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TITLE

Admission profile and discharge outcomes for infants aged less than 6 months admitted to inpatient therapeutic care in 10 countries. A secondary data analysis.

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SHORT RUNNING TITLE

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CONFLICT OF INTEREST

The authors declare that they have no conflict of interest

CONTRIBUTIONS

AJS, MK, MM conceived the study. CW, JCH and PD contributed data. CSGE analysed and interpreted the data, and wrote the initial draft of the manuscript. All authors contributed to the manuscript revisions. All authors read and approved the final manuscript.

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Admission profile and discharge outcomes for infants aged less than 6 months admitted to inpatient therapeutic care in 10 countries. A secondary data analysis.

ABSTRACT

Evidence on the management of acute malnutrition in infants aged less than 6 months (infants <6mo) is scarce. To understand outcomes using current protocols, we analysed a sample of 24,045 children aged 0-60 months from 21 datasets of inpatient therapeutic care programmes in 10 countries. We compared the proportion of admissions, the anthropometric profile at admission, and the discharge outcomes between infants <6mo and children aged 6-60 months (older children).

Infants <6mo accounted for 12% of admissions. The quality of anthropometric data at admission was more problematic in infants <6mo than in older children with a greater proportion of missing data (a 6.9 percentage points difference for length values, 95%CI: 6.0; 7.9, p<0.01), anthropometric measures that could not be converted to indices (a 15.6 percentage points difference for weight-for-length z-score values, 95%CI: 14.3; 16.9, p<0.01), and anthropometric indices that were flagged as outliers (a 2.7 percentage points difference for any anthropometric index being flagged as an outlier, 95%CI: 1.7; 3.8, p<0.01). A high proportion of both infants <6mo and older children were discharged as recovered. Infants <6mo showed a greater risk of death during treatment (risk ratio 1.30, 95%CI: 1.09; 1.56, p<0.01).

Infants <6mo represent an important proportion of admissions to therapeutic feeding programmes and there are crucial challenges associated with their care. Systematic compilation and analysis of routine data for infants <6mo is necessary for monitoring programme performance and should be promoted as a tool to monitor the impact of new guidelines on care.

KEYWORDS

Malnutrition, Infant and Child Nutrition, Management of Acute Malnutrition, Mortality, Anthropometry, Wasting.

Admission profile and discharge outcomes for infants aged less than 6 months admitted to inpatient therapeutic care in 10 countries. A secondary data analysis.

INTRODUCTION

Acute malnutrition is a serious global health concern (Black et al. 2013). Global estimates indicate that wasting, a type of acute malnutrition characterized by acute mass loss (WHO 1995), affects 50 million children aged <5 years and accounts for 11.5% of their total deaths (UNICEF et al. 2015;Black et al. 2013). Severe wasting affects 16 million children and accounts for 7.8% of their total deaths (UNICEF et al. 2015;Black et al. 2013). Moreover, it is also estimated that wasting affects 8.5 million infants aged less than 6 months (henceforth referred to as infants <6mo) (Kerac et al. 2011). Beyond its short-term impact on survival and health, this wasting burden has long-lasting consequences for both individuals and societies (Victora et al. 2008).

Despite these high global burdens, infants <6mo were only recently included in the new World Health Organisation (WHO) guidelines for the management of severe acute malnutrition (SAM) (WHO 2013;WHO & UNICEF 2009). Although, inclusion of infants <6mo in these guidelines represents an important development, there is also a recognised need for developing the evidence base in order to improve care in this age group (Angood et al. 2015).

Describing the profile and outcomes associated with the management of acute malnutrition in infants <6mo is central for expanding our understanding about the effectiveness of current care strategies and setting the baseline evidence to help guide improved future care. This study, which preceded the new WHO 2013 guidelines (WHO 2013), aimed at providing evidence on infants <6mo receiving inpatient therapeutic care to determine what is their proportion among children aged 0-60 months, what is their anthropometric profile at admission, and what their outcomes are at discharge.

PARTICIPANTS AND METHODS

Ethics

This study carried out a secondary analysis of routinely collected and fully anonymised programme data. The analysis of data from programmes in which there is no intervention trial of planned change in procedures is widely classified as audit or service evaluation by research ethics committees. Consequently, no ethical approval was required.

Field datasets

An appeal for datasets containing individual-level programme data on acute malnutrition care of infants <6mo was put out from May to December 2008. We received a total of 30 datasets from Action Contre la Faim (ACF) and one from Médecins Sans Frontières. Of these, only 23 datasets from ACF contained inpatient therapeutic care programme data from 25,195 children aged 0-60 months from 34 field sites located in 12 countries. **Table 1** provides details of the children in these datasets by country and the type of inpatient therapeutic programme care. The majority of the individuals in our dataset (81.9%) were admitted into therapeutic feeding centres (TFC). We excluded the data from Afghanistan and Ethiopia (n=1,150) as their programme data included only very young children with no older children for comparison. A final sample of 24,045 children aged 0-60 months was used for analysis.

