A Comparison of Site-Based versus Home-Based Child Malnutrition Treatment Programs

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ABSTRACT

Acute malnutrition in children is a serious global health issue and various strategies have been utilized to address undernutrition. In this study, the outcomes and costs of two different child malnutrition treatment strategies implemented by a non-governmental organization in the Philippines were compared. Both treatment programs utilized a rice-based micronutrient fortified food for feeding, with the key difference between the interventions being the location of treatment, fixed-site versus home-based. The fixed-site strategy reported higher proportions of recovery (94%) and percent weight gain (24%), while comparatively, recovery (68%) and percent weight gain (16%) was lower in the home-based strategy. Dropout rates were slightly higher in the fixed-site strategy (13%) than the home-based strategy (11%), and the home-based strategy was estimated to be more cost effective than the fixed-site strategy when cost per child treated was assessed. While treatment outcomes and costs are critical factors when designing a child malnutrition strategy, additional factors such as program designs inadvertently excluding the poorest households or participant resource constraints such as time or the need for an adult to accompany children during treatment should also be considered. This study highlights the need to continuously evaluate malnutrition treatment program designs so that treatment strategies can be improved and optimized while ensuring equitable access for children from the poorest or most marginalized households in a community.

Keywords: Malnutrition, Home-based treatment, Site-based treatment, Poverty alleviation

1. Introduction

Child malnutrition persists as a serious global health issue. The reduction of child mortality remains a key goal, and around 3 million deaths annually, or approximately half of all child mortality among those under 5 years of age are attributed to malnutrition, or more specifically, undernutrition [1]. In almost all countries and contexts, a greater proportion of children from lower income settings will be malnourished due to the link between poverty and undernutrition [2].

Numerous treatment programs and therapies have been devised to treat severe acute malnutrition (SAM) and moderate acute malnutrition (MAM), however it has been recognized that additional research around program implementation is needed [3]. International Care Ministries (ICM) is a Philippine-based non-governmental organization (NGO) that implemented two child-feeding programs from 2012 to 2014. The first intervention was a Site-Based Feeding (SBF) program, while the second was a Home-Based Feeding (HBF) program. Both programs used a rice-based micronutrient fortified soy blended food which requires cooking, differentiating these programs from those that use ready-to-use-therapeutic food (RUTF). The SBF and HBF programs were implemented in two consecutive years by the same organization with largely similar staff, providing a good opportunity to compare the outcomes of the two strategies. This study seeks to evaluate the differences between the two programs and describe the findings to inform future iterations of feeding strategies and guidelines, such as the recently updated community management of acute malnutrition guidelines [4].

2. Materials and Methods

Selection and Description of Participants

This study analyzes monitoring and evaluation data collected by ICM from June 2012 to May 2014. All households enrolled in ICM programs were recruited according to self-reported household income and poverty indicators, and must qualify as “ultra-poor”, defined in this context as living on less than $0.50 USD per person per day. Two child malnutrition treatment programs targeted at this demographic were implemented in the Visayas and Mindanao regions of the Philippines by ICM and will be the focus of this study. Written or oral consent was obtained for participating household survey data, and ICM provided the researchers access to relevant financial data. All cost estimates in this study are presented in US dollars. This retrospective investigation was approved by the Health Sciences Research Ethics Board of the University of Toronto (Protocol Reference #30943).

Interventions

The Site-Based Feeding (SBF) Program was a 16-week site-based feeding program for moderately and severely wasted children between the ages of 6 to 60 months. Severe acute malnutrition (SAM), was defined as a weight-for-height *Z*-score (WHZ) of ≤ -3SD from median reference values, and moderate acute malnutrition (MAM) was defined as ≤ -2SD from reference values according to internationally agreed weight-for-height scores [4]. Children were identified though the local health centre's list of malnourished children and house-to-house

visitations. When 10 to 15 children could be identified within a small geographical area, the program would be initiated. In a fixed community-based location, the children and their caregivers where gathered by ICM staff and volunteers for five days per week for the duration of the program and given a single meal of the prepared nutritional product. The product used for feeding was a micronutrient fortified rice-based soy blend which required cooking. Other program content included deworming, a health assessment, weight monitoring, weekly health and nutrition education, and home-based vegetable gardening. Children who remained severely wasted (WHZ ≤-3) at the end of the 16 weeks were referred for additional assessment and management.

