



# The impact and effectiveness of emergency nutrition and nutrition-related interventions: a review of published evidence 2004-2010



ISBN 0-9547052-9-7



Emergency, Nutrition Network



Canadian International Development Agency

Agence canadienne de développement international

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This review was funded by the Canadian International Development Agency. June 2011.

Recommended citation: The impact and effectiveness of emergency nutrition and nutrition-related interventions: a review of published evidence 2004-2010. Hall A, Blankson B and Shoham J. Emergency Nutrition Network, Oxford, UK. June 2011.

Front cover photos:

D Doledec, Uganda, 2008; Veronique Priem, Niger, 2002; Mesfin Teklu, WV, Ethiopia, 2006; Mulugeta Wtsadik/UNHCR, Ethiopia, 2009; M Manary, Malawi, 2003.

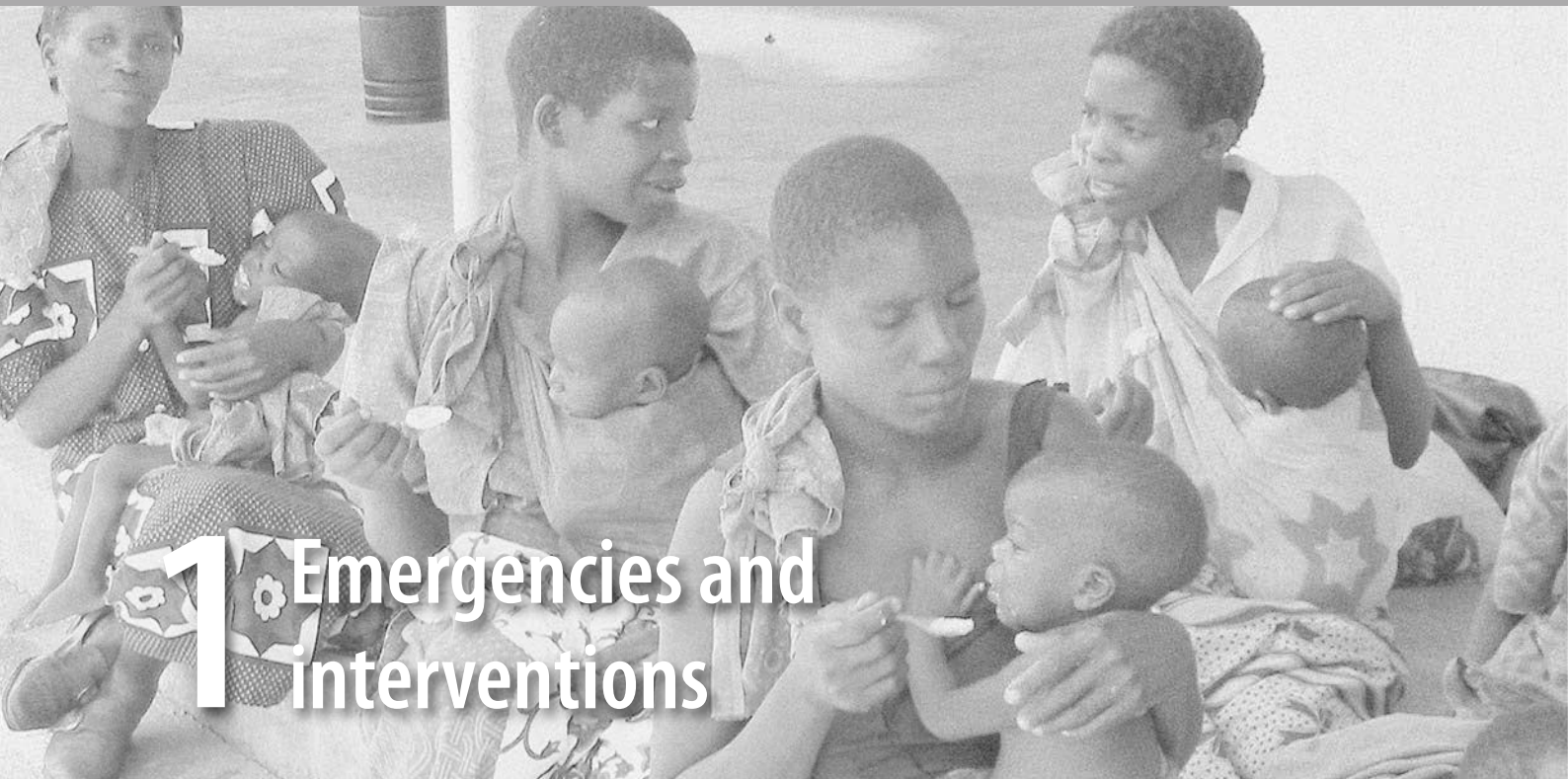
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# The impact and effectiveness of emergency nutrition and nutrition-related interventions: a review of published evidence (2004-2010)

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M Manary, Malawi, 2003.

## 1 Emergencies and interventions

In the context of humanitarian emergencies, the term intervention describes any thing provided, or measure put in place, to prevent, mitigate, alleviate, treat or repair the harmful effects of whatever has caused the emergency.

### 1.1 Causes of emergencies

An emergency could be caused by:

- A sudden natural physical event such as a flood, earthquake, tsunami, cyclone or hurricane.
- A chronic natural event such as a drought, out-break of pests or disease that kills or injures crops or livestock upon which people depend for food or income.
- An epidemic of disease that debilitates or kills large numbers of people.
- A breakdown of order, institutions and supplies due to public unrest, civil war, ethnic conflict, government collapse or international wars
- A political or economic crisis.

When an acute event occurs, it is relatively easy to define an emergency, although the scale and number of people involved will likely influence whether an official emergency is declared by a government or the United Nations. However the threshold between a slowly deteriorating situation and an emergency is hard to define in some circumstances, such as a drought.

As the focus of this review is on interventions that could improve nutrition, the prevalence of wasting or underweight could offer thresholds to define an emergency or disaster. The World Health Organisation (WHO) consider that a prevalence of wasting of  $\geq 15\%$  is 'critical'<sup>1</sup> but this can be exceeded relatively easily in countries such as India, Bangladesh and Ethiopia where there is chronic and often seasonal undernutrition. National governments, such as Ethiopia, may use the prevalence of wasting plus other criteria, sometimes described as 'aggravating factors', which could make the situation worse to classify the severity of the situation.<sup>2</sup>

So the threshold between an emergency situation and a chronically malnourished population is unclear and means that deciding whether an intervention is being applied in an emergency or not, is also often unclear.

### 1.2 Main interventions during emergencies

The main interventions provided by governments and relief agencies during an emergency are:

- Money, such as cash (conditional or not), credit or loans, or by buying livestock, called destocking and restocking.
- Food, such as a general ration, blanket feeding for vulnerable groups, and supplementary and therapeutic food for young children.
- Preventive health care, such as vaccinations, vitamin A

capsules and other micronutrients, iodised table salt, deworming, and impregnated bed nets.

- Support for breastfeeding or artificial feeding if necessary.
- Psychosocial care and counselling, especially in disasters that may have killed many people.
- Water or water purification facilities or chemical sterilising tablets.
- Sanitation facilities.
- Shelter, clothes and domestic equipment.
- Agricultural supplies, seeds, saplings and livestock
- Rescue, relocation and physical safety, usually in the short term.

### 1.3 Consequences of disasters

A major focus of efforts during and after an emergency are:

- To prevent deaths.
- To sustain optimal feeding practices and prevent or minimise practices that put children at risk.
- To treat and prevent undernutrition, particularly among young children.
- To restore housing, infrastructure, health and education facilities, often by 'building back better'
- To restore or create livelihoods.
- To increase robustness to future shocks.

### 1.4 Determining the causes of malnutrition

There is a common but mistaken assumption that cross-sectional data from surveys can be used to determine the causes of malnutrition. Data collected during surveys may be analysed to identify statistical associations between potential risk factors and indices of anthropometric or nutritional status, but an association does not prove causation, for two main reasons.

First, the relationship could be confounded, in which both the risk factor and the outcome variable are not related through a causal pathway but are both independently related to a third, confounding factor that is causative. One particular form is called confounding by intention. For example, a mother may stop breastfeeding a child who is failing to gain weight, perhaps because of illness, so the wasting is mistakenly associated with a lack of breastmilk rather than with the actual cause.

Second, cross-sectional data can also be mistakenly interpreted because it cannot be determined which came first, the exposure or the outcome, called reverse causality bias. For example, if malnourished children are found to be infected with worms it cannot be known if the worms contributed to the malnutrition or whether malnutrition predisposed to the children to worms. One of the most important principles for determining causality, that the exposure must precede the outcome,<sup>3</sup> is not met in cross-sectional data.

The situation is often made worse during a disaster because new or more serious causes of malnutrition occur, such as epidemics of disease or severe food shortages, which add to and exacerbate pre-existing malnutrition. The best solution

is to undertake a needs assessment based on an understanding of the potential causes of malnutrition, perhaps using a tool such as the UNICEF conceptual framework to create a checklist. For these reasons, data collected during a disaster can rarely be used to determine the chronic, underlying causes of malnutrition in any community, but can be used to assess people's immediate needs based on what they lack.

### 1.5 Measuring the impact of interventions

The focus of the first review<sup>4</sup> and of this update is on finding and summarising evidence for the impact and cost-effectiveness of interventions provided during emergencies. There are several reasons why obtaining such evidence is conceptually and practically difficult.

First, because it is hard to show that something has been prevented or has not happened. If deaths have been prevented for example, it is not possible to know, for obvious reasons, how many would have occurred without the intervention. The best that can be done is to show that the death rate has not increased. This requires prior data on the normal death rate in the population before the emergency, which may not be available or, if it is known, may have been unacceptably high in the first place. Any other estimate is speculation, perhaps based on the death rates observed during other similar emergencies, although making such comparisons can require many assumptions.

Second, to be able to assess the attributable benefit of any intervention on human health such as nutritional status, it is necessary to know what would have happened without it. The attributable benefit is the effect of an intervention on an outcome that is additional to the change that would have occurred without the intervention. It is the antonym of attributable risk.<sup>5</sup> The usual conclusion in circumstances in which humanitarian aid is provided is to assume that any change in an outcome in the right direction is due to the intervention or, in epidemiological terms, the exposure. This is illustrated in Figure 1A. Figures 1B, 1C and 1D illustrate other possible ways to mis-estimate the attributable benefit, of which 1D is the most worrying and important; if there is no change in a measured outcome it could be assumed that the intervention has had no effect when, in fact, it has been successful at preventing the situation from getting worse. The changes that occur at the same time as the intervention could be due to concurrent interventions and activities, which is often the case during an emergency, or could be due to changes in external factors, such as climate and rainfall, which influence normal methods of food production.

It is also possible that an intervention may do harm. A study after an earthquake in Indonesia reported that children who were given donated breast milk substitutes had a greater risk of diarrhoea than children who did not.<sup>6</sup>

Figure 1 shows that estimating a simple change in measures at two points in time is not sufficient to conclude that all or part of the impact is attributable to the intervention. In order to do this, a comparison group is needed to assess the

# Emergencies and interventions

The impact and effectiveness of emergency nutrition and nutrition-related interventions: a review of published evidence

change that would have happened anyway, without the intervention, and thus estimate a difference between two groups, not simply a change in one group. This is because other factors often influence nutritional status concurrently. For example if rainfall after a drought coincides with the distribution of rations of food, the rain may lead to more fodder for livestock which provide milk to give children a better diet, in addition to the ration, so Figure 1C may apply. For this reason the control or comparison group needs to be studied concurrently and in the same physical location, so is exposed to the same external influences.

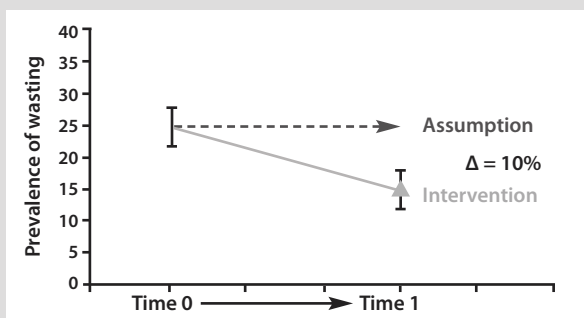
To be able to measure the extra or attributable benefit and achieve internally valid results, the methods of evaluation should ideally include:

- Random allocation of subjects to groups to receive the intervention or not, so that any differences or confounding factors are evenly distributed between groups and are controlled for; prior stratification can be used to ensure that likely confounders are evenly distributed between groups.
- Avoidance or minimisation of contamination between groups, so that only the intervention group gets the intervention.

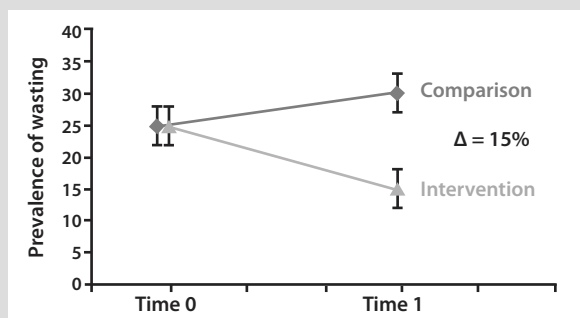
- Clear, measurable and relevant outcomes that are known to be influenced by the intervention so that the difference in benefit between the groups can be estimated.
- A sufficient period to detect differences between groups, because different outcomes may take different amounts of time to diverge.
- Measures to ensure data quality including accuracy and precision.
- An estimate of the probability that the difference is due to the intervention, not chance.

These criteria are almost impossible to meet during a humanitarian emergency for ethical reasons, mainly because it is not possible deliberately to withhold an intervention in order to achieve a comparison or control group. This means that the evidence of a beneficial impact can rarely be obtained experimentally, usually it can only be derived from data that provide plausible evidence of an effect.<sup>7</sup> Plausible is defined as apparently true or reasonable, although what is reasonable to one person may not be to another. A cynic could define plausible as an outcome that meets expectations, and if it meets the expectations of more than one person it could be concluded as proof.<sup>8</sup> Plausibility is the antithesis of probability, as it is not numerical, it is subjective.

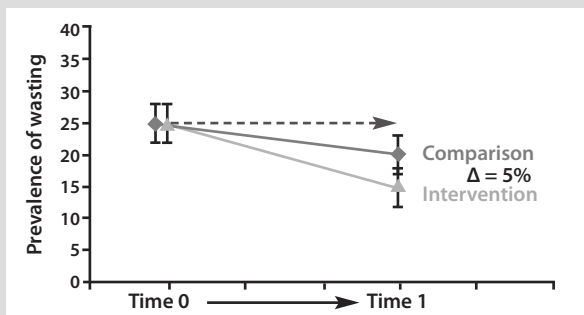
**Figure 1.** Examples of how the attributable benefit of an intervention can be mistakenly estimated using an example of the prevalence of wasting, a common target of nutritional interventions during an emergency, measured twice, over a period of time. Also shown is what might have happened to concurrent comparison group. The value of delta  $\Delta$  is the attributable benefit under each different circumstance.



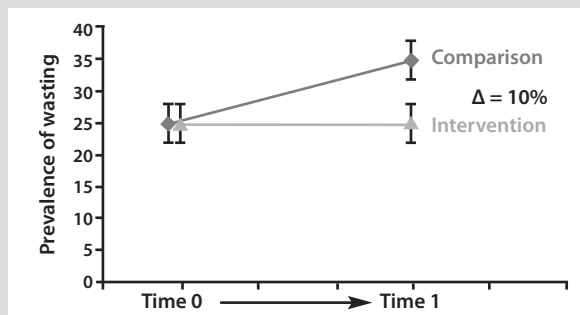
**A. Mistaken conclusion 1:** The attributable benefit is estimated by measuring the difference in prevalence between T0 and T1 which is assumed to be due to the intervention because it has fallen.



**B. Mistaken conclusion 2:** The attributable benefit is underestimated because the prevalence of wasting would have increased without the intervention.



**C. Mistaken conclusion 3:** The attributable benefit is over-estimated because the nutritional situation improved concurrently and the prevalence of wasting would have fallen anyway.



**D. Mistaken conclusion 4:** The attributable benefit was not estimated at all because the intervention prevented the prevalence of wasting from increasing, so no change was observed.



## 2 Providing plausible evidence of impact

Andy Catley, Ethiopia, 2005

**T**here are a number of possible ways plausible evidence of an effect may be obtained. There may be more than are proposed here; this is a topic currently being developed by the Emergency Nutrition Network (ENN)<sup>1</sup>.

### 2.1 Comparison with historical data

If data on key outcomes such as death rates, the prevalence of anthropometric indicators, or micronutrient status have been collected periodically - in good times as well as bad - then an increase followed by a prompt return to normal after an intervention could plausibly be due to the intervention. Routine surveillance data are currently collected in countries such as Ethiopia, where there have been many emergencies, to provide an early warning of an impending crisis, so they could suffice if key outcome indicators (see below) are measured. An example of this is a paper identified during the present review, of data from 900 surveys in the Eritrea, Ethiopia, Kenya, Somalia, Sudan and Uganda which recorded fluctuations in the prevalence of wasting.<sup>9</sup> Such periodic data can indicate a cause and effect relationship between an intervention and improvement of the situation, provided that they are specific to the circumstances in which the disaster occurs and to the ethnic group and type of livelihood. Comparing data between different communities or with national averages may not be valid because, paradoxically, the average is not common; most communities are either above or below the average.

A major problem arises because of seasonality. Because agricultural production and malnutrition are both seasonal and tend to be cyclical, and because interventions may be provided when the situation is at the worst point in a natural cycle, the improvement in an outcome measure may have occurred anyway. Such data alone are weak and prior data may not exist in places that rarely experience an emergency or cannot afford to collect them.

Another problem arises with interpreting longitudinal data when the intervention is widespread or comprehensive, such as a change in policy that affects all individuals within a population. There are, however, statistical approaches to estimating impact that can control for bias.<sup>10</sup>

### 2.2 Cohort studies

If subjects enrol for interventions over a period of time while an emergency continues, it is possible to use the later recruits to provide evidence of what might have happened without any intervention. Early recruits may also benefit to a greater degree than later recruits if they are studied as a cohort (see 3). However later recruits may be drawn from previously disadvantaged communities within the population, so might have been different prior to the emergency. It cannot necessarily be assumed that all potential recruits are homogeneously mixed and then sampled over time, which is necessary to achieve equality in risk.

## 2.3 Natural experiments 1 Dose-response effects

In most circumstances, there is not a uniform delivery or coverage of an intervention, or there are circumstances within households that affect the implementation of the intervention. These differences or 'variance' create the circumstances for natural experiments in which measures of the effectiveness of delivery can be related to the degree of change in an outcome. If the variance in the exposure is associated with the variance in the outcome, there may be a causal association, although confounding can also occur. Again this requires paired data from a cohort of subjects so that the magnitude of a change in an outcome can be measured, such as weight, height, mid upper arm circumference (MUAC) or haemoglobin concentration, for example.

After the flood in Pakistan in 2010, each household was able to claim a standard amount of food every month based on a family of five people, two adults and three children. It could be hypothesised that small households would be at lower risk of having malnourished children than large households after controlling for prior socio-demographic indicators.

There is also the potential to examine how changes in nutritional outcomes are related to initial characteristics. For example, weight gain is likely to be related to initial body weight and to the degree of undernutrition of children. This can be standardised by expressing weight gain in terms of grams per kilogram of initial body weight per day, or changes in height or MUAC in mm/day (see below).

