHO, 2013). The high non-adherence could be attributed to the unavailability of the feeding charts in patients' files which give clear instructions regarding the feed increment and feeding frequency and also lack of communication among the clinicians, nurses, nutritionists, and caregivers.

Sensory stimulation should be provided through a multidisciplinary approach involving the healthcare workers and the caregivers. In this study, 44.3% of the respondents adhered to sensory stimulation as per the WHO recommendations where structured play therapy and provision of toys are recommended (WHO, 2013). The poor adherence to this step could have been due to a lack of playroom, play therapist or poor communication among the health team.

This phase of treatment entails planning for discharge and follow-up care. This phase of treatment should

be instituted based on good weight gain of >10g/kg/day, the presence of a good appetite, and the readiness of the caretaker for home-based therapeutic care (WHO, 2013). In this study, there was high adherence (71.1%) to the discharge and follow-up plans as recommended by WHO.

The study also found that nurses who had received formal SAM training after employment were more likely to adhere to the protocol ($p<0.05$), confirming the significance of training in improving adherence. This finding aligns with studies from North Ethiopia (Tefera et al., 2014) and Muzigaba et al. (2018), which emphasize the importance of regular refresher training for healthcare workers managing SAM.

Overall, the study highlights a strong association between nurses' knowledge of SAM protocols and their adherence to the WHO guidelines ($p=0.0001$). This mirrors findings from a Sudanese study (Bilal et al., 2018), which also demonstrated that higher knowledge levels lead to better adherence.

Strengths and Limitations

The study addressed a critical gap regarding nurses' adherence to SAM protocols, providing evidence that can inform future training and interventions. It underscored the need for refresher training in SAM management, emphasizing its importance in improving adherence.

Study Limitations Several limitations warrant consideration. First, the cross-sectional design precludes causal inference regarding training-adherence relationships. Second, self-reported adherence measures may overestimate actual practice due to social desirability bias, particularly given that WHO protocols were displayed in study wards. Third, our single-site design limits generalizability to other healthcare settings with different resource levels or organizational cultures. Fourth, we did not validate self-reported adherence through direct observation or chart review, which may have provided more objective assessment. Finally, the study did not capture patient outcomes, limiting our ability to assess the clinical significance of adherence variations.

Conclusion

Conclusion: This study reveals critically low adherence to WHO SAM management protocols among nurses in Northern Ghana, with formal training emerging as the strongest predictor of guideline implementation. The substantial knowledge-practice gap identified suggests that improving SAM care quality requires comprehensive interventions addressing both individual competencies and organizational support systems. Key findings include: only 28.9% of nurses had received SAM management training. More than half of the respondents were unaware of WHO protocols displayed in the ward. While nurses had adequate knowledge of certain aspects of SAM, adherence to the 10 essential WHO protocol steps was generally low, especially in areas like electrolyte correction, feeding initiation, and dehydration management. Nurses who received formal training were more likely to adhere to the protocol, reinforcing the need for continued training programs.

Nursing Implications

1. Implement mandatory 40-hour SAM management certification for all pediatric nurses, including hands-on simulation training and competency assessment.
2. Establish monthly refresher sessions with case-based learning to reinforce protocol adherence.
3. Integrate SAM management modules into pre-service nursing curricula with minimum 20 clinical hours in nutrition rehabilitation units.
4. Develop mobile application decision-support tools to guide real-time protocol implementation at the bedside.

What is already known about this topic?

Severe Acute Malnutrition (SAM) is a critical health issue, especially in low- and middle-income countries like Ghana, where it significantly contributes to child morbidity and mortality.

The World Health Organization (WHO) SAM management protocol is widely recognized as an evidence-based guideline for treating SAM in children. It outlines steps that health workers, particularly nurses, must follow for effective treatment.

Nurses play a pivotal role in managing SAM in healthcare settings, but gaps in adherence to these protocols are commonly reported.

Previous studies suggest that nurses' knowledge and training are essential factors in the effective management of SAM. A lack of refresher training and resources often leads to suboptimal adherence to treatment guidelines.

What this study adds

This study provides empirical evidence on the specific adherence rates of nurses to the WHO SAM protocol in Tamale, Ghana. While adherence was generally low (only 4.8% had good adherence), certain steps, such as managing hypothermia (74.7%) and follow-up after recovery (71.1%), had relatively higher adherence rates.

It highlights that only 28.9% of nurses received formal training in SAM management, and a significant portion (51.8%) had never utilized the WHO SAM protocol.

The study identifies training as a key factor influencing adherence, with trained nurses demonstrating significantly higher adherence rates (52.9%) compared to their untrained counterparts (12.2%).

It also reveals that knowledge of the SAM management protocol significantly affects adherence levels, with nurses who had better knowledge demonstrating improved adherence to the protocol steps.

