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Research Article

Evaluation of The Integrated Protocol for The Management of Severe Malnutrition in Children at The National Hospital of Nouakchott-Mauritania

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Abstract
Malnutrition is a worldwide concern with worrisome outcomes that affect substantially the lifestyle of infants. The main aim is to investigate the efficacy of the IMSAM protocol over malnourished Mauritanian children during hospitalization. A cohort of 230 participants, including 126 boys and 104 girls collected from rural and urban areas with an average age of 15.52 ± 7.727 months were enrolled. The study is carried out in the Pediatric Service of the National Hospital Center of Nouakchott, Mauritania on children who have undergone 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 findings exhibit during nutritional-based intervention significant differences between the mean of weight during the pre- and post-intervention ($P < 0.001$). Moreover, through a regression test, we found a negatively predicted weight gain ($P < 0.05$) by the variables Z-score of weight to height (P / T) Edema after Nutritional Support and final health status. Last, but by no means least, the IMSAM-based intervention with rational management might make inroads into mitigating adverse outcomes of malnutrition through maximizing social skills.

Keywords: malnutrition, IMSAM, anthropometric parameters, mauritania

1. INTRODUCTION

The multiple detrimental effects of malnutrition in an infant under six months of age were noted [1]. Former research surmised a link between malnutrition and nutritional, biochemical, and anthropometric markers [2]. Malnutrition ought to exhibit nutritional vulnerability associated with anthropometric deficiencies, wasting, underweight, stunting, and low birth weight [3]. These deficiencies are linked to a greater chance of death, morbidity, ensuing malnutrition, and hampered growth [4]. A recent study has postulated that anthropometric deficiencies viz. wasting, underweight and stunting were to blame for the mortality of infants under 6 months (U6M) [5]. For instance, it is predicted that 8.5 million infants, of which 3.8 million are squandered and wasted [6]. Additionally, 20.5 million live births are thought to have LBWs [7]. 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 [8]. An additional section about infants' U6M was unprecedently updated by WHO (2013) guidelines to manage the depletion. Several risk factors for malnutrition increasing the risk of mortality have been reported by Africans [9]-[11], some Asian studies have indeed highlighted serious depletion of nutritional elements and malaria [12] and social determinants for example Nepal [13]. This section delineates recommendations for outpatient care rather than inpatient treatment for clinically stable malnourished newborns U6M. Care for everyone, regardless of clinical status, delineates paramount recommendations for outpatient infants rather than malnourished ones [14].

However, the vast majority of LMICs have not implemented these new recommendations into national guidelines. This is due, in part; to A, poor understanding of malnutrition burden is a common reason for not prioritizing the care of small and nutritionally at-risk infants aged U6M [15]. Questionable admission standards based on weight-for-length Z-scores (WLZ) [15] are difficult and have low reliability to achieve in toddlers. Thus, it is challenging to measure their length, U6M (more than in children), and lengths less than 45 cm

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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%)
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)		5.80 ± 1.435
Weight after nutritional support (kg)		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

cannot be used to calculate WLZ [16] babies' complicated treatment demands [17] and the lack of high-quality research on the most effective methods to address those needs. 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 support their predictive utility within this age range. Furthermore, it is still necessary to establish the best predictive cut-off values [18]. The increasing understanding of the common coexistence of various anthropometric program entry requirements [19]. Our comprehension of the most accurate definitions of malnutrition is further complicated by the rising recognition of the common coexistence of many types of anthropometric deficit. Intending to achieve this, the Composite Index of Anthropometric Failure (CIAF) is a combined indication of malnutrition that combines traditional wasting, stunting, and being underweight are alarming signs [20]. 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 [21]. Infants should only receive treatment from inpatients, according to current Ministry of Health guidelines. U6M after being identified with a WLZ 3 [22] to assist in planning future programming and study taking into account 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 [23]. 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 [24] (CEA, 2014) outlines that the odds of children experiencing chronic malnutrition predicted by underweight have increased. 43% of the active population suffers from stunted growth during their childhood. Mauritania lost 13.3% of its GDP due to the cumulative effects of stunted growth on productivity. 4.5% of infant mortality in Mauritania which undernourishment was to blame. The key aim of this current study is to investigate the effectiveness of the program of IMAM on malnourished children in Mauritania during hospitalization.

2. MATERIALS AND METHODS

2.1. 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 $\geq$ - 3 and < -2 moderate malnutrition). A cohort of 230 participants, including 126 boys and 104 girls collected from rural and urban areas, with an average age of 15.52 ±7.727 months were enrolled.

2.2. Procedure

The study is carried out in the Pediatric Service of the National Hospital Center of Nouakchott, Mauritania on children who have undergone the national protocol for the 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).

2.3. Instruments

2.3.1. 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 (Ministry of Health –

Table 2. The correlation between age, gain weight, and anthropometric parameters (weight and height).

	Age (month)	Weight pre-intervention (kg.g)	Height E (cm)	Weight post-intervention (Kg.g)	Height S (cm)	Weight Gain (kg/j)
Age(month)	1	0.431**	0.506**	0.454**	0.497**	-0.003
Weight BNS (kg)	0.431**	1	0.890**	0.907**	0.877**	-0.170**
Height BNS (cm)	0.506**	0.890**	1	0.909**	0.981**	-0.056
Weight ANS (kg)	0.454**	0.907**	0.909**	1	0.928**	0.018
Height ANS (cm)	0.497**	0.877**	0.981**	0.928**	1	-0.055
Gain Wight (g/kg/day)	-0.003	-0.170**	-0.056	0.018	-0.055	1

* $p < 0.05$. ** $p < 0.01$. *** $p < 0.001$

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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							
Weight before - Weight After nutritional support (Kg.g)	Poids Before	230	5.800	1.435	- 14.333	229	P < 0.000
	Poids After	230	6.384	1.428			
Height							
Height before - Size After nutritional support (cm)	Height Before	230	70.126	7.673	0.501	229	P > 0.617
	Height After	230	70.076	7.686			

National Health Development Plan (NHDP) 2022-2030 – Volume I: Situational analysis and NHDP 2022).

