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*Original Research Article*

# Assessment of the Efficiency of Application of the National Protocol for Integrated Management of Severe Acute Malnutrition in National Hospital Center of Nouakchott -Mauritania

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ABSTRACT

Malnutrition is a worldwide concern with worrisome outcomes that affect substantially the lifestyle of infants. Addressing and combating malnutrition is crucial for ensuring the healthy growth and development of infants. It requires comprehensive interventions that encompass not only improving access to nutritious food but also addressing underlying causes such as poverty, inadequate healthcare, and lack of education. By addressing malnutrition, we can enhance the well-being and prospects of infants worldwide. This study aimed to investigate the effectiveness of the IMSAM protocol on malnourished Mauritanian children during their hospitalization. The study sample consisted of 230 participants, including 126 boys and 104 girls, who were selected from both rural and urban areas. The study was conducted in the Pediatric Service of the National Hospital Center in Nouakchott, Mauritania, focusing on children who underwent the national protocol for the Integrated Management of Severe Acute Malnutrition (IMSAM). In addition, the medical and nutritional treatment, and body measurements were appreciated as well as the anthropometric parameters. The study results revealed significant differences in average weight before and after the intervention ($P < .001$). The regression test indicated a negative prediction of weight gain ($P < .05$), influenced by variables such as the Z-score of weight-to-height (P/T), presence of edema after nutritional support, and final health status. Finally, it is important to highlight that an IMSAM-based intervention, when combined with rational management, has the potential to mitigate the adverse effects of malnutrition by maximizing social skills.

***Keywords***: Malnutrition; IMSAM; Anthropometric parameters; Mauritania.

## Introduction

The multiple detrimental effects of malnutrition in an infant under six months of age were noted. Former research surmised a link between malnutrition and nutritional, biochemical, and anthropometric markers.[1,2] Malnutrition ought to exhibit nutritional vulnerability associated with anthropometric deficiencies, wasting, being underweight, stunting, and weak birth weight.[3,4] These deficiencies are linked to a greater chance of death, morbidity, ensuing malnutrition, and hampered growth.[5,6] A recent study has proposed that anthropometric deficits, namely wasting, underweight, and stunting, were responsible for the mortality of infants under 6 months of age.[7] For instance, it is predicted that 8.5 million infants, of which 3.8 million are squandered and wasted.[8] Additionally, 20.5 million live births are thought to have LBWs.[9] It is noteworthy that the likelihood of occurrence the of nutritional difficulties in the first time of life is widely reported. Nevertheless, nutritional depletion could have long-standing and detrimental effects during mainstream development windows.[10]

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An additional Section about infants u6m was unprecedently updated by WHO guidelines to manage the depletion. Several risk factors of malnutrition increase the risk of Mortality were reported by African and some Asian studies, indeed, severe depletion of nutritional elements and malaria social, determinants (eg; Nepal,).[11,12] This section delineates recommendations for outpatient care rather than inpatient treatment for clinically stable malnourished newborns u6m. Care for everyone, regardless of clinical status, as was customarily carried out Regardless of clinical status, as was customarily carried out, these sections delineate paramount recommendations for outpatient infants rather than malnourished ones.[13]
However, the majority of low- and middle-income countries (LMICs) have yet to incorporate these updated recommendations into their national guidelines. One contributing factor to this lack of implementation is the limited understanding of the burden of malnutrition, particularly when it comes to prioritizing the care of vulnerable infants under the age of six months who are at a high risk of nutritional deficiencies.[14] Questionable admission standards based on Weight-for-length z-scores (WLZ) WHO, which are difficult and have low reliability to achieve in toddlers because it is challenging to measure their length, u6m (more than in children), and lengths less than 45 cm cannot be used to calculate WLZ (WHO, 2006) babies' complicated treatment demands.[15,16] and (iv) the lack of high-quality research on the most effective methods to address those needs. Requires. Weight-for-age z-score (WAZ) and the mid-upper arm measurements are used to address the first two issues. MUAC) have been proposed as superior substitutes for recognizing tiny newborns who are nutritionally vulnerable, however, there is little data to