Data available

Age, the presence of bilateral pitting oedema, and anthropometric data, namely weight, length or height, and mid-upper arm circumference (MUAC), were available for most children at admission. For most children, discharge outcomes were also available. Anthropometric data was also available at discharge but there was a large heterogeneity in the type and timing of data collected. Consequently, this analysis focused only on anthropometric and oedema data at admission and outcomes at discharge.

Data handling and data analysis

Data was manipulated and analysed in Stata software (Stata Statistical Software: release 14, 2015; StataCorp LP). We calculated the anthropometric indices weight-for-age, height/length-for-age and weight-for-height/length z-scores (WAZ, HAZ, WHZ, respectively) from weight, height or length, age and sex variables at admission, based on the 2006 WHO Growth Standards (WHO Multicentre Growth Reference Study Group 2006) using the zscore06 command (Leroy 2011). Extreme z-score values are usually assumed to represent measurement or data entry errors (WHO 1995). We flagged these extreme values as outliers using commonly applied cleaning criteria (Crowe et al. 2014) as follows: Flag 1: WAZ <-4 or >4 z-scores from the observed mean; Flag 2: HAZ <-4 or >3 z-scores from the observed mean; and Flag 3: WHZ <-4 or >4 z-scores from the observed mean. Acute malnutrition, based on WHZ and/or the presence of oedema, was classified as global (GAM; WHZ<-2 and/or oedema), moderate (MAM; WHZ<-2 but ≥-3), and severe (SAM; WHZ<-3 and/or oedema). Wasting, based on WHZ among children without reported oedema, was classified as total (WHZ<-2), moderate (WHZ<-2 but ≥-3), and severe (WHZ<-3).

Discharge outcomes were coded differently between and within datasets, differing primarily in the terminology used and the manner in which they were abbreviated. Discharge codes were grouped into the four Sphere discharge codes recovered, died, defaulted, and non-recovered (The Sphere Project 2011); as well as admission error, or missing: if no discharge outcome data was available (see **Table S1**).

To describe the burden for programmes providing therapeutic care for acute malnutrition to infants <6mo, we calculated what proportion of programme admissions were within this age group. To assess the quality of the anthropometric data collected at admission for infants <6mo, we compared the proportion of missing values, the proportion of values that failed to convert into anthropometric indices, and the proportion of anthropometric indices that were categorised as outliers against their older counterparts. To assess the nutrition profile at admission for infants <6mo, we compared the proportion of GAM, MAM, SAM, oedema, and of total, moderate and severe wasting against their older counterparts. Lastly, we compared the proportions of discharge outcomes and performed a meta-analysis to assess the risk of death during treatment between the different age groups. To test for the equality of means and proportions we used the ztest and prtest commands, respectively. For meta-analysis we used the metan command.

RESULTS

Programme burden - Proportion of children aged <6 months

Our sample for analysis included 24,045 children aged 0-60 months who were receiving therapeutic care for acute malnutrition (see **Table 1**). We observed that a large proportion of these were young; i.e. 17,963 (75%) and 2,939 (12%) were aged 0-24 months and less than 6 months, respectively. **Figure S1** shows the age frequency distribution of the sample, where one can also observe rounding of age to the nearest half-year from 12 months of age onwards. Infants <6mo represented 16% of the sample of children aged 0-24 months. Regarding the type of programme therapeutic care, infants <6mo accounted for 6%, 10%, 18% and 13% of the sample for Day Centre (DC), Home Treatment (HT), Stabilisation Centre (SC) and TFC programmes, respectively. The proportion of boys was similar between the two groups, i.e. 50.3% and 50.6% for infants <6mo and 6-60 months, respectively.

Quality of data at admission

Table 2 displays the difference in the quality of anthropometric data at admission for infants <6mo and children aged 6-60 months. At admission, data on infants <6mo contained a significantly greater proportion of missing values for length and for MUAC than their older counterparts; but both age groups had a similar low proportion of missing values for weight and for the presence of bilateral pitting oedema.

Secondly, the WHZ index could not be calculated for a significantly greater proportion of infants <6mo using the anthropometric data collected at admission. The main reason for this difference was that for most infants <6mo, for whom WHZ could not be calculated (467 out of 471), their length was lower than 45cm, the minimum reference value needed for calculating this index. The proportion of WAZ and HAZ indices that could not be calculated was very low for both groups.

Lastly, there is a significantly greater proportion of anthropometric indices that were flagged as statistical outliers in infants <6mo compared to children aged 6-60 months. **Figure S2** provides a visual comparison of the difference in the availability of anthropometric data between infants <6mo and their older counterparts. After accounting for missing data, poor quality or out of range anthropometric data, only 74% of the sample of infants <6mo have anthropometric data that would allow for the assessment of wasting, as defined by WHZ, compared with 97% of their older counterparts.

