

# A Cohort Study to Evaluate the Effect of Nutritional Intervention on Severe Acute Malnutrition Children Admitted to A Nutritional Rehabilitation Centre in A Tertiary Care Hospital in Central Gujarat, India

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## ABSTRACT

**Background:** Undernutrition is one of the most concerning health and development issues in India as well as in the world. Nutritional rehabilitation centres (NRC) were started by Government of India to control severe acute malnutrition. The aim is to assess the effect of nutrition interventional measures for severe acute malnutrition (SAM) children admitted at NRC through selected anthropometric indicators.

**Methodology:** A hospital-based prospective cohort study was conducted at NRC of SSG Hospital, Vadodara, Gujarat from April to September 2022, all children of 6-60 months of age admitted during this period were observed during their stay with three follow-ups after discharge at 15 days interval. The data was entered in Microsoft Excel and was analysed using Medcalc Software.

**Results:** A total of 76 children were analysed for anthropometric indicators. A statistically significant difference was obtained between the weight of children at admission, discharge and 3 follow-ups (ANOVA=141,  $p<0.001$ ); difference of mid upper arm circumference (MUAC) (ANOVA=84.2,  $p<0.001$ ) and difference of height (ANOVA=43.3,  $p<0.001$ ) at admission, discharge and follow-up were also statistically significant.

**Conclusions:** NRCs have had a positive impact on the selected anthropometric indicators of severe malnourished children but lag behind proper follow-up visits.

**Key-words:** Severe acute malnutrition, Nutritional Rehabilitation Centre, Under five children, Anthropometric Indicators

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## INTRODUCTION

Undernutrition among under-five children is a major public health problem in India as well as around the world. Nearly one-third to half of all under five children who die each year in the world due to undernutrition which is linked to high rates of morbidity and mortality.<sup>1</sup>

According to NFHS-5, the prevalence of stunting, wasting, severe wasting and underweight in under five years children was found to be 33.5%, 19.3%, 7.7% and 32.1 respectively and children under five who are stunted were found to be approximately 39%, wasted 25.1%, severely wasted 10.6% and underweight is 39.7% in Gujarat.<sup>2</sup>

Severe Acute Malnutrition (SAM) is the most extreme and visible form of undernutrition. Severe acute malnutrition is defined as very low weight-for-height/length (Z-score below -3 SD of the median World Health Organization (WHO) child growth standards), or a mid-upper arm circumference <11.5 cm, or by the presence of nutritional oedema.<sup>1,3</sup> To combat malnutrition, the National Rural Health Mission (NRHM) has launched an innovative strategy by constructing Nutritional Rehabilitation Centres (NRCs) under Mission Balam Sukham.<sup>1,4,5</sup>

Nutrition Rehabilitation Centre (NRC) is a unit in a health facility where children with SAM are admitted and managed. Children are admitted as per the defined admission criteria and provided with medical and nutritional therapeutic care.<sup>1,3</sup> Once discharged from the NRC, the child remains enrolled in the Nutrition Rehabilitation program till he/she attains the defined discharge criteria.<sup>3,7</sup>

Follow-up of severe acute malnutrition (SAM) children is crucial because mortality rate of 10-30% has been documented after discharge from hospital.<sup>6</sup> Hence, this study commits among children aged 6 to 60 months admitted at NRC and their follow-ups after discharge from NRC at an interval of 15 days for assessment of nutritional status and growth of the child through anthropometric measurements.

Based on this background, main objective of the present study is to evaluate the effect of nutritional intervention undertaken at NRC in improving the nutritional status of admitted SAM children through review of selected anthropometric indicators.