The Home-based Feeding Program (HBF) was a community-based program for moderately and severely wasted children between the ages of 6 to 60 months. SAM and MAM were defined according to the same guidelines as in SBF. Children were identified though the local health centre's list of malnourished children, house to house visitation and community mobilisation, nested within the context of a community-based poverty alleviation intervention implemented by ICM. Guardians were given one packet of the nutritional product to prepare each day and advised to add additional fat, protein and micronutrient-rich foods, giving the preparation at least three to five times per day. Other program content included deworming, a health assessment and weekly weight monitoring. The community-based education program which HBF is nested within provides comprehensive values, health and nutrition and livelihood education, including home-based vegetable gardening. Severely wasted children remain on the program until they reach a WHZ score of greater than -2 but receive a minimum of 16 weeks feeding.

Costing

Program cost estimates were extracted by accessing the actual costs recorded in ICM's accounts. SBF was a stand-alone program, allowing for simple tabulation of total program costs, whereas HBF was a program nested within a complex poverty alleviation program. To estimate HBF costs, we assumed that HBF was approximately 1% to 2% of the whole poverty alleviation program, thus high and low estimates of HBF plus a proportion of total program costs are reported. The cost of HBF alone, excluding all costs associated with the poverty alleviation program, was also included. Costs per child treated and recovered were estimated for each program.

Statistics

The characteristics of children at admission and overall outcomes at the completion of program were compared using Student's t-test. Program outcomes were assessed by weight gain over the course of treatment, percent weight gain, WHZ score change, height-for-age *Z*-score (HAZ) change, rate of weight gain (g/initial kg/day), proportion dropout, and proportion recovered. Outcomes were stratified according to WHZ score at admission and child age. Two-way ANOVA tests were used to compare SBF and HBF according to weight gain, proportion dropout, and proportion recovered. Multivariable linear or logistic regression was used to check the role of covariates. All analyses were conducted using R version 3.1.2.

3. Results

A total of 2658 children were admitted into SBF, of which 2216 (83.4%) completed the program (Fig. 1). Of those who completed the program, 94.4% recovered, reaching the target of > -2 SD WHZ score. In the HBF program, a total of 860 children were admitted with 89.3% (n=768) completing the program, and 67.6% recovering within the program period (Fig. 2). The dropout proportions in the SBF and HBF programs were 16.4% and 10.5% respectively, while the mortality rates in both programs were 0.2%. Dropout proportions and program recovery were further analyzed after stratifying children by initial WHZ score (WHZ_i) and age.

At the time of admission, the mean age was comparable between programs, 33 months (SD: 15.8) in SBF, and 32 months (SD: 16.3) in HBF (Table 1). The initial weight and height were significantly different between the two programs, in SBF the mean weight-for-height *Z*-score (WHZ) at admission was -2.4 (SD: 0.9), whereas in HBF, the mean WHZ was -3.0 (SD: 0.8).

Table 1. Characteristics at Admission into SBF or HBF program.