## 2.4 Natural experiments 2 Case-control studies

If data on changes due to interventions are needed, then it is best to study cohorts of individuals so that paired data are obtained so, for example, weight gain can be estimated. To obtain paired data requires that children are identified on at least two occasions, something that can be difficult to do reliably in emergencies.<sup>11</sup> The alternative is to study large independent, random samples at intervals, but the potential for applying analytical statistics is weaker than if paired data are obtained.

Paired data allow nested case-control studies, either prospective or more likely, retrospective, in which parameters that capture the efficiency of an intervention can be related to a standardised change in an outcome measure. For example, during a period of severe food shortage in northern Kenya, a blanket feeding programme was implemented for young children in which the mother was given enough corn-soy blend and oil each month to provide a child with an average of 1,000 kcal/d. It was hypothesised that the anthropometric status of a singleton child would be better than a child with older siblings, with whom the ration might be shared. In such an analysis it would be best to control for age, sex and the date of recruitment, but a sample of several hundred children in many villages could have helped to control for environmental and secular changes that occurred at

the same time. It would have to be assumed that the parents did not eat the ration, too.

## 2.5 Actual experiments: Comparing interventions

When it is not known whether one intervention is better than another, but both are known to be effective, it can be ethical to undertake a comparative study, especially if the study subjects are relatively low risk groups. For example, moderately undernourished children could be given corn soy blend (CSB) and oil or ready-to-use food (RUF). If the subjects are randomly allocated, if informed consent is obtained and, ideally, if the person making the anthropometric measurements does not know which child is receiving which ration to introduce an element of blinding, then data on the comparative effectiveness of the treatments can be obtained. Such allocations can be done by individuals or in clusters, such as villages or treatment centres, providing that there are a sufficient number of clusters. Establishing the number of clusters requires prior data on the intra-cluster correlation coefficient for the outcome variable, which may not be available, so an arbitrary rule of thumb of a minimum of 25 clusters may be applied.

Such experiments can rarely be planned in detail, so require preparedness in principle: to have potential interventions in mind, to assess whether the circumstances will allow random allocation, and to be able to get ethical approval rapidly from a recognised Review Board. Without ethical approval it will not be possible to publish the resulting data.

## 2.6 Actual experiments: non-emergency

For many practical reasons, experimental studies need careful planning and ethical approval, which takes time, so cannot be set up within the short notice in which an emergency or natural disaster occurs. For this reason, much of the data about the effectiveness of the interventions that may be applied during an emergency actually come from managed, independent, scientific studies. The data may be internally valid for the community in which the study was done, but are they valid in other circumstances, such as during an emergency? Again this is where plausibility must be considered. Is it reasonable to assume that a vitamin A capsule given during an emergency is as efficacious as one given as a part of national vitamin A or health day? There are two main reasons why there may be differences: endogenous reasons due to genotypic and phenotypic differences between individuals, which are beyond the scope of this review, and exogenous reasons due to differences in the delivery of interventions that affect coverage of the population at risk.





## 3 Efficacy and effectiveness

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**T**he main exogenous difference between individuals during an emergency lies in the distinction between the efficacy and effectiveness of an intervention. Efficacy is the attributable benefit of an intervention given under ideal circumstances while effectiveness is the attributable benefit of an intervention under usual circumstances. The difference between the two is usually estimated as coverage or the efficiency of allocation or whatever measures are put in place to make sure that beneficiaries actually benefit to the maximum possible degree from the intervention. So for vitamin A, a crucial difference between an emergency and normal circumstances is the coverage of treatment, which may be greater than normal during an emergency because beneficiaries are more easily accessible in a camp, for example. So if there is variation in coverage, then there may be a proportional variation in outcomes as a consequence, so a natural experiment may have taken place. The main question is whether the causal pathway was direct or indirect. But, whatever the causal pathway, the measurement of outcomes is crucial to the estimation of any impact, whether attributable and probable or simply just plausible.



## 4 Outcome measures

Stuart Katwikirize/C-SAFE, Lesotho, 2006

**T**he main expected effects of interventions during emergencies can be grouped as follows:

- To increase money and assets, estimated as income or monetary value, or by the presence or absence of capital items.
- To increase food security, estimated as agricultural production, dietary diversity and food intake
- To increase anthropometric status, which is estimated from measurements of weight, height and age which are compared with values for a well-nourished reference population and expressed in standard deviations (z-scores) or as the percentage of children with values less than -2 or -3 z-scores.
- To increase nutritional status, measured as the concentration in blood and body fluids of micronutrients or indicative substances such as haemoglobin.
- To sustain breastfeeding and ensure the dietary diversity of complementary foods.
- To improve health, estimated as the incidence of infectious diseases.
- To prevent deaths.
- To improve mental and psychological status and reduce stress, measured by psychometric tests or by the concentration of hormones in blood.

A very important outcome of interest is weight gain, as this can be achieved quickly by a number of different interventions, although most quickly by giving nutrients, and because improving nutritional status greatly reduces the risk of dying. The rate of weight gain is related to the following:

- Age and initial body weight, as the size of children influences how much they can eat and thus gain each day.
- The initial degree of undernutrition, as the most undernourished children have more weight to catch up.
- The sex of the child, although this effect is small in very young children.
- The ethnic origin of the child, although they are rarely mixed or diverse to a degree that leads to differences in measured outcomes.
- The amount and density of energy and nutrients consumed.
- The period of treatment, as weight gain tends to be greatest initially during recovery and then slows down over time.<sup>12</sup>

For these reasons weight gain is usually expressed as grams per kilogram of initial body weight per day ( $\text{g/kg/d}$  or  $\text{g}\cdot\text{kg}^{-1}\cdot\text{d}^{-1}$ ) and is often estimated over the first 28 days (4 weeks) of treatment when the weight gain is likely to be most rapid, and for non-oedematous children only. This is a some-

what arbitrary period but is long enough to achieve a satisfactory weight gain and represents a typical period of treatment and a sufficient period of recovery before discharge. The therapeutic or supplementary foods given to young children typically provide between 75 and 210 kcal/kg/d.

Weight gain may also be affected by the presence of oedema, which will tend to mask low body weight. The presence of oedema means that z-scores of weight-for-height and weight-for-age are underestimated, or that weight gain can only accurately be estimated once the oedema has gone, or that weight gain has to be calculated separately for children with or without oedema.

The criteria used to admit children to a feeding programme can also have an effect on measuring the outcome of an intervention. This may happen especially if resources are in limited supply so that priority is given to the most undernourished children.

If different criteria are used to admit children, such as MUAC <110 mm or <80% of the median or weight-for-height, then such children are not necessarily similarly undernourished, and if both criteria are applied it is not clear how to classify a child who exceeds one criterion but not another.<sup>13</sup>

Assessing the criteria of success or discharge from a programme, an alternative estimate of the success of a programme, is also variable and inconsistently defined. This can be done either by estimating the time it takes for children to meet the stated criteria or by assessing the percentage of subjects who meet the criteria within a given period. The main problems lie in defining and standardising the criteria for discharge and the fact that not all children are equally undernourished, so some may meet the discharge criteria more quickly than others. This makes comparisons difficult between different samples of children, especially if several different criteria need to be met. Some examples are:

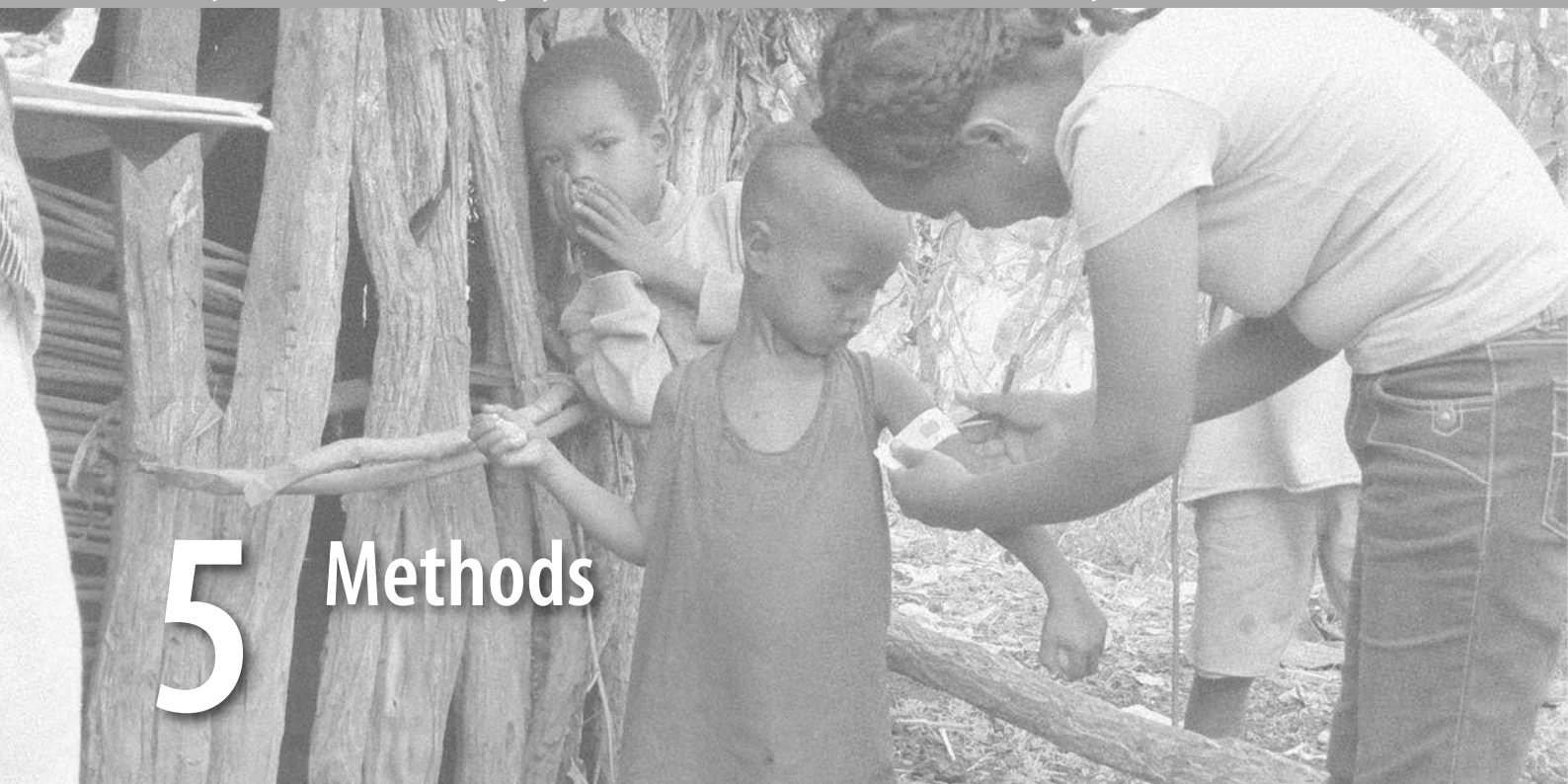
- Loss of oedema
- Percentage weight gain
- Crossing a threshold MUAC e.g. 115 mm
- A combination of MUAC and an increase in weight<sup>13</sup>
- Achieving a weight-for-height of >-2 z-scores<sup>14</sup>
- Achieving for at least 2 weeks a median weight-for-height of 85% of the median<sup>15</sup>
- Reaching 100% of weight-for-height.<sup>16</sup>

As it can be seen, there are no standard criteria but average daily weight gain over a period of 28 days and standardised for initial body weight offers the best method to compare the efficacy or effectiveness of different treatments. The first final edition of the SPHERE humanitarian standards published in 2002 (reported by Collins *et al.* in 2002<sup>17</sup>) apparently specified that the minimum mean rate of weight gain should be 8g/kg/d, but no rate is specified in the 2011 edition.<sup>18</sup>

Similar data can be used to assess the effect of food on linear growth but, as gaining length or height usually takes longer than gaining weight, the rate is usually measured in

mm per day over a period of 8 weeks and is not standardised for initial height.

This review will now focus on the recently published evidence of the effectiveness of interventions in emergencies since the review of Duffield *et al.* (2004).



Hailu Sitotaw, Ethiopia, 2010

## 5 Methods

**A** search of the published literature was undertaken using the PubMed and Cochrane Databases with limits set for papers published since 2004, the year of the first review. The searches were done between November 2010 and January 2011. The search terms used were the same as those given in Appendix 3 of Duffield *et al.* (2004). Papers were classified into seven categories:

1. General studies and surveys.
2. Treatment of moderate or severe acute malnutrition separately, as community-based treatment or as hospital or clinic-based treatment.
3. Micronutrients distribution.
4. Food security or agricultural interventions
5. General ration distribution programmes e.g. food-for-work, food-for-cash.
6. Conditional cash transfers, loans or vouchers.
7. Cost and cost-efficiency.

The papers were then reviewed by JS and BB and those considered not to be relevant were dropped. The papers were classified into those relating to emergencies and those of relevance but not done during emergencies. A summary of the papers is provided as a separate document<sup>ii</sup>. This review summarises the papers concerning emergencies only.

The analysis of data was undertaken using Stata version 11 and graphs were produced using Microsoft Excel.



Ellen van der helden/MSF Ethiopia

# 6 Results

## 6.1 General studies and surveys

The prevalence of undernutrition of young Sri Lankan children living in relief camps a month after the Asian tsunami of 2004 was reported to be significantly higher than the Sri Lankan national average,<sup>19</sup> but it might have been the same before the disaster. This illustrates the value of having prior data.

Surveys have also been reported in Mozambique<sup>20</sup> (where there was also no prior data), Afghanistan<sup>21</sup> (to describe and 'understand' the causes of malnutrition in an area after conflict); and in four camps for internally displaced people in Uganda<sup>22</sup> (to describe the situation and factors associated with malnutrition).

Surveys of the prevalence of wasting over a period of 3-4 years at seven sites in the Congo after a civil war indicated that the prevalence had declined by 1.3 to 10.4%.<sup>23</sup> These numbers were extracted from Figure 2 in the paper, so are estimates. Data at one site (Shabunda 02) is uncharacteristic. No confidence intervals were given so no assessment can be made about the statistical significance of any differences.

A natural experiment was reported in a retrospective study of changes in the composition of general food rations in Bhutanese refugee camps in Nepal and subsequent changes

in mean birth weight and the incidence of low birth weight.<sup>24</sup> It was suggested that the fall in the incidence of low birth weight from 16% to 8% between 1996 and 1998 and the increase in mean birth weight was due to a change in the food ration, which provided more micronutrients. The rates of low birth weight in the camp in 1998 were lower than in both Bhutan and in Nepal. The fact that all refugees received the same ration and the lack of a concurrent control group means that the cause of the apparent change cannot be determined.

An evaluation of the impact of nutrition care centres established in Baran District, Rajasthan, India during a severe drought reported a reduction in prevalence of underweight from 66.7% to 59.6% after six months and a reduction in the prevalence of severe underweight from 32.9% to 26.1%.<sup>25</sup> No confidence intervals were given around estimates but they can be estimated from the data to be around  $\pm 2.3\%$  for both estimates so were: 66.7% (64.4, 69.0) down to 59.6% (57.3, 61.9), so the smallest possible difference between the two percentages is about 2.5%, which is a small change in prevalence of underweight. There was no control group. The effect of the programme, which is described in great detail and was apparently widely replicated, was considered to be 'positive'. The authors stated that the standardisation of procedures had 'been worked out' to deal with the problem of child malnutrition' (p 205)<sup>25</sup> but actually had little effect.

## Conclusions

Data from surveys are useful to describe the situation for the purposes of advocacy and if data are collected after the emergency has ended, they can show that the situation is now better, although this assumes that the sample of individuals studied on both occasions has similar underlying characteristics. One problem that may occur with survey data is that in an emergency the people who are better-off tend to leave the area so that the residual population tends to be the poorest and most deprived. This means that the prevalence of undernutrition may increase because the denominator has changed, as well as increasing because of the emergency.

The 2011 SPHERE standards only specify that z-scores of weight-for-height should be calculated using the WHO reference values, measurements of MUAC should be taken, and they should be used to classify children based on thresholds of one or both measurements.<sup>18</sup> There are advantages to limiting data to body measurements only and avoiding the problems with determining a child's age. A recent evaluation of a blanket feeding programme in Kenya indicated that mothers were under-estimating their child's date of birth, perhaps to ensure that they were eligible to get a ration even though the basis of inclusion was height, not age.<sup>11</sup> But data on age allow weight-for-age, height-for-age and Body Mass Index (BMI)-for-age to be calculated and if the composite index of anthropometric failure is calculated, then the total burden of undernutrition can be estimated.<sup>26</sup>

## 6.2 The treatment of moderate and severe malnutrition

These are dealt with together because they are not separate conditions even though they lead to separate programmes: children who are classified as severely wasted are a subset of all children who are classified as wasted as both are based on the same index, weight-for-height.

The most important development in the field since the last review is the increasing use of RUFs, in addition to fortified blended food, which has greatly improved the treatment of wasting and is now being used in supplementary as well as therapeutic nutrition programmes and in community as well as clinic-based programmes.

Ready to use therapeutic food (RUTF) is a type of RUF that is an energy-dense soft paste made of ground peanuts, full-cream milk powder and vegetable oil fortified with micronutrients, provided in a foil-wrapped packet. A packet<sup>3</sup> provides 500 kcal of energy in each 92g sachet. It is given at dose of 175 kcal/kg body weight/day (733 kJ/kg/d) and provides about 5.3 g protein/kg/d. It was formulated for the management of severe acute malnutrition. Table 1 shows the main differences and advantages of RUTF over the previous products, such as F75 and F100, used to treat severely malnourished children. Another RUF called Plumpy'Doz<sup>®</sup> is designed as a 'foodlet' or supplement to be given as 3 teaspoons a day (approx 45g) and to the recommended intake of micronutrients and some essential fatty acids. This is now being widely used and promoted by agencies such as UNICEF.

### Effect of RUTF on gains in weight, height and MUAC

Seven studies were identified which provided standardised data on weight gain over the first four weeks of treatment with an RUTF and reported data on z-scores of initial anthropometric indices, to control for the prior degree of undernutrition: Amthor *et al.* (2009)<sup>27</sup> who studied 826 children in Malawi, 99% of whom had oedema; Ciliberto *et al.* (2005)<sup>28</sup> who studied 992 children in Malawi; Ciliberto *et al.* (2006)<sup>29</sup> who studied 171 children identified passively and 48 identified actively, in Malawi; Linneman *et al.* (2007)<sup>30</sup> who studied 2,131 severely malnourished children and 806 moderately malnourished children in Malawi; Manary *et al.* (2004)<sup>31</sup> who studied 69 children in Malawi (but did not report the SD of mean weight gain); Ndekha *et al.* (2005)<sup>16</sup> who studied 20 children in Malawi given RUTF to take home; and Sandige *et al.* (2004)<sup>32</sup> who compared 125 children treated with Plumpy'Nut with 125 children treated with a locally made RUTF, in Malawi.

