Clinical Spectrum and Comorbidity Pattern of Severe Acute Malnutrition in Hospitalised Children Age between 6 Months to 59 Months

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Research article

Keywords: severe acute malnutrition, children, co morbidity and oedema

Posted Date: June 29th, 2021

DOI: https://doi.org/10.21203/rs.3.rs-446283/v1

Abstract

BACKGROUND The prevalence of underweight children in India is the highest in the world, and is nearly double that of Sub-Saharan Africa. Poor nutrition in the first 1000 days of a child's life leads to stunted growth, impaired cognitive ability, reduced school and work performance. The mortality rate and duration of stay in hospital with oedematous SAM has remained unacceptably high. Such high mortality in inpatients has been attributed to co-morbidities.

METHOD Descriptive hospital based study was done in the Department of Paediatrics, Kamla Raja Hospital, Gwalior from October 2018 to October 2020. Children 6-59 months of age with severe acute malnutrition admitted in severe acute malnutrition treatment unit were enrolled. WHO criteria were used to define severe acute malnutrition. The quantitative variables were described as mean ± standard deviation and categorical variables were in terms of proportion.

RESULT Out of 29036 children, 1020 have severe acute malnutrition, constitute prevalence of 3.51%. A total of 400 cases met eligibility criteria and exploited. Sex ratio male and female 52.5%:47.5%. The peak prevalence was found in age group between 6-12 months (55%). Anaemia (68.25%) was found to be the commonest co morbidity, and then pneumonia (17.75%) dehydration (16.5%) followed by sepsis (13.5%). Most common chief complaint was fever (69%), followed by cough (38%) and watery loose motion (38%).

CONCLUSION Severe acute malnutrition remains severe public health problem and mainly affects children under 24 months. Commonest causes are poor feeding practices, improper care of sick child at home, low maternal BMI. Maternal nutrition, education, media awareness, domestic decision, adequate nutrition of the girl child, early identification of anaemia, diarrhoea, pneumonia, sepsis and comprehensive treatment can reduces the morbidity and mortality.

Introduction

Childhood malnutrition is an underlying cause in an estimated 35% of all deaths under five years of age. [1] The prevalence of underweight children in India is the highest in the world, and is nearly double that of Sub-Saharan Africa.

Poor nutrition in the first 1000 days of a child's life leads to stunted growth, impaired cognitive ability, reduced school and work performance. Malnutrition occurs as a complex interplay factors like poverty, maternal BMI, mother age at marriage, home environment, feeding practices, hand washing and other hygiene practices. Low birth weight, diarrhoea within the last 6 months and developmental delay are associated with malnutrition.

By 2030, end all forms of malnutrition, including achieving, by 2025, the internationally agreed targets on stunting and wasting in children under 5 years of age and the nutritional needs of adolescent girls, pregnant and lactating women are indicators of primarily prevalence of stunting, wasting and overweight

under 5 years of age. The intermediate target is a reduction in the prevalence of stunting by 40% by 2025 (from 2012 levels). SAM has been a real obstacle to achievement for the fourth Millennium development Goal [2]. Global Nutrition Report 2018, revealed the prevalence of stunting, wasting and overweight at national level as 37.9, 20.8 and 2.4% respectively [3]. National Family Health Survey-4 in India, 21% of children under five were underweight (low weight for height) and among them, more than 7.5% suffered from SAM [4]. Globally, around 10 million children die every year, more than 1.5 million of them from diarrhoea [5]. Diarrhoea is the most common morbidity in SAM children, it may also be severe, prolonged, difficult to manage, and unpredictable and relationship between malnutrition and diarrhoea is bidirectional. The risk of fatal outcome is high when children with pneumonia have co-morbidity of severe acute malnutrition, fatality increased by 15 times.

Children with malnutrition have higher incidence and severity of infections due to deterioration of immune function, limited production and/or diminished functional capacity of the immune system [6]. The mortality rate and duration of stay in hospital with complicated SAM has remained unacceptably high. Such high mortality in inpatients has been attributed to co-morbidities.

By keeping view of this a study has been planned on severe acute malnutrition with the aim to determine the epidemiological, clinical presentations, co-morbidity and outcome.

Methods

At 5% level of significance considering prevalence of clinical feature fever, as 54.5% (Babatola AO et al) [7] and at 5% absolute error, sample size using formula,

$n = Z^2_{@/2}\ PQ/d^2$

where $Z^2_{@/2} = 1.96$,P = 54.5 ,Q = 45.5, d = 5

Sample estimated as 381, considering 5% non response error, sample 400.