## METHODOLOGY

A hospital-based prospective cohort study was conducted at Nutritional Rehabilitation Centre of a Tertiary Care Hospital (SSGH) (Sir Sayajirao General Hospital), Vadodara, Gujarat. The study group comprised of all Severe Acute Malnourished (SAM) children of 6-60 months of age, admitted in NRC from April 2022 to September 2022 and discharged from NRC as per Government guidelines (discharge after

15% weight gain of the admission weight with the absence of associated illness), were selected for the study after taking consent from their parents or caregivers.<sup>1,3</sup> The admission criteria for 6-60 months children are any of the following: (1) Mid Upper Arm Circumference (MUAC) <115mm with or without any grade of oedema (2) Weight-for-height < -3 SD with or without any grade of oedema (3) Bilateral pitting oedema +/++ (children with oedema +++ always need inpatient care).

Children who left without completing the treatment protocol and children who were referred to higher centre/NICU for treatment were excluded from the final analysis. According to record, every month average 15-18 SAM children were admitted at NRC of SSG Hospital. Hence, at the end of six months, approximate sample size came out 90. During the study period, total 82 children were registered. From them, three children were referred to higher centre for medical complications, two children had left NRC without completing treatment protocol and one child was died due to severe bronchopneumonia, hence ultimate sample size was 76.

A pre-tested, semi structured questionnaire was prepared and the data of baseline, socio-economic parameters and anthropometric details of admitted 6 to 60 months of age SAM children from April to September 2022 was collected at the time of admission, discharge and three follow-up visits after discharge with a gap of 15 days (at 15 days, 1 month and 1.5 month after discharge) from NRC to check the improvement in growth of child. The socio-economic scale was assessed by Modified B.G. Prasad socio-economic classification.

Upon admission to NRC, medical and nutritional therapeutic care was provided after assessment of severely malnourished child. Children were given supervised therapeutic feeding diet F-75 (75 kcal/100ml and 0.9 gm protein/100 ml), F-100 (100 kcal/100ml and 2.9 gm protein/100 ml) or special feeds according to complications/ symptoms by the NRC staff. Counselling sessions focusing health and nutrition aspects were conducted for the caregivers/ mothers about the hygiene, feeding practices, child care and immunization. The growth was monitored using WHO reference charts.<sup>3</sup> Follow-up data were obtained for each child from NRC who regularly showed up for the follow-up at appointed time and those who did not, collection of data was done through telephonic conversations with 'field workers of the government health centre (ASHA or Anganwadi worker)' of their residential area.

Among the anthropometric indicators, weight, height and mid-upper arm circumference (MUAC) were measured at the time of admission, discharge and 3 follow-up visits to assess nutritional status. The weight (kg) and height (cm) of each child were compared with the WHO growth reference data for the particular age and sex and Z score was calculated. Children below -3SD were considered as SAM. The

MUAC (cm) was used to classify malnutrition in children. Children with MUAC 11.5-12.5 and less than 11.5 were considered as mildly malnourished and severely malnourished respectively. The anthropometric measurements of children enrolled in the study were recorded by trained and experienced health professional at NRC and by trained field workers (ASHA or Anganwadi worker) at time of follow-up.

### Measurement Tool

**Weight:** Weight is measured using electronic weighing machine to the nearest 0.1 kg. The beam should be properly balanced and the pointer should be on zero and should move freely when at rest. The scale should be set on a flat horizontal surface and keep the pan clean. The weight should be taken with minimum clothing and shoes should be removed. The result was read when beam attains its balance point. If case of unavailability of electronic weighing scale, Salter's scale was used for measuring the weight of children.

**Height/ Length:** For children below two years of age, an infant meter, a horizontal measure was used for measuring length after removing shoes and head covering. Beyond the age of two, stadiometer, a vertical measure was used for measuring height to the nearest 0.1 cm. After removing the shoes, the subject was made to stand on a flat surface with feet along with heels, buttocks, shoulder and back of head touching the scale upright. A wooden scale was put on the head crushing hair and making contact with the top of the head.