	Site-Based Feeding [n=2658]		**Home-Based Feeding [n=860]**		
	mean	**(SD)**	**mean**	**(SD)**	**p value[1]**
Age (months)	33.0	(15.8)	32.0	(16.3)	0.14
	n (%)		*n (%)*		
0 ≤ mos. < 15	472 (17.8%)		169 (19.7%)		
15 ≤ mos. < 30	760 (28.6%)		262 (30.5%)		
30 ≤ mos. < 45	670 (25.2%)		220 (25.6%)		
45 ≤ mos. < 60	709 (26.7%)		189 (22.0%)		
60 ≥ mos.	8 (0.3%)		20 (2.3%)		
Initial weight	9.5 kg	(2.3)	8.9 kg	(2.2)	<0.01
Initial height	84.8 cm	(11.0)	83.4 cm	(11.4)	<0.01
Initial WHZ	-2.4	(0.9)	-3.0	(0.8)	<0.01
Initial HAZ	-2.0	(1.9)	-2.0	(3.6)	0.79

1. Student's t-test was used to determine p values.

At program completion, mean WHZ score change and rate of weight gain (g/initial kg/day) were observed to differ between the two programs (Table 2). Comparing SBF with HBF, the mean weight gain (SBF: 2.2kg, HBF: 1.3kg) and change in WHZ score (SBF: 2.1, HBF: 1.6) was significantly greater during SBF than in the HBF program.

Table 2. Outcome of the SBF and HBF programs at completion of feeding.

	Site-Based Feeding [n=2658]		Home-Based Feeding [n=860]		
	mean	**(SD)**	**mean**	**(SD)**	**p value[1]**
Weight gain	2.2 kg	(1.1)	1.3 kg	(1.0)	<0.01
% weight change	24.4%	(0.2)	16.3%	(0.1)	<0.01
WHZ change	2.1	(1.2)	1.6	(1.3)	<0.01
HAZ change	-0.3	(0.8)	-0.4	(1.4)	<0.01
Rate of weight gain (g/initial kg/day)	3.6	(2.6)	3.3	(2.7)	<0.01

1. Student's t-test was used to determine p values

After stratifying children by WHZ_i, the observed differences in outcomes remained (Table 3). In both programs, the rate of weight gain and change in WHZ was progressively greater when malnutrition was more severe at admission. Similarly, the unrecovered proportion was progressively higher when the child was further from median WHZ. Two-way ANOVA results show that the location of the program, site-based versus home-based, significantly affects weight change, dropout, and recovery (Table 4). The WHZ score at admission was associated with weight change and recovery, and appears to interact with location for the weight change outcome. Notably, only the location was observed to affect dropout.

Outcomes were also compared when children were stratified by age (Table 5). Trends in outcomes such as percent weight gain, and WHZ score change were comparable to the trends observed in Table 3, however other outcomes such as dropout and recovery did not appear to vary according to age. This was confirmed by the ANOVA results (Table 6), age was significantly associated with weight change, but not with dropout and recovery. Only location was found to be significantly affect all three outcomes of weight change, dropout and recovery.

Table 3. Outcomes of Treated Children after Stratifying by WHZ score at Admission

	Site-Based Feeding [n=2658]				Home-Based Feeding [n=860]			
	≤ -4 SD [n=125]	≤ -3 SD > -4 SD [n=376]	≤ -2 SD > -3 SD [n=1605]	≤ -1 SD > -2 SD [n=461]	≤ -4 SD [n=102]	≤ -3 SD > -4 SD [n=253]	≤ -2 SD > -3 SD [n=498]	≤ -1 SD > -2 SD [n=5]
Age (mean - months)	26.49	31.80	34.46	30.27	26.10	31.32	33.65	36.80
Weight change (mean)	2.80 kg	2.38 kg	2.24 kg	1.71 kg	2.02 kg	1.52 kg	1.10 kg	0.74 kg
% weight gain (mean)	42.0%	28.2%	24.1%	19.3%	29.0%	18.8%	12.5%	7.9%
WHZ change (mean)	3.55	2.62	2.05	1.47	2.80	1.92	1.22	0.66
HAZ change (mean)	-0.82	-0.43	-0.23	-0.32	-0.57	-0.43	-0.39	-0.24
Rate of weight gain (g/initial kg/day)	7.02	4.15	3.49	3.14	5.92	3.84	2.55	1.61
Dropout (%)	17.6%	18.1%	15.5%	1.82%	9.8%	9.1%	11.6%	0.0%
Unrecovered (%)	34.0%	10.7%	3.1%	2.9%	43.5%	36.5%	28.2%	20.0%