This cross sectional study was done in the Department of Paediatrics, Kamla Raja Hospital, Gwalior from October 2018 to October 2020. Children 6–59 months of age with severe acute malnutrition admitted in severe acute malnutrition treatment unit were enrolled. WHO criteria were used to define severe acute malnutrition [8].

Informed consent was obtained before the participants were enrolled. Detailed history and systemic examination were done and the clinical signs of micronutrient deficiencies were assessed and recorded on a pre designed pro forma. Baseline investigations, including blood sugar, complete blood counts, serum electrolytes, chest x-rays, Monteux test, routine and microscopic urinalysis, and blood culture sensitivity, were done and managed according to the standard protocol [9]. Socio-demographic data (age, sex, religion, residence) and maternal characteristics (age at marriage, maternal illness, BMI), teenage parents, anthropometric parameters, signs and symptoms on admission, clinical forms of SAM,

complications and co morbidities. Clinical outcome: number of days of hospitalization, weight gain, clinical evolution of discharged. The quantitative variables were described as mean ± standard deviation and categorical variables were in terms of proportion.

Operational Definitions:

1. Severe Acute Malnutrition [9]:

a. Weight/height or weight/length <-3SD or weight for- height less below the median

b. Mid-upper arm circumference < 115 mm
c. Bipedal edema of nutritional origin.

2. Complicated SAM [9]: Presence of Anorexia, fever, hypothermia (< 35°C), persistent vomiting, severe dehydration, not alert, apathetic, unconscious, convulsion, hypoglycaemia, severe anaemia, severe pneumonia or extensive superficial infection. The operational guidelines were followed.[9].

Children aged 6 – 59 months from out-patient department were screened. SAM were identified and admitted. The presenting complaints, nutritional history along with daily diet for last week were recorded. Anthropometric measurements including height, weight, mid arm circumference and head circumference was measured. Anthropometric measurements were plotted against WHO Graphs. Starter diet (F75), cereal based starter diet and catch-up diet were used for treatment. Daily monitoring of amount of formula needed, amount child has taken, weight changes were recorded. All subjects received age-appropriate multivitamin and minerals as per WHO protocol. Iron was added in the rehabilitative phase. All subjects were monitored for complications like hypoglycaemia, hypothermia, shock, dehydration, and congestive cardiac failure. Child's progress was monitored daily by calculating the weight gain (gm/kg/day), 24-hour dietary intake, disappearance of oedema, weekly length/height and MUAC. Children with persistent diarrhoea were re-examined for co morbidities like pneumonia, urinary tract infections, HIV, and tuberculosis.

Discharge criteria:

1. Oedema has resolved

2. Weight gain of > 15% and has weight gain (> 5 gm/kg/day) for 3 consecutive days
3. Child is eating an adequate amount of nutritious food that the mother can prepare at home
4. All infections and medical complications have been resolved.
5. Child is provided with micronutrients
6. Immunization is updated

Achieved target weight: 15% weight gain, no sign of illness/no edema and has 3 consecutive daily weight gain (> 5gm/kg/day)

Non responder: who fail to respond to the treatment e.g. a patient remain for a long period of time under target weight, no reason in investigation, refer to higher facility.

Recovered/cured: reached discharge criteria within reporting period

Defaulter: admitted in ward but absent for 3 consecutive days.

Readmission: previous discharge from inpatient cares but meets admission criteria again

Return after default: who return after default away for 2 consecutive days and meet admission criteria

SAM cases followed after discharge by health provider till reaches weight for height of -1SD

Follow up: at 2 weeks in 1st month then monthly until weight for height reaches – 1SD or above

Result

A total **29,036** children were admitted in the paediatric unit. Out of 29036 children, 1020 have SAM, constitute prevalence for SAM of 3.51%. A total of 400 cases met eligibility criteria and exploited. Sex ratio male and female 52.5%:47.5%. 230 children (57.5%) had Weight/Length and Mid Upper Arm Circumference criteria, Mid Upper Arm Circumference criteria only in 43 subjects (10.75%) had satisfied. On the basis of Weight/Length only 41 children satisfied (10.25%), On the basis of oedema only 40 children satisfied (10%), MUAC, oedema and weight for length all three found in 24 patients (6%), both MUAC and oedema found in 15 patients (3.75%), while both weight for length and oedema found in 7 patients (1.75%). The peak prevalence was found in age group between 6–12 months (55%) followed by 13–24 months (32%), 25–59 months(13%) were least in number. Anaemia (68.25%) was found to be the commonest co morbidity, and then pneumonia (17.75%) dehydration (16.5%) followed by sepsis (13.5%). (Table 1**)**