Anthropometric and clinical profile at admission

Table 3 presents the nutrition profile data from the subsample of children aged 0-60 months that had no missing weight or height/length data and their calculated WHZ values were not flagged as outliers. Overall, the nutritional profile of infants <6mo was better compared to their older counterparts. Infants <6mo showed a significantly lower GAM proportion than older children, of which a significantly larger and lower proportion were MAM and SAM, respectively. In addition, infants <6mo presented with a significantly lower proportion of bilateral pitting oedema. Similarly, after removing from the sample those reported to have oedema, infants <6mo had a significantly lower proportion of wasting compared to their older counterparts, of which a significantly larger and lower proportion were moderate and severe wasting, respectively. Lastly, mean WHZ values were significantly greater for infants <6mo.

Discharge outcomes

Table 4 displays the discharge outcomes by age group. Overall, both age groups have a similar high proportion of children being discharged as recovered. However, we observed a significantly lower proportion of infants <6mo discharged as defaulted. **Figure 1** presents a forest plot of the pooled risk ratio for death during treatment for infants <6mo against their older counterparts. Overall, the risk ratio for death was significantly greater for infants <6mo. However, there was a high level of variation in the risk ratio between study sites (86.6% variation in risk ratio attributable to heterogeneity; chi-squared = 67.0 $p < 0.01$).

DISCUSSION

Main findings

To our knowledge, this is the first analysis of programme information from a variety of countries and care programmes containing data on infants <6mo receiving therapeutic care for acute malnutrition. One of our main findings is infants <6mo represent an important proportion of the children receiving malnutrition care in the programmes run by international relief agencies.

Our analysis provides insights into some of the main challenges that malnutrition care programmes face when assessing infants <6mo. We found that the collection of anthropometric data in infants <6mo is challenging as indicated by the greater proportion of missing data at admission, particularly length. The MUAC data was also missing, far more than in older children; however, this was not surprising as MUAC is not recommended as an admission criterion for infants <6mo (Kerac et al. 2012). Furthermore, even when weight and length data were successfully collected, it was not possible to convert a large proportion of them into any useful anthropometric index since WHZ cannot be calculated when length is <45cm. In addition, when this index calculation was possible, a large proportion of the values were observed to be extreme.

Furthermore, our study found that infants <6mo who are receiving therapeutic care for acute malnutrition presented a better nutritional profile at admission when compared with their older counterparts. Specifically, infants <6mo presented a lower proportion of oedema and had, on average, greater WHZ values at admission. These differences were manifested in the lower proportion of GAM and total wasting, as well as the proportion of SAM and severe wasting observed in infants <6mo.

Lastly, our analysis showed that infants <6mo have a similar proportion of recovered outcomes at discharge. However, infants <6mo had a higher risk ratio for death during treatment.

Programme burden

We have previously showed that despite the lack of focus on assessing the nutritional status in this age group (Lopriore et al. 2007), acute malnutrition among infants <6mo is a public health concern (Kerac et al. 2011); a prevalence that others have characterised as an underestimated public health problem (Patwari et al. 2015). Our analysis contributes to this evidence by showing that infants <6mo also account for an important proportion of children receiving inpatient therapeutic care. This burden of care is important given the weak evidence base on which care for this age group is based, and their care often falls in the gap between neonatal care and the management of malnutrition for older children (Kerac et al. 2015).

It is not possible for us to assess the extent to which the disease burden observed in our sample reflects the actual prevalence of acute malnutrition in the catchment areas of the therapeutic programme, as infants <6mo are not routinely included in prevalence surveys of acute malnutrition. Recent evidence has shown that the proportion of infants <6mo suffering from acute malnutrition compared to their older counterparts is greater in hospital settings than in the wider community (Karunaratne et al. 2015). Furthermore, others and we have argued that because it is commonly assumed that this age group is better protected from nutritional stress than their older counterparts, the available estimates are likely to represent an underestimate of its prevalence in both inpatient and community settings that provide malnutrition care. However, evidence supporting the assumption of greater protection among infants <6mo exists (Pongou et al. 2006), making it difficult for us to extrapolate our findings to the wider population.

Assessing nutritional status of infants aged <6 months

How acute malnutrition among infants <6mo should be defined is, at present, a top priority research question (Angood et al. 2015). This definition will determine who will receive malnutrition care. The two anthropometric indicators commonly used for assessing SAM in children aged 6-59 months are also being considered for infants <6mo (WHO 2013;WHO & UNICEF 2009), namely low WHZ and low MUAC. Discussions about which of these indicators is better suited to assess acute malnutrition in older children have focused almost exclusively on their predictive value for assessing a high risk of death (Walters et al. 2012), in spite of the large body of evidence about the long-term consequences of the impaired development associated with acute malnutrition (Victora et al. 2008).

