

Original Research Article

Performance and costing of nutrition intervention measures on admitted children in malnutrition treatment center: a case study from Jharkhand, India

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Received: 22 July 2020

Revised: 07 September 2020

Accepted: 09 September 2020

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ABSTRACT

Background: Children with severe acute malnutrition (SAM) having medical complications require immediate care at malnutrition treatment centers (MTC). Thus, it becomes important to assess the effect and treatment cost of such children in these facilities. Hence, the present study was done with these aims in two MTCs in Jharkhand, India.

Methods: A retrospective record review was done of the children admitted to these two MTCs between 1st April 2017 and 31st March 2018. A predesigned proforma was used to collect child related information. The data collected was entered in Microsoft excel sheet and analysed.

Results: Majority of the admitted children (90.6%) were in 6-23 months age group. 358 (51.5%) children were females. Only, 194 (27.9%) children admitted were SAM had any medical complication. 690 (99.3%) children were discharged of whom 499 (72.3%) were discharged after achieving the target weight. The average weight gain during their stay was 8.1±2.4 g/kg/day and average length of stay was 16.7±3.2 days. Post discharge follow up rates were found to be low and only 130 (18.8%) children completed all three follow ups. Average cost per SAM child treated was Rs. 18,599 (US\$ 272) and per SAM child cured was Rs. 25,904 (US\$ 379).

Conclusions: MTCs are effective in managing medically complicated SAM children. However, improvements are necessary to ensure that more such children should be treated at facility level, complimented with a community based programme for managing uncomplicated SAM children to improve coverage and ensure continuum of care.

Keywords: SAM, MTC, Jharkhand, Cost effectiveness

INTRODUCTION

Globally, undernutrition affects an estimated 165 million children and contributes to an estimated 45% of all child deaths.¹ Poor nutrition also carries a huge economic burden for individuals and for the entire country. Undernutrition among children less than 5 years is associated with poor cognitive and educational performance, reduced work capacity and lower wages in

adulthood.² Individual productivity losses attributable to undernutrition are estimated to be more than 10 percent of lifetime earnings and around 2-3% of gross domestic product (GDP) loss (World Bank, 2006).³ India has a large proportion of the world's children with undernutrition. One of the markers of undernutrition is SAM among children aged 6-59 months, defined by a weight-for-height/length Z-score (WHZ) <3, a mid-upper arm circumference (MUAC) <115 mm or by the presence

of nutritional edema.⁴ An estimated 7.5% of children aged 6-59 months in India are suffering from SAM at any point of time.⁵

The children with SAM are at higher risk of deaths when they develop medical complications.^{6,7} Recognizing this elevated risk of mortality, the World Health Organization (WHO) laid down guidelines for management of complicated SAM at facility level.⁸ Later, it also published guidelines for the management of uncomplicated SAM at community level.⁹ Indian Academy of Paediatrics (IAP) and Government of India (GoI) adapted the WHO guidelines for managing complicated SAM and issued guidelines for facility-based management of children with SAM.^{10,11} National Health Mission (NHM) ensured the availability of additional resources for establishing Nutrition Rehabilitation Centres (NRCs) in different states to treat children with complicated SAM at facility level.¹² NRCs are considered as the primary mode of intervention for their treatment and provide intensive, high quality care for children with SAM, where SAM management is done as per WHO and GoI protocols for facility based care.^{8,11} The NRCs are intended to rehabilitate children with SAM by providing a basic medical intervention to treat infection and locally prepared therapeutic milk based formulas for nutritional rehabilitation.

There are two levels of care for managing children with SAM: community-based management of SAM and facility-based management of SAM. Children with SAM without any medical complication are managed in the community based programmed while those with medical complication are managed in the facility based programmed in NRCs. Currently in India, the treatment of SAM remains based in inpatient care and there is no community based programmed for managing children with uncomplicated SAM. In the absence of any community based programme for managing children with uncomplicated SAM, a large proportion of NRCs are also admitting and treating uncomplicated SAM children who do not need facility-based care.¹³⁻¹⁵ A few reported studies on the cost effectiveness analysis of the community based management of SAM suggest that it is much more cost-effective compared to facility based management of uncomplicated SAM.^{16,17}