The average duration of stay in the hospital was 11.67 ± 6.16 days. As per religion based, 92.3% children belong to the Hindu community while 7.8% were Muslims. As per residence 59.5% of cases belong to rural while 40.5% to urban. The mean age of subject were (16.51 ± 10.57) months.

Table 1

Frequency distribution of Co morbidities among severe acute malnourished children

S.N	CO MORBIDITY	FREQUENCY	PERCENT (400)
1	ANEMIA	273	68.25
2	PNEUMONIA	71	17.75
3	DEHYDRATION	66	16.5
4	SEPSIS	54	13.5
5	EDEMA	39	9.75
6	CONVULSIONS	36	9
7	DIARRHOEA	30	7.5
8	CEREBRAL MOTOR DISABILITY	30	7.5
9	ACUTE HEPATITIS	25	6.25
10	TUBERCULOSIS	22	5.5
11	SKIN DISORDER	17	4.25
12	PEDIATRIC SURGERICAL CASES	15	3.75
13	VITAMIN DEFICIENCY	14	3.5
14	COMPLICATION	12	3
15	PYOGENIC MENINGITIS	11	2.75
16	CHD(ACYANOTIC)(CYANOTIC)	8(6)(2)	2
17	UTI	8	2
18	ASOM	1	0.25
19	BODYACHE	1	0.25

Table 2

Frequency distribution of Chief complaint among severe acute malnourished children

S.N	CHIEF COMPLAINT	FREQUENCY	PERCENTAGE AMONG 400
1	FEVER	276	69.00
2	COUGH	152	38.00
3	WATERY LOOSE MOTION	152	38.00
4	VOMITING	137	34.25
5	ANY OTHER	26	6.50
6	DYSENTERY	20	5.00
7	EDEMA	13	3.25
8	PALENESS	10	2.50
9	WEAKNESS	7	1.75
10	NOT TAKING FOOD	5	1.25
11	PAIN IN ABDOMEN	3	0.75
12	INFANTILE TREMOR SYNDROME	2	0.50
13	RESPIRATORY DISTRESS	2	0.50

Most common chief complaint was fever (69%), followed by cough (38%) and watery loose motion (38%). (Table 2) Among mother of malnourished children 87.3% had parity of ≥ 3 while < 3 parity found in 12.8%. Patient MUAC less than 11.5cm constitute 77.8% while MUAC ≥ 11.5cm in 22.3%. Severe wasting found in 75.8% while 24.3% had SD score < 3. Oedema found in 22.3% of patient while 77.8% were non oedematous. (Table 3)

Mean weight at admission was 6.14 ± 1.60(2.56–12.18), mean height on admission 69.55 ± 8.13(51.5–98.50), mean MUAC 10.73 ± 1.36(6.8–15.7), mean mother age at marriage 18.54 ± 2.52(10–32), mean mother weight 44.58 ± 7.98(24.3–78.70), mean mother BMI 19.70 ± 3.31(11.59–38.49).

Table 3
Logistic regression analysis of predictors influencing oedema:

Variables		n	Edematous	Chi square	P Value	β Coefficient	OR (CI)
Outcome	Achieved Target Weight	51	7(13.7%)	2.455	0.117	-0.66	0.52(0.22–1.19)
	Partial Weight Gain	349	82(23.5)			-	1(Ref)
SEX	Female	190	53(27.9)	6.666	0.010	0.63	1.87(1.16–3.02)
	Male	210	36(17.1)			-	1(Ref)
Residence	Rural	238	52(21.8)	0.055	0.815	-0.06	0.94(0.58–1.52)
	Urban	162	37(22.8)				1(Ref)
Religion	Hindu	369	82(22.2)	0.002	0.963	-0.02	0.98(0.41–2.35)
	Muslim	31	7(22.6)			-	1(Ref)
Age(months)	6–12	220	52(23.6)	0.558	0.756	0.14	1.15(0.55–2.41)
	13–24	128	26(20.3)			-0.05	0.95(0.43–2.10)
	25–59	52	11(21.2)			-	1(Ref)
Parity of Mother	< 3	349	76(21.8)	0.355	0.551	-0.21	0.81(0.41–1.60)
	≥ 3	51	13(25.5)			-	1(Ref)
MUAC Category	< 11.5	311	43(13.8)	57.332	0.000	-1.90	0.15(0.09–0.25)
	≥ 11.5	89	46(51.7)			-	1(Ref)
Weight for height(W/H)	Normal	97	55(56.7)	87.854	0.000	2.34	10.36(6.05–17.73)
	Wasted	303	34(11.2)			-	1(Ref)