Figure 2 shows the relationship between weight gain in g/kg/d and children's initial anthropometric status before treatment with RUTF. Figures 2A and 2B show that an exponential fit gives a higher value of  $r^2$  than a linear fit, which indicates a stronger association. An exponential fit was also better for weight-for-age and weight-for-height, so only they are shown. An exponential fit is biologically more appropriate as it indicates that the rate of weight gain increases with the degree of undernutrition, and that there is slower weight gain

**Table 1. The major differences between an RUTF, such as Plumpy'Nut, and F100, both used to treat malnourished children.**

	RUTF	F100
How provided	Individual 92g sachets	Bag of 114g of dry powder
Shelf life at shipment	2 y	1.5 y
Preparation required on site	None	Mixed with 500 ml warm, clean water
Amount per child/day	1.5 – 2.5 sachets (140 – 230 g)	750 – 1250 ml
Utensils required	No	Yes
Life when being consumed	Several hours	<1 hours
How consumed	Sucked from sachet	Given with spoon or cup
Child needs assistance to consume	No	Yes
Energy density, raw	5.4 kcal/g	5.3 kcal/g
Energy density as consumed	5.4 kcal/g	1.0 kcal/ml
Cost/kg		
	Sold by UNICEF (2011)	USD 4.22
	Made in Malawi	USD 2.60
	Plumpy'Nut (Nutriset, France)	USD 4.56

even among relatively well nourished children, indicated by the positive value of the first coefficient (a) in the equation for the line,  $y = ae^{bx}$  in which  $e=2.71828$ . A linear fit would give a negative weight gain among well nourished children whereas in fact it is just slower than among malnourished children.

The average weight gain shown by the treated children in Figure 2 ranges from 2.0 g/kg/d (95% CI 1.35, 2.65) to 5.6 g/kg/d (95% CI 4.92, 6.28), which is substantially greater than expected from the WHO reference data. An analysis of data for boys aged 6 - 24 months in the WHO reference sample indicate average gains of 0.16 g/kg/d for children with a z-score of weight-for-age of -3 and 0.24 g/kg/d for children of median weight for age.

An analysis was done for this review of data reported on the unstandardised average weight gains of 11,941 children at 11 sites in three countries, Ethiopia, Sudan and Malawi in a review of community based therapeutic care.<sup>13</sup> The range in weight gain was 3.0 to 6.6 g/kg/day (n=11) with a weighted average of 5.45 g/kg/day (95% CI 4.58, 6.31).

However these observed weight gains are substantially lower than theoretical estimates of 10 g/kg/d weight gain based on an energy intake of 175 kcal/kg/d (733 kJ/kg/d), which is the amount usually given as RUTF.<sup>33</sup> A study of 6,363 children treated at an in-patient centre in Bangladesh achieved an average of 11 g/kg/d.<sup>34</sup> Another study in Bangladesh of children also achieved weight gains of 10 g/kg/d in the first 8 days of treatment followed by 7 g/kg/d in the following 10 days.<sup>35</sup> The average calculated over 28 days

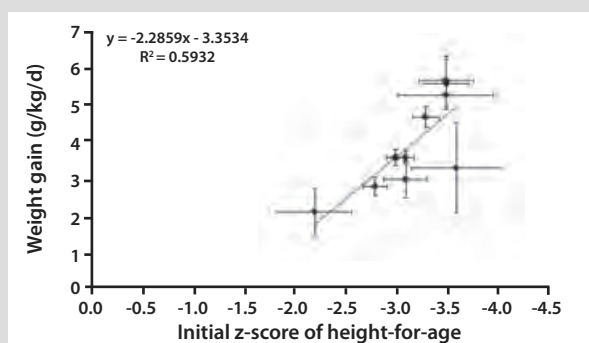
may have been lower however, which reiterates the point that such data need to be standardised over the same period of measurements, ideally over 28 days, if they are to be compared reliably.

Figures 2B, 2C and 2D indicate that the rate of weight gain is most strongly predicted by height-for-age ( $r = 0.826$ ) followed by weight-for-age ( $r = 0.782$ ) and then weight-for-height ( $r = 0.652$ ), which is unexpected, although all are statistically significant associated. This means that the weight gain of children given RUTF is more strongly associated with the prior degree of stunted linear growth than the prior degree of underweight (which is a composite indicator of stunted growth and of wasting) or prior wasting alone. The reasons for this are unclear but may be related to the fact that the data on weight gain is standardised by initial body weight and the highest rates of weight gain may be achieved by the largest children, who are also the tallest.

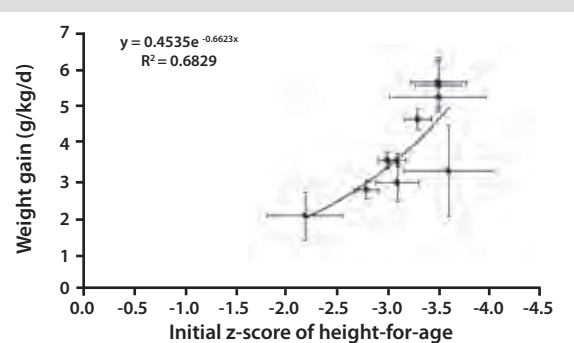
Figure 3 shows that average gain in height in the same studies is most strongly associated with height-for-age ( $r = 0.572$ ) but is not associated with weight-for-age or weight-for-height. The average gain in MUAC in the same studies was not associated with any anthropometric index (data not shown).

The fact that all of the seven studies were done in Malawi is of concern. It would be useful to have data from children treated in other countries in Africa as well as in Asia and the Indian sub-continent. Given that RUTF is being widely used elsewhere, such as in Kenya, Niger, Sudan and Ethiopia, data

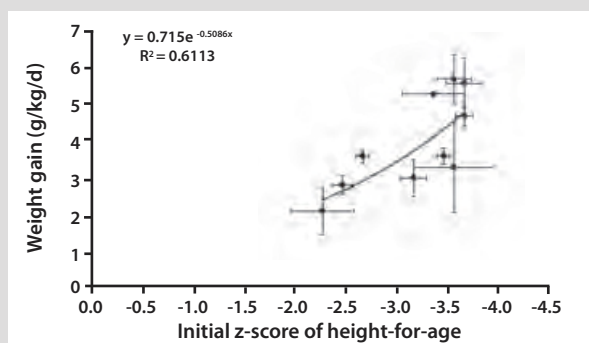
**Figure 2. The observed relationship between weight gain in grams/kilogram initial body weight/day (g/kg/d) and initial z-scores of height-for-age (with linear or exponential fitted lines), weight-for-age and of weight-for-height (both with exponential fits). The estimated 95% CI are also shown except for one point which has no CI for weight gain.**



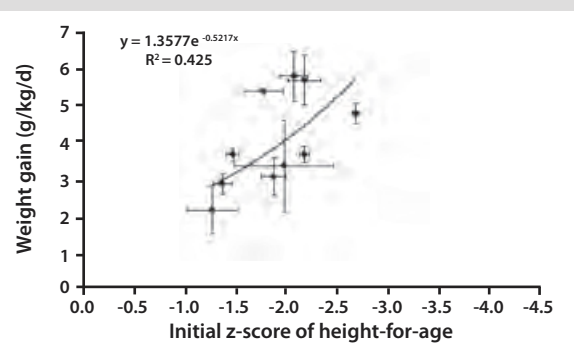
A. Height-for-age vs weight gain (linear fit)



B. Weight-for-height vs weight gain (exponential fit)

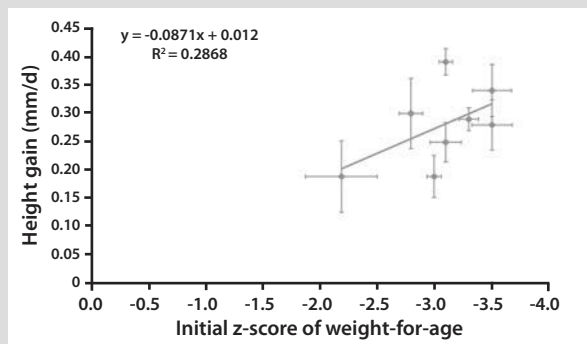


C. Weight-for-age vs weight gain (exponential fit)

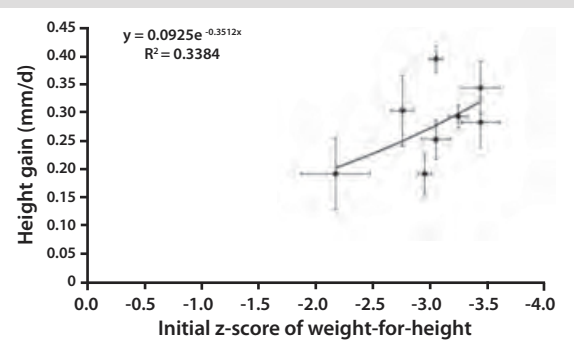


B. Weight-for-height vs weight gain (exponential fit)

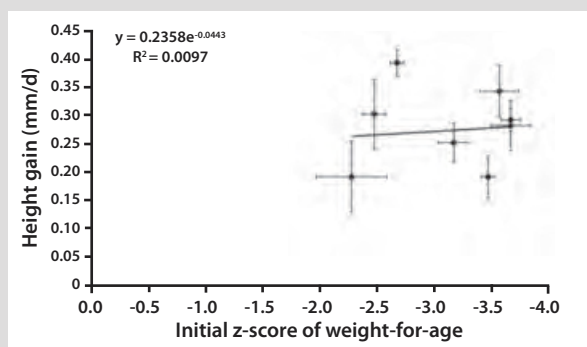
**Figure 3.** The observed relationship between height gain in mm/d and initial z-scores of height-for-age (with linear or exponential fitted lines), weight-for-age and weight-for-height (with exponential fits). The x and y 95% CI are also shown.



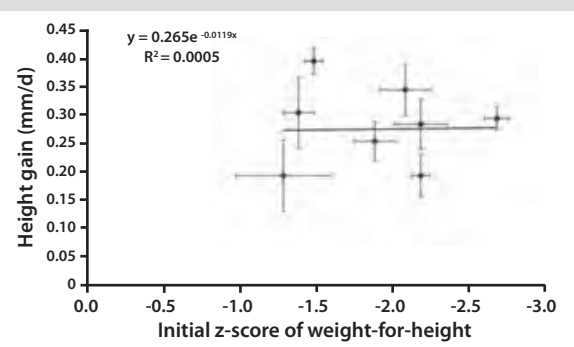
A. Height-for-age vs height gain (linear fit)



B. Height-for-age vs height gain (exponential fit)



C. Weight-for-height vs height gain (exponential fit)



D. Weight-for-height vs height gain (exponential fit)

should be obtainable. The data required are listed in the section on *Further Research*, below.

The study cited above by Ciliberto *et al.* (2005) compared RUTF with the then standard treatment for severe underweight, F75 followed by F100.<sup>28</sup> The 992 children treated with RUTF gained 3.5 g/kg/d (95% CI 3.27, 3.73) compared with a weight gain of 2.0 g/kg/d (95% CI 1.01, 2.99) by the 186 children given the standard treatment. The rate of weight gain of children treated with RUTF was 1.8 times faster than children given the standard treatment and they also recovered more quickly ( $P < 0.001$ ), defined as a z-score of weight-for-height of  $> -2$ .

### Analysis of weighted mean averages

An analysis of the average gains in weight drawn from nine samples of children in six studies of RUTF with a total sample size of 5,565 children, indicates that the average gain, weighted for the sample size in each study, is 3.6 g/kg/d (95% CI 3.0, 4.2).<sup>32, 28, 36, 29, 30, 27</sup>

An analysis of the average gains in height drawn from nine samples of children in six studies of RUTF with a total sample size of 5,565 children, indicates that the average gain, weighted for the sample size in each study, is 0.3 mm/d (95% CI 0.25, 0.37).<sup>32, 28, 36, 29, 30, 27</sup>

### Other studies of weight gain

There have been other studies of RUFs, some in comparison with other foods, but the data have not been presented in a standard manner that allows comparisons between studies.

A small trial in Malawi of RUF in comparison with maize-soy flour indicated that the beneficiaries actually received less than 50% of the food they were given, so the effectiveness of the study was compromised.<sup>37</sup> Another study in Malawi compared RUTF with a very small group given a corn-soy blended food and reported a faster gain in weight (3.1 vs 1.4 g/kg/d,  $P < 0.001$ ).<sup>36</sup> A third trial in Malawi compared the weight gain of moderately malnourished children given either a lipid based nutrient supplement or CSB with the weight gain of an untreated control group and reported a small extra weight gain of 150g of borderline statistical significance ( $P = 0.05$ ) over 12 weeks by the group given the RUTF.<sup>38</sup>

A comparison of data before and during a civil war in Guinea-Bissau in 1998-99 suggested that a supplementary feeding programme prevented the deterioration of nutritional status.<sup>39</sup>

A cluster trial in Haiti examined the effectiveness of giving food to all children aged 6 – 23 months to try to prevent undernutrition compared with giving food only to underweight children  $< 5$  years of age to help them recuperate.<sup>40</sup> The prevalence of stunting, underweight and wasting were 4% to 6% lower in the preventive group than in the recuperative group and the mean z-score of weight-for-age and weight-for-height were 0.24 z-scores higher ( $P < 0.001$ ).<sup>40</sup>

A trial in Malawi compared two fortified spreads, one made with milk and peanuts, the other made with soya and peanuts, against a traditional CSB for treating moderately underweight children.<sup>14</sup> Recovery was quicker in children given



the two fortified spreads, but of the 1,362 children treated a total of 109 or 8% in each of the three groups developed oedema while being fed.<sup>14</sup> Why children should develop kwashiorkor while being treated for malnutrition is unknown. The factors associated with developing oedema were being young, being wasted and not gaining weight in the first two weeks of treatment, although none of these factors was specified quantitatively to suggest risk factors that could be used to screen or identify potentially susceptible children.<sup>14</sup> The authors called this 'intriguing' rather than worrying. It suggests that there may be risks in giving young, moderately wasted children an energy- and nutrient-dense food.

A blanket supplementary feeding programme in Niger provided children aged 6–26 months who had a MUAC >110 mm with 4 x 325g pots of Plumpy'Doz®, which is designed to be given as a daily dose of three tablespoons or about 50g/d, and should last about a month.<sup>41</sup> The authors claimed that fewer children were given therapeutic feeding than in previous years, and that the proportion of children requiring intensive care was lower than in children not registered for the programme. The results could be explained by a concurrent improvement in food security and selection bias in identifying beneficiaries of the programme, as there was no random allocation.

Also in Niger, 12 villages were randomised into two groups: in one group all non-malnourished children aged 6–60 months were given a daily packet of RUTF while nothing was given in the control villages.<sup>42</sup> There were significant differences in changes in z-scores of weight-for-height after 8 months and the intervention was estimated to have led to a 36% difference in the incidence of wasting and a 58% difference in the incidence of severe wasting.<sup>42</sup> However there was a higher prevalence of stunted or severely stunted children in the control villages at the start of the study, which Figure 2D shows to be associated with subsequent weight gain. The authors claimed that the difference was a 'reduction', but it could have been due to an increase in the incidence of wasting in the control villages and no change in the intervention villages: see Figure 1D, rather than Figure 1A.

A study in Niger compared RUTF with CSB as a treatment for moderately malnourished young children.<sup>15</sup> The criterion for recovery was achieving and sustaining a weight-for-height of 85% of the median for 2 weeks. Children given RUTF gained 1.1 g/kg/d more than children given CSB until recovery, so recovered more quickly.<sup>15</sup>

An analysis of the weight gain of Ugandan children in a nutrition rehabilitation unit reported their mean absolute weight gain which was corrected statistically for 'days in care' (presumably days in the unit) and age at admission (rather than weight or degree of undernutrition, which might have been better).<sup>43</sup> The children were sampled from all admissions at the same time of year over three successive years. In the first year children were given milk alone (F75 followed by F100) and then in the next two years a semi-solid porridge with an energy density of 4.4 kcal/g. The authors reported a mean weight gain of 525g (95% CI 373,676) in 2001, 771g (95% CI 618,925) in 2002 and 1,274g (95% CI 1,120, 1,427) in 2003.<sup>43</sup> This occurred at the same time as 'various improvements were made in the

nutritional rehabilitation unit' so not all the increase could be attributed to the new diet.<sup>43</sup> Other outcomes also improved; the cure rate went up and the death rate and default rate fell.<sup>43</sup> The food cost €0.056 a serving including labour and fuel.<sup>43</sup> The lack of standardisation of weight gain as g/kg/d over a period of 28 days makes it impossible to assess whether the 143% improvement in weight gain is from a very poor level to a level that should normally be achieved, or is a significant development in treating wasted children.

Severely malnourished children in Niger were treated in one of three situations: for their entire treatment at a therapeutic feeding centre (TFC) with F100 and RUTF (n=660); at a TFC first then at home (n=937); or were exclusively treated at home with food prepared at home plus RUTF (n=340).<sup>44</sup> The data for each group cannot be compared as subjects were not randomly allocated to each group and the children treated at home were less severely wasted, so there was selection bias. The rates of weight gain were also not standardised as the mean length of stay until the children were classified as recovered was 17.4, 39.4 and 29.0 days in each of the three groups respectively and the children gained 20.8, 10.1 and 9.7 g/kg/d.<sup>44</sup>

### Effects of antibiotics

Malnourished children in a camp for internally displaced people in south Sudan were randomly allocated either to receive treatment with injected ceftriaxone for two days or amoxicillin given orally for five days plus the same standard therapeutic nutritional treatment with F100 followed by RUTF plus micronutrients and deworming. There was no statistically significant difference between groups in terms of the percentage who had a weight gain of  $\geq 10$  g/kg/day over the first 14 days or in terms of the recovery rate or case fatality rate.<sup>45</sup> The treatments were concluded to be similar, so the costs are likely to be the main distinguishing feature.

### Coverage surveys or programme evaluations

Two simultaneous surveys in Malawi estimated the period and point coverage of TFCs or community-based therapeutic care (CTC) in two districts using a centric systematic area sampling method.<sup>46</sup> The CTC programme gave higher period coverage (73.6% vs 23.6%) and higher point coverage (60.0% vs 20%) of children <5 years old whose weight-for-height was  $\leq 70\%$  of the NCHS median.<sup>46</sup>

An evaluation was undertaken in Burundi of the impact and 'appropriateness' (not defined) of 20 TFCs and 224 supplementary feeding centres, one in every province of the country, during a humanitarian emergency between 1999 and 2004.<sup>47</sup> The evaluation claimed that the nutrition programme was responsible for a difference in death rate estimated by unpublished surveys of children aged <5 years of 6/10,000 in 2000 compared with 3.1 to 4.9/10,000 in 2004, but no confidence intervals around these estimates were given,<sup>47</sup> so no evidence for a significant difference is provided. The impact on nutritional status was said to be 'limited' as the prevalence of acute malnutrition (not defined) was 8% in 2000 and 7% in 2004.<sup>47</sup> The prevalence of severe malnutrition was said to have worsened from 0.5% to 1.1%. Although no confidence intervals are given, it would be necessary to have a sample of 15,000 children in each group to be able to detect

a statistically significant difference between 8% and 7%, so limited is an inappropriate term; there was probably no difference. The fact that only 8% of children were acutely malnourished, presumably wasted, suggests that malnutrition was not a major problem either, as this prevalence is only classified as poor by the WHO.<sup>1</sup> The evaluation also examined performance indicators.

Surveys in Ethiopia, Malawi, Niger and north and south Sudan of 12 community-based therapeutic care programmes were undertaken to identify why the caretakers did not enrol their malnourished child in the programmes.<sup>48</sup> The top five reasons given were previous rejection (38.6%), condition not recognised as malnutrition (18.8%), no belief in the programme (14.0%), the child had relapsed (11.3%), and the distance to the site of the programme (10.8%).<sup>48</sup>

## Conclusions

The development of RUF seems to have improved the coverage of treating malnourished children with moderate and severe wasting in all circumstances, both in emergencies and in situations of chronic undernutrition, mainly, it seems, because it does not need to be prepared and can be taken home. The development of RUTF has extended nutritional therapy into communities and away from residential treatment centres which have disadvantages for all but the sickest, most malnourished children who need medical treatment. As RUTF requires no preparation, it has a long shelf life and as many, but not all, malnourished children are old enough to feed themselves, this frees the mother from the responsibility of staying with a malnourished child at a therapeutic feeding centre. The child can be treated at home, away from the danger of nosocomial infection as well. The risk is that the supply of RUTF may be shared or even sold, and that it removes from the mother the responsibility and need to prepare nutritious food for her malnourished child.