Recent evidence, relevant for infants <6mo, has shown that MUAC data, collected at the age of routine vaccination, 6-14 weeks of age, predicts child survival at age 12 months better than WHZ data (Mwangome et al. 2012a). Furthermore, collection of MUAC data among infants <6mo has also been shown to be more reliable and accurate than WHZ when collected by trained community health workers, using hanging scales with a precision of 100g (Mwangome et al. 2012b;Mwangome & Berkley 2014). Our study adds to this evidence by showing that for inpatient therapeutic care programmes, obtaining reliable WHZ data in infants <6mo is problematic because of problems arising at different steps, from collection of anthropometric data through calculation of indices and cleaning of data. That a greater number of WHZ were flagged for infants <6mo is also relevant from an epidemiological standpoint; and suggests that further work is necessary to better understand if the cleaning criteria originally envisioned to be applied to older children should be applied to this younger age group. It is difficult to draw any conclusion regarding the reliability of MUAC data collection in this analysis, as the data was collected during a period when the use of MUAC measures in therapeutic care was not a firmly established practice in older children; and it has never been recommended in infants <6mo.

Despite the relative ease of MUAC data collection, compared to WHZ, and its strong association with mortality risk, doubt remains as to how well it indicates acute weight loss in infants <6mo. A recent study of a sample of healthy infants aged ≤6 months in Ethiopia showed that MUAC values in this very young population are weakly associated with body composition (Grijalva-Eternod et al. 2015). MUAC variability among these infants reflects more the variability in length, independently of age and sex, and less the variability of tissue masses. Conversely, WHZ variability seems to index nutritional status better as it more closely reflects variability in tissue masses. Given that these two indicators have a different relationship with body composition data and mortality, it has been proposed that MUAC measurements among infants <6mo might have a greater capacity to assess growth failure as opposed to an acute loss of tissue mass, for which WHZ might be better-suited (Grijalva-Eternod et al. 2015). Further longitudinal evidence is needed to empirically test this proposal. Nonetheless, even if WHZ is a better indicator of acute tissue mass loss, and MUAC a better indicator of mortality, the challenge remains that collection of anthropometric data, like length, and calculation of indices, like WHZ, among infants <6mo is highly problematic.

The nutrition profile of infants aged <6 months at admission to therapeutic care

At admission to therapeutic care, infants <6mo present a better anthropometric profile than their older counterparts do, even after accounting for oedema. To our knowledge, this is the first report of this difference. There is scarce literature to help us understand why oedema was significantly lower among infants <6mo; or why they seem to be admitted to therapeutic care at a less severe stage of malnutrition. In infants <6mo, oedema might be more difficult to diagnose; as in older children of whom most can stand, gravity might influence in narrowing the location of the oedema to the limbs. Also, infants <6mo compartmentalise body water differently than older children. Studies have shown that total body water, as a percentage of body weight, and extracellular water, as a fraction of total body water, decrease rapidly during the first 130 days of life, with extracellular water decreasing more rapidly (Fomon & Nelson 2002). It might be that clinically detectable oedema is more likely only after certain developmental milestones have taken place, such as the decrease in the ratio of extracellular to cellular water mentioned above. This idea is supported by the observation that the proportion of oedema among older children with SAM increases with age, peaking at three to five years of age (Girma et al. 2013).

Care outcomes

We are not the first to show that a high proportion of infants <6mo admitted to receive care for acute malnutrition recover (Singh et al. 2014;Vygen et al. 2013). However, our findings adds to this evidence. We showed that the proportions discharged as recovered are similar between infants <6mo and older children, as well as the proportions discharged as non-recovered. We also observed a lower proportion of infants <6mo being discharged as defaulted. However, this findings may be because the proportion discharged as dead is higher in this age group (borderline significant). To investigate this borderline fatality, we conducted a meta-analysis of the date from different countries. This revealed that infants <6mo have a higher relative risk of death; despite a better nutritional profile at admission.

The higher relative risk of death for infants <6mo observed in our study needs cautious interpretation given the high level of heterogeneity observed between the countries where the data was collected. It is not possible to disentangle whether the observed heterogeneity in our results reflects a different mortality risk among infants <6mo in these different settings, at comparable levels of anthropometrically defined malnutrition; or if this observed heterogeneity may be due to differences in the quality of therapeutic care provided to infants <6mo. Likewise, it is not possible to assess how much of the higher relative risk of death observed in infants <6mo may be due to suboptimal care driven by the existence of inadequate care protocols, or an inadequate provision of care, or both, given the lack of international guidelines for the management of malnutrition in infants <6mo.

Limitations

Our study has some limitations. First, most programmes were less likely to have actively sought infants <6mo in the community compared to older children aged 6-59 months, and might not have recommended inpatient care for all cases of SAM identified in infants <6mo. This potential bias may have resulted in an under-representation of malnourished infants <6mo, that may have varied between contexts, but could not be quantified. Second, the absence of a clear anthropometric criterion for admission to therapeutic feeding of many infants <6mo suggests that alternative criteria were also used. The alternative criteria might include a number of non-anthropometric criteria, such as clinical signs of infection, disability, feeding difficulties, and maternal factors; an assumption that is supported by a review of admission criteria used for this age group (ENN & CIHD 2010). How much these additional criteria might help explain the differences observed in the nutritional profile of these two age groups where infants seems to be admitted to care at a less severe stage in malnutrition is unknown and could not be quantified in our analysis. Lastly, all datasets used for this analysis originate from one international relief agency limiting the study capacity to extrapolate our findings to the other care providers.