Table 4. Analysis of Variance (ANOVA) of Initial WHZ score for Weight Change, Dropout, and Recovery

Outcome	Source of Variation	dF	MS	F	P value
Weight Change	WHZ_i[1]	3	20.4	19.6	<0.001***
	Location	1	540.8	519.8	<0.001***
	WHZ_i x Location	3	4.7	4.5	0.004**
	Residuals	2898	1.0		
Dropout	WHZ_i	3	0.1676	1.321	0.266
	Location	1	1.8847	14.856	<0.001***
	WHZ_i x Location	3	0.1353	1.067	0.362
	Residuals	3416	0.1269		
Recovery	WHZ_i	3	5.836	32.107	<0.001***
	Location	1	15.073	82.921	<0.001***
	WHZ_i x Location	3	0.425	2.341	0.071
	Residuals	3416	0.182		

1. WHZ_i is initial WHZ score

Table 5. Outcomes of Treated Children after Stratifying by Age at Admission

	Site-Based Feeding [n=2658]				Home-Based Feeding [n=860]			
	≤ 15 mo. [n=472]	≤ 30 mo. > 15 mo. [n=760]	≤ 45 mo. > 30 mo. [n=670]	≤ 60 mo. > 45 mo. [n=709]	≤ 15 mo. [n=169]	≤ 30 mo. > 15 mo. [n=262]	≤ 45 mo. > 30 mo. [n=220]	≤ 60 mo. > 45 mo. [n=189]
Age (mean - months)	11.25	23.18	37.50	53.17	10.89	22.98	37.86	53.19
Weight change (mean)	2.03 kg	2.10 kg	2.29 kg	2.24 kg	1.33 kg	1.30 kg	1.21 kg	1.51 kg
% weight gain (mean)	30.9%	26.1%	23.3%	19.9%	22.4%	17.1%	13.1%	13.9%
WHZ change (mean)	2.44	2.16	2.06	1.79	2.08	1.61	1.40	1.46
HAZ change (mean)	-0.90	-0.23	-0.12	-0.12	-0.82	-0.46	-0.30	-0.17
Rate of weight gain (g/initial kg/day)	4.69	3.86	3.38	3.00	4.58	3.49	2.68	2.83
Dropout (%)	16.3%	17.0%	17.9%	14.5%	11.2%	9.2%	10.9%	11.6%
Unrecovered (%)	5.8%	6.5%	4.4%	5.0%	28.0%	35.3%	34.2%	28.7%

Table 6. Analysis of Variance (ANOVA) of Age for Weight Change, Dropout, and Recovery

Outcome	Source of Variation	dF	MS	F	P value
Weight Change	Age	3	8.8	7.651	<0.001***
	Location	1	388.2	339.315	<0.001***
	Age x Location	3	3.9	3.422	0.017*
	Residuals	2918	1.1		
Dropout	Age	3	0.0762	0.600	0.615
	Location	1	2.1991	17.299	<0.001***
	Age x Location	3	0.0789	0.621	0.601
	Residuals	3442	0.1271		
Recovery	Age	3	0.375	2.046	0.105
	Location	1	21.112	115.043	<0.001***
	Age x Location	3	0.057	0.312	0.817
	Residuals	3442	0.184		

Linear or logistic regression analyses for each outcome were also conducted to confirm observed relationships. Age was included as a covariate for models assessing WHZ_i, and WHZ_i was controlled for when assessing the effect of age. The regression results indicated that the associations observed and reported in Tables 4 & 6 were unchanged after controlling for the added covariate.

The costs estimates reveal that the cost per child treated and recovered was greater for the SBF strategy compared to the HBF strategy (Table 7).