As this review has focused on papers published since 2004, most of them have studied the rate of weight gain of children given RUTF, and most of the studies have been done in Malawi. There is a need for studies in Asia and the Indian sub-continent to see if the same effectiveness can be achieved either with an RUTF based on peanuts or one based on an indigenous source of protein, because as there is some resistance to giving children a food that is not commonly eaten by their parents. It seems unlikely that very young children will have developed any preference and although there may be benefits of using a locally available source of protein, there is no reason why children in the Indian sub-continent should not be able to digest, absorb and assimilate the nutrients in peanuts. An interesting study would be to compare a peanut-based RUTF with a gram- (chick-pea) or lentil-based RUTF fortified with oil to make them equivalent in energy and protein in both Malawi and India, perhaps.

It would also be useful to undertake a general review of the rates of weight gain, ideally standardised over the first 4 weeks after the start of treatment. Although RUTF is rich in fat, protein and micronutrients, the rates of weight gain are rarely much more than 6 g/kg/d and are related in general to the prior degree of undernutrition (see Figure 2), but most strongly with

the degree of stunting (see Figure 2B), which seems counter-intuitive. Why is the rate of weight gain not more strongly associated with the prior degree of wasting (Figure 2D)? But 6 g/kg/d is less than the old Sphere standard of 8 g/kg/d, which seems to have disappeared from the recommendations, and is less than the gains of 10 g/kg/d which have been achieved in the past when treating malnourished children in Bangladesh, although such rates are not standardised for the period of treatment. It would be useful to assess whether RUTF, for all its ease of use, is a less effective treatment for wasting than other foods. Such an analysis is beyond the scope of this review but is proposed below in the section Research questions.

## 6.3 Micronutrients distribution

Surveys of micronutrient deficiencies in people living in refugee camps have shown that they are common in all age groups.<sup>49</sup> However to be able to interpret the data it is necessary to know the prevalence of deficiencies in the population from which the refugees originally came; if they are the same, then being a refugee is no greater risk.

The prevalence of micronutrient deficiencies may even be lower among refugees, because they tend to be given fortified foods. A study of the concentration of iodine in the urine of adolescents in six refugee camps in five African countries showed evidence of excessive iodine consumption while the prevalence of visible goitre was as high as 7%, probably due to hyperthyroidism.<sup>50</sup> It seems reasonable to conclude that as most solid food given to refugees is fortified with iodine there is a risk of excessive consumption, especially if they are given over-iodised salt as well.<sup>50</sup>

A randomised, controlled trial in Algeria studied the growth of children given one of five treatments, a highly fortified snack plus metronidazole (a broad spectrum antimicrobial), a highly fortified snack without metronidazole, an unfortified snack with metronidazole, an unfortified snack without metronidazole; and a control group given nothing until the study had finished.<sup>51</sup> The fortified snack consisted of 50g of a paste of peanuts, milk powder and oil that provided about 320 kcal/d and was fortified with between 1.5 and 3.0 times the reference intakes of 11 vitamins and seven minerals. As there was no evidence of an effect of metronidazole, the two pairs of groups were merged. The children given the fortified snack gained  $9 \pm 3$  mm/month in length in the first three months of treatment compared with  $7 \pm 3$  mm/month in the group given the unfortified snack and  $6 \pm 3$  mm/month in the control group, which was said to be statistically significant ( $P < 0.001$ ).<sup>51</sup> If the  $\pm$  values are presumed to be standard deviations around a normal distribution, then 95% CI can be estimated as follows: fortified 9 mm 95% CI 8.43, 9.57; unfortified 7 mm 95% CI 6.42, 7.58; control 6 mm 95% CI 5.12, 6.88. This indicates statistically significant differences between the group given the fortified spread and the other two groups, but not between the unfortified spread and the control group. There were also statistically significant differences in the increase in haemoglobin concentration over a six month period of supplementation: fortified supplement group, 37 g/L (95% CI 29.4, 44.6); unfortified supplement group 19 g/L (95% CI 16.1, 21.9); and control group 16 g/L (95% CI 11.0, 21.0).<sup>51</sup> The

prevalence of anaemia fell by 90% in the group given the fortified supplement, by 40% in the unfortified supplement group and by 27% in the control group. The haemoglobin concentration of 40 children in the untreated control group increased by 17.6% from 93 g/L (95% CI 85.9, 100.1) to 109 g/L (95% CI 103.1, 114.9) over a period of 6 months without any treatment, which was said not to be statistically significant ( $p = 0.978$ )<sup>51</sup> although the estimated 95% CI suggest otherwise. The study concluded that the differences were due to the micronutrients. Without the control group, the study would have greatly over-estimated the attributable effect of the supplements, particularly on the haemoglobin concentration.

An evaluation of a food for work programme at five different sites in Indonesia attempted to assess if the programme had an effect on the odds that children or mothers were anaemic in comparison with control households not taking part in the programme.<sup>52</sup> However the 'control' households were significantly different from households eligible for the programme at the start of the study in terms of education, income and the prevalence of stunted children,<sup>52</sup> so there was strong evidence of selection bias. The analysis reported statistically significant odds of being anaemic between mothers in the two treatment and control groups in one of the five sites and no statistically significant odds between children in the two groups in the five sites<sup>52</sup>. The probability of finding a statistically significant difference in 10 statistical tests by chance alone is  $P = 0.1$  which is only twice the usual threshold for assessing statistical significance of 0.05. This illustrates the need to be able to allocate subjects randomly to intervention and control groups from the same pool of eligible subjects, either individually or in clusters so that the only difference between subjects is the intervention, not education, income or any other factor that could influence the outcome.

An attempt was made in Guinea-Bissau to assess whether vitamin A supplements had an effect on death rates of young children during a civil war.<sup>53</sup> It was estimated that the risk of dying increased by 89% during the war. Two methods were used: a variation in the delivery of vitamin A described as a stepped wedge design, although there was no random allocation, and a comparison of death rates before the war, when vitamin A was not provided, with death rates during the war. There was no statistically significant difference in the death rate estimated in March 1999 between children given vitamin A supplements in October 1998 and eligible children who did not get treatment, but the death rate among children given vitamin A during the war was 12% lower than before the war (mortality ratio 0.88, 95% CI 0.41, 1.87).<sup>53</sup>

Ten supplementary feeding sites in Haiti were randomised into two groups: one group of children ( $n = 254$ ) at five sites were given micronutrient sprinkles for 2 months and the other group ( $n = 161$ ) at five sites acted as an untreated control.<sup>54</sup> Anaemia was defined as a haemoglobin concentration  $< 100$  g/L, which is not the standard WHO definition.<sup>55</sup> Although there was a significant difference in the prevalence of anaemia between the treatment and control groups before the treatment started (52.3% vs 36.6%), a likely consequence of the small number of clusters, the haemoglobin concentration increased over a 2 month period by an estimated 5.5 g/L

in the treated group compared with -1.0 g/L in the untreated control group (both means were adjusted for initial haemoglobin concentration, age and sex).<sup>54</sup> The prevalence of anaemia fell to 28.3% in the treated group and increased to 44.8% in the untreated group.<sup>54</sup>

A study in a refugee camp in Zambia estimated the haemoglobin concentration of young children, adolescents and women before and after their maize meal rations were fortified with seven vitamins, iron and zinc.<sup>56</sup> There was no statistically significant change in the haemoglobin concentration of women and adolescents or in the prevalence of anaemia over a period of 12 months, although the prevalence of anaemia actually increased in both groups. The mean haemoglobin concentration of young children increased by 8.7 g/L which was adjusted for an estimated increase of about 2.7 g/L due to age. The prevalence of anaemia fell by 23.4%, from 47.7% to 24.3% ( $P < 0.001$ ).<sup>56</sup> There were significant improvements in the concentration of serum transferrin receptor and serum retinol concentration.<sup>56</sup> However the lack of an untreated control group and the lack of a significant effect on the haemoglobin concentration of adolescents and women makes it difficult to assess the effectiveness of the intervention as there was not a consistent effect among all three study groups.

A weak evaluation was done in Palestine by comparing two random samples of children, one selected in September 2004 before giving children iron supplements, rations of food, health education and free medical treatment, and then another random sample eight months later, in May 2005.<sup>57</sup> The authors claim that the intervention led to a 50% drop in the prevalence of anaemia from 30.1% to 18.8% (which is only a 38% difference), and a 70% drop in the prevalence of wasting from 6.0% to 1.4% (which is a 77% difference).<sup>57</sup> The lack of a control group to account for seasonal changes in food prices and disease transmission, presumably during the winter, means that it is not possible to estimate the attributable change due to the package of interventions. It would also have been better to have studied a cohort of children, because it is possible that the two random samples were different. No data were presented on socio-economic characteristics of the two groups of children to indicate that they were from similar households.

A study in two refugee camps in Tanzania compared the concentration of haemoglobin and serum transferrin receptor in children in households in one camp that were all given stainless steel cooking pots with children in another camp that used clay or aluminium cooking pots.<sup>58</sup> There was no change in haemoglobin concentration over a period of a year in either group and there was no difference between study groups. The concentration of serum transferrin receptor was higher in the group using steel cooking pots, so their iron status was worse than the group using clay or aluminium pots.<sup>58</sup> The lack of effect could have been because the iron in stainless steel is poorly soluble compared with cast iron cooking pots which have been shown in studies in Ethiopia<sup>59</sup> and Brazil<sup>60</sup> to lead to an improved haemoglobin concentration. The subjects of the study did not like cast iron cooking pots, so steel was used instead but it seems to have rendered the intervention ineffective.

## Conclusions

The few studies described here are generally weak in their design: they compare subjects before and after an intervention, suffer from selection bias or have non-randomly selected 'controls' so cannot estimate the attributable change in micronutrient status. One of the main problems is that the haemoglobin concentration of children tends to increase with age, so this needs to be controlled for in any study, ideally by having an untreated control group. The only study with such a control was done in Algeria and showed an 18% increase in the haemoglobin concentration of the control group over a period of three months, which suggests that other factors had an influence, not just age. There are also inconsistent results in some studies of multiple groups: why in the refugee camp in Zambia was there no apparent effect of fortifying maize flour with micronutrients on the haemoglobin concentration of adolescent children and adult women, but there was an effect on young children? Again, an untreated control group could have told us whether the increase in the mean haemoglobin concentration of young children was due to the fortified food or occurred naturally in whole or in part due to natural processes associated with age.

It is very difficult to do properly controlled studies in emergencies let alone in normal circumstances among undernourished populations, and it is not clear that such studies are necessary, either. If micronutrients are efficacious during a non-emergency and have a measureable biomedical effect on micronutrient status, then there is no reason why that effect is not likely to occur during an emergency. Surely the issue during an emergency is delivering micronutrients either in food or as supplements, and achieving high coverage to minimise the risk of deficiency. As most foods given to people during emergencies are now fortified with micronutrients, it is possible that intakes are better than normal for some people. The fact that people in several long-term refugee camps in Africa show signs of an excessive intake of iodine<sup>50</sup> is perhaps an indicator, although iodine is obtained from iodised salt as well as rations of food, so there is more than one source. Nevertheless, humanitarian agencies are aware that the micronutrient status of people during emergencies needs to be sustained and there has been a joint WHO/WFP/UNICEF statement on the topic.<sup>61</sup>

## 6.4 Food security or agricultural interventions

No papers were found with any such interventions during an emergency.

A study in Bangladesh compared the production and consumption of vegetables by households that had participated in a homestead gardening programme and 'control' households that had not.<sup>62</sup> The design was weak because the controls were households in the same villages that had not participated or had not been selected for the programme for some reason, and were more likely to have no regular income, so there was selection bias. Unsurprisingly households that had participated in the programme grew, consumed and sold more vegetables than households that had not. The median weight of vegetables grown was 135kg vs 46kg and the median weight of vegetables consumed was 85kg vs 38kg.

About two thirds of the participant households generated a median of Taka 347 (approx USD6.8 in 2005 prices) and spent much of it on buying extra food.

## 6.5 General ration distribution programmes e.g. food-for-work

The fact that rations are given to the general population means that estimating the impact on any outcome is very difficult. A study of death rates in areas of Ethiopia that were either affected or unaffected by the drought of 2002-03 concluded that receiving food aid had a small but significant effect on reducing death rates among children, but that the overall lack of an effect on child mortality was perhaps more remarkable.<sup>63</sup>

In Bangladesh, women and children in households that were randomly selected for a cash-for-work programme in the chars (riverine islands and sandbanks) were compared with women and children in control households that were not selected for the programme. The two groups of households were stated to be similar in terms of the adults' occupations, the number of household members and the age of the adult female.<sup>64</sup> There were no significant differences between the groups in terms of the anthropometric status of children or women.<sup>64</sup> There were statistically significant differences in the mean increase in weight and height of children and the mean weight and MUAC of women also differed.<sup>64</sup> However it is not clear how beneficiaries were chosen or not chosen for the programme in the first place; if it was not random then there could have been selection bias. The targets of such programmes are usually the most needy, and some method of identifying them is usually applied. Random selection of beneficiaries to the programme or to a control group would have helped to ensure that there were no differences between the study group in some unmeasured factors that could have led to the differences, rather than the intervention.

## Conclusions

The main problem with assessing the impact of general rations or food for work is that they are either general, so everyone is eligible and no control group can be achieved, or the targets are the most needy and are most likely to have undernourished children. So in both instances having an untreated control group during a humanitarian emergency is unethical.

However here is potential to assess the impact of programmes during non-emergencies using a stepped wedge design. This design utilises the fact that programmes can rarely be implemented immediately to reach the whole target population, so they are staggered or phased in. If the units of delivery such as villages within a single area could be randomly assigned to receive the intervention at different intervals, then there is the potential for people in later villages to act as controls for the first phase villages. If the villages could be involved in the process of randomisation and understood the reasons for it, then it may be acceptable and help to minimise the risk of contamination. It is somewhat surprising that an agency such as the World Food Programme (WFP) has not attempted such a design to evaluate the nutritional impact of food for work programmes.

## 6.6 Conditional cash transfers, loans or vouchers

There have been few studies of such intervention during an emergency, perhaps because the ability to purchase necessary food and goods are often greatly reduced or because prices are inflated. During emergencies, people at risk tend to be given food or gifts in kind to replace items lost or sold.

Surveys during a drought in Ethiopia of households that were clients of a microfinance programme found that the children of female clients were less likely to be malnourished than community controls, and that male clients and community controls were more likely to have received food aid.<sup>56</sup> However it is possible that clients were systematically different from community controls, which was indicated by the membership of a microfinance programme. Random allocation of potential subjects to the programme and to a control group, so that confounding variables were equally distributed between groups before the intervention, is necessary to show that being a microfinance client has an effect on any outcome.

During a conditional cash transfer programme in Brazil, young children in beneficiary households were compared with children in households that had been selected for the programme but were excluded as a result of 'quasi-random administrative errors'. For example, potential beneficiaries were mistakenly rejected by a computer programme because their name included a non standard character such as é, ô or ç.<sup>65</sup> Data on anthropometric measurements were obtained from growth monitoring cards. Six months after the start of the programme, the children of beneficiaries had a weight-for-age that was 0.13 z-scores lower (worse) than non-beneficiaries.<sup>65</sup> There was also an inverse dose-response relationship: each additional month in the programme was associated with a rate of weight gain in the intervention group that was 31g lower (worse) than in the control group and amounted to about 180g over six months.<sup>65</sup> This was attributed to the fact that mothers may have thought that their participation was dependent on their child being underweight and that their benefits would be lost if the child started to grow well.<sup>65</sup> This could be a harmful effect of growth monitoring linked to benefits.

A conditional cash transfer programme was implemented in 6,400 poor communities in Mexico.<sup>66</sup> The cash amounted a maximum of \$90 for a household containing primary school children and \$160 for a household containing secondary school children and was conditional on children's enrolment in school and parents attendance at health education sessions.<sup>66</sup> A total of 506 poor communities were randomly sampled in proportion to size and 306 were randomly assigned to start receiving the cash transfers in April 1998 while the remaining 200 were started 20 months later, in December 1999.<sup>66</sup> This is a good stepped wedge design. The impact on reproductive health outcomes was assessed in a sample of women in each group of communities who had given birth to a single child, 606 and 419 children respectively in the intervention and control communities. After adjusting for a large number of individual, household and community characteristics, a small difference of 127 g ( $P = 0.02$ ) in birth weight was found and a 4.6% lower risk of having a low birth weight baby ( $P = 0.05$ ).<sup>66</sup> It is odd that it took about 8 years for the

data to be analysed and published given that the study had such a good design, perhaps because the differences were not large and required statistical manipulation.

A meta-analysis of the effect of conditional cash transfers on health outcome was done under the auspices of the Cochrane Collaboration.<sup>67</sup> Ten papers reporting data from six studies were analysed. The analysis showed evidence of effects on nutritional status and health, but it was hard to attribute the effects specifically to the cash transfers as other components may have contributed. Positive effects on anthropometric status were found in three studies, two cluster randomised controlled trials (RCTs) and one controlled before and after study, but one study (reported above) found a negative effect. No estimates were made of the pooled effect, probably because the number of studies with the same measured outcome was too small.

## Conclusions

Cash tends to be an uncommon intervention during an emergency unless the commercial infrastructure and supply lines are still operating. A disaster such as the tsunami that struck Sri Lanka in 2004 is an example: the damage to housing and infrastructure was restricted to a narrow band around the southern and eastern coast so that supplies of food and goods were sustained. Again there is considerable potential to collect better data in non-emergency situations, perhaps during cluster randomised trials or using a stepped wedge design.

## 6.7 Costs and cost-efficiency

The effects of buying cattle during a drought, called destocking, were studied in southern Ethiopia in 2006. Households received an average of USD 186 from the sale of cattle that might have died during the drought which provided 54% of household income and was used to buy food and health care rather than waiting for food aid.<sup>68</sup> The cost-benefit ratio was estimated to be 41:1 and destocking was given the highest score of all possible interventions.

An analysis of school feeding programmes operated by the WFP in 42 countries in 2005 for about 8.6 million children showed that cost from \$11 to \$52 per child per year, with an average of \$21.59.<sup>69</sup> The types of programme included cooked meals, fortified baked biscuits or take-home rations. The main costs were due to delivery but did not include any financial or economic costs for schools. Fortified biscuits were considered to offer the best option, especially in contexts where security was poor.

## Conclusions

The data on costs and cost-effectiveness of any intervention during an emergency are generally lacking. This is a little surprising given that agencies operating during emergencies are often given funds specifically for use in that situation so they know how much they have spent and, at minimum, record the number of people they have helped, so can estimate the cost per person treated. Give that non-governmental organisations routinely collect lots of data that could contribute to creating cost menus, such as staff time, mileage of vehicles, tons of RUTF purchased, and they avidly record the number of beneficiaries to show the scale of their programmes, such data should be relatively easy to extract and analyse. So why not?



## 7 Discussion

Mesfin Teklu, WV, Ethiopia, 2006

This update of the review by Duffield and colleagues<sup>4</sup> has found few studies published since 2004 on the impact of humanitarian interventions on the nutritional status of beneficiaries and target populations. The first review found a similar lack of literature published before 2004, so this is not new, if disappointing. This update has also taken a different approach to presenting the data and to discussing it, largely so as not to repeat too much of the background given in the first report, but also to try to make points in a new, or at least a different, way.