Discussion

Prevalence of severe acute malnutrition in this study was 3.51%, National prevalence of SAM at community level is 6.8% [9]. This rate was higher than found by Ubesie *et al*. in Nigeria which was 2.8% [10] and below 3.75% found by Ehouzou [11] in 2014 at the Mother and Child Centre of the Chantal Biya

Foundation (MCC/CBF). This difference can be explained by the fact that high prevalence was due to lack of awareness about malnutrition in community especially in rural population due to high illiteracy of mothers and lower socioeconomic status of family.

The sex ratio was 1.1 which indicates a virtual equality between the sexes with a slight male predominance. Mutombo *et al*. in Ivory Coast had found a sex ratio of 0.91 [12]. Ubesie *et al*. in Nigeria had also found a female predominance [10] and Irena *et al*. in Zambia in 2014 had shows a male predominance [13] with no difference statistically.

The mean age of study population was 16.51 ± 10.57 months. This age was lower than the 17 months found by Irena *et al*. in 2011 in Zambia [13]. In this study, cases were more common in the age group of 6 to 12 months (55%) and 13 to 24 months (32%), while Ubesie *et al*. found that majority of children from 6 to 12 and 13 to 24 months. Whereas age between 6 to 12 months had the highest proportion. Faulty feeding practices, inadequate care of sick patient at home, and improper management that promotes malnutrition. The maternal age from 15–32 years with a mean age (18.54 ± 2.52years), those whose ages ranged between 20 and 24 years were most represented (18.4%); this age is period of maternity in India according to the NFHS-4(4).

In this study, maximum cases (92.25%) were Hindus as compared to Muslims (7.75%) this shows the prevalence of SAM in two communities. Similarly, Malik et al. [14] reported that malnutrition was more in Hindus as compared to Muslims (70.7% v/s 29.2%) but the severity of malnutrition (PEM grade III and IV) was more in Muslims due to large family size, low literacy rate and low socioeconomic status. Singh et al. [15] and Rao et al. [16] also observed the same. SAM was more (59.5%) from rural area as compared to 40.5% in Urban. Ashraf et al. [17] observed that malnutrition was more prevalent ($p < 0.01$) in children living in nonindustrial than industrial area (82.8% v/s 17.1%). Poor nutritional status of rural children compared to urban counterparts is due to the cumulative effect of a series of less favourable conditions, including lower socioeconomic conditions, improper maternal antenatal care, birth care, faulty complementary feeding and poor immunization status.

In this study, prevalence of oedematous SAM was higher (25.5%) in the family having ≥ 3 children. Rao et al. [16] observed that malnutrition in urban slums reported average family size of 5.77. Likewise, Sharma [18] reported that prevalence of malnutrition higher in family size more than 2–3 siblings. It might be due to low per capita income and poor childcare practices. In this study, mean maternal BMI were 19.7 ± 3.31 (11.59–38.49), with oedematous SAM child significantly associated with BMI less than 18.5 kg/m^2 with p-value (0.002) OD (CI)(1.13(1.05–1.21) as compared to non oedematous SAM cases. Maternal under nutrition (BMI < 18.5 kg/m^2) constitutes more than 20% in sub-Saharan Africa, south-central and south eastern Asia [19]. A similar finding was seen in 50.6% of mothers in study by Rai R, *et al* in 2015(20). More than 33% mothers were underweight in the study by Nagabhushan BM, *et al* in 2017(21) and 57.7% mothers were underweight in the study by Bhatia P, *et al* in 2018(22). Association between malnutrition and multiple factors such as parent's education, mother's occupation, maternal age at marriage, birth order, and mother's BMI, have been reported by Moestue H *et al* in 2008(23). Similarly, the International