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support their predictive utility within this age range. Furthermore, it is still necessary to establish the best predictive cut-off values.[17] The increasing understanding of the common coexistence of various anthropometric Program entry requirements.[18] Complicating understanding of more precise definitions of malnutrition is the growing recognition of the coexistence of many anthropometric deficits. To achieve this, the Composite Anthropometric Failure Index (CIAF) is a combined indicator of malnutrition that combines classic wasting, stunting and underweight, which are alarming signs [19], although, to our knowledge, it has not been used to describe neonatal malnutrition u6m. Infant malnutrition is a public health issue as it is in many other LMICs.[20] Infants should only receive treatment from inpatients, according to current Ministry of Health guidelines. u6m after being identified with a WLZ 3, FMOH, to assist in planning future programming and studying the difficulties of a randomized sample size planned controlled trial (RCT). In Mauritania, combating worrisome malnutrition-related issues is challenging. Pregnant, nursing women and children under the age of five years were the most affected by this phenomenon the vulnerable and susceptible ones were associated with the detrimental effect of this dilemma WFP. Nutritional outcomes esp. in children aged under five (un5) in various areas were clear-cut. The investigation dedicated to the cost of hunger in Mauritania CEA outlines that the prevalence of chronic malnutrition in children, as indicated by underweight, has seen a concerning rise. Approximately 43% of the active population experiences stunted growth during their childhood. This has had a significant impact on Mauritania's economy, with a loss of 13.3% of its GDP attributed to the cumulative effects of stunted growth on productivity. Moreover, undernourishment has been identified as the cause of 4.5% of infant mortality cases in Mauritania.[21,22] The primary aim of this study is to assess the efficacy of the Integrated Management of Acute Malnutrition (IMAM) program in treating malnourished children in Mauritania during their hospitalization.

## Materials and Methods

*Study population*

The sample was selected in compliance with the WHO reference criteria, which was based on the value of the weight-to-height ratio if, P/T less than -3Z severe acute malnutrition score, or P/T ≥ - 3 and < -2 moderate malnutrition). A total of 230 participants, including 126 boys and 104 girls collected from rural and urban areas, with an average age of 15.52 months ±7.727 were enrolled.

*Procedure*

The study was conducted at the Pediatric Service of the National Hospital Center in Nouakchott, Mauritania, with a focus on children who underwent the national protocol for Integrated Management of Severe Acute Malnutrition (IMSAM). We contacted the Pediatric Service Department, to authorize us to collect data (weight, height, residence, etc.) from the register of the Internal Nutritional Rehabilitation Center (INRC) within a limited period (As of 03/04 /2022 to 10/06/2022).

*Instruments*

*The INRC register*

Corresponds to a database of children hospitalized with a poor appetite and/or presenting complications of severe acute malnutrition. Either at the USN (Special Nutrition Unit) or regional hospitals and Health Centers (Ministère de la Santé – Plan National de Développement Sanitaire (PNDS) 2022-2030 – Volume I: Analyse situationally et PNDS 2022).

*Nutritional treatment*

It is through nutritional support with sachets of Therapeutic milk, either F75 milk which intervened during the acute phases of the treatment or F100 milk in the transition/rehabilitation phases of the treatment for the states of Severe Acute Malnutrition.[23].

*Medical Treatment*

It is a treatment that is divided into two types: The first pertains to drugs used daily for the management of malnutrition such as: (Amoxicillin - Gentamicin - Fluconazole - Mebendazole / Albendazole - Vitamin A - Folic acid - antimalarials). While for the second type are specific drugs for complications.