Our study has also strengths. To our knowledge this is the largest multicentre analysis of inpatient therapeutic care data that includes data on infants <6mo. As such, this dataset allows for a more global understanding of differences in the management of acute malnutrition in these two groups. Likewise, given the paucity of the evidence base for the management of acute malnutrition in infants <6mo (Kerac et al. 2015), even after their inclusion in the WHO guidelines (WHO 2013), our analysis provides the best available comparisons at admission and discharge between these two age groups.

Conclusions

Infants <6mo represent an important proportion of admissions to therapeutic feeding programmes for acute malnutrition. There are numerous challenges associated with their care: anthropometric measurement; knowing which measures and signs of illness or poor feeding are best to use for assessment; interpreting current programme outcomes and knowing to what extent the observed mortality is avoidable through better guidelines or better implemented guidelines. Systematic compilation and analysis of routine data of infants <6mo is important for monitoring programme performance and should be promoted as a tool to assess the impact of new guidelines on care.

KEY MESSAGES

- Infants aged less than 6 months account for an important proportion of patients that receive inpatient therapeutic care for acute malnutrition.
- Collection of infant's anthropometric data at admission to therapeutic care is problematic compared to that of their older counterparts (children aged 6-60 months). Data on infants had a greater proportion of missing anthropometric data, anthropometric data that could not be used to estimate nutrition indicators, and estimated nutrition indicators that were flagged as extreme and unlikely values.
- At admission to therapeutic care, infants aged less than 6 months presented with a better nutritional profile, including a lower proportion of oedema, global acute malnutrition and severe acute malnutrition compared to their older counterparts.
- The proportion of infants aged less than 6 months and older children discharged as recovered was similar. However, infants aged less than 6 months suffered a higher case fatality rate.
- Systematic compilation and analysis of routine data is an important tool for monitoring programme performance and should be promoted as a tool to monitor the impact of rolling out new guidelines on therapeutic care.

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LEGENDS TO FIGURES

Figure S1. Age frequency distribution of a sample of 24,045 children aged 0-60 months from 10 countries (Burundi, Kenya, Liberia, Myanmar, Niger, Democratic Republic of Congo, Somalia, Sudan, Tajikistan and Uganda). The continuous line denotes the cumulative frequency.

Figure S2. Proportion of values of the weight-for-height z-score that are available for the assessment of the nutritional status at admission, by age group, from a sample of 24,045 children aged 0-60 months from 10 countries (Burundi, Kenya, Liberia, Myanmar, Niger, Democratic Republic of Congo, Somalia, Sudan, Tajikistan and Uganda).

Figure 1. Forest plot of the risk ratio (RR) of death during treatment for infants aged <6 months compared to children aged 6-60 months, by country, from a sample of 24,045 children aged 0-60 months from 10 countries (Burundi, Kenya, Liberia, Myanmar, Niger, Democratic Republic of Congo, Somalia, Sudan, Tajikistan and Uganda).
Test for heterogeneity chi-squared = 67.0 (degrees of freedom = 9; p<0.01).
I-squared (variation in RR attributable to heterogeneity) = 86.6%.
Test of RR=1: z = 2.96 (p<0.01)

TABLES

Table 1. Programme datasets by country

Country	Years	Type of Therapeutic Care				6-60 months	<6 months	Age (months)		
		DC	HT	SC	TFC	n (%)	n (%)	mean ± s.d.	Min	Max
Afghanistan [a]	2002-04	633			460	63 (5.8)	1,030 (94.2)	3.4 ± 1.5	0.5	9
Burundi	2006-07	2,359				2,213 (93.8)	146 (6.2)	33.5 ± 16.7	0	60
DRC	2005-07				6,229	4,829 (77.5)	1,400 (22.5)	18.7 ± 15.6	0	60
Ethiopia [a]	2008			57		24 (42.1)	33 (57.9)	4.3 ± 1.9	0	8
Kenya	2005-07				539	502 (93.1)	37 (6.9)	18.2 ± 11.4	1.5	60
Liberia	2006-08				2,436	2,269 (87.1)	167 (6.9)	16.3 ± 9.8	1	60
Myanmar	2006-08		1,143	248		1,211 (87.1)	180 12.9)	22.9 ± 14.6	0.1	60
Niger	2006-08				1,108	963 (86.9)	145 (13.1)	14.6 ± 9.2	1	58
Somalia	2006-08				2,997	2,595 (86.6)	402 (13.4)	17.7 ± 13.0	1	60
Sudan	2005-08			109	5,218	4,967 (93.2)	360 (6.8)	18.0 ± 9.7	0	60
Tajikistan	2005-06				373	287 (76.9)	86 (23.1)	10.9 ± 6.7	1	46
Uganda	2005-07				1,286	1,270 (98.8)	16 (1.2)	21.6 ± 10.8	1	60
Total	2002-08	2,992	1,143	414	20,646	21,193 (84.1)	4,002 (15.9)	19.0 ± 14.0	0	60

DC: Day centre, HT: Home treatment, SC: Stabilisation centre, TFC: Therapeutic feeding centre, DRC: Democratic Republic of Congo

[a] This programme data was excluded from analysis as it included only very young children with no older children for comparisons.