A total of 59 papers have been reviewed in some detail here, several of which were not about emergencies but were included here because there were so few papers in general, let alone in emergencies. Other papers could have been reviewed, so the distinction is more arbitrary than methodical. There was not time to review several papers in the field of interventions that could improve nutritional status, such as micronutrients sprinkles or deworming, an intervention that is often applied during an emergency as a matter of routine, but not specifically because of the emergency. The nutritional benefits of deworming have been reviewed extensively elsewhere.<sup>70</sup> There are many other interventions that can be provided during an emergency, but most are delivered collectively or as a package: permutations of food in various forms or delivery mechanisms, money to buy food or help restore livelihoods, vaccinations, micronutrients, deworming,

bed nets, clean water, sanitation, health education, interventions for feeding young children etc. The list of options is typical of humanitarian aid in an emergency.

It is very likely that there are a large number of unpublished studies, evaluations and analyses in the so called 'grey literature', mainly produced by humanitarian agencies as reports of internal evaluations or to describe the impact of programmes to donors. While some of this work may be reported within non-peer reviewed publications such as *Field Exchange* ([www.enonline.net/fex](http://www.enonline.net/fex)) or in publications such as the monthly in-house journal of *Médecins sans Frontières* or may be presented at international technical meetings and then appear as a brief abstract in the proceedings,<sup>71-75</sup> much of it will be generally unavailable. There are many reasons for the lack of published literature, which include the difficulty of conducting research in emergencies, a lack of technical capacity to design research studies that would be acceptable for publication in peer reviewed journals, and lack of time, resources and skills to complete the lengthy process of writing, reviewing and revising a paper that is necessary to publish in a peer reviewed journal. Because of the lack of evidence, this means that programme decisions have often been based on extrapolation, anecdotes and intuition, with hopes of doing the right thing.<sup>76</sup> A proposal to extract the best data from the grey literature and examine its strengths and weaknesses is outlined below, in the *Recommendations*.

*Ready-to-use therapeutic foods*

The most significant advance in the emergency nutrition sector over the past 30 years has been the treatment of severe wasting in the community using RUTFs, mainly because of the strong evidence for the benefits of the therapeutic food itself and for allowing mothers of malnourished children to take it home so that their children are treated in the community, not in a treatment centre or hospital. This evidence is provided by a number of robust, well-designed studies undertaken since 2000, which were steered by a consortium of donors, implementing agencies and research groups. The research showed that a community-based approach of acute malnutrition management using RUTF was as effective as treating children in hospitals or feeding centres, and achieved far greater coverage. There is need for similarly robust evidence for other interventions currently employed in nutrition emergencies. Without evidence, donors and implementing partners cannot be sure that their current programmes are adequately meeting the needs of vulnerable populations in nutrition emergencies, or may even be doing harm as a couple of studies reported here have shown. This is discussed further, below, in the section *Research questions*.

The main body of published work since 2004 relates to studies on the performance and impact of community based treatment of wasting using RUFs, and mainly RUTF. These studies most often compare different types of food or different delivery mechanisms, so are effectively comparative clinical trials. Not all these studies could be included in some of the analysis presented in Figures 2 and 3 because the methods were not the same, such as the period of feeding, or the data were not reported in a standardised way. The lack of untreated control groups in many of these studies is understandable, but this prevents accurate estimates of the benefit attributable to the treatment. Problems with methods were also evident in studies of general food and cash transfer programmes, blanket feeding programmes, and cost-effectiveness studies of community treatments of wasting. This is discussed further, below, in the section *Research methods*.

Very few of the studies of RUTF have had an untreated control group unless the study has been done using clusters; if individuals had been randomised some would get RUTF and others would not, so it is difficult to find willing participants for such a study. The cluster trial in Niger with untreated controls was probably undermined by major differences in the initial prevalence of stunting between the two groups of villages – an almost 10% difference.<sup>42</sup> But it can be difficult to achieve similar group means when a large sample size is drawn from a small number of clusters, in this case 1000 children in six clusters per group, or 167 subjects per group. This means that children in one outlier village can have a major influence on the group mean and it is impossible to distribute those outliers between the two groups by stratification as they are aggregated as a cluster. It is better to have 1000 children in >25 villages per group than 1000 children in only 6 villages. Many investigators know to apply an arbitrary design effect of two when doing a sample size calculation to study subjects in clusters, but often fail to have

sufficient clusters or to take the clustering of subjects into account when estimating confidence intervals for their data.

The most useful studies of the effect of RUTF on growth and weight gain have measured the change in anthropometric measurements over a period of 28 days for weight and 56 days for height or length, and have expressed the gain as grams per kilogram body per day (g/kg/d) for weight gain and in millimetres per day for height gain (mm/d). The studies have also reported the initial z-scores of weight-for-height, height-for-age and weight-for-age; in future it would be useful to have MUAC-for-age and BMI-for-age, both of which are calculated by the new WHO Anthro software. As there are several suitable studies of RUTF, it would be interesting to review past studies to see how the average weight gain compared with other older, therapeutic diets used in different circumstances, if the data could be compared. The two studies in Bangladesh that reported gains in weight of around 10 g/kg/d, which is considerably higher than the average of 3.6 g/kg/d estimated from six studies of RUTF, did not report weight gain averaged over a period of 28 days.

The analysis for this review of data from the few standardised studies of RUTF offered interesting insights into the relationship between initial anthropometric status and the rate of weight gain, but the review of the literature on this topic was not exhaustive, so further research is proposed (see *Further research*, below).

*Research questions*

This review has shown that the type of research currently being published fails to answer adequately many of the questions posed by the studies. Furthermore, there are many research questions relating to operational practice in nutritional emergencies that are not being addressed. This is sometimes due to the practical difficulties of doing research in emergencies but there are also problems with study design.

Some key questions relate to the impact and relative cost-effectiveness of different programme designs. For example can cash interventions reduce the prevalence of wasting and, if so, in which contexts and what are key design features of these programmes which will promote a nutritional impact. And what is the cost-effectiveness of blanket supplementary feeding compared with an expanded general distribution of food, or how does decentralised, targeted supplementary feeding compare with blanket supplementary feeding?

What is needed is agreement and prioritisation amongst humanitarian agencies as to what key questions need to be answered and consensus about the methods to be used to answer these questions (see below).

*Research methods*

The studies described in this review often have weak methods and use an inconsistent or un-standardised approach to assessing or reporting impact which contributes to weak conclusions. In many cases, the limitations of the methods and analysis are poorly described. More standardisation of

methods is needed if coherent answers are to be provided. Currently agencies that conduct research in emergencies (especially impact studies) use their own research tools and methods, which mean that it is difficult for decision makers to compare or merge findings for meta-analysis. Donors in particular are increasingly demanding standardisation of monitoring and impact assessment. For example, ECHO (European Commission Humanitarian Aid Department) is planning to adopt minimum reporting standards for emergency supplementary feeding programmes. While standardised approaches must take account of the realities of the research environment, such as funding opportunities and the methods that can be used within an emergency context, broad agreement on the key research questions and approaches will help guide the type of institutional arrangements to facilitate research in emergencies. Institutional issues that need to be addressed include the current short term nature of funding, a lack of flexibility with regard to budget lines for research in emergencies, the slowness of obtaining ethical approval for research, flexibility in programme design to allow research to be done that is adapted to local circumstances, and the lack of coordination between stake-holders such as donors, implementing agencies and research groups. This last issue is being addressed by the research consortium model currently being used by the UK Department for International Development (DFID). This consortium allows for more coordination between bodies funding the research, study designers and the people who are implementing programmes that will act as vehicles for the research.

Another critical challenge for research in emergencies, especially impact studies, is that it is very difficult to have a valid control group to estimate the effect attributable to the intervention alone. This is largely for ethical reasons. A comparison of two interventions or of the same interventions delivered in different ways simply allows an estimate of the difference in their effects. Control groups of subjects living in non-intervention areas or in households that don't participate in the intervention are likely to be systematically different from beneficiaries, which means that estimates of attributable benefit will be wrong. Ideally, both groups should be drawn randomly from all potential beneficiaries, but this is not always possible. These sampling issues are rarely addressed directly.

There are ways to improve methods used in studies during emergencies that can be applied within the existing constraints outlined above. For example, step wedged designs, nested case-control studies, dose-response analysis, and comparing current with historical data. If several different lines of evidence can be obtained, conclusions can perhaps be drawn with a degree of plausibility rather than obtaining a single but strong probabilistic estimate of statistical significance.

### *Funding*

Emergencies provide a very difficult environment within which to conduct rigorous impact studies. Many occur suddenly, so it is difficult to plan. This is compounded by the nature of funding opportunities for research in emergencies. Most funding windows exist within the humanitarian sections

of donor agencies such as ECHO, DFID, and the Canadian International Development Agency (CIDA), and tend to be short-term (rarely more than two years, although some donors may allow for a one year no cost-extension). It is not unusual for donors to grant funding one or two months before the grant start date. Research groups are then faced with having to turn a project proposal into a research protocol, recruit researchers, liaise with implementing agencies in order to identify and secure a research site, seek ethical approval for the research both in the country of the research and the country of the investigators, seek administrative approval in the country of research, and then begin doing the study, by which time the emergency may be over and the main period of impact may have passed. This process can also easily take 6 months or more of a two-year grant.

There have been exceptions to this short-term type of funding opportunity, such as the long-term research funding made available to Valid International by Concern Worldwide and DFID, which allowed a series of studies to be done that provided evidence for the effectiveness of treating acute malnutrition in communities using RUTF.





# 8 Recommendations

Indrias Getachew, UNICEF Ethiopia, 2009.

**A**s there is likely to be a significant body of unpublished reports of studies held by humanitarian agencies which would be useful to appraise and add to the published literature summarised here, a focused approach is proposed to obtain and summarise the data. The lead nutritionist in each of the main humanitarian agencies could be approached and asked to identify the five best studies or evaluations that they know of done by their agency in the major fields of humanitarian aid. The reports could then be provided or obtained and critically reviewed, possibly with some re-analysis of data, if appropriate and if available. The findings of this review could then be presented at an international technical meeting with four principle objectives:

1. Present key findings and conclusions from the selected studies
2. Examine the strengths, weaknesses and constraints of the studies with a view to identifying better methods that could be used in emergencies that could lead to stronger or more robust conclusions
3. Identify how such reports could be published in future
4. Identify further research questions arising from this work.

An agency such as 3ie ([www.3ieimpact.org](http://www.3ieimpact.org)) could be involved with this review.

### Further research

The review of published papers and the analysis of extracted data suggest a number of areas where further research may be useful:

- Rates of weight gain and standardisation of reporting. It would be interesting to search the literature for studies that have reported the weight gains of children given therapeutic foods other than an RUTF based on peanuts. Although this review has estimated that RUTF can achieve an average gain in weight of 3.6 g/kg/d, there is little evidence yet of the relative effectiveness of this form of supplementary food compared with other foods. In order that data can be reliably compared and evaluated in the ways shown in Figures 2 and 3, the following data need to be provided:
- the sample size by study group and the proportion of females in each group
- the initial mean and standard deviation of the age of each study group in months
- the mean and standard deviation or 95% confidence intervals around the change in body weight over 28 days feeding, expressed in g/kg body weight/day
- the mean and standard deviation or 95% confidence intervals around the change in height or length over 56 days expressed as mm/day;
- the mean and standard deviation or 95% confidence intervals around the change in MUAC over 56 days expressed as mm/day

- the initial mean and standard deviation or 95% confidence intervals around initial z-scores of height-for-age, weight-for-age, weight-for-height.

These data would allow comparisons to be made of the rates of weight gain between different foods. It would be useful to have these recommendations critically reviewed and then widely promoted so that future studies could report data in a standardised way.

- Relapse rates and long term development.  
The focus on treating acute wasting in the community has been on the effectiveness of RUTF: the mother is given a large supply of foil wrapped packets of food to take home which the child then consumes independently, one to two packets a day, at his or her own pace. However as some children may not be fed by the mother, if RUTF is the only food that a child then eats, the child may lose opportunities for psycho-social stimulation. The guidelines for community-based treatment of malnourished children identify this as an issue and promote the need to sustain psychosocial stimulation while the child is eating RUTF. Nevertheless, if there is no requirement for a young child to be fed, the degree of contact between mother and child may be reduced, perhaps with consequences for the child's physical and cognitive development. Studies in Jamaica and Bangladesh have shown that psycho-social stimulation of malnourished children is important for their subsequent development.<sup>77-79</sup> It would be useful to undertake long term follow-up studies of children treated at home with RUTF to assess their growth, anthropometric status, cognitive development and the risk of relapse in comparison with children treated in a conventional manner.

It would be of interest to do a study comparing the rates of recovery of malnourished children whose mothers were given a month's supply of either RUTF or a ration of fortified blended food, oil and micronutrient sprinkles so that the two rations of food provided similar amounts of energy, fat, protein and micronutrients. The children's weight gain over a period of a month could be compared and then followed by 3-6 months follow up to assess the subsequent rate of growth and to assess any relapse. Tests of cognitive function could also be administered. The hypothesis is that mothers who have to prepare food for their child and then give it may achieve better long term growth rates because of a stronger mother-child bond and psychosocial stimulation.

It would also be interesting to examine the consequences of giving RUTF to older infants aged 6 – 12 months in terms of their long term development and any problems with making the transition to normal family foods.



# 9 Annexes

Mesfin Teklu, WV, Ethiopia, 2006

## Annex 1

**S**ummary tables of published studies assessing the impact of nutrition interventions conducted in emergency and non-emergency situations

### Emergency situations

1. General studies and surveys of malnutrition
2. Treatment of moderate acute malnutrition, community and facility based
3. Treatment of severe acute malnutrition, community and facility based
4. Micronutrients distribution
5. Food security or agricultural interventions
6. General ration distribution programmes
7. Conditional cash transfers or vouchers
8. Cost and cost-efficiency.

### Non-emergency situations

1. Conditional cash transfers or vouchers
2. Treatment of moderate acute malnutrition, community and facility based
3. Treatment of severe acute malnutrition, community and facility based
4. Micronutrients distribution

## Emergency situations

### 1. General studies and surveys of malnutrition

Author of study	Objective of Study	Setting	Study design, Statistics	Survey population	Indicator/outcome	Impact	Conclusion
Seal <i>et al</i> (2005)	To assess the level of iron deficiency, anaemia and vit A deficiency in populations dependent on long-term international food aid & humanitarian assistance. <i>(Very little information has been published on their prevalence on this type of population).</i>	Five African refugee camps in Kenya, Uganda, Ethiopia and Algeria (March 2001-Sept 2002).	- Observational study (cross sectional surveys in all five camps) - Statistics presented	Children aged 6-59 months N= Approx 1035 Adolescents aged 10-19y Women aged 20-55y.	• Anaemia • Iron deficiency • Vitamin A deficiency	Children Prevalence of anaemia ranged from 12.8% to 72.9% in different camps Iron deficiency ranged from 23% to 75% Vitamin A deficiency ranged from 20.5% to 61.7% in 4 camps assessed Coverage Vitamin A coverage in 4 camps ranged from 3.5 up to 66.2%.	The high level of micronutrient deficiencies seen in long-term refugees argues in favour of further enhancements in food aid fortification and the strengthening of nutrition and public health programs.
Seal <i>et al</i> (2006)	To assess the iodine status of long-term refugees dependent on international food aid and humanitarian assistance.	Six refugee camps in Kenya, Uganda, Ethiopia, Algeria and Zambia (2001-2003).	- Observational study (series of cross-sectional two-stage cluster or systemic random sample surveys) - Statistics presented	- Male and female adolescents aged 10-19y - Sample size varied from 105 to 723 in different camps	- Urinary iodine concentration (UIC) - Visible goitre	Median UIC ranged from 254 to 1200µg/l and in five of the camps exceeded the recommended maximum limit of 300µg/l, indicating excessive iodine intake. Visible goitre ranged 0.0 to 7.1% in 4 camps. The camp with highest UIC also had the highest prevalence of visible goitre. The iodine conc in 11 salt samples from 3 camps exceeded the production level conc of 20-40ppm recommended by WHO but were < 100ppm.	Excessive consumption of iodine is occurring in most of the surveyed populations. Urgent revision of the level of salt iodisation is required to meet current WHO recommendations. However the full cause of excessive iodine excretion remains unknown and further investigation is required urgently to identify the cause, assess any health impact and identify remedial action.
Jayatissa <i>et al</i> (2006)	To measure the extent and severity of malnutrition among the tsunami affected population living in relief camps	Forty relief camps in Sri Lanka one month after the tsunami (Jan 17 to 28, 2005)	- Observational study (A cross-sectional, two-stage, 30 cluster study). Each camp was considered a cluster and 30 children randomly selected from each camp - Statistics presented	- Children < 5y N=878 - Pregnant women N=168 - Lactating women N=97	<i>Children</i> - Wasting, stunting and underweight (defined as W/H, H/A and W/A below - 2SD of the NCHS/WHO reference respectively). <i>Pregnant women</i> Acute undernutrition (defined as MUAC ≤ 230mm). <i>Lactating women</i> Underweight (defined as BMI < 18.5 kg/m <sup>2</sup> ) and overweight (defined as BMI > 24.9 kg/m <sup>2</sup> ).	<i>Children</i> 16.1% wasted 20.2% stunted 34.7% underweight <i>Pregnant women</i> 37% undernourished <i>Lactating women</i> 31% underweight 20% overweight Although the general food distribution was well in place, the food supply lacked diversity and 70.9% of the children did not get appropriate supplementary food.	The prevalence of both acute and chronic undernutrition among children in the camps was significantly higher than the national Sri Lankan average. It was recommended that a one-day vitamin A megadose supplementation be given to children 6months to 5y and supplementary food be given to children, pregnant and lactating women for a minimum of 1y in tsunami affected areas.
Renzaho (2007)	To assess prevalence of malnutrition, CMRs, causes of death, and the prevalence of malnutrition after 2.5y of humanitarian response to a crisis (chronic food insecurity characterised by floods in 2000 and severe droughts in 2002 and 2003). <i>(This study was conducted to provide baseline data, because sound epidemiological baseline data were not established against which to assess the impact of the programs)</i>	Cahora Bassa and Changara districts, Tete Province, Mozambique (2004)	Observational study (a cross-sectional two-stage, 30-cluster household survey) Statistics presented	838 households Children aged 6-59 months N = 874	- Acute malnutrition, W/H < -2 Z scores - Underweight, W/A < -2 Z scores - Chronic malnutrition, H/A < -2 Z scores - CMRs - Prevalence of lost pregnancies <u>Baseline info</u> Not available but anthropometric data indicate that in 2003, the prevalence of acute malnutrition was 9.9% in Tete Province.	The prevalence of acute malnutrition was 8.0% (95%CI: 6.2-9.8%), underweight 26.9% (95%CI: 24.0-29.9%), chronic malnutrition, 37% (95%CI: 33.8-40.2%). CMR was 1.23/10,000/day (95%CI: 1.08-1.38) which is 1.4 times higher than the CMR cut-off point used to define excess mortality in emergencies. Proportion of lost pregnancies was estimated at 7.7%	The impact of the food programmes would be improved if mutually acceptable food aid programme objectives and beneficiary targets and selection criteria are developed