Table 7. Cost Estimates of the SBF and HBF Programs

	SBF	HBF + 2%[2]	HBF + 1%[2]	HBF only
Total Cost[1]	$263,171.10	$51,730.73	$27,024.73	$2,318.73
Cost per child treated	$99.01	$60.15	$31.42	$2.70
Cost per child recovered	$125.74	$99.67	$52.07	$4.47

1. Total costs reflect the actual expenses incurred for the whole program.
2. "+ 2%" or "+ 1%" are the costs estimates with 2% or 1% of the poverty alleviation program included.

4. Discussion

This study attempts to compare two acute malnutrition treatment strategies, a site-based strategy (SBF) against a home-based strategy (HBF). Numerous studies have examined the efficacy of home-based versus day-care or inpatient approaches [5–9] however the majority of these therapies utilize a form of ready-to-use therapeutic food (RUTF). This study analyses two programs that use dry-feeding strategies, requiring staff or caregivers to cook and prepare food. Additionally, the comparison of malnutrition treatment programs has been found to be challenging due to variability in numerous factors such as definitions and reporting of outcomes [10]. In this scenario, numerous factors including geographical location, the implementing NGO, food product utilized, economic and demographic characteristics of children and their households were kept fairly consistent, minimizing the variation between the programs being compared.

The differences in the admission characteristics of children between SBF and HBF (Table 1) revealed that the HBF program recruited children with more severe malnutrition than the SBF program. These differences could be a reflection of dissimilar recruitment strategies, while HBF was a treatment initiative nested within a community-based poverty alleviation program, SBF attempted to recruit children from communities without substantive community engagement prior to the start of the program. HBF was designed to prioritize SAM after 6 weeks of community engagement, so it is possible that less complicated cases of SAM and MAM were resolved within ICM's poverty-alleviation program through the distribution of supplementary food to a household, leaving the more severe cases requiring intervention. Whereas the households of children who were recruited into SBF were not being engaged with a poverty alleviation program, therefore fewer severe cases required a targeted feeding program. A study in Malawi which compared in-patient versus home-based treatment of malnutrition in children noted that mothers of MAM children would avoid being screened for in-patient treatment because of the time and resources required to comply with the therapy [5]. This bias is also potentially true in this study, SBF requires a greater investment of time and resources than HBF, and therefore fewer MAM cases were screened and admitted into SBF.

To address these biases, the outcomes of the treatment programs were compared after stratifying children by WHZ score at admission (WHZ_i) and age. It was found that the

location of treatment, site-based versus home-based, was a significant factor in the outcomes of weight change, dropout and recovery. The association of location of treatment with weight change suggests that children who were treated at a fixed site gained significantly more weight than children who were treated at home. This is likely due to differences in duration of feeding as well as the difficulty in encouraging adherence to feeding regimens during the HBF program, whereas during SBF, hired program staff prepare the food and monitor feeding sessions. A study of home-based therapy in Bangladesh observed that meal preparation for a malnourished child at home is difficult; attaining the adequate quantity and frequency of meals are common challenges [8]. A different study also observed low rates of weight gain in a home-based therapy, and suggest that sharing of food may be a contributing factor [6], which is difficult to avoid in low-income households such as those in the programs examined here. The observed interaction between location and WHZ_i showed that children suffering from SAM in the SBF program gained weight more rapidly than SAM cases in HBF. It is possible that the increased caregiver engagement in the SBF program stimulated caregivers of SAM children to more readily adopt positive practices than in the HBF program where less caregiver engagement is involved. It is also possible that social connectivity increases among caregivers of SAM children in the SBF program during periods of feeding, which also plays a role in increased weight gain. A similar interaction effect was observed when children were stratified by age.