Table S1. Coding of original discharge outcomes (Supplementary Appendix)

Recovered	Died	Non-recovered	Defaulted	Admission error
C	Dead	Autres	Abandon	Admission mistake
Cured	Death	C.N.R	D	AM
Guéri	Décédé	CNR	Default	CH
	Décès	Critères non-atteints	Defaulter	Cheating
	Died	Criteria not reached		Erreur d'admission
	M	DNG		Error
		Inconnu		Mistake
		Medical transfer		Mistake admission
		Non guéri		
		Non répondant		
		Non respondant		
		Non respondent		
		Non responder		
		Non response		
		Non-respond		
		NR		
		Other		
		Others		
		T		
		TFC		
		To other OTP		
		Transfer		
		Transfer HP		
		Transfer Others		
		Transfer TFC		
		Transfer to other OTP		
		Transfer to OTP		
		Transfer to TFC		
		Transféré		
		Transfert		
		Transfert Centre de s		
		Transfert CNT		
		Transfert CS		
		Transfert H		
		Transfert hopital		
		Transfert medical		
		Transfert vers crenas		
		Unknown		

Table 2. Quality of anthropometric data at admission by age group.

	<6 months (n = 2,939)		6 – 60 months (n = 21,106)		Difference		
Percentage of anthropometric data at admission that was missing							
	%	95%CI	%	95%CI	%	95%CI	p-value
Weight	0.51	0.25; 0.77	0.62	0.51; 0.72	-0.11	-0.38; 0.17	0.24
Height/length	7.55	6.60; 8.50	0.63	0.53; 0.74	6.92	5.96; 7.89	<0.01
MUAC	49.4	47.6; 51.2	24.2	23.6; 24.8	25.2	23.3; 27.1	<0.01
Oedema data	1.60	1.15; 2.05	1.57	1.41; 1.74	0.03	-0.46; 0.51	0.46
Percentage of anthropometric indices that could not be calculated when measurement data was available							
	<6 months (n = 2,939)		6 – 60 months (n = 21,106)		Difference		
	%	95%CI	%	95%CI	%	95%CI	p-value
WAZ	0.00	- -	0.01	0.00; 0.02	-0.01	-0.02; 0.00	0.30
HAZ	0.00	- -	0.00	- -	0.00	- -	- -
WHZ	16.0	14.7; 17.3	0.40	0.31; 0.48	15.6	14.3; 16.9	<0.01
Percentage of anthropometric indices flagged as outliers							
	<6 months (n = 2,939)		6 – 60 months (n = 21,106)		Difference		
	%	95%CI	%	95%CI	%	95%CI	p-value
Flag 1	1.40	0.97; 1.82	0.70	0.58; 0.81	0.70	0.26; 1.14	<0.01
Flag 2	6.91	5.99; 7.82	4.26	3.99; 4.53	2.65	1.69; 3.60	<0.01
Flag 3	1.91	1.41; 2.40	1.54	1.37; 1.71	0.37	-0.16; 0.89	0.07
Any flag	8.47	7.47; 9.48	5.71	5.40; 6.02	2.76	1.71; 3.82	<0.01

WAZ: Weight-for-age z-score, HAZ: Height-for-age z-score, WHZ: Weight-for-height z-score, MUAC: Mid-upper arm circumference.
Flag 1: WAZ <-4 or >4 z-scores from the observed mean
Flag 2: HAZ <-4 or >3 z-scores from the observed mean
Flag 3: WHZ <-4 or >4 z-scores from the observed mean

Table 3. Nutritional profile at admission of children aged 0-60 months by age group.

Proportion of acute malnutrition at admission							
	<6 months (n = 2,190)		6 – 60 months (n = 20,556)		Difference		
Indicator	mean or %	95%CI	mean or %	95%CI	mean or %	95%CI	p-value
Global (%)	85.4	84.4; 87.3	98.7	98.5; 98.8	-12.8	-14.3; -11.4	<0.01
Moderate (%)	13.7	12.2; 15.1	4.70	4.41; 4.99	8.95	7.49; 10.4	<0.01
Severe (%)	72.2	70.3; 74.1	94.0	93.7; 94.3	-21.8	-23.7; -19.9	<0.01
Oedema (%)	5.53	4.57; 6.48	35.3	34.7; 36.0	-29.8	-31.0; -28.6	<0.01
Proportion of wasting [a] at admission							
	<6 months (n = 2,069)		6 – 60 months (n = 13,295)		Difference		
Indicator	mean or %	95%CI	mean or %	95%CI	mean or %	95%CI	p-value
Total (%)	85.0	83.5; 86.6	98.0	97.7; 98.2	-12.9	-14.5; -11.4	<0.01
Moderate (%)	14.5	12.9; 16.0	7.27	6.82; 7.71	7.19	5.61; 8.76	<0.01
Severe (%)	70.6	68.6; 72.5	90.7	90.2; 91.2	-20.1	-22.2; -18.1	<0.01
WHZ (z-score)	-3.89	-3.93; -3.85	-4.31	-4.32; -4.29	0.42	0.37; 0.46	<0.01

WHZ: Weight-for-height z-score.