Food Policy Research Institute explored the relationship between women's status and children's nutrition in three developing regions: South Asia, Sub-Saharan Africa, Latin America and the Caribbean. They summarized malnourished women will deliver low birth weight babies and this increases the risk of being malnourished throughout childhood. Malnourished mothers will have low energy levels and reduced cognitive abilities which effect inadequate care of their children [24]. A study conducted in Bangladesh also confirms that women's education, exposure to media, and domestic decision play a significant role in the nutritional status of women.(25)

Fever, cough and watery loose motion were the most frequent symptoms on admission representing 69%, 38% and 38% respectively. This could be due to high proportions of severe wasting (75.75%) in study subjects. Ubesie *et al*. and Irena *et al*. had found a predominance of diarrhoea in 72.7% and 59.2% respectively (10, 13). Bernal et al. [26] and Bagga et al. [27] in their study also reported diarrhoea and fever as common presenting symptom. Ashraf et al. [17] also observed that diarrhoea (25.8%) and fever/vomiting (30.9%) were the common presenting symptoms. Sepsis was seen in 13.5% of subjects, which was higher to a Columbian study which reported a similar incidence [26]. Culture positive sepsis found in 31 cases out of 54 (57.40%) while remaining 42.59% with probable sepsis.

The most encountered complication was dehydration (16.5%); this is due to the large proportion of diarrhoea (38%) in our study. Dehydration directly alters anthropometric indices, such as weight, weight-for-height and mid upper arm circumference (MUAC). [28] Severe anaemia (22.7%) when the haemoglobin level less than 4 g/dL or hematocrit was below 12%. This rate was higher than found by Bachou *et al*. in Uganda (6.5%) (29) and lower than that found by Ubesie *et al*. (24.2%) (10).

The most predominant clinical form of SAM was non oedematous (77.75%), followed by oedematous (22.5%).The predominance of non oedematous SAM was found by other authors Ubesie *et al*. (34.9%), and Mutombo *et al*. in Ivory Coast (70.5%) (10,12). In Sudan, Gabbad *et al*. instead found a predominance of oedematous SAM in children under 5 years (43.8%) (30).Multiple co morbidities was found in children with SAM (49.5%) while 40.5% study subjects had single co morbidity that is, anaemia (68.75%), pneumonia (17.75%) and dehydration (16.5%). These three co morbidity were also observed by Ubesie *et al*. study (10), but in different proportions. In India in 2014, Kumar *et al*. had found a high proportion of lung infections of 27.8 % [31].

The average duration of hospitalization was 11.67 ± 6.16 days with a range of 1 to 34 days, which is higher by Page *et al*. (8 days) [32] and by Irena *et al*. (9 days) (13). Ubesie *et al*. had found a longer duration (16 days). On comparing with a study done by Maurya et al, the duration of study was 6.8 days [33]. Oedematous SAM stayed longer, 13.39 ± 7.53 days in comparison to non oedematous 11.18 ± 5.63 days in hospital. Ubesie *et al*. had also found similar finding. This difference can be explained that oedematous SAM stay longer in the stabilization phase. Therefore, their management takes longer time than with non oedematous SAM. Among 89 cases of oedematous SAM with favourable evolution, 13.7% achieved target weight, while 23.5% achieved partial weight gain. The recovery rate of weight gain in this study was 40% as compared to Singh et al study found a recovery rate of 46.8 % [34]. The defaulter rate

was 11.25% in our study compared to Singh et al was 47.2%. The major handicap was found that parents were not stay for a longer duration because of various social/economical factors. A study by Dasgupta R et al also concluded the difficulty faced by nutritional rehabilitation centre. [35]

Limitation of our study is that results could not be generalized to the community since the present study was a facility-based hospital study, edematous SAM was less in number as compared to non oedematous SAM.

Conclusion

Severe acute malnutrition remains severe public health problem and it mainly affects children under 24 months. Dominated causes are poor feeding practices, improper care of sick child at home, low maternal BMI. Maternal nutrition, education, media awareness, domestic decision, adequate nutrition of the girl child, identification of anaemia, diarrhoea, pneumonia, and comprehensive treatment can reduces the morbidity and mortality. There is a strong need to emphasize mother about nutritive diets that they can prepare at home, parents should be pre sensitized about SAM and its care needed, must be educated for low cost, nutritious food.

Declarations

Ethical approval –Approved by Institute ethical committee

Consent for publication Not Applicable

Availability of data and material Data sharing not applicable to this article as no data-sets were generated or analyzed during the current study.