2.3.2. 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 [25].

2.3.3. 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 is specific drugs for complications.

2.3.4. Body Measurement

A measurement of the weight and height according to the manual of the United Nation of the Department of Technical Cooperation for Development [26] (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.

3. RESULTS AND DISCUSSIONS

The Distribution of malnourished children according to socio-demographic and anthropometric parameters and the final state of care showed in Table 1. The results presented in Table 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 Tables 1-4, 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 $P < 0.000$. 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 4 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 $F(1, 228) = 23.550$, $P< 0.001$. The findings revealed that the Z-scores P/T ANS positively predicted gain weight ($\beta = 0.306$, $P < 0.001$). 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 $F(2, 227) = 17.817$, $P < 0.001$. The findings revealed that the Z-scores P/T ANS ($\beta = 0.294$, $P < 0.001$) and Edema ANS negatively predicted gain weight ($\beta = -0.205^{**}$, $P < 0.001$). The ΔR^2 value of 0.042 revealed a 4.2% change in the variance of models 1 and 2 with ΔF (1, 227) = 11.046, P< 0.001. In step 3, the R^2 value of 0.154 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 < 0.001. The findings revealed that the Z-scores P/T ANS (β = 0.260, P< 0.001), Edema ANS (β = -0.187, P< 0.003) and final health status negatively predicted gain weight (β = -0.140*, P< 0.029). The ΔR^2 value of 0.018 revealed a 1.8% change in the variance of models 1, 2, and 3 with ΔF (1, 226) = 4.827, P < 0.029. Our 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 result obtained shows a significant weight change only, for height, the duration of the study was not fully sufficient to detect a change in height.

3.1. The Impact of The Care of Children with Acute and Severe Malnutrition on Weight and Height

Our results show a significant change (P < 0.001) 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. [27] over 259 cases experiencing severe acute malnutrition, they managed to treat successfully 54.83%. Moreover, a further study conducted by Bah et al. [28] 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 in stabilizing (85%) of cases and transferring to the severe outpatient nutritional education and recovery unit (URENAS). In the same vein, a study carried out by Kambale et al. [29] for 574 severely malnourished at the Nutritional and Therapeutic Center of Bukavu, has shown an average of 520 cases were cured with a rate of 90.8% success.

3.2. Improving The Weight and Height of Children with Severe Acute Malnutrition According to Age

In our studied samples, we find that most 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 [25] 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, another study conducted over

Table 4. Hierarchical Regression Results for Gain Weight.

Variable	B	95% CI LL	95% CI UL	SE B	β	R^2	ΔR^2
Step 1						0.094	0.094***
(Constant)	4.925**	1.258	8.593	1.861			
Z-scores P/T ANS	6.157***	3.657	8.657	1.269	0.306***		
Step 2						0.136	0.042***
(Constant)	5.639**	2.025	9.253	1.834			
Z-scores P/T ANS	5.926***	3.476	8.377	1.244	0.294***		
Edema ANS	-6.998**	-11.147	-2.849	2.106	-0.205**		
Step 3						0.154	0.018*
(Constant)	9.682***	4.583	14.780	2.587			
Z-scores P/T ANS	5.228***	2.719	7.738	1.274	0.260***		
Edema ANS	-6.362**	-10.516	-2.208	2.108	-0.187**		
Final health status	-2.607*	-4.944	-0.269	1.186	-0.140*		

*Note. CI= confidence interval; LL = Lower limit; UL = Upper Limit; ***P < 0.001; P/T = weight to height ANS =After Nutritional Support. * p < 0.05. ** p < 0.01. *** p < 0.001* small malnourished children by Hamid et al. [10] 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. [30] encompasses the age group from 6 to 23 months provided evidence that studied children were most affected by malnutrition with an odd of 51.8% of the sample with a proportion of boys (50 .3%) and girls (49.7%).

3.3. Variables That Affect Healing and Weight Gain in Children with Severe Acute Malnutrition

Our results show a percentage of recovery reached (87.4%) since 230 cases were treated in care, however, in a study carried out by [29] for 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= -0.170**; P<0.001. 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. [31] postulated that the mean weight gain during stay days in the hospital was 12.918 ± 7.9735 days; 8.808 ± 3.7312 g/kg/day, respectively.

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 < 0.029) by 15.4% variance. According to Bhat et al. [31] 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.

4. CONCLUSIONS

Severe acute nutrition (SAP) in Mauritania seems to be the dilemma that impedes the development of children who are age under 6. The IMSAM-based intervention has displayed an enhancement in terms of weight gain albeit the insufficiency of schedule for the malnutrition children during hospitalization.

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Conflicts of Interest

The author(s) declare no conflict of interest.

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DATA AVAILABILITY

The data that underlie the findings of this study are available from the corresponding author and the Maastricht Study Management Team (*Elhafedh.elmouhab@fst.utm.tn*) upon reasonable request.

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