*Body measurement*

A measurement of the weight and height according to the manual of the United Nations of the Department of Technical Cooperation for Development (National Household Survey Capability Program, 1986) for each child hospitalized before and after the management of Severe Acute Malnutrition within the Pediatric Service of the National Hospital Center of Nouakchott in Mauritania.

*Statistical analysis*

Each experiment was conducted in three iterations. To analyze variance (ANOVA) and compare average values, Duncan's Multiple Range Test was employed. The results were reported as average value ± standard deviation. Statistical data analysis was carried out using the Statistical Package for the Social Sciences (SPSS) version 22.0, with a confidence level of 95%.

## Results and Discussion

The results presented in Tables 1and 2, show a significant and positive relationship between the age variables and the weight and height scores and only one significant and negative relationship between the weight gain variable and the weight score of the children who participated before the intervention. As outlined in the above-mentioned Table 3, and according to the results of the paired samples t-test, a significant relationship only for the weight variable between the two weight-performed measurements was observed (before and after) with T = - 14.333 and P <.000 then we, therefore, accepted H1, so there is a difference between the means of the two weights measured (weight in and weight out). Regarding height, we did find a non-significant relationship with T = 501 and P > 0.05. Hence, we accept H0 and there is no difference between the means of the two measured sizes (entrance height and height Release).

Table 1 shows the impact of Z-scores P/T ANS, Edema ANS, and final health status on gain weight. In step 1, the $R^2$ value of 0.94 revealed that the Z-scores P/T ANS explained 94% variance in gain weight with F(1, 228) = 23.550, P< .001. The findings revealed that the Z-scores P/T ANS positively predicted gain weight (β = .306, P< .001). In step 2, the $R^2$ value of .136 revealed that the Z-scores P/T ANS and Edema ANS explained 13.6% variance in gain weight with F (2.227) = 17.817, P< .001. The findings revealed that the Z-scores P/T ANS (β = .294, P< .001) and Edema ANS negatively predicted gain weight (β = -.205**, P< .001). The $\Delta R^2$ value of .042 revealed a 4.2% change in the variance of model 1 and model 2 with ΔF (1.227) = 11.046, P< .001. In step 3, the $R^2$ value of .154 revealed that the Z-scores P/T ANS, Edema ANS, and final health status explained a 15.4% variance in Gain weight with F(3. 226) = 13.687, P< .001. The findings revealed that the Z-scores P/T ANS (β = .260, P< .001), Edema ANS (β = -.187, P< .003) and final health status negatively predicted gain weight (β = -.140*, P< .029). The $\Delta R^2$ value of .018 revealed a 1.8% change in the variance of model 1, model 2, and model 3 with ΔF (1.226) = 4.827, P< .029 (Table 4).

To evaluate the IMSAM protocol for the care of children with severe acute malnutrition in the age group from 6 to 59 months, the following result was shown.

*The impact of the care of children with acute and severe malnutrition on weight and height*

Through Table 1, the results of the study show a significant change (P<.001) in weight measured during pre-and post-intervention for hospitalized children with a significant. Whereas, about the height, no significant modification was observed. The level of Z-Score varied from (< -3z) with odds of 99.1% for all malnourished children hospitalized to a Z-Score between (< -2z and < -1z ) with a rate of 36.95%). Our current findings were in line with the following previous works, carried out by Diall *et al*,[24] over 259 cases experiencing severe

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acute malnutrition, they managed to treat successfully 54.83%. Moreover, a further study conducted by Bah *et al*, [25] aimed to identify the prevalence of severe acute malnutrition and the complication in children selected with a weight/height index below -3 Z score they have succeeded to stabilize (85%) of cases and transfer to the severe outpatient nutritional education and recovery unit (URENAS).
In the same vein, a study carried out by Kambale *et al*, [26] for 574 severely malnourished at the Nutritional and Therapeutic Center of Bukavu, have shown an average of 520 cases were cured with a rate (of 90.8%) success.