Competing interests

The authors declare that they have no competing interests.

Funding Not Applicable

Authors' contributions (research articles only)

Dr Ashutosh Kumar Sharma carried out the studies, participated in the data collection and drafted the manuscript. Dr Ghanshyam Das conceived of the study, and participated in its design and coordination and helped to draft the manuscript. Durgesh Shukla participated in the statistical analysis. All authors read and approved the final manuscript.

Acknowledgements Not applicable

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Figures

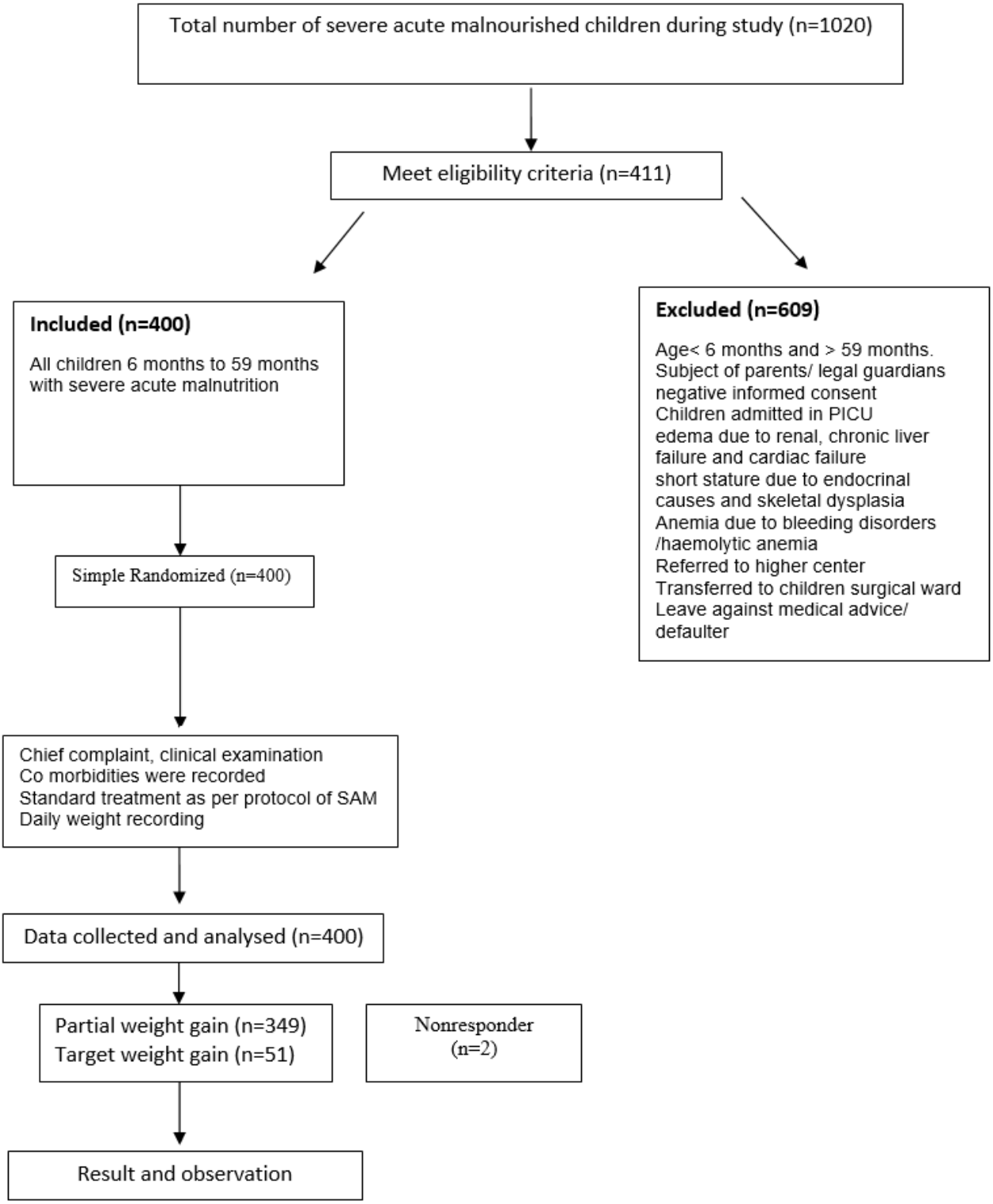

Figure 1

Flow chart of participants in the study.