In the state of Jharkhand, 11.4% children are SAM at any point of time.⁵ Currently, there are around 100 NRCs called MTCs across Jharkhand. Evidence on the functioning and outcome of MTCs in the state is scarce. A study of 48 MTCs in Jharkhand found high survival rate of SAM children, a significant increase in body weight from admission to discharge however, only two-fifth of children gained more than 15% of their admission weight.¹³ Other similar studies on the facility based management of SAM were conducted in other parts of the country also focused mainly on the outcome and not on the treatment cost of providing care to SAM children and

its cost effectiveness. Hence, the present study was conducted to assess the effectiveness of MTCs in providing therapeutic care for children with SAM in Jharkhand, to provide estimate of unit cost of treating a SAM child in the MTC and its cost effectiveness. To the best of knowledge, this is the first study that has examined the treatment cost and cost-effectiveness of delivering facility-based management of SAM in MTC in addition to its effectiveness. The cost analysis conducted will guide policy makers in Jharkhand to understand the cost implications of treating a SAM child in the facility, guide them in making budgetary provision for future scaling up of MTCs in the state and help the state in making decisions about the state level strategies in managing complicated and uncomplicated SAM. Additionally, it will also provide them empirical evidence to compare the cost of treating a SAM child in the facility with that of community and their cost effectiveness, if the state decides to implement the community based programme for managing uncomplicated SAM in future, alongside managing complicated SAM at facility level.

METHODS

Study design

A retrospective record review study was conducted in two purposively selected MTCs in Jharkhand, one each from West Singhbhum and Hazaribagh districts, involving the review of existing centers' records. These two districts were selected as the districts were Aspirational Districts of Government of India and the bed-occupancy rates of the MTCs were above the state average. Additionally, these two MTCs were willing to participate in the study for improvement in MTC processes. Children admitted to these two MTCs, between 1st April 2017 and 31st March 2018, were included in the study.

Management of children at MTCs

The selected MTCs consisted of 20-bedded wards with a kitchen, toilet facility and demonstration room attached to existing government health facilities. In the community, children aged 6-59 months were screened using anthropometric measurements and assessment of bilateral pitting oedema. When conducted this study in Jharkhand, there was no community-based programme for managing children with uncomplicated SAM in the state. Hence, all children with SAM, both complicated and uncomplicated, were referred to the MTCs for their treatment. At MTC, anthropometric measurements and reassessment of presence or absence of bilateral pitting oedema were again done before admitting a child. A medical doctor conducted medical examinations to detect presence of any medical complication like respiratory tract infections, diarrhoea, dehydration, fever, anaemia, tuberculosis etc. using the Integrated Management of Neonatal and Childhood Illnesses (IMNCI) criteria in the centre.¹⁸ SAM children with any medical complication or with

bilateral pitting oedema and having poor appetite were fed a locally prepared therapeutic formula called starter diet. Starter diet was fed every 2 hours for 2 days while they were treated for medical complications. After 2 days and upon recovery from medical complications, these children were fed locally prepared therapeutic formula called catch-up diet during the transition phase of 2 days for six times daily for their rapid weight gain. SAM children with normal appetite and without any medical complication or bilateral pitting oedema were fed catch-up diet right from the admission day. After fourth day of the child's stay, the child was fed both catch-up diet and locally prepared supplementary diet alternatively until the child was discharged. A child was discharged as cured if s/he attained the target weight i.e. increase in at least 15% of the admission weight. After discharge from the MTC, the child was to be linked with the Supplementary Nutrition Programme (SNP) of the Integrated Child Development Scheme (ICDS) and was to be followed up in the MTC every 15 days for four times and s/he should also be followed up in the community by the frontline workers of ICDS and NHM.

Data on admission and outcome variables of admitted children

Data on age groups, sex and status of medical

complications among SAM children were collected from MTC admission records. Data on total discharge, discharge cured, loss of care i.e. child left the MTC against medical advice before completion of full treatment, no response to treatment and deaths were also collected. Cured was defined as weight gain >15% of the admission weight during their in-patient stay. The other outcome included average weight gain and average length of stay. Data on coverage of follow up of children post discharge at different follow up rounds were also collected from the facility records.

Data on cost of treatment of admitted children

In this study, the costs were assessed for treating children with SAM in the MTC looking at human and financial resources used from the implementer's perspective. Total cost and cost-effectiveness from a provider's perspective for children treated in the MTC were assessed. Primary data on different cost items were collected from the MTC using a simple cost-capture form. Costs data were collected through semi-structured interviews with implementing staff and from the MTC accounting records. Economic costs were calculated for some of the cost items for which financial costs were not available (e.g. estimated rent of the MTC premise). Table 1 provides details of implementation costs and their data source.