*Improving the weight and height of children with severe acute malnutrition according to age*
Through Table 1, in our studied samples, we find that the majority of children who have been hospitalized for the management of acute and severe malnutrition (with a Z-Score of -2 and -3) are in the age category of 6-24 months (93.48%) and most are boys, while the age category of 25-60 months (with a Z-Score only of -3) is in low percentage (6.52%). These results are compatible with those of Nguefack *et al*, [23] who also noticed that the most represented age group is from 12 to 23 months with the dominance of the boy's gender. Of note, in another study conducted over small malnourished children by Ouermi *et al*,[11] the age group from 9 to 23 months, exhibited a rate of (62.34%) all of the malnourished, needless to say, raised boys. Our outcomes are at odds with the results of a study implemented by Zoungrana *et al*,[27]encompasses the age group from 6 to 23 months provided evidence that studied children were most affected by malnutrition with an odds of (51.8%) of the sample with a proportion respectively of boys (50 .3%) and girls (49.7%).

**Table 1:** Distribution of malnourished children according to socio-demographic and anthropometric parameters and the final state of care

| | | Frequency (%) |
|---|---|---|
| *Gender* | | |
| Male | | 126 (54.8%) |
| Female | | 104 (45.2%) |
| *Residence* | | |
| Urban | | 186 (80.9%) |
| Rural | | 44 (19.1%) |
| *Admission-Readmission* | | |
| Admission | | 221 (96.1%) |
| Readmission | | 9 (3.9%) |
| *final health status* | | |
| Cure | | 201 (87.4%) |
| Abandonee | | 13 (5.7%) |
| Death | | 16 (7.0%) |
| Age categories and Z-scores before nutritional support | | |
| 6-24 Month | Z-scores: -2 | 2 (0.87%) |
| | Z-scores: -3 | 213 (92.61%) |
| 25-60 Month | Z-scores: -2 | - |
| | Z-scores: -3 | 15 (6.52%) |
| **Z-scores P/T** | | |
| Before nutritional support | Z-scores: -2 | 2(0.86%) |
| | Z-scores: -3 | 228(99.14%) |
| After nutritional support | Z-scores: -1 | 145(63.04%) |
| | Z-scores: -2 | 83(36.10%) |
| | Z-scores: -3 | 2(0.86%) |
| | | Mean ± SD |
| AGE (in Month) | | 15.52 ± 7.727 |
| duration of stays | | 10.46 ± 7.967 |
| Weight before nutritional support (kg. g) | | 5.80 ± 1.435 |
| Weight after nutritional support ( Kg.g) | | 6.38 ± 1.428 |
| Height before nutritional support (cm) | | 70.12 ± 7.673 |
| Height after nutritional support (cm) | | 70.07 ± 7.686 |
| Gain Wight after nutritional support (g/kg/day) | | 13.41 ± 10.135 |

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**Table 2:** The correlation between age. gain weight. and anthropometric parameters (Weight and Height)

| | Age (month) | Wieght pre-intervention (kg.g) | height E(cm) | Wieght post-intervention (Kg.g) | heightS(cm) | Weight gain (kg/j) |
|---|---|---|---|---|---|---|
| Age(month) | 1 | .431** | .506** | .454** | .497** | -.003 |
| Weight BNS(kg.g) | .431** | 1 | .890** | .907** | .877** | -.170** |
| Height BNS (cm) | .506** | .890** | 1 | .909** | .981** | -.056 |
| Weight ANS(kg.g) | .454** | .907** | .909** | 1 | .928** | .018 |
| Height ANS (cm) | .497** | .877** | .981** | .928** | 1 | -.055 |
| Gain Wight (g/kg/day) | -.003 | -.170** | -.056 | .018 | -.055 | 1 |