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Author of study	Objective of Study	Setting	Study design, Statistics	Survey population	Indicator/ outcome	Impact	Conclusion
Johnecheck and Holland (2007)	To use data from 2 large scale surveys to assess malnutrition rates and understand the underlying causes of malnutrition in a post-conflict area  <i>(Two large-scale studies, the National Surveillance System (NSS) Pilot Study and the National Risk and Vulnerability Assessment (NRVA) were conducted by government, UN and NGOs in Afghanistan, as part of wider efforts characterizing Afghan livelihoods in relation to particular outcomes of interest: vulnerability to poverty, food insecurity, and malnutrition).</i>	Afghanistan  <i>NSS study [Nov-Dec 2003 (Fall) and May-June 2004 (Spring)]</i>  <i>NVRA study (July-Sept 2003)</i>	<i>NSS study -</i> Observational study (two cross-sectional surveys on different HH, one in Fall and the other in Spring)  Statistics presented  <i>NVRA study</i> Observational study (one cross-sectional survey)	<i>For NSS</i> A total of 911 and 910 HH (5936 and 5935 individuals ie all members in each HH) for Fall and Spring respectively.  Children aged 6 to 59 months N= 793 and 545 for Fall and Spring respectively.  <i>For 2003 NVRA</i> N= 11,227 HH (85,577 individuals)	Acute malnutrition (wasting) as defined by SPHERE and the Afghan Ministry of Public Health is <10% GAM (W/H < - 2 z-scores for children aged 6 to 59 months).  <i>* This aggregated information is not statistically representative of any region, group, or subgroup in the Afghan population, and should not be used for prevalence estimates.</i>	- Acute malnutrition rates were 8% (<80% of median W/H) in children during the fall season and 9% during the spring season.  - Acute malnutrition is below emergency levels for children < 5y but the level of chronic malnutrition indicates a problem of public health importance.  - The findings suggest that in addition to lack of adequate HH food intake, recurrent illness and suboptimal infant and young child feeding and hygiene practices contribute to poor nutritional outcomes in this age group. The survey also found poor access to health care, markets, and water for HH use.	Improving nutritional status requires a multipronged approach, directly targeting malnutrition, coupled with economic growth, HH livelihood security, social protection, access to public health services and water and sanitation.
Olwedo et al (2008)	To estimate the prevalence of and describe the risk factors for protein energy malnutrition among children < 5y living in IDP camps (as a result of a protracted 20y civil war)	Four IDP camps in Omoro County, Gulu district Northern Uganda (2006)	- Observational study (cross-sectional survey using multistage sampling). Two zones in each camp were randomly selected. A zone constitute a study cluster  - Statistics presented	- Children aged 3 to 59 months N= 672	Wasting and stunting using z-scores (standard deviations) of W/H and H/A indices.  Global refers to < - 2SD.	High prevalence of global stunting of 52.4% and global acute malnutrition of 6.0% were observed in the camps.  The main sources of foodstuff for IDPs included; food rations distributed by WFP (which were inadequate in quantity and limited in variety), cultivation and purchase.	There is high prevalence of protein energy malnutrition (stunting) among children in the IDPs camps in Gulu district.  Stake holders should intensify efforts to improve the nutritional status of IDPs especially children in the camp settings.
Rowe et al (2008)	To obtain data on storage, preparation and usage of fortified blended foods provided by the USAID  <i>(This is because an important consideration in determining the ability of fortified food-aid commodities to meet the nutritional needs of beneficiaries is the manner in which commodities are utilized and prepared and the degree to which micronutrient losses occurs during handling and cooking by the beneficiaries).</i>	Guatemala, Malawi and Uganda (Jul-Aug 2005)	- Observational study (interviews and physical observation)  - Some statistics presented	Primary caregivers in a household.  N= More than 100 households and two wet-feeding sites	Corn-soy blend, cornmeal, soy-fortified cornmeal, soy-fortified bulgur and fortified vegetable oil.	Storage practises by beneficiaries appeared to be appropriate and all commodities observed were free from off-flavours and odours.  Cooking water was typically obtained from boreholes or open wells with a pH range of 4.7 to 7.7.  - Food preparation usually took place in covered areas with the use of an aluminium or clay pot over a wood-fuelled fire.  - Thin or thick porridges were the most common dishes prepared from cereal-based products, with concentration ranges of 10% to 31% (wt/wt) in water.  - Cooking times for porridges ranged from 5 to 53 minutes, with a mean of 26 minutes.	Cooking fuel could be saved and nutritional quality probably improved if relief agencies emphasized shorter cooking times. These data can be used to simulate preparation methods in the laboratory for assessment of the nutritional impact of cooking.  Household sizes are larger than those used by private voluntary organizations to determine the amount of food aid allocated to households.  Another major concern is the actual nutrient delivery achieved after preparation of fortified commodities by the beneficiaries.

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Author of study	Objective of Study	Setting	Study design, Statistics	Survey population	Indicator/ outcome	Impact	Conclusion
Gelli <i>et al</i> (2009)	To estimate the programmatic costs and cost-efficiency associated with providing food through schools in food-insecure, developing-country contexts, by analyzing global project data from the World Food Programme (WFP).	WFP project data for 2005 for 42 countries	Project data, including expenditures and number of schoolchildren covered, were collected through project reports and validated through WFP Country Office records. Yearly project costs per schoolchild were standardized over a set number of feeding days and the amount of energy provided by the average ration. Output metrics, such as tonnage, calories, and micronutrient content, were used to assess the cost-efficiency of the different delivery mechanisms.  <i>*The proportion of food distributed in food-for-education (FFE) activities over the total food distribution in each WFP project is used as a parameter that is then used to scale total project expenditure in order to estimate the FFE expenditure.</i>	School aged children. N= > 8.6 million	WFP Standard Project Report • expenditures • beneficiaries • food distribution  Estimated yearly expenditure by beneficiary <i>Cost-efficiency</i> • Tonnage • Calories • Micronutrient content delivered,	The average yearly expenditure per child, standardized over a 200-day on-site feeding period and an average ration, excluding school-level costs, was US\$21.59. The costs varied substantially according to choice of food modality, with fortified biscuits providing the least costly option of about US\$11 per year and take-home rations providing the most expensive option at approximately US\$52 per year. Comparisons across the different food modalities suggested that fortified biscuits provide the most cost-efficient option in terms of micro-nutrient delivery (particularly vitamin A and iodine), whereas on-site meals appear to be more efficient in terms of calories delivered. Transportation and logistics costs were the main drivers for the high costs.	The choice of programme objectives will to a large degree dictate the food modality (biscuits, cooked meals, or take-home rations) and associated implementation costs. Fortified biscuits can provide substantial nutritional inputs at a fraction of the cost of school meals, making them an appealing option for service delivery in food-insecure contexts. Both costs and effects should be considered carefully when designing the appropriate school-based intervention. The costs estimates in this analysis do not include all school-level costs and are therefore lower-bound estimates of full implementation costs.
Hossain <i>et al</i> (2009)	To assess the relationship between food aid and acute malnutrition following the Oct 2005 earthquake in Pakistan	Mansehra and Muzaffarabad districts, northern Pakistan. (Mansehra, 21 to 25 Nov; Muzaffarabad, 14 to 18 Dec 2005)	- Observational study (two separate cross-sectional surveys, one in Mansehra district and the other in Muzaffarabad district). Clusters were selected using the probability proportional to size (PPS) methodology. - Statistics presented	- Children aged 6 to 59.9 months - Mansehra N= 602 - Muzaffarabad N= 512	- Acute malnutrition defined as wasting (WHZ) < -2 SD based on WHO/NCHS/CDCP reference or presence of oedema.  Information collected included; • Receipt of food aid • Child health • Level of HH damage • Water sources and • Excreta disposal	Children in HH receiving food aid had a lower prevalence of acute malnutrition in Mansehra (adjusted OR, controlled for confounders, 0.40; 95%CI, 0.13 to 1.22) and Muzaffarabad (adjusted OR, 0.72; 95% CI, 0.36 to 1.44).  The coverage of food aid tended to be higher in clusters with a greater percentage of homes completely destroyed.	Food aid recipients had lower prevalence of acute malnutrition than HH not receiving food aid.  Communities with higher levels of complete HH destruction were more likely to receive food aid suggesting that food aid was successfully targeted to the areas in greatest need.
Shrimpton <i>et al</i> (2009)	To assess the adequacy of improved general food ration in reducing the incidence of low birthweight in Bhutanese refugee camps in Nepal.  This research was commissioned by WFP because reports indicated that rates of low birthweight in the camps were close to 10% as compared with 15% for Bhutan as a whole, 21% for Nepal and >30% in hospitals surrounding camp areas.	Four Bhutanese refugee camps in Nepal (2009)	- Retrospective study of medical records on birthweight and maternal factors from 1994 to 2001 were analysed. - The adequacy of the food ration and food supplements provided to pregnant women were calculated using food-composition tables for 4 different periods; 1993-94, 1995-97, 1998, 1999-2001 and assessed by comparing the nutrient energy density of the ration provided to the general population both with and without the supplement provided to women during pregnancy in the four periods - Statistics presented	Infants N= 5,672 Mothers N=5,234	- Low birthweight < 2.5kg - Nutritional adequacy of food ration provided to all refugees and the supplements given to pregnant mothers were also evaluated.	The rates of low birthweight were low in the refugee camps, averaging 11% in the years reviewed. Between 1996 and 1998, the mean rates of low birthweight fell from 16% to 8% and mean birthweight increased from 2.84kg (SE, 2.80-2.87) to 3.0kg (SE, 2.97-3.03). - The increase in birthweight occurred following improvements in the micronutrient-to-energy ratios of the general ration (from mid 1994)	Rates of low birthweight were probably achieved because basic needs of mothers were met, including both the quantity and the micronutrient content of food, water and sanitation, antenatal care and education.  It is hypothesized that increased periconceptional micronutrient intake may be responsible for the increase in birthweight.

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Author of study	Objective of Study	Setting	Study design, Statistics	Survey population	Indicator/outcome	Impact	Conclusion
Chotard <i>et al</i> (2010)	To estimate levels of and fluctuations in wasting prevalence in children from surveys conducted in arid and semiarid areas of the Greater Horn of Africa according to livelihood.  <i>(The prevalence of wasting in preschool children is widely used to assess possible needs for emergency humanitarian interventions in areas vulnerable to drought, displacement and related causes of food insecurity).</i>	Eritrea, Ethiopia, Kenya, Somalia, Southern Sudan and Uganda (2000-2006)	- Observational study (results from around 900 area-level nutrition surveys were compiled and analyzed) - Statistics presented	Children aged 0 to 5 y Livelihood populations Pastoral (PP) Agricultural (AP) Mixed (MP) Migrants (MiP)	Wasting defined as < -2 SD weight-for-height).	Fluctuations in wasting were greater among pastoral population during years of drought, with prevalence rising to 25% or higher; prevalence among agricultural population seldom exceeded 15%.  Among pastoral population, the average prevalence of wasting was about 17%, 6-7 percentage points higher than the rates among agricultural population or mixed population.  IDPs and urban migrants have somewhat higher prevalence rates of wasting.	Tracking changes in wasting prevalence over time at the area level—eg with time-series graphical presentations—facilitates interpretation of survey results obtained at any given time. Different population should be judged by population-specific criteria and invariant prevalence cut-off points avoided; interpretation rules are suggested.

## 2. Summary of published studies assessing the impact of moderate acute malnutrition programmes in emergency situations

Author of study	Objective of Study	Setting	Study design, Statistics	Survey population	Indicator / outcome	Impact	Conclusion
Nielson <i>et al</i> (2004)	To investigate the effect of a supplementary feeding programme (SFP) on malnourished children in Guinea-Bissau who were returning to their homes after having been displaced within the country because of war in 1998–1999.	Bissau, Guinea Bissau (Sep 1, 1998- May 31, 1999)	Observational study. The effect of the war on the nutritional status of children who were present in Bissau was evaluated by comparing the mortality and the prevalence of malnutrition with the values expected had the war not occurred and by comparing the severity of malnutrition in malnourished children before and during the war.  - No control group - Statistics presented	Children < 5y with MUAC < 130mm. N= 433 of which 247 received supplementary feeding. Children with MUAC < 130 mm were provided weekly medical consultations and supplementary feeding for 7d or until recovery (MUAC ≥ 130mm)	Mortality Recovery rate Growth rate using MUAC Weight gain Baseline info Median (quartiles) of MUAC (mm) = 122 (118, 126).	The degree of malnutrition and mortality of malnourished children did not increase during the war. The prevalence of malnutrition increased with the start of the war but then decreased. Seventy-four percent of the referred children received treatment (N=247); of those, 1% died, 67% (95% CI: 61%, 73%) recovered, and 32% (95% CI: 26%, 38%) abandoned treatment. Compliance was 89%. The recovery rate was 13.1/1000/d, and the median time to recovery was 48 d (95% CI: 34, 72 d). MUAC growth rate of 0.78 (95%CI: 0.31, 1.25) mm/d and weight gain of 4 (95%CI: 3, 5) g/d was observed. Better compliance was associated with shorter time to recovery.	Our findings may be biased by changes in the cultural and socioeconomic background of the malnourished children. However, 3 different analyses indicated a beneficial effect of the SFP. Thus, the home-based SFP probably prevented nutritional deterioration during the war in Guinea-Bissau.
Maleta <i>et al</i> (2004)	To compare the effect of maize and soy flour with that of ready-to-use food (RTUF) in the home treatment of moderately malnourished children in an area with chronic food insecurity and poverty.	Lungwena, Mangochi district, Malawi (Jul 2000 - April 2001)	A parallel group intervention study.  <i>Intervention</i> - one of two food supplements: RTUF (92 g/day) or maize and soy flour (140 g/day) or 12 weeks. Both supplements provided 2 MJ (500Kcal) of energy daily but had different energy and nutrient densities.  There was a 12-week post supplementation observation. Weight and height were measured at 4-week intervals during intervention and at the end of the 12-week follow-up. Twenty-four-hour dietary recall was assessed fortnightly  • No control group • Statistics presented	Underweight and stunted children aged 42 to 60 mo (WAZ and HAZ < -2, WHZ < -0.3)  N= 61 of which RTUF= 30 and maize and soy flour= 31  - Participants were drawn from the Lungwena Child Survival Study (LCSS) cohort.	- Weight and height gain - Dietary intake  Baseline info Mean (SD) of WHZ, WAZ and HAZ was -0.9 (0.5), -2.5 (0.5) and -3.2 (0.9) in the RTUF group and -0.9 (0.5), -2.4 (0.5) and -3.0 (0.8) in the maize and soy flour group respectively	During the supplementation phase, the consumption of staple food fell among children receiving maize and soy flour but not among those receiving RTUF. There was thus higher intake of energy, fat, iron, and zinc in the RTUF group.  Both supplements resulted in modest weight gain, but the effect lasted longer after RTUF supplementation [mean diff = 77 (95% CI: 20, 140) p= 0.01].  Height gain was not affected in either group. Periodic 24-hour dietary recalls suggested that the children received only 30% and 43%, respectively, of the supplementary RTUF and maize and soy flour provided.	RTUF is an acceptable alternative to maize and soy flour for dietary supplementation of moderately malnourished children. Approaches aimed at increasing the consumption of supplementary food by the selected recipients are needed.
Patel <i>et al</i> (2005)	To test the hypothesis that supplemental feeding with RUTF would result in better growth in Malawian children at risk of malnutrition than feeding with corn/soy-blend (Crises in Malawi affects food production hence chronic food insecurity exists)	Seven nutritional rehabilitation units (NRUs) in rural areas of southern Malawi (Dec 2002 to May 2003)	A controlled, comparative clinical effectiveness trial of 2 supplementary regimens. A stepped-wedge design with prospective systematic allocation was used for assigning children to receive either ready-to-use therapeutic food (RUTF) or micronutrient-fortified corn/soy-blend (MFCSB) for up to eight weeks.  - No control group - Statistics presented	Children aged 10-60 mo at risk of malnutrition, W/H >80%, but < 85% of the standard reference values of WHO without oedema.  N= 331 (RUTF group) N= 41 (MFCSB group)	- Recovery (defined as W/H > 90%) - Rate of weight gain.  Baseline info Mean ± SD of W/H (% of international standard)= 82 ± 1, and 82 ± 2 for MFCSB and RUTF groups respectively	Children receiving RUTF were more likely to recover (58% vs 22%; difference 36%; 95% CI: 20- 52) and had greater rates of weight gain (3.1 g/kg.d vs 1.4 g/kg.d; difference 1.7; 95% CI 0.8-2.6) than children receiving corn/soy-blend.  <i>*Main limitation of this study was that its participants were not randomly assigned to receive either corn/soy-blend or RUTF.</i>	The results of this preliminary work suggest that supplementary feeding with RUTF promotes better growth in children at risk of malnutrition than the standard fortified cereal/legume-blended food.

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Author of study	Objective of Study	Setting	Study design, Statistics	Survey population	Indicator / outcome	Impact	Conclusion
Ruel <i>et al</i> (2008)	To compare the effect of (i) targeting all children aged 6-23 mo (preventive) and ii) targeting underweight children younger than 5 years (recuperative) in reducing community prevalence of stunting, underweight, and wasting in a food-assisted maternal and child health and nutrition programme in Haiti.  <i>(Previous evidence suggests that targeting nutrition interventions earlier in life, before children become undernourished, might be more effective for reduction of childhood undernutrition).</i>	Three communes of Central Plateau region in Haiti (May-Sep, 2002 and exactly 3 years later)	- A cluster randomised trial. - Compared two programmes which included a behaviour change and communication (BCC) component: a preventive model and a recuperative model. Both models also targeted pregnant and lactating women.  Two cross-sectional surveys (at baseline and 3 years later)  Intervention = 8kg/mo wheat-soy blend + oil general ration, health education, growth monitoring, parasites treatment, immunizations, vit A supplement, ORS provision and home visits  - Duration of intervention was 9 mo in recuperative and up to 18 mo for preventive group. - The two programme models were delivered at the community level, rather than the individual level. - No control group - Statistics presented	<i>Preventive group</i> All children aged 6-23 mo.  N= 10 communities  <i>Recuperative group</i> Underweight children (WAZ < -2) aged 6-59 mo and children aged 24-59mo with WAZ < -3.  N= 10 communities Children aged 12-41 months were selected for effect assessment (roughly 1500 children per survey).	• Mean Z scores for H/A, W/A and W/H  • Prevalence of childhood stunting, underweight, and wasting (using WHO 2006 reference data).  <u>Baseline info</u> There were no differences between programme groups at baseline.	At follow-up, stunting, underweight, and wasting were 4-6 percentage points lower in preventive than in recuperative communities; and mean anthropometric indicators were higher by +0.14 z scores (height for age; p=0.07), and +0.24 z scores (weight for age and weight for height; p<0.0001). The effect was greater in children exposed to the preventive programme for the full span between 6 and 23 months of age than in children exposed for shorter durations during this period. The quality of implementation did not differ between the two programmes; nor did use of services for maternal and child health and nutrition.	The preventive programme was more effective for the reduction of childhood undernutrition than the traditional recuperative model.
Matilsky <i>et al</i> (2009)	To determine the relative recovery and growth rates for moderately wasted children receiving either soy/peanut FS, milk/peanut FS, or CSB as a supplementary food.  <i>The sites were identified in the southern region of Malawi based on census reports of moderately wasted children provided by the World Food Programme.</i>	Twelve rural study sites, southern Malawi (Jul 2007 to Feb 2008)	A randomized clinical effectiveness trial of 3 locally produced foods for 8 weeks (reassessment and supply of supplement food was performed every two weeks).  - Children were randomly assigned to 1 of the 3 diets: milk/peanut FS, soy/peanut FS, or CSB  - Focus group discussions were used to collect information from caretakers. - No control group - Statistics presented	Children aged 6-60 mo with moderate wasting (defined as WHZ < -2 but ≥ -3 without oedema)  N= 1362 of which milk/peanut FS n= 465, soy/peanut FS n= 450 and CSB n= 447	- Recovery, defined as having a WHZ > -2 - Weight gain rate - Adverse outcomes such as severe malnutrition or death. - Cost  <u>Baseline info</u> The mean (SD) of WHZ was -2.2 ± 0.4 for all three groups.  Mean weight (kg) was 7.56 ± 1.68, 7.55 ± 1.77, 7.46 ± 1.80 for milk/peanut FS, soy/peanut FS and CSB respectively.	- Children receiving soy/peanut FS had a similar recovery rate to those receiving milk/peanut FS and children in either FS group were more likely to recover than those receiving CSB (80% in both FS groups vs. 72% in the CSB group; P < 0.01).  - The rate of weight gain in the first 2 wk was greater among children receiving milk/peanut FS (2.6 g/kg/d) or children receiving soy/peanut FS (2.4 g/kg/d) than among children receiving CSB (2.0 g/kg/d; P < 0.05). - Rates of length gain did not differ among the 3 groups.  - A total of 8% of children in each feeding group developed malnutrition, while receiving supplemental feeding. - The cost of the foods in Malawi at the time of the study for locally manufactured milk/peanut FS was US\$ 0.16/1000 kJ, soy/peanut FS was US\$ 0.08/1000 kJ, and CSB was US\$ 0.04/1000 kJ.	We conclude that FS are superior supplementary foods to CSB for moderately wasted Malawian children.