Table 1: Details of different costs for treating children with SAM in the MTCs.

Description	Data sources	Comments
Salaries and incentives (medical officer, staff nurses, nutrition counsellor, cook cum caretaker, accountant, other support staff and ASHAs), training cost, logistics (rent, utilities, medical and other supplies, MTC ward and kitchen equipment), transport, caregiver lost wage costs	Review of MTC's financial accounts, records and national guidelines on budgetary provision for MTC	<ul style="list-style-type: none"> As no rent charged on ward, estimations of the rental value were taken based on similar infrastructure in the locality. For capital costs, the national guidelines for MTC ward set up were used where budgetary provisions for civil work, ward equipment and kitchen equipment are outlined. Average life of equipment was assumed to be 5 years to determine their annual value.

Data management

Data from MTC records were extracted into an electronic database created in MS-excel. Admission and discharge variables were summarized using proportions, means and standard deviations in MS-excel. Similarly, cost analyses were also conducted in MS-excel.

RESULTS

Admission and outcome details of children treated in the MTCs

The analysis presented here concerns the children who were admitted to these two MTCs between 1st April 2017 and 31st March 2018.

As per the centre's record, during the study period, 695 children with SAM were admitted in the two MTCs. 51.5% of the total admitted cases were female. More than 90% of the children admitted were below 2 years of age. 194 (27.9%) children with SAM were admitted with some medical complications while 501 (72.1%) cases did not have any medical complication (Table 2).

690 (99.3%) children were discharged during the study period. Of the total discharge, 499 (72.3%) children were reached the discharge criteria of gaining >15% of the admission weight. 81 (11.7%) children did not respond to the treatment and 18 (2.6%) left the MTCs on medical advice without completing the treatment. A total of 9 (1.3%) children were died during treatment. Average weight gain for each child during their MTC stay was 8.1±2.4 gram/kg/day. Average length of stay per child

was 16.7±3.2 days (Table 3).

Follow up rates were found to be low with gradual fall from first to third follow up. It was found that, 190 (27.4%) children were completed one follow up, 152 (21.9%) children were completed two and 130 (18.8%) children were completed all three follow ups (Table 3).

Table 2: Characteristics of the children admitted to the selected MTCs between April 2017 and March 2018 (n=695).

Characteristics	N (%)
Sex	
Male	337 (48.5)
Female	358 (51.5)
Age-group (months)	
6-23	630 (90.6)
24-59	65 (9.4)
SAM with medical complications	
Yes	194 (27.9)
No	501 (72.1)

Cost effectiveness analysis of children treated in the MTCs

During the study period of one year, the total cost of the two MTCs was of Rs. 1,29,26,000 (US\$ 1,89,032) which includes cost incurred on staff (Medical Officers, Nurses and other support staff), medical and kitchen supplies,

rent, maintenance, utilities and wage loss compensation for accompanying their children. Of the total cost, 76.8% were staff cost, 7.8% were medical and kitchen supplies, 4.6% were rent, maintenance and utilities and 9.2% were wage loss compensation for mothers (Table 3).

Table 3: Programme outcomes in children with SAM admitted to the selected MTCs between April 2017 and March 2018 (n=695).

Particulars	n (%)
Outcome	
Discharged	690 (99.3)
Discharge-cured	499 (72.3)
Defaulter	18 (2.6)
Non-responder	81 (11.7)
Death	9 (1.3)
Average (SD) weight gain (gm/kg/day)	8.1±2.4
Average (SD) length of stay (days)	16.7±3.2
Follow up post discharge	
First follow up	190 (27.4)
Second follow up	152 (21.9)
Third follow up	130 (18.8)

The annual cost of managing all 695 admitted children in the two MTCs were Rs. 1,29,26,000 (US\$ 1,89,032) (Table 4). Average cost of treating a SAM child was Rs. 18,599 (US\$ 272). Average cost per patient day was Rs. 1,114 (US\$ 16.3). Average cost per SAM child cured was Rs. 25, 904 (US\$ 379) (Table 5).

Table 4: Estimated annual cost of treatment of SAM children in the two MTCs.