*p < .05. **p < .01. ***p < .001

**Table 3:** Results of the difference of the means of two matched samples (Weight and Height) before and after nutritional support

| | Test | N | Mean | SD | T-test | dol | p-value |
|---|---|---|---|---|---|---|---|
| Weight<br>Weight Before - Weight After nutritional support ( kg.g) | Poids Before<br>Poids After | 230<br>230 | 5.800<br>6.384 | 1.435<br>1.428 | - 14.333 | 229 | P<.000 |
| Height<br>Height before - Size After nutritional support (cm) | Height Before<br>Height After | 230<br>230 | 70.126<br>70.076 | 7.673<br>7.686 | .501 | 229 | P >.617 |

*p < .05. **p < .01. ***p < .001

**Table 4:** Hierarchical Regression Results for Gain Weight

| Variable | B | 95% CI LL | UL | SE B | β | R² | ΔR² |
|---|---|---|---|---|---|---|---|
| Step 1 | | | | | | .094 | .094*** |
| (Constant) | 4.925** | 1.258 | 8.593 | 1.861 | | | |
| Z-scores P/T ANS | 6.157*** | 3.657 | 8.657 | 1.269 | .306*** | | |
| Step 2 | | | | | | .136 | .042*** |
| (Constant) | 5.639** | 2.025 | 9.253 | 1.834 | | | |
| Z-scores P/T ANS | 5.926*** | 3.476 | 8.377 | 1.244 | .294*** | | |
| Edema ANS | -6.998** | -11.147 | -2.849 | 2.106 | -.205** | | |
| Step 3 | | | | | | .154 | .018* |
| (Constant) | 9.682*** | 4.583 | 14.780 | 2.587 | | | |
| Z-scores P/T ANS | 5.228*** | 2.719 | 7.738 | 1.274 | .260*** | | |
| Edema ANS | -6.362** | -10.516 | -2.208 | 2.108 | -.187** | | |
| final health status | -2.607* | -4.944 | -.269 | 1.186 | -.140* | | |

Note. CI= confidence interval; LL = Lower limit; UL = Upper Limit; ***P < .001; P/T = weight to height ANS =After Nutritional Support. * p < .05. ** p < .01. *** p < .001.

*Variables that affect healing and weight gain in children with severe acute malnutrition*

Through Table 1, the results show a percentage of recovery reached (87.4%) since 230 cases were treated in care, however, in a study carried out by Kambale *et al*,[26] of 574 severely malnourished children hospitalized at the Nutritional and Therapeutic Center of Bukavu, 520 cases were cured with a percentage of (90.8%).

The weight gain is significantly and negatively correlated with weight before nutritional-based intervention by (R= -.170**; P< .001). Also, the mean duration of hospital stay of patients was 10.46 ±7.967 with an average weight gain of 13.41 ±10.135 g/kg/day.

A work made by Bhat *et al*,[25] postulated that the mean weight gain during stay days in the hospital was respectively 12.918±7.9735 days; 8.808±3.7312g/kg/day.[23]

A regression statistical test has identified that the variables Z-Score of weight to height (P/T) and Edema after Nutritional Support with final health status were negatively predicted gain weight (P< .029) by 15.4% variance. While according to Hossain et al., and through the use of stepwise logistic regression models with backward selection, they found maternal and social factors that had significant associations with SAM in both age groups studied in children aged from 6 to 59 months and from 6 to 24 months.[12]

## Conclusion

This study aimed to evaluate the IMSAM protocol for the care of children who suffered from acute and severe malnutrition in the age category of 6 to 59 months. While the results obtained show a significant weight change, the duration of the study was not sufficient to fully detect a change in height. Severe acute malnutrition (SAM) in Mauritania seems to be the dilemma that impedes the development of children under the age of 6. The IMSAM-based intervention has displayed an enhancement in terms of weight gain, despite the insufficiency of the schedule for malnourished children during hospitalization.

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## Conflict of Interest

The authors declare no conflict of interest.

## Authors' Declaration

The authors hereby declare that the work presented in this article is original and that any liability for claims relating to the content of this article will be borne by them.

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