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Pérez-Expósito and Klein (2009)	A review to examine the impact that fortified blended foods used in humanitarian relief programs have had on the health and nutritional status of infants and young children with moderate malnutrition, or at risk of undernutrition, in developing countries.	Various developing countries (study period not stated)	Published articles were identified using electronic databases of PubMed and the Cochrane Library with no restrictions regarding date, age, or language as well as general Web searches. Search terms included commodity types and names and terms related to food assistance and fortification programs.	Published studies and reports assessing either the efficacy or effectiveness of FBFs to improve the health and nutritional status of infants and young children with moderate malnutrition, or at risk of undernutrition in developing countries  N= 11 published studies and reports	- Recovery from moderate acute malnutrition, defined as weight-for-height z score (WHZ) > -2 or weight-for-height > 85% of the median + no oedema has been used as an indicator of programme success in many of the supplementary feeding interventions.  - Weight gain	Positive effects on recovery from moderate acute malnutrition and weight gain were observed when fortified blended foods were distributed as dietary supplements.  Prevention of severe micronutrient deficiencies in populations reliant on food aid has been reported, but measurements of micronutrient status have rarely been conducted.	Evidence of the efficacy of fortified blended foods for improving nutritional outcomes is currently limited and weak.
Defourmy <i>et al</i> (2009)	To evaluate a large-scale distribution (blanket supplementary feeding) of a nutritional supplement on the prevention of wasting in children living in areas with high burden of child malnutrition and chronic food insecurity (especially during the hunger gap period)	Maradi, Niger (May to Oct 2007)	- Intervention study  <i>Intervention</i> consisted of a monthly distribution of 4 pots of ready-to-use food (RUF) (325 g/pot) to each child for six months.  At each monthly distribution, children were also screened for SAM and referred for therapeutic treatment if indicated.  - (No clear control group but in one district children admitted to the therapeutic programme and registered for RUF distribution were compared with children not registered for distribution but had been admitted for therapeutic programme)  • Statistics presented	All children aged 6 to 36 mo (or height between 60-85cm) with moderate malnutrition (MUAC > 110mm)  N= approximately 60,000  Children with MUAC < 110mm was referred for therapeutic feeding	MUAC < 110 mm  <i>Baseline info</i> Data for 2002-2005 presented as a figure  <i>Cont'd impact for this study</i> The proportion of complicated cases of malnutrition requiring intensive care was lower among children registered for RUF distribution (7.8%, p= 0.005) than among those not registered for distribution (9.9%). The proportion of malnourished children treated exclusively in outpatient facilities was higher among beneficiaries of the preventive distribution (84.2%, p<0.0001) than among children not registered for distribution (80.5%).  Among children receiving a preventive distribution of RUF, cure rate was higher (92.3%, p= 0.003) and default rate was lower (4.7%, p = 0.026), when compared with rates of children not receiving any preventive distribution (cure rate: 90.1%; and default rate: 6%).	Admission trends for severe wasting (WFH < 70% NCHS) in Maradi, 2002–2005 show an increase every year during the hunger gap. In contrast, in 2007, throughout the period of the distribution, the incidence of severe acute malnutrition (MUAC < 110 mm) remained at extremely low levels. Comparison of year-over-year admissions to the therapeutic feeding programme shows that the 2007 blanket distribution had essentially the same flattening effect on the seasonal rise in admissions as the 2006 individualized treatment of almost 60,000 children moderately wasted.	These results demonstrate the potential for distribution of fortified spreads to reduce the incidence of severe wasting in large population of children 6–36 months of age. Although further information is needed on the cost-effectiveness of such distributions, these results highlight the importance of re-evaluating current nutritional strategies and international recommendations for high burden areas of childhood malnutrition.

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Author of study	Objective of Study	Setting	Study design, Statistics	Survey population	Indicator / outcome	Impact	Conclusion
Isanaka <i>et al</i> (2009)	To evaluate the effectiveness of a population-based, preventive distribution of ready-to-use therapeutic food (RUTF) on the nutritional status, mortality and morbidity of children in Niger (an area with high levels of child malnutrition and chronic food insecurity)	Twelve villages in Maradi, Niger (August 2006 - March 2007).	<ul style="list-style-type: none"> <li>- A cluster randomized trial of 12 villages, 6 villages were randomized to intervention and 6 to no intervention.</li> <li>Intervention villages received a monthly distribution of 1 packet per day of RUTF (92g [500 kcal/d]) for 3 months (Aug to Oct 2006).</li> <li>- Non intervention villages received no preventive supplementation.</li> <li>Follow-up period was over 8 month.</li> <li>- Statistics presented</li> </ul>	<p>Non malnourished children with weight-for-height 80% or more of the NCHS reference median aged 6 to 60 months</p> <p>N= 1671 for intervention group</p> <p>N= 1862 for non intervention group</p>	<ul style="list-style-type: none"> <li>- Changes in WHZ according to the WHO Child Growth Standards</li> <li>- Incidence of wasting (WHZ &lt; -2) over the 8 months of follow-up.</li> </ul> <p><b>Baseline info</b> <i>Intervention group</i> The mean (SD) for WHZ was -0.7 (1.0) and HAZ was -1.9 (1.3). 8.2% and 1.0% were wasted and severely wasted while 46.7% and 17.6% were stunted and severely stunted respectively.</p> <p><i>Non intervention</i> The mean (SD) for WHZ was -0.7 (1.0) and HAZ was -2.2 (1.3). 8.6% and 1.4% were wasted and severely wasted while 56.2% and 27.9% were stunted and severely stunted respectively.</p>	The number of children with height and weight measurements in August, October, December and February was 3166, 3110, 2936, and 3026, respectively. The WHZ difference between the intervention and non intervention groups was -0.10 z (95% CI: -0.23 to 0.03) at baseline and 0.12 z (95% CI: 0.02 to 0.21) after 8 months of follow-up. The adjusted effect of the intervention on WHZ from baseline to the end of follow-up was thus 0.22 z (95% CI, 0.13 to 0.30). The absolute rate of wasting and severe wasting, respectively, was 0.17 events per child-year (140 events/841 child years) and 0.03 events per child-year (29 events/943 child-years) in the intervention villages, compared with 0.26 events per child-year (233 events/895 child-years) and 0.07 events per child-year (71 events/1029 child-years) in the non intervention villages. The intervention thus resulted in a 36% (95% CI, 17% to 50%; P < 0.001) reduction in the incidence of wasting and a 58% (95% CI, 43% to 68%; P < 0.001) reduction in the incidence of severe wasting. There was no reduction in mortality, with a mortality rate of 0.007 deaths per child-year (7 deaths/986 child-years) in the intervention villages and 0.016 deaths per child-year (18 deaths/1099 child-years) in the non intervention villages (adjusted hazard ratio, 0.51; 95% CI, 0.25 to 1.05).	Short-term supplementation of non malnourished children with RUTF reduced the decline in WHZ and the incidence of wasting and severe wasting over 8 months.
Isanaka <i>et al</i> (2010)	To compare the incidence of wasting, stunting, and mortality among children who are receiving preventive supplementation with either ready-to-use supplementary foods (RUSFs) or ready-to-use therapeutic foods (RUTFs) in an area with high levels of child malnutrition and chronic food insecurity	Twelve villages in Maradi, Niger (Apr 2007 - Oct 2007).	<p><i>Population-based study</i></p> <ul style="list-style-type: none"> <li>- Cohort study (two groups)</li> <li>- No control group.</li> <li>- Children either received a monthly distribution of RUSFs (247 kcal [3 spoons] per day) for 6 months or RUTFs (500-kcal sachet per day) for 4 months.</li> <li>- Distribution of supplements and follow ups were done monthly.</li> <li>- Statistics presented</li> </ul>	<p>All children aged 6 to 36 months in the 12 villages</p> <p>N= 1645 of which 873 received RUTFs and 772 received RUSFs.</p> <p><i>*Study limitations</i> <i>In addition to the dose, the 2 preventive strategies under comparison differed in important ways, including the duration of supplementation, mode and time of initiation of distributions, as well as the age of children eligible for supplementation.</i></p> <p><i>The frequency of anthropometric screening also differed according to strategy; children who received the RUSF strategy were screened twice as often as those who received the RUTF strategy, because of screening at both the RUSF distribution sites and monthly follow-up visits. As a result, our conclusions relate to the relative performance of the 2 preventive strategies overall rather than to the individual products.</i></p>	<p>Incidence of wasting (WHZ &lt; -2), severe wasting (WHZ &lt; -3), stunting (HAZ &lt; -2), and severe stunting (HAZ &lt; -3) according to WHO growth standards, and mortality.</p> <p><b>Baseline info</b> Data shown as mean (SD)</p> <p><b>RUTF group</b> WHZ = -0.7 (1.1). 11.8% were wasted of which 3.2% were severely wasted. HAZ = -2.4 (1.1). 64.6% were stunted of which 31.9% were severely stunted.</p> <p><b>RUSF group</b> WHZ = -1.0 (1.1). 16.4% were wasted of which 3.7% were severely wasted. HAZ = -2.4 (1.1). 65.8% were stunted of which 26.8% were severely stunted.</p> <p>More children in the RUSF strategy than in the RUTF strategy were in villages that received the previous nutritional intervention (50.3% vs 43.9%). On average, children had higher WHZs (-0.76 ± 1.07 vs -0.93 ± 1.10) and HAZs (-2.24 ± 1.04 vs -2.56 ± 1.15) at baseline in villages in which nutritional intervention was previously implemented.</p>	The effectiveness of RUSF supplementation depended on receipt of a previous preventive intervention. In villages in which a preventive supplementation programme was previously implemented, the RUSF strategy was associated with a 46% (95% confidence interval [CI]: 6%–69%) and 59% (95% CI: 17%–80%) reduction in wasting and severe wasting, respectively. In contrast, in villages in which the previous intervention was not implemented, we found no difference in the incidence of wasting or severe wasting according to type of supplementation. Compared with the RUTF strategy, the RUSF strategy was associated with a 19% (95% CI: 0%–34%) reduction in stunting overall.	We found that the relative performance of a 6-month RUSF supplementation strategy versus a 4-month RUTF strategy varied with receipt of a previous nutritional intervention. Contextual factors will continue to be important in determining the dose and duration of supplementation that will be most effective, acceptable, and sustainable for a given setting.

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Author of study	Objective of Study	Setting	Study design, Statistics	Survey population	Indicator / outcome	Impact	Conclusion
Nackers <i>et al</i> (2010)	To compare the clinical effectiveness of ready-to-use therapeutic food (RUTF) and a corn/soy-blend (CSB) based pre-mix for the treatment of moderately malnourished children in Niger. An area affected by chronic food insecurity marked each year with a 'hunger gap' period when previous year's stocks have run out.	Two SFCs in Zinder region, South of Niger (Aug 2007 to July 2008)	Field-randomized trial. Children were individually randomized to; <ul style="list-style-type: none"> <li>Group 1 Receive RUTF (Plumpy'Nut) two packs daily, i.e. 1000 kcal/day]</li> <li>Group 2 Receive a CSB pre-mix (1750g of CSB, 175 ml of vegetable oil and 105 g of sugar, i.e. 1231 kcal/day).</li> </ul> <ul style="list-style-type: none"> <li>Children were followed weekly up to recovery (recruitment took place from Aug-Oct 2007 with a 6-mo follow up).</li> <li>No control group</li> <li>Statistics presented</li> </ul>	All children measuring 65 to <110 cm (used as a proxy for the age of 6–59 mo), newly admitted to the SFCs with MAM and good appetite. MAM was defined as a W/H% of the median from 70 to <80% (NCHS ref), without oedema and with MUAC $\geq$ 110 mm. <p>N= 215 in RUTF group N= 236 in CSB pre-mix group.</p>	<ul style="list-style-type: none"> <li>Weight gain (g/kg/day)</li> <li>Recovery rate</li> <li>Also transfer to the inpatient TFC (I-TFC), mortality, non-responder and defaulter rates, length of stay, MUAC gain and haemoglobin gain during treatment, relapse and height gain 6 months after discharge.</li> </ul> <p><u>Baseline info</u> Data are mean<math>\pm</math>SD</p> <p>RUTF group W/H %median= 76.7 <math>\pm</math> 2.6 MUAC (mm)= 120.9 <math>\pm</math> 4.9</p> <p>CSB pre-mix group W/H %median= 76.4 <math>\pm</math> 2.4 MUAC (mm)= 120.0 <math>\pm</math> 5.6</p>	Overall recovery rate was 79.1% and 64.4% in the RUTF and CSB pre-mix group respectively (p<0.001). There was no evidence for a difference between death, defaulter and non-responder rates. More transfers to the I-TFC were observed in the CSB pre-mix group (19.1%) compared to the RUTF group (9.3%) (p= 0.003). The average weight gain up to discharge was 1.08 g /kg/day higher in the RUTF group (95% CI: 0.46–1.70) and the length of stay was 2 weeks shorter in the RUTF group (p<0.001).	For the treatment of childhood MAM in Niger, RUTF resulted in a higher weight gain, a higher recovery rate, a shorter length of stay and a lower transfer rate to the I-TFC compared to a CSB pre-mix. This might have important implications on the efficacy and the quality of SFPs.
Thakwalakwa <i>et al</i> (2010)	To determine whether lipid-based nutrient supplements (LNS) or corn-soy blend (CSB) supplementation improves weight gain of moderately underweight children in an area with high levels of child malnutrition and chronic food insecurity.	Lungwena, Mangochi district of Malawi (Dec 2006 to Feb 2007). Follow up of last participant ended in May 2007.	<ul style="list-style-type: none"> <li>A single-centre randomised, controlled, investigator-blinded clinical trial for 12 weeks.</li> <li>Trial intervention</li> </ul> <p>Control group: no food supplement CSB group: received 500g of CSB weekly LNS group: received 300g of LNS weekly for 12 weeks. Food supplements were delivered to their homes. Both supplements were fortified with micronutrients although levels of fortification varied between products.</p> <ul style="list-style-type: none"> <li>Statistics presented</li> </ul>	Moderately underweight infants & children aged 6 to 15 mo with WAZ < -2 based on NCHS/CDC growth reference. <p>N= 192 of which 59- control group; 67- CSB group &amp; 66- LNS group.</p>	<p>Weight change</p> <p>Changes in anthropometric indices, Hb levels and morbidity.</p> <p><u>Baseline info</u> Values are presented as mean (SD). Weight (kg) and WAZ for control, CSB &amp; LNS were 7.03 <math>\pm</math> 0.74 and -2.98<math>\pm</math>0.86; 6.89 <math>\pm</math>1.04 and -3.06 <math>\pm</math>1.08; &amp; 7.11 <math>\pm</math>0.91 and -2.83 <math>\pm</math>0.78 respectively.</p>	<p>Body weight increases did not differ and were 620 <math>\pm</math>470, 510 <math>\pm</math>350, and 470 <math>\pm</math> 350 g in the LNS, CSB and control groups respectively (p= 0.11).</p> <p>Compared with controls, infants and children in the LNS group gained more weight [mean (95%CI) = 150g (0-300g); p= 0.05] and had a greater increase in WAZ [0.33 (-0.02-0.65); p= 0.04].</p> <p>Weight and WAZ changes did not differ between the control and CSB groups.</p> <p>In exploratory stratified analysis, the weight increase was higher in the LNS group compared with the control group among those with lower initial WAZ [250g (60- 430g; p= 0.01].</p>	Supplementation with LNS but not CSB modestly increases weight gain among moderately underweight children and the effect appears most pronounced among those with a lower initial WAZ.