The location of treatment was found to be associated with dropout, but not with WHZ_i or age. This reveals that the proportion of dropouts was not significantly affected by the severity of malnutrition or the age of a child, but was related to the location of treatment. Children enrolled in the site-based feeding strategy were more likely to drop out than children treated at home, this differential proportion of dropout was also observed in a study that followed children with SAM who were treated in both facility-based and community-based settings [11]. A reason for the discrepancy could be related to SBF requiring greater primary caregiver involvement in terms of time, energy and commitment. In SBF, the primary caregiver was required to accompany the enrolled child to the treatment location every day for feeding over the course of 16 weeks, while in HBF the caregiver would only be required to pick up food once a week and participate in the poverty-alleviation program. The decreased disruption to a caregiver's routine for activities such as housework or income opportunities was identified as an advantage of home-based therapy [8]. Additionally, only the malnourished child is fed in SBF, whereas the whole household benefits from additional food in HBF. Blanket feeding of the household in HBF is necessary to ensure that the malnourished child receives enough food without neglecting the possibility of other hungry household members. An additional benefit of household blanket feeding identified here is the decreased proportion of dropouts.

The recovery of a treated child was observed to be affected by treatment strategy and WHZ_i, but not by age. Although SBF had a significantly higher proportion drop out, children were also more likely to recover. This is in direct contrast to HBF, where the dropout was lower, but children were less likely to recover. These findings reveal that tradeoffs exist between the two programs, and advantages and disadvantages should be balanced. Of children that completed the program, 94% of children in SBF reached their target weight, while 68% did so in HBF, and both of these programs used food products that required cooking, dissimilar to RUTF. The proportion recovered is

comparable to other programs implemented in India [11], Bangladesh [12], and Malawi [6] where community-based malnutrition treatment programs successfully treated 65%, 70%, and 84% of enrolled children, respectively. The rates of weight gain observed in SBF and HBF, 3.6 and 3.3 g/kg/day respectively, fell within the range of 1.2 g/kg/day to 6.4 g/kg/day noted in a review of community-based programs [9], but were slightly lower than 4g/kg/day reported in a home-based program [8], and lower than the conventional target of 5 g/kg/day [12]. Rate of weight gain was not modeled in the ANOVA analyses since initial WHZ was included as a covariate.

When program costs are included in the assessment of treatment strategy, it was clear that to nest the HBF intervention within a poverty alleviation program was more cost-effective than running a SBF intervention as a stand-alone program. These cost estimates also took into account the additional food required for HBF, as sufficient food for the whole household is provided in this strategy. Additional considerations between the two programs include less logistical oversight required for the HBF strategy, therefore saving on staff time and effort, while the SBF strategy necessitates hired staff to manage and oversee daily feeding sites. Even though SBF increases the proportion of recovered among those enrolled, the lower resource requirement for HBF could lead to wider coverage of a program, and a greater number of children treated. To balance some of these advantages and disadvantages, some programs have adopted an integrated strategy that has in-patient and home-based phases [12]. During future program design, implementers should be aware of the variation between the two strategies, and consider these factors to align towards program targets and goals.

This study faces limitations, specifically regarding the comparability of the two programs. Although numerous characteristics were shared between the two programs, discrepancies that were recognized, such as the recruitment process of children, as well as discrepancies that were not identified, were present. A number of covariates such as the distance of a participant's home from feedings site were not collected, and could not be in the statistical analyses. The data also faces potential errors as all measures and surveys were collected in low-income settings where the precision and reliability of instruments such as weighing scales and height measures were limited. The potential for bias is also possible since the same staff that managed the feeding programs were also requested to collect anthropometric data. Regardless, the results of this study highlight the continued need to assess outcomes of community-based health interventions, and to utilize the findings constructively for future program design.

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FIGURE LEGENDS

Fig. 1. Outcomes of Children Admitted into SBF. A flow diagram of the outcomes in 2658 children ages 6 to 60 months who were admitted into the Site-Based Feeding Program

Fig. 2. Outcomes of Children Admitted into HBF. A flow diagram of the outcomes in 860 children ages 6 to 60 months who were admitted into the Home-Based Feeding Program