**Mid upper arm circumference (MUAC):** MUAC was measured midway between the tip of the acromial process of the scapula and olecranon process of the ulna. To locate the correct point for measurement, the child's elbow is flexed to 90°. The measuring tape is placed snugly around the arm at the midpoint mark. The tape should not be pulled too tight or too loose.

After getting permission from The Institutional Ethics Committee for Human Research- PG Research (IECHR-PGR) (IEC approval letter number-IECBHR/093-2022 and Date of approval was 08/06/2022) to carry out this study, the data of SAM children admitted at NRC from April to September 2022 were collected after taking their informed written consent.

The data was entered in Microsoft Excel 2019 and was analysed using MedCalc/ JAMOVI Software.<sup>8,9</sup> Key output analysis for quantitative variables like weight, height, mid upper arm circumference (MUAC), z-score etc. of children was summarized as Mean (standard deviation) or Median (Inter-quartile range) depending on the normalcy of data and qualitative variables like gender, socioeconomic status, vaccination status, feeding data etc. of children in proportions and percentages. A repeated measures ANOVA were used to determine the association of

growth outcome at admission, after discharge and at their 3 follow-ups in NRC. Level of significance was considered at  $p < 0.05$ .

## RESULTS

A total of 76 children were included in the analysis amongst them 38 (50%) males and 38 (50%) females. Majority (42.2%) belonged to age group of 13-24 months and 40.8% were in age group of 6-12 months. The mean age of study population was  $17.7 \pm 11.0$  months and for boys it was  $17.6 \pm 11.0$  months while for girls  $17.8 \pm 11.2$  months. More than half of the children (89.47%) were from lower socio-economic class (class IV & V) according to Modified B.G. Prasad socio-economic classification.<sup>10</sup> [Table 1]

At time of admission and discharge in NRC, total 76 children were analysed for anthropometric data. From them, 62 children were reported for the first follow-up visit, 56 for the second follow-up visit and 45 for 3rd follow-up visit with drop-out rates of 18.42%, 26.31% and 40.78% respectively. There was gradual decline of SAM children during each follow up.

The average weight gain of children during their stay at NRC was  $7.90 \pm 5.65$  g/kg/day. According to discharge criteria from facility-based care of SAM children, achieved weight gain should be  $\geq 15\%$  after admission at NRCs (Target weight). More than half of children (56.58%) had achieved their target weight after admission at NRC.

**Table 1: Socio-demographic profile of admitted SAM children**

Variable	Cases (%)
<b>Age (months)</b>	
6-12	31 (40.78)
13-24	32 (42.11)
25-36	7 (9.21)
37-48	3 (3.95)
49-59	3 (3.95)
<b>Gender</b>	
Male	38 (50)
Female	38 (50)
<b>Religion</b>	
Hindu	69 (90.8)
Muslim	7 (9.2)
<b>Socio-economic class</b>	
I (Upper class)	1 (1.31)
II (Upper middle class)	2 (2.63)
III (Middle class)	5 (6.58)
IV (Lower middle class)	16 (21.05)
V (Lower class)	52 (68.42)
<b>Residential Status</b>	
Rural	37 (48.69)
Urban	25 (32.89)
Tribal	14 (18.42)
<b>Type of Family</b>	
Nuclear	24 (31.58)
Joint	51 (67.1)
Broken	1 (1.32)

**Table 2: Anthropometric measures of SAM children on admission, on discharge, and on 3 follow-up visits at NRC**

Admitted children	On admission (n=76)	On Discharge (n=76)	On 1 <sup>st</sup> f-up (n=62)	On 2 <sup>nd</sup> f-up (n=56)	On 3 <sup>rd</sup> f-up (n=45)	ANOVA P value
Mean ± SD weight (kg)	5.82±1.54	6.66±1.59	6.77±1.55	6.88±1.50	7.05±1.58	<0.001
Mean ± SD height (cm)	70.2±7.84	70.2±7.82	70.7±7.30	70.3±7.16	70.1±7.46	<0.001
Mean ± SD MUAC (cm)	10.8±1.03	11.2±0.926	11.4±0.80	11.5±0.83	11.6±0.82	<0.001