MTC-related cost items	Economic cost (INR)	Remarks
Total staff costs	99,28,800	Collected from center records
Estimate of staff training costs	15,400	Estimated cost of two rounds of trainings organized for MTC staffs
Expenses on medical supplies (Medicine, vaccine) costs	5,53,906	Collected from center records
Expenses on non-medical consumables/supplies (kitchen supplies and therapeutic food, non-medical consumables/supplies (kitchen supplies and therapeutic food)	4,54,777	Collected from center records
Estimate of equipment and other setting up costs	1,60,000	National/State MTC guideline provides that for a 10 bedded MTC, 1 time set up cost is Rs. 2,00,000. Hence for setting up a 20-bedded MTC, it was assumed that 1-time setup cost would be Rs. 4,00,000. Average lives of equipment are assumed to be 5 years. Hence, depreciation value of one year has been taken.
Rent (or equivalent rental cost)	3,00,000	Estimated rental value of the premise in that locality
Expenses on maintenance costs (miscellaneous exp, photocopy, gas fitting, others)	1,28,017	Collected from center's records
Estimate of utility cost (electricity, water)	1,62,000	Collected from center's records
Wage loss compensation for mothers	11,85,800	Collected from center's records for financial cost. For economic cost, expected wage loss compensation was calculated based on no. of patient day

Continued.

MTC-related cost items	Economic cost (INR)	Remarks
Wage loss compensation for mothers in follow up visits including incentives to frontline workers	37,300	Collected from center records for financial cost. economic cost, expected wage loss compensation calculated based on no of follow ups in that year
Total costs-INR (US\$)	1,29,26,000	(US\$ 1,89,032)

Table 5: Cost effectiveness ratios.

Outcome	Number	Cost Effectiveness Ratios	Cost Effectiveness Ratio-Economic Cost INR (US\$)
Total number of patients treated	695	Cost per SAM child treated	18,599 (US\$ 272)
Total patient day	11,607	Cost per patient day	1,114 (US\$ 16.3)
Total number of patients discharge-cured	499	Cost per SAM child cured	25,904 (US\$ 379)

DISCUSSION

Present study showed that out of the 695 children admitted to the study MTCs, majority (90.6%) children were aged 6-23 months. The proportion of females (51.5%) among the admitted children was higher. These two features are very important and evidence shows that severe acute malnutrition is very high among females and among the younger age group of children¹⁹ and they should be given priority in programs for tackling malnutrition. Similar findings were reported in others studies where a greater number of females were admitted in NRCs as compared to males.^{20,21}

It is important to note that close to three-fourth (72.1%) of the total admitted SAM cases did not have any medical complication. Other studies also showed that around 50 to 70% of SAM cases admitted to NRCs were medically uncomplicated.¹³⁻¹⁵ This shows that NRCs are not functioning optimally as due to the absence of the community-based management of acute malnutrition programme, a large proportion of uncomplicated SAM cases are getting admitted and treated in the facility.

Uncomplicated SAM cases do not require facility-based care and international guidelines suggest that such cases

could be managed through a community-based programme for the management of SAM.²²

The average weight gain among the admitted children during their stay at the centre was 8.1±2.4 g/kg/day. In a study conducted in Hyderabad, the average weight gain was 5 g/kg/day²³ whereas another study conducted in Ujjain and Indore district of Madhya Pradesh found average weight gain of 9.25±5.8 g/kg/day.²⁴ The study conducted in Indore found average weight gain of 7.9±1.6 g/kg/day.²⁰

The average length of stay at the MTCs was found to be 16.7±3.2 days. The finding is comparable with other studies conducted in Vadodara district of Gujarat (16 days), Ujjain and Indore district of Madhya Pradesh (14 days) and in Krishna district of Andhra Pradesh (18

days).²⁴⁻²⁶

Target weight was achieved in 72.3% of all discharged cases which was comparable with the study conducted in Krishna district of Andhra Pradesh (71%).²⁶ This compares slightly unfavourably with national and international standards of care. According to these standards, cure rate of >75% is considered good quality of care to the children.^{11,27} However, the recovery rate was found better than other studies conducted in NRCs in Nigeria (52.7%) and Indore district of Madhya Pradesh (26%).^{20,28}

The present study found that a total of 9 (1.3%) children died during treatment which was slightly higher than the study conducted in 48 MTCs in the same state (0.6%).⁹ Other studies have reported mortality varying between 0.4% and 3.5% in different States which is less than other countries.¹³⁻²⁹ This compares favourably with the national and international standards of care (<10% child deaths).^{11,27} This is a significant finding as the primary objective of facility-based management of SAM is to reduce fatality rates. However, it is equally important to study whether children discharged from MTCs continued to survive and thrive and future studies should also document this aspect.