The findings emphasize the need for continuous training and reinforcement of the WHO guidelines in healthcare settings to improve adherence and patient outcomes.

Competing interests

No competing interests to declare.

Authors' contributions

ANA and YNA conceptualized the study, methodology, and literature review. ANA undertook the data collection and analysis. ANA also drafted the manuscript, which YNA reviewed for intellectual content. All authors read and approved the final manuscript for publication.

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APPENDIX

Tables and figures

Table 1: Socio-demographic characteristics of participants

Table 2: SAM management-related behaviour among participants

Table 3: Nurses' knowledge of SAM and management protocol

Table 4: Nurses adherence to SAM protocol

Table 5: Chi-square test for association between level of adherence and socio-demographic characteristics of participants.

Table 6: Chi-square test for association between level of adherence and SAM management-related

behaviour among participants.

Figure 1: Overall knowledge of SAM management protocol

Figure 2: Level of SAM protocol adherence among participants

Figure 3: Chi-square test for association between level of adherence and level of knowledge among participants

Tables and figures

Table 1: Socio-demographic characteristics of participants

Variables	Number (n=83)	Percentage (%)
Age mean (sd)	31 (4)	
Age Group		
≤ 30 years	43	51.8
31 years and above	40	48.2
Gender		
Male	42	50.6
Female	41	49.4
Highest education		
Diploma	41	49.4
BSc	37	44.6
Postgraduate	5	6.0
Years of experience		
mean (SD)	5 (5)	
<5 years	38	45.8
5-9 years	31	37.4
10 years and above	14	16.9

Table 2: SAM management-related behaviour among participants

Variables	Number (n=83)	Percentage (%)
SAM management training		
No	59	71.1
Yes	24	28.9
SAM management involvement		
No	7	8.4
Yes	76	91.6
Usage of WHO SAM protocol		
No	43	51.8
Yes	40	48.2
Display of SAM protocol on the ward		
No	44	53.0
Yes	39	47.0

Table 3: Nurses' knowledge of SAM and management protocol

Variables	Correct response	Number (n=83)	Percentage
Definition of malnutrition			
The balance between energy intake and expenditure	False	17	20.5

The imbalance between energy intake and expenditure	**True**	64	77.1
Increase in appetite	False	2	2.4
The commonest form of malnutrition in Ghana			
Over nutrition	False	6	7.2
Undernutrition	**True**	74	89.2
Equal nutrition	False	3	3.6
Energy deficiency result in the following			
Marasmus (wasted)	**True**	52	62.7
Kwashiorkor (Oedematous)	False	31	37.3
Results of protein deficiency			
Kwashiorkor (oedematous)	**True**	52	62.7
Marasmus (wasted)	False	31	37.3
Sign of bilateral pitting oedema			
Kwashiorkor (oedematous)	**True**	48	57.8
Marasmus (wasted)	False	25	30.1
Obesity	False	10	12.1
Case definition of SAM			
Weight for height below- 3 z scores or below 70% and or oedema on both feet and MUAC below 11.5cm	**True**	68	81.9
Weight for height above -3 z scores or below 70% and or oedema on feet and MUAC greater than 11.5cm	False	15	18.1
Hypoglycemia in SAM: RBS			
Below 2.5mmol/L	False	39	47.0
Below 3mmol/L	**True**	35	42.2
Below 2.2mmol/L	False	9	10.8

Number of essential steps in SAM management protocol			
Nine (9)	False	16	19.3
Twelve (12)	False	32	38.6
Ten (10)	**True**	35	42.2
Component of the SAM guideline			
Stabilization and rehabilitation phase	**True**	60	72.3
Orientation and introduction phase	False	18	21.7
Admission and discharge phase	False	5	6.0
At what phase is acute medical conditions managed			
The stabilization phase	**True**	41	49.4
Rehabilitation phase	False	19	22.9
Introductory phase	False	4	4.8
Admission phase	False	19	22.9
Causes of death in malnourished children			
Hypoglycemia, hypothermia, Dehydration, electrolyte imbalance	**True**	15	18.1
Hypoglycemia, infections, dehydration, and heart failure	False	68	81.9

Table 4: Nurses adherence to SAM protocol

Variables	Number	Percentage (%)
Step 1: hypoglycaemia		
Non-Adherence	70	84.3
Adherence	13	15.7
Step 2: hypothermia		
Non-Adherence	21	25.3
Adherence	62	74.7

Step 3: Dehydration		
Non-Adherence	46	55.4
Adherence	37	44.6
Step 4: Correction of electrolytes		
Non-Adherence	80	96.4
Adherence	3	3.6
Step 5: infections		
Non-Adherence	35	42.2
Adherence	48	57.8
Step 6: Correct micronutrient deficiencies		
Non-Adherence	78	94.0
Adherence	5	6.0
Step 7: Start cautious feeding		
Non-Adherence	59	71.1
Adherence	24	28.9
Step 8: Achieve catch-up growth		
Non-Adherence	45	54.2
Adherence	38	45.8
Step 9: Sensory stimulation and emotional support		
Non-Adherence	46	55.4
Adherence	37	44.6
Step 10: Prepare for follow-up after recovery		
Non-Adherence	24	28.9
Adherence	59	71.1

Table 5: Chi-square test for association between level of adherence and socio-demographic characteristics of participants.