Acute malnutrition: Global (WHZ<-2 and/or oedema), moderate (WHZ<-2 but ≥-3) and severe (WHZ<-3 and/or oedema).

Wasting: Total (WHZ<-2), moderate (WHZ<-2 but ≥-3) and severe (WHZ<-3).

[a] Wasting was measured among children with no reported oedema.

Table 4. Discharge outcomes of children aged 0-60 months

	<6 months (n = 2,939)		6 – 60 months (n = 21,106)		Difference		
Discharge outcome	%	95%CI	%	95%CI	%	95%CI	p-value
Recovered	75.7	74.2; 77.3	74.5	73.9; 75.1	1.23	-0.43; 2.89	0.08
Died	4.60	3.81; 5.31	3.95	3.68; 4.21	0.61	-0.19; 1.41	0.06
Non-recovered	10.2	9.14; 11.3	10.1	9.68; 10.5	0.15	-1.01; 1.32	0.40
Defaulted	6.43	5.54; 7.32	7.75	7.39; 8.11	-1.31	-2.27; -0.36	<0.01
Admission error	0.37	0.15; 0.60	0.50	0.41; 0.60	-0.13	-0.37; 0.11	0.18
Missing values	2.69	2.10; 3.27	3.24	3.00; 3.48	-0.55	-1.18; 0.08	0.05

FIGURES

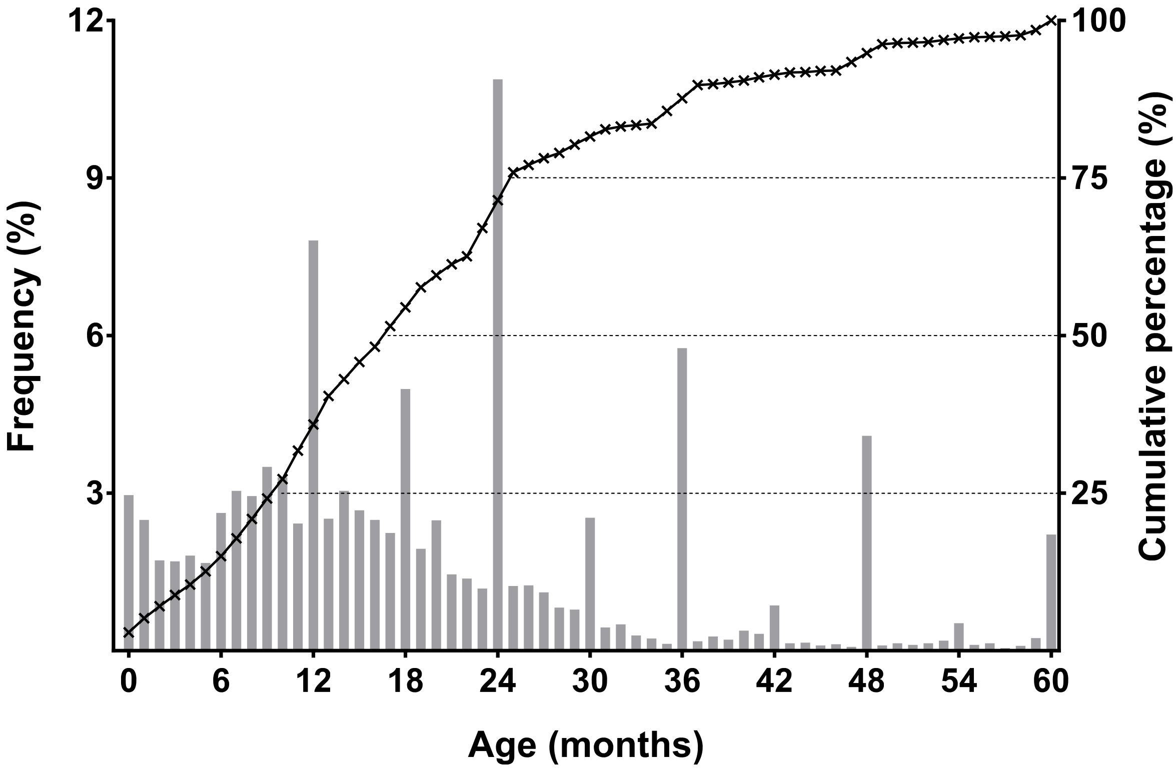

Figure S1 (Supplementary Appendix)