**Table 3: Post hoc comparisons of weight, height and MUAC at admission. Discharge & during three follow-ups**

Anthropometric measures	P value
<b>Comparison of Weight</b>	
Weight 0 vs Weight 1,2,3,4	<0.001
Weight 1 vs Weight 3,4	<0.001
Weight 2 vs Weight 3,4	<0.001
Weight 3 vs Weight 4	<0.001
Weight1 vs Weight 2	0.891
<b>Comparison of MUAC</b>	
MUAC 0 vs MUAC 1,2,3,4	<0.001
MUAC 1 vs MUAC 3,4	<0.001
MUAC 2 vs MUAC 3,4	<0.001
MUAC 3 vs MUAC 4	<0.001
MUAC 1 vs MUAC 2	0.076
<b>Comparison of Height</b>	
Height 0 vs Height 2,3,4	<0.001
Height 1 vs Height 3,4	<0.001
Height 2 vs Height 4	<0.001
Height 3 vs Height 4	<0.001
Height 0 vs Height 1	0.444
Height 1 vs Height 2	0.002
Height 2 vs Height 3	0.004

(0= At Admission, 1= At Discharge, 2= At 1<sup>st</sup> follow-up, 3= At 2<sup>nd</sup> follow-up, 4= At 3<sup>rd</sup> follow-up)

Median length of stay at the centres was 17 days with IQR (14-23). A total 65 (85.53%) of the children in the study population had stayed at the NRCs for at least 14 days and rest 11 (14.47%) children had been discharged before 14 days because of achievement of target weight (15% weight gain after admission) as per discharge criteria of NRC.

According to z-score, 34 (44.74%) children were severely malnourished (z score  $\leq 3$  SD) from admitted 76 SAM children at the time of discharge. There was an observed improvement of z- score on successive follow-ups, but decreasing trend of follow-up visits in some children.

As per table 2, the details of anthropometric measures of all admitted SAM children on admission, discharge and 3 follow-up visits at NRC 15 days apart at 15 days, 1 month and 1.5 months were studied. It shows a significant increase in mean  $\pm$  SD weight, mean  $\pm$  SD height and mean  $\pm$  SD MUAC of all admitted children, which was found to be statistically significant ( $P < 0.05$ ) in a repeated measure ANOVA test.

To ascertain the association between socio-demographic factors and the improvement in child's growth between admission and discharge, as well as between admission and the first, second, and third follow-up; gain in weight, height, and MUAC were

analysed based on the socio-demographic profile. Within all socio-demographic variables, the weight gain difference between age group of 6-12 months and 12-60 months SAM children showed statistically significant from admission into to discharge from NRC ( $t=2.577$ ,  $p=0.01$ ). Following a comparison of height gain by family type from admission to the second follow-up, it was also found that there was a statistically significant difference between nuclear and joint families ( $t=-2.107$ ,  $p=0.03$ ), while rest of the all variables did not show any significant differences.

After analysing post hoc comparison using Tukey's test, it found that difference in weight was statistically significant between all pairs except weight at discharge and 1st follow-up; difference in MUAC was statistically significant between all pairs except MUAC at discharge and 1st follow-up and difference in height was not statistically significant between all pairs. [Table 3]

## DISCUSSION

Total 82 severely acute malnourished children aged 6 months to 59 months admitted at NRC during April to September 2022. From them, six were excluded as per exclusion criteria, so the socio-demographic details and anthropometric data were taken for 76 admitted SAM children.