Variables	Poor adherence N (%)	Good Adherence N (%)	x^2 (p – value)
Age Group			
≤ 30 years	24 (48.9)	19 (55.9)	
31 years and above	25 (51.0)	15 (44.12)	0.38 (0.536)
Gender			
Male	26 (53.1)	16 (47.1	
Female	23 (46.9)	18 (52.9)	0.29 (0.591)
Highest education			
Diploma	25 (51.0)	16 (47.1)	
BSc	22 (44.9)	15 (44.1)	
Postgraduate	2 (4.1)	3 (8.8)	0.8157 (0.728)!
Years of experience			
<5 years	24 (48.9)	14 (41.2)	
5-9 years	18 (36.7)	13 (38.2)	
10 years and above	7 (14.3)	7 (20.6)	0.75 (0.687)

! Fisher exact chi-square test

Table 6: Chi-square test for association between level of adherence and SAM management-related behaviour among participants.

	Poor adherence	Good Adherence	

Variables	N (%)	N (%)	x^2 $(p-value)$
SAM management training			
No	43 (87.8)	16 (47.1)	
Yes	6 (12.2)	18 (52.9)	16.17 (<0.0001)
Sam management involvement			
No	4 (8.2)	3 (8.8)	
Yes	45 (91.8)	31 (91.2)	0.01 (0.607)!
Usage of WHO SAM protocol			
No	35 (71.4)	8 (23.5)	
Yes	14 (28.6)	26 (76.5)	18.44 (<0.0001)
Display of SAM protocol guidelines on the ward			
No	29 (59.2)	15 (44.1)	
Yes	20 (40.8)	19 (55.9)	1.83 (0.176)