Eighteen (2.6%) children left the MTC without completing the treatment. This is much below the national and international standards (<15%). Other studies have also reported higher defaulter rates. An earlier study conducted in 48 MTCs in Jharkhand showed that the defaulter rate of 18.4%.¹³ Another study conducted in Hyderabad also reported high defaulter rate.²³

Out of the 690 children who were discharged, 18.8% attended all three follow-up visits, 21.9% attended two and 27.4% attended one follow-up visits. Other studies from Jharkhand also reported low attendance rate for follow-up visits. Chaturvedi et al reported only 19% children attended three follow-up visits while Puett C et al reported only 14.9% children completed the three follow-up visits.^{30,16} Lack of caregivers' awareness about the need to re-visit MTCs for follow-ups, non-availability

of other adult family members to take care of their households in absence of the caregivers and their opportunity cost are some of the factors behind poor follow-up attendance.³⁰

Present study found that the cost per child treated (complicated and uncomplicated cases) was Rs. 18,599 (US\$ 272). Currently, MTCs in Jharkhand treat both complicated and uncomplicated cases due to a lack of alternative facilities in which to treat uncomplicated cases. Present study also showed that more than 70% cases treated in the MTCs were uncomplicated SAM. This is more costly, given that the cost of community-based management of uncomplicated cases is much lower compared to inpatient management, as well as for families, who incur travel and opportunity costs (time away from work and caring for other children) for MTC visits.^{16,17} This is not only expensive for the state but children are at an increased risk of cross-infection when attending inpatient services which should be avoided if possible. Additionally, families are hesitant to attend inpatient services due to the high opportunity cost associated with doing so. The most cost-effective approach for the treatment of SAM is facility-based management of children with complicated SAM in the MTC complemented with community-based management of children with uncomplicated SAM.

Using NFHS-4 data, about 5.5 Lakhs (11.4%) children aged 6-59 months are SAM at any point of time⁵ in Jharkhand, of whom estimated fifty-five thousand children are likely to have medical complications; assuming 10% children with SAM will have medical complications.³¹ Taking incidence correction factor of 1.6 estimated caseload of medically complicated SAM children will be about ninety thousand annually.³² Jharkhand has currently around 96 functional MTCs. Assuming that all MTCs with an average of 15 beds, run with 100% bed occupancy with an average stay of a child being 15 days and all children being treated have complicated SAM, around forty-three thousand children can be treated annually. This shows that even in full capacity, and assuming that all children treated in MTCs have complicated SAM; they can only treat around 40% of all medically complicated SAM cases. This shows that, we need more facilities to treat complicated SAM cases and a large-scale community-based programme to treat uncomplicated SAM cases. The community-based programme not only will release large number of beds for treatment of complicated SAM cases but also reduce the caseload of complicated SAM by doing early case identification and their community level management. As prevention of acute malnutrition is also one of the core aspects of any community-based programme, it will also prevent child undernutrition in the community.

There are several limitations of the study. First, it was conducted only at two MTCs purposively selected from two districts and may not be representative of the entire state. Selection bias of districts and MTCs and social desirability bias of responses by MTC staffs could also play as limiting factors in generalizing the study findings.

Second, as the study was based on a review of records maintained by MTCs, it is limited by the quality of the data recorded. However, as MTCs in Jharkhand are supervised and monitored frequently by the state and district level authorities, we feel that errors in recording of data were minimal. Third, due to low follow-up attendance after discharge, mortality status of children post discharge could not be ascertained. Also, mortality among children who defaulted remains unknown.

CONCLUSION

MTCs provide life-saving care for children with SAM and medical complications as demonstrated by the low mortality rates of the programme. However, the data shows that more than 70% children treated in the MTCs were uncomplicated SAM. For continuum of care of children and to sustain the benefits of low mortality and preventing relapse, facility-based management of SAM needs to be complimented with community-based management of SAM, which will not manage uncomplicated SAM but also promote nutrition and prevent undernutrition among children in the community through its preventive approach.

Funding: No funding sources

Conflict of interest: None declared

Ethical approval: The study was approved by the Institutional Ethics Committee

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Cite this article as: Sinha RK, Kiran A, Kashyap V, Kumar P. Performance and costing of nutrition intervention measures on admitted children in malnutrition treatment center: a case study from Jharkhand, India. *Int J Community Med Public Health* 2020;7:4048-55.