Maximum number (82.89%) of SAM children were within the age group of 6-24 months. Similar findings were found in the study conducted by Patel D et al., Panda et al. and Joshi P et al.<sup>11,12,13</sup> In our study, there was almost an equal distribution of male and female children similar to the studies conducted by Taneja et al., Bhanat MJ et al. and Bhujade et al.<sup>14,15,16</sup> The children admitted to NRC were more from rural and tribal (67%) areas compared to urban areas. This is similar to the results of study by VS Anjan et al.<sup>17</sup>

In the enrolled children, most of them (89.47%) belonged to lower socio-economic status (Modified BG Prasad class IV and V) and it was found in our study that the majority of the mothers (59.2%) were illiterate or educated up to primary school which was similar to the findings of study conducted by Bhanat and Mall et al. and Kumar et al.<sup>15,18</sup> A large family size (Joint family) was associated with increased risk of SAM in our study (67.10%) which was similar to study by Sen et al.<sup>7</sup>

With regards to objective, study indicates that the overall mean weight of admission was  $5.88 \pm 1.48$  kg and the mean weight at discharge was  $6.66 \pm 1.59$  kg.



A statistically significant difference was observed between the mean weight at discharge and admission ( $t=15.6$ ,  $P<0.001$ ,  $df=75$ ). The mean height of admission was  $70.2 \pm 7.84$  cm and at discharge was  $70.2 \pm 7.82$  cm. But no difference was observed between mean height between admission and discharge ( $t=1.86$ ,  $P<0.067$ ,  $df=75$ ). The mean MUAC at admission and discharge were  $10.8 \pm 1.03$  cm and  $11.2 \pm 0.926$  cm respectively. There was also a difference found between the mean MUAC at discharge and at admission ( $t=11.6$ ,  $P<0.001$ ,  $df=75$ ).

According to a study conducted by Siddharam G et al., in 2019 in Madhya Pradesh, the mean weight at admission was  $6.27 \pm 2.15$  Kg and mean weight at discharge was  $6.78 \pm 2.28$  Kg and this difference was found to be statistically significant.<sup>19</sup> The mean mid upper arm circumference (MUAC) at admission was  $11.07 \pm 1.22$  cm and at the time of discharge it was  $11.30 \pm 1.21$  cm. The total MUAC increase was 0.23 cm and this difference was found to be statistically significant. Similar results were obtained from a study done by Taneja et al. and Sen et al.<sup>7,14</sup>

An average weight gain of at least 8 g/kg/day is considered to be adequate for child during stay as per NRC guidelines. In our study, 43.42% SAM children had achieved >8 g/kg/day weight gain till discharge. The average weight gain of children during their stay at NRC was  $7.90 \pm 5.65$  g/kg/day which is lower than results observed by Taneja et al.<sup>14</sup> (Average weight gain was  $9.25 \pm 5.89$  g/kg/day) and by Rastogi et al.<sup>20</sup> (Average weight gain was  $9.915 \pm 5.43$  g/kg/day). In contrast to this findings, average weight gain for entire study group was  $3.2 \pm 2.3$  g/kg/day found in a study conducted by Rawat et al.<sup>21</sup>

According to discharge criteria from facility-based care of SAM children, achieved target weight should be  $\geq 15\%$  after admission at NRCs. Our study reveals that 43% had achieved target weight after admission. This finding was comparable to a study conducted by Aguayo et al. in Jharkhand, found that only 39.4% of admitted children gained 15% or more of their initial weight.<sup>22</sup>

According to NRC guidelines, minimum duration of stay should be 14 days. In this study, it was found that the median duration of stay at NRCs was 17 days with IQR (14-23). Most of the children (85.53%) in the study population had stayed at the NRCs for at least 14 days. However, in a study by Rinki Shah et al, the duration of stay was 16 days while in a study by G Taneja et al, the duration of stay was 14 days.<sup>14,23</sup>