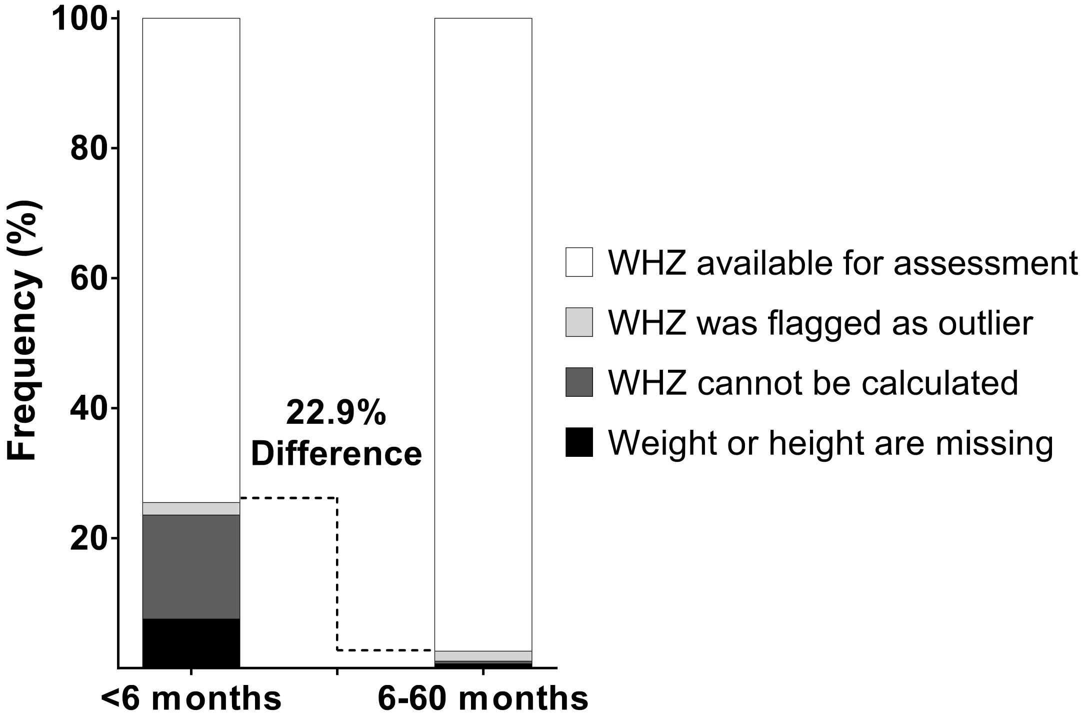

Figure S2 (Supplementary Appendix)

	Infants <6 months n/N	Children 6-60 months n/N	RR (95% CI)	% Weight
Liberia	5/167	15/2,269	4.53 (1.67, 12.3)	1.15
Tajikistan	0/86	4/287	0.37 (0.02, 6.77)	1.17
Myanmar	5/180	11/1,211	3.06 (1.08, 8.70)	1.59
Uganda	6/16	137/1,270	3.48 (1.81, 6.67)	1.91
Burundi	17/146	39/2,213	6.61 (3.83, 11.4)	2.70
Kenya	9/37	59/502	2.07 (1.12, 3.84)	4.53
Somalia	5/402	43/2,595	0.75 (0.30, 1.88)	6.46
Sudan	26/360	224/4,967	1.60 (1.08, 2.37)	17.0
Niger	11/145	116/963	0.63 (0.35, 1.14)	17.0
DRC	50/1,400	185/4,829	0.93 (0.69, 1.27)	46.6
Overall	**134/2,939**	**833/21,106**	**1.31 (1.09, 1.56)**	**100**

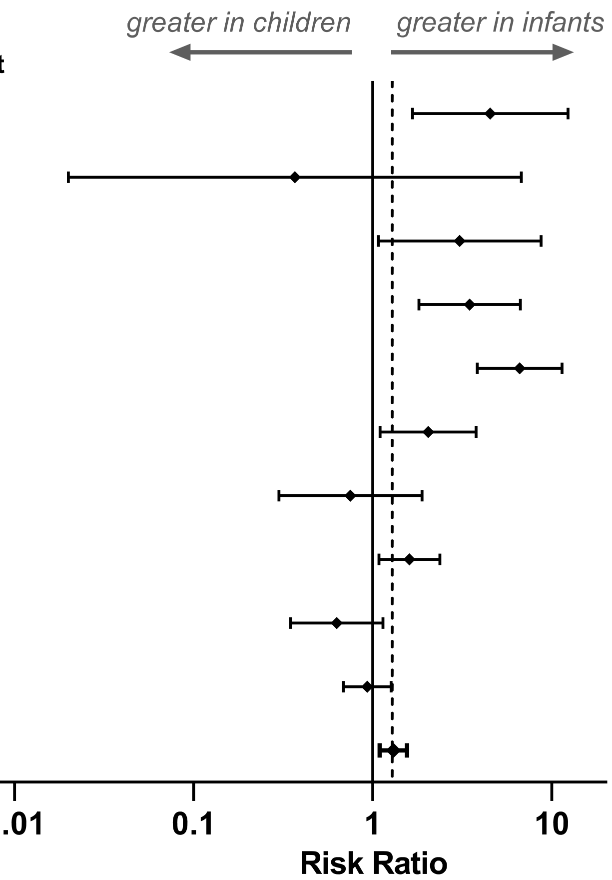

Figure 1