Fisher exact chi-square test

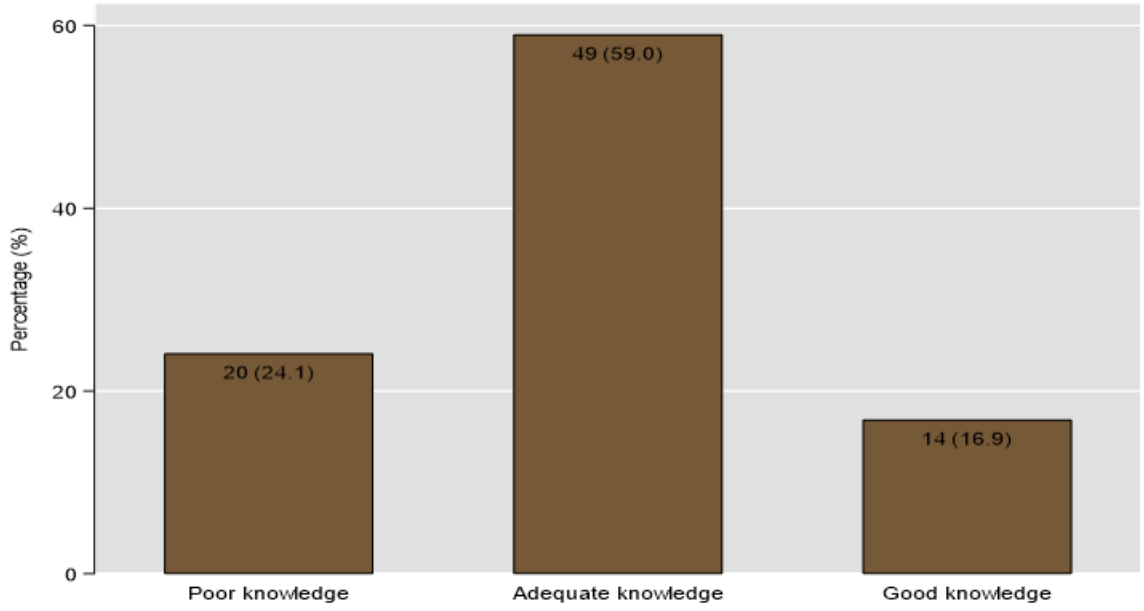

Figure 1: Overall knowledge of SAM management protocol

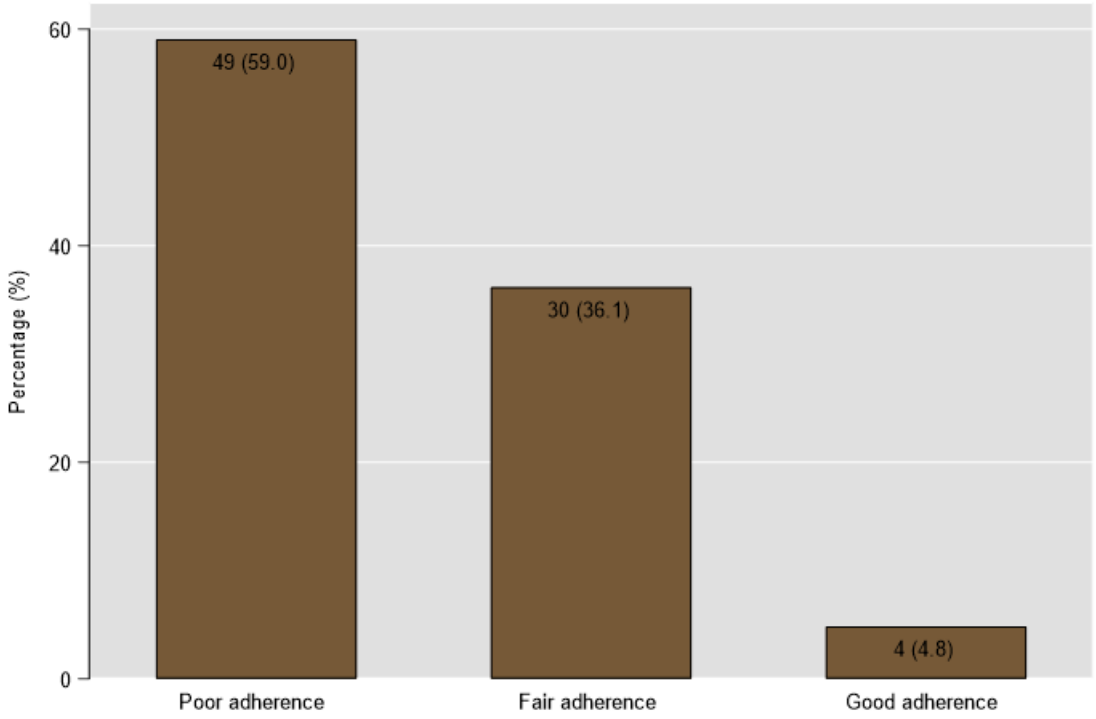

Figure 2: Level of SAM protocol adherence among participants

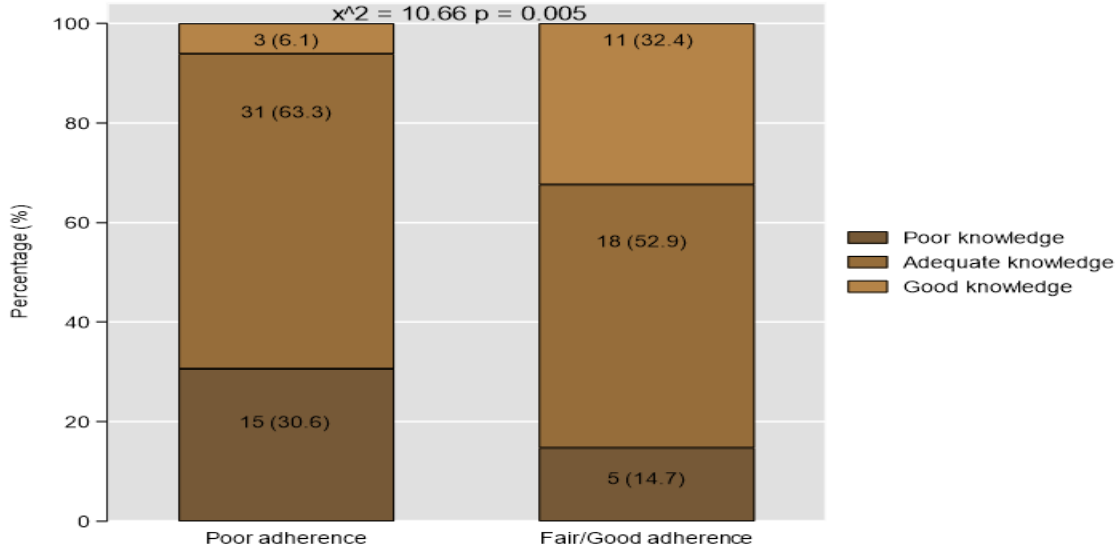

Figure 3: Chi-square test for association between level of adherence and level of knowledge among participants