At analysis after discharge, the follow-up of SAM children was gradually declining with drop-out rates 18.4% at 1st follow-up ( $n=62$ ), 26.3% at 2nd follow-up ( $n=56$ ) and 40.8% at 3rd follow-up ( $n=45$ ). A similar study conducted by PC Panda et al. (2019) reveals that dropout rates increased with each successive follow up visit. Dropout rates of 9.89%, 23.07%, and 61.76% were obtained for the three follow-up visits conducted 15 days, 1 month and 2 months

from the day of discharge.<sup>13</sup> VS Anjankumar MD et al. proved similar findings in that out of 330 children who were recovered & discharged from NRC, 258 112 children came for first follow up visit with a drop-out rate of 21.82%, for second follow up visit 24.85% and for third follow up visit was 27.87%.<sup>17</sup>

The dropout rate in this study was higher than that observed by Taneja et al.<sup>14</sup> Caregivers defaulted on their follow-up visits to NRC due to lack of awareness about the necessity of follow-up visits and non-availability of family members or acquaintance to accompany caregivers to NRC. Similar findings were observed in other studies conducted by Taneja et al, Das K et al and Dhanalaxmi K et al.<sup>14,24,25</sup>

In the present study, the weight gain difference between age group of 6-12 months and 12-60 months SAM children were found statistically significant from admission into to discharge from NRC ( $t=2.577$ ,  $p=0.01$ ). Saxena DM et al. proved similar findings that the weight gain difference between different age group children was found statistically significant ( $F=8.17$ ,  $p=0.001$ ).<sup>26</sup> The comparison of height gain by family type from admission to the second follow-up, it was also found statistically significant difference between nuclear and joint families ( $t=-2.107$ ,  $p=0.03$ ). This result is supported by the study of AS Bhadoria et al. (2017), where the SAM children outcome was significantly associated with family size.<sup>27</sup>

The nutritional intervention at NRC elicited statistically significant changes through repeated measure ANOVA in weight from admission to 3rd follow-up, ( $F = 141$ ,  $p < 0.001$ ). Post hoc analysis revealed that difference in weight was statistically significant between all pairs except weight at discharge and 1st follow-up. A statistically significant changes in MUAC also observed, ( $F = 84.2$ ,  $p < 0.001$ ). Post hoc analysis revealed that difference in MUAC was statistically significant between all pairs except MUAC at discharge and 1st follow-up. There was a statistically significant changes also in height ( $F = 43.3$ ,  $p < 0.001$ ). Post hoc analysis revealed that difference in height was not statistically significant between all pairs. Saxena DM et al., in their study revealed a statistically significant difference between the mean weight at follow up, at discharge and at admission for the entire study group ( $f=106.26$ ,  $p<0.001$ ).<sup>26</sup>

## STRENGTH & LIMITATIONS

Since this was prospective cohort study, the main strength of this study is that participants were followed up over the period of time after they have left an NRC to determine the long-term impact of the nutritional intervention on the growth of the admitted SAM child at nutritional rehabilitation centre through obtaining regular anthropometric measurements.

As this study was limited to one NRC of Vadodra district of Gujarat and it was conducted in a limited

group of subjects, hence, the findings cannot be generalized for the entire population. Lost to follow-up of SAM children were more on successive follow-ups.

## CONCLUSION

NRCs have had a positive impact on the selected anthropometric indicators of severe malnourished children but lag behind proper follow-up visits. The study reveals that the average weight gain amongst the children was lower as compared to NRC guidelines and a proportion of 56.58% SAM children amongst the study group recovered (cured) with achieved target weight. As evident by the findings, the differences of weight, MUAC, height of the SAM children at the time of admission, discharge and three follow ups were statistically significant. There was observed a gradual decline in successive follow-up of SAM children after discharge with increasing drop-out rates for 1st, 2nd and 3rd follow-up visits respectively. In other words, effective management of SAM must be based on the basic principle of "Continuum of Care"-from the home and community, to the health centre/health facility and back again.

## RECOMMENDATIONS

There is a need to have strong reference linkages of NRCs with community-based core model of management of severe acute malnutrition for better follow-up on long-term basis to provide a continuum of nutritional care and to reduce the drop-out rate.

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