### 3. Summary of published studies assessing the impact of severe acute malnutrition programmes in emergency situations

Author of study	Objective of Study	Setting	Study design, Statistics	Survey population	Indicator / outcome	Impact	Conclusion
Sandige <i>et al</i> (2004)	To determine the efficacy of home-based therapy with ready-to-use food (RTUF) in producing catch-up growth in malnourished children and to compare locally produced RTUF with imported RTUF for this purpose.	Blantyre, Malawi (Apr – Aug 2002) <i>(The area has high rates of child malnutrition (of which a significant fraction are HIV infected) and chronic food insecurity. Children with HIV infection in Malawi do not receive antiretroviral therapy due to economic constraints upon the healthcare services).</i>	- Observational intervention study Children were systematically allocated to receive home therapy with either imported commercially produced RTUF or locally produced RTUF after a brief inpatient stabilization at a hospital. - Each child received 73kJ/kg/day and was followed up fortnightly. Analyses were stratified by human immunodeficiency virus (HIV) status. Intervention lasted for 16 weeks - Reassessment was performed every two weeks. - No control group - Statistics presented	Severely malnourished (WHZ < -2 with or without oedema) children aged 1 to 5y. N= 260 of which local RTUF= 135 and imported RTUF= 125	Recovery (attaining WHZ > -0.5 by 14 weeks)  - Relapse, death, or failure to achieve WHZ > -0.5 after 16 weeks.  Baseline info Mean $\pm$ SD of WHZ was -2.1 $\pm$ 0.8 and -2.2 $\pm$ 0.9 in local and imported groups respectively.	Seventy eight percent of all children reached WHZ > -0.5, 95% of those with HIV-negative status and 59% of those with HIV-positive status. Eighty percent of those receiving locally produced RTUF and 75% of those receiving imported RTUF reached WHZ > -0.5. The difference between recovery rates was 5% (95% CI: -5–15%). The rate of weight gain was 0.4 g/kg/day (95% CI, -0.6, 1.4) greater among children receiving locally produced RTUF. The prevalence of diarrhoea reported by mothers was 3.7% for locally produced RTUF and 4.3% for imported RTUF. After completion of home therapy and resumption of habitual diet for 6 months, 91% of all children maintained a normal WHZ.	Home-based therapy with RTUF was successful in affecting complete catch-up growth. In this study, locally produced and imported RTUF were similar in efficacy in treating of severe childhood malnutrition
Manary <i>et al</i> (2004)	To test the hypothesis that the recovery rate for ready-to-use food (RTUF) is greater than two other home based dietary regimens in the treatment of malnutrition.	Blantyre, Malawi (Jan 25 – Oct 15, 2001) <i>(The area has high rates of child malnutrition and chronic food insecurity. The standard treatment of severe malnutrition in Malawi often utilises prolonged inpatient care, and after discharge results in high rates of relapse).</i>	- Observational intervention study - Children were systematically allocated to one of three dietary regimens: RTUF (730 kJ/kg/day), RTUF supplement (2100 kJ/day), or blended maize/soy flour (730 kJ/kg/day). - Children were followed fortnightly. - Children completed the study when they reached WHZ >0, relapsed, or died. - No control group - Statistics presented	HIV negative children >1y discharged from the NRU. N= 282 of which RTUF group= 69, RTUF supplement group= 96 and maize/soy group= 117	- Recovery (WHZ > 0, WHZ, based on initial height). - Weight gain  Baseline info No significant differences between groups  Mean (SD) WHZ was -1.8 (0.8), -2.0 (0.9) and -1.9 (1.0) for RUTF, RUTF supplement and maize/soy groups respectively.	- Children receiving RTUF were more likely to reach WHZ >0 than those receiving RTUF supplement or maize/soy flour (95% v 78%, RR 1.2, 95% CI: 1.1 to 1.3).  - The average weight gain was 5.2 g/kg/day in the RTUF group compared to 3.1 g/kg/day for the maize/soy and RTUF supplement groups. Six months later, 96% of all children that reached WHZ > 0 were not wasted.  *The primary limitation of the study was that dietary intake was not measured at home, and thus we are uncertain as to why RTUF was a superior home therapy.	Home based therapy of malnutrition with RTUF was successful; further operational work is needed to implement this promising therapy.
Ndekha <i>et al</i> (2005)	To determine if home-based nutritional therapy will benefit a significant fraction of malnourished, HIV-infected Malawian children, and to determine if ready-to-use therapeutic food (RUTF) is more effective in home-based nutritional therapy than traditional foods.	Blantyre, Malawi (Jan – Sep 2001) <i>(The area has high rates of child malnutrition and chronic food insecurity. Children with HIV infection in Malawi do not receive antiretroviral therapy due to economic constraints upon the healthcare services).</i>	- Observational intervention study - Children were prospectively, systematically allocated to receive RTUF (730 kJ/kg/day), RTUF supplement (2100 kJ/day), or blended maize/soy flour (730 kJ/kg/day) based on their week of discharge from the hospital - Children did not receive antiretroviral chemotherapy - Children were followed fortnightly. Children completed the study when they reached 100% weight-for-height, relapsed or died. - Follow up was after 6 months - No control group - Statistics presented	HIV-positive severely malnourished children aged 12-60 mo N= 93 of which RTUF group= 20, RTUF supplement group= 28 and maize/soy group= 45	- Reaching 100% weight-for-height - Weight gain rate  Baseline info Mean (SD) WHZ was -2.0 (1.1), -2.8 (0.9) and -1.8 (0.8) for RUTF, RUTF supplement and maize/soy groups respectively.	Fifty-two children (56%) of all children reached 100% weight-for-height. Eleven children died  Median survival from the time of enrolment in the home-based therapy study for these children was 42 d.  Regression modeling found that the children receiving RUTF gained weight more rapidly and were more likely to reach 100% weight-for-height than the other two dietary groups ( $p < 0.05$ ).  *An important limitation of this study was the differences in severity of malnutrition between the different dietary groups. The children receiving RUTF supplement were clearly more wasted	More than half of malnourished, HIV-infected children not receiving antiretroviral chemotherapy benefit from home-based nutritional rehabilitation. Home-based therapy RUTF is associated with more rapid weight gain and a higher likelihood of reaching 100% weight-for-height.

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Author of study	Objective of Study	Setting	Study design, Statistics	Survey population	Indicator / outcome	Impact	Conclusion
Kumar and Bhawani (2005)	To assess the impact of 'Nutrition Care Centres' on nutritional status in a chronic moderate to severe drought affected area.	Villages in the district of Rajasthan, India (March and Sept, 2003)	<ul style="list-style-type: none"> <li>- Intervention study. Intervention = provision of targeted feeding and care at nutrition care centres (NCC). Impact was measured after 6mo of intervention</li> <li>- No control group</li> <li>- Some statistics presented</li> </ul>	<ul style="list-style-type: none"> <li>- All severely and moderately malnourished children, W/A or W/H &lt; 2 SD below NCHS median reference, aged &lt;5y.</li> <li>Initial survey of all children in 40 selected villages N=3,206</li> <li>- Follow up survey in 22 intervention villages after 6 months N= 1775</li> </ul>	<p>Severe underweight (defined as W/A &lt; 3 SD below NCHS median reference).</p> <p><b>Baseline info</b> About 66.7% of children were underweight of which 32.9% were severely underweight.</p> <p>Also 27.3% of children were wasted of which 4.7% were severely wasted.</p>	<p>There was a reduction in the prevalence of underweight in children from 66.7% to 59.6% and severe underweight from 32.9% to 26.1%.</p> <p><i>No confidence intervals or p values were given</i></p>	Successful management of severe malnutrition amongst children by workers at NCCs and in family settings using standard protocol led to the wide scale replication of the approach by Anganwadi centres in different districts of Rajasthan.
Ciliberto et al (2005)	To compare recovery rates among children with moderate and severe wasting, kwashiorkor, or both receiving either home-based therapy with RUTF or standard inpatient therapy. <i>(Not clear from paper if emergency or not so it is assumed that the study period (2002 to 2003) was during an emergency. Also, the Office of Foreign Disaster Assistance of the Bureau for Democracy, Conflict and Humanitarian Assistance supported the study).</i>	Malawi (Dec 2002-June 2003)	<ul style="list-style-type: none"> <li>- A controlled, comparative, clinical effectiveness trial. A stepped wedge design was used to systematically allocate children into standard therapy or home-based therapy with RUTF.</li> <li>- Statistics presented</li> </ul>	<p>All children aged 10 to 60mo in 1 of 7 NRUs and eligible for second phase treatment for childhood malnutrition as well as children brought in from the community with wasting (WHZ &lt; -2), mild oedema, or both with a good appetite were eligible for inclusion.</p> <p>Of note, anthropometric criteria for admission to this study were those used locally in Malawi rather than those outlined in the WHO guidelines, which designate that only children with a WHZ &lt; -3 be offered standard inpatient therapy.</p> <p>N = 1178 of which home-based was 992 and standard therapy was 186.</p>	<p>Weight-for-height z score &gt; -2</p> <p>Weight gain</p> <p>Prevalence of fever, cough and diarrhoea</p>	<p>Children who received home-based therapy with RUTF were more likely to achieve a WHZ &gt; -2 than those who received standard therapy (79% compared with 46%; p&lt; 0.001) and were less likely to relapse or die (8.7% compared with 16.7%; p&lt;0.001).</p> <p>Home-base with RUTF group had greater rates of weight gain (3.5 compared with 2.0 g.kg<sup>-1</sup>.d<sup>-1</sup>; difference: 1.5; 95%CI: 1.0, 2.0 g.kg<sup>-1</sup>.d<sup>-1</sup>) and a lower prevalence of fever, cough and diarrhoea than the standard therapy group.</p>	Home-based therapy with RUTF is associated with better outcomes for childhood malnutrition than is standard therapy.
Rossi et al (2006)	To evaluate health projects and nutrition & food security programmes on nutritional status in chronic post-conflict situation: the case of Congo as an example	Seven out of 14 nutrition/food security projects were visited in the eastern regions of Congo for a period of 4 weeks (July to Aug 2004).  The nutritional approach in Congo is the classical emergency programme with Nutrition Centres; TFCs admitting severely malnourished subjects in local hospitals and SFCs correcting moderate wasting.	<ul style="list-style-type: none"> <li>- Semi structured individual and group were held with key informants at the level of implementing partners (IPs), relevant Ministries, UN agencies, local authorities, as well as randomly selected members of the target population groups. Interviews were often coupled with direct observation during visits to project sites.</li> <li>Mortality and Morbidity statistics were collected from hospitals and health centres, while nutrition and food security information were gathered from databases provided by different IPs.</li> <li>- Statistics not presented eg sample size not stated.</li> </ul>	<ul style="list-style-type: none"> <li>- Children aged &lt; 5y</li> <li>- Older children (6-18yrs)</li> <li>- Women of childbearing age</li> <li>- Nutritional programmes were evaluated according to internationally accepted Sphere standards.</li> </ul>	<ul style="list-style-type: none"> <li>- Acute malnutrition or wasting defined as WHZ &lt; -2 using NCHS reference.</li> <li>- Sphere key indicators</li> <li><b>Baseline Info</b></li> <li>- There was no baseline information</li> </ul>	<p>The impact of nutrition centres was demonstrated by the reduction of global wasting and its severe form in the areas covered by nutritional programmes. (Bar graph was used to illustrate. CIs and p values were not presented)</p> <ul style="list-style-type: none"> <li>- Key indicators under the sphere minimum cut-off points were good for 4 different geographical sites. Values were shown in a table.</li> <li>- Of note, the presence of patients in NCs was influenced by security, possibility of access and seasonality.</li> </ul>	<p>The current targeted short term action should evolve towards 'integrated basic needs projects', implemented by one or a consortium of partners.</p> <p>Also, health, nutrition and food security components should be considered a standard public health intervention strategy representing the most sensible approach to address the needs of the affected population.</p>

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Collins <i>et al</i> (2006)	A review to assess the impact of community-based therapeutic care (CTC) programs on severe acute malnutrition in mostly emergency situations and a few (approx 2) non-emergency situation	Malawi, Ethiopia, North Sudan and South Sudan (2000-2005)	Compilation and analyses of CTC programs in different locations	Twenty one CTC programmes were analysed. Severely malnourished children (defined according to the criteria of <70% of weight-for-height percentage of median (WHM) or MUAC < 110mm), aged < 5y. N=23,511	<ul style="list-style-type: none"> <li>- Recovery rates</li> <li>- Weight gain</li> <li>- Coverage rate</li> <li>- Cost-effectiveness (data available for 3 emergency CTC programmes)</li> </ul> Baseline info Not readily interpretable because they are all in tabular forms.	Recovery rates of 79.4% were achieved. Rates of weight gain were between 4 & 5g/kg/day which are < Sphere standards but did not result in increased mortality or default rates. Mortality rates of 4.1% were achieved which is < half of the Sphere standards. Default rates = 11% Transfer and non-recovery rates were 3.3% and 2.2% respectively. Coverage rates were approximately 73%. Of the severely malnourished children presented, 76% were treated solely as outpatients. Cost effectiveness varied from US\$12 to US\$132 per year of life gained.	Initial data indicate that CTC programs are affordable, with the cost-effectiveness of emergency community-based therapeutic programs varying from US\$12 to US\$132 per year of life gained.
Chaiken <i>et al</i> (2006)	To compare the effectiveness of the CTC strategy in combination with conventional treatments for acute malnutrition at the individual level in drought ravaged rural Southern Ethiopia (An area which is not usually associated with the drought cycle for which Ethiopia is known). This emergency was identified through a regional early warning system of the Disaster Prevention and Preparedness Commission.	Southern Ethiopia (Sept 2003-March 2004)	Data from monitoring the initial phase of programme implementation were reviewed to ascertain programme impact	Children aged less than 5y with W/H < 70% of normal, MUAC reading under 11.0cm, or bilateral oedema in their extremities were enrolled in the OTP. N= 5,799  Children with W/H between 70% and 80% of normal were enrolled in the supplemental feeding programme. N=7,961	<ul style="list-style-type: none"> <li>- Under-5 mortality rates</li> <li>- Rates of severe acute malnutrition (SAM)</li> <li>- Recovery rates determined by graduation to SFP.</li> <li>- Default rates and mortality rates</li> <li>- Coverage rates</li> </ul> Baseline info At start of programme, daily under-five mortality was 1.47/10,000 and the rate of SAM was 1.0% (95%CI, 0.5-2.0)	By the end of the programme mortality rates had improved to 0.45/10,000 and SAM rates to 0.6% (95%CI, 0.2-0.9), respectively. Out of the 5,799 children with SAM, over a 5-month period, 64.9% progressed sufficiently to graduate to the supplementary feeding programme. Default rate was low (2.3%), indicating community acceptance of the approach. Mortality rate was low (0.2%) OTP coverage was 78.3% and SFP was 86.8% which are both excellent.	CTC is an important tool to effectively address nutritional emergencies and may be a valuable entry point for long term development.  CTC may help make the transition from relief to development.
Greco <i>et al</i> (2006)	To assess the effect of milk plus porridge made from local ingredients versus milk alone on nutritional status during a war crisis in Northern Uganda as milk is not always available outside the hospital and given the disappointing results of nutritional rehabilitation with milk only.	St Mary's Nutritional Unit in Lacor, Northern Uganda (2001-2003)	<ul style="list-style-type: none"> <li>- Cohort study design in which 3 different cohorts of children were studied before and after the intervention.</li> </ul> Intervention Introduction of porridge in the diet (called nutricam) in 2002. Treatment period An average of 20 days Cohort 1- before intervention, milk only in 2001 Cohort 2- soon after intervention in 2002 Cohort 3- more than one year after intervention in 2003  Children were randomly sampled for 3 months (Oct, Nov, Dec) for each year (2001, 2002, 2003) to control for seasonal effects  <ul style="list-style-type: none"> <li>- No control group</li> <li>- Some statistics presented</li> </ul>	Children aged 6mo to 6y with severe malnutrition defined as weight < 70% of that expected for length or height (marasmic cases), peripheral oedema score between 1 and 4+ (kwashiorkor cases) or both marasmus and oedema. N= 100 cases for each year group.	<ul style="list-style-type: none"> <li>- Oedema free weight gain</li> <li>- Survival</li> <li>- Cost</li> </ul> Baseline info None provided * Of note, during the study, the number of admission increased and the status of the children at admission was worse, probably because warring factions had caused many families to abandon their village	Nutricam plus milk was more effective than milk alone in nutritional rehabilitation of severely malnourished children. Oedema disappeared rapidly, and daily weight increments rose significantly compared with treatment with milk only <ul style="list-style-type: none"> <li>- Average oedema-free weight gain increased from 21 g/d (95%CI, 12-29) in 2001 to 35 g/d (95%CI, 25-45) in 2002 and reached 59 g/d (95%CI, 51-65) in 2003.</li> <li>- Mortality decreased from 22% to 7.8%, and nutritional failures (insufficient weight gain) decreased by greater than 50%.</li> <li>- Nutricam is locally feasible at a low cost (about €0.056/serving, including labour and fuel).</li> </ul>	<ul style="list-style-type: none"> <li>- The low-cost porridge supplement (€2640/yr per 100 children) was effective in treating malnutrition.</li> <li>- Widespread use of the porridge, which resulted in better outcomes than milk alone, could produce savings in the medium to long term, thereby releasing resources for other uses.</li> </ul> Limitations There couldn't be a comparison of an untreated cohort with a different treated cohort and the cohorts could not be divided into milk-only and milk-plus-nutricam subgroups because the children were severely malnourished and in need of supplementation.

Author of study	Objective of Study	Setting	Study design, Statistics	Survey population	Indicator / outcome	Impact	Conclusion
Gabouland <i>et al</i> (2007)	To assess the effect of three nutritional strategies on recovery rates of severely malnourished children in Maradi, Niger (It is assumed that the study period (2002 to 2003) was during an emergency).	Maradi, Niger (August 2002-October 2003)	Cohort study made up of 3 groups. Group 1 maintained in a TFC during entire treatment. Group 2 initially treated at TFC and completed treatment at home. Group 3 were exclusively treated at home.	Children aged 6 to 59 mo with severe malnutrition defined as W/H index < -3 z-scores or bilateral pitting oedema or MUAC < 110mm. N= 1937 of which 660 were in group 1, 937 in group 2 and 340 in group 3.	- Weight gain - Length of stay Recovery - Case fatality - Defaulting <u>Baseline info</u> No baseline information provided. Also CIs and p values were not provided	All 3 cohort's average weight gain and time in programme met the international standards (> 8g/kg/day, 30-40 days). Default rates were 28.1, 16.8 and 5.6% for TFC only, TFC plus home-based and home-based alone strategies respectively. The case fatality rates were 18.8% for TFC only and 1.7% for home-based alone. No deaths were recorded in the TFC plus home-based group.	This study suggests that satisfactory results for the treatment of severe malnutrition can be achieved using a combination of home and hospital-based strategies.
Sadler <i>et al</i> (2007)	To compare programme coverage of two therapeutic feeding interventions (CTC and TFC) for severely malnourished children in neighbouring districts in Malawi as a result of a national nutritional emergency declared by the Malawi Government in Feb 2002.	Dowa district (CTC programme) and Mchinji district (TFC programme) in Malawi (2002-2003)	- Observational study (two surveys implemented simultaneously one in each of the two programme areas.) - Thirty 100 km <sup>2</sup> quadrats were sampled. Communities located closest to the centre of each quadrat were sampled using a case-finding approach. - Not a controlled study - Statistics presented	Cases were defined as children aged <5y with </= 70% of W/H median using NCHS reference or presence of bilateral pitting oedema. N= not stated - Seven months into implementation of both studies, a study was conducted to compare coverage. <u>Baseline info</u> Not provided	Receipt of treatment was ascertained by the child's presence in a TFP or by documentary evidence. Coverage in each quadrat was estimated in two ways, a period estimate that provides an estimation of coverage for the recent period preceding the survey and a point estimate that provides an estimation of coverage at the exact point in time of the survey. - Cost	Overall the period coverage was 24.55% (95% CI, 17.8-31.4%) in the TFC programme and 73.64% (95% CI, 66.0-81.3%) in the CTC programme. The point coverage was 20.04% (95% CI, 13.8-26.3%) in the TFP programme and 59.95% (95% CI, 51.4 - 68.5%) in the CTC programme. Cost of the CTC programme was US\$197 per child during the emergency set up programme. The equivalent cost data from the TFC programme was not available for comparison but little information from elsewhere indicates that TFC care can cost anything between US\$156 & US\$355 per child treated.	CTC gave substantially higher programme coverage than a TFC programme. Given effective treatment, this enabled higher impact of CTC on severe malnutrition in this population.
Linneman <i>et al</i> (2007)	To determine the operational effectiveness of home-based therapy with RUTF for moderate and severe childhood malnutrition in southern Malawi  (Home-based therapy with RUTF for the treatment of malnutrition has better outcomes in the research setting than standard therapy. Malawi is a chronic food insecure area with high rates of child malnutrition).	Twelve rural centres in southern Malawi (May 2005 – May 2006)	Observational Intervention study  <i>Intervention</i> - 733 kJ/kg/day of RUTF and followed fortnightly for up to 8 weeks. - Staff at each centre followed one of three models: medical professionals administered treatment (5 centres), patients were referred by medical professionals and treated by community health aids (4 centres), or community health aids administered treatment (3 centres). - Regression modelling was conducted to determine what aspects of the centre (formal training of staff or location along a main road) contributed to the outcome. - No control group - Statistics presented	Severely malnourished children (< 70% of reference W/H or presence of oedema) and moderately malnourished (70-85% of reference W/H using WFP categorization) with a good appetite. N= 2131 SAM and N= 806 MAM	- Weight gain - Recovered (If children's oedema resolved and they gained weight such that their final W/H was > 85% of their ideal W/H), - Failed (if they did not achieve a W/H > 85% of their ideal W/H or relapsed requiring inpatient treatment), - Died or dropped out. - Aspects of the centre (formal training of staff or location along a main road) contributing to outcome <u>Baseline info</u> 98% of children with SAM had kwashiorkor. Mean (SD) of WHZ was -1.5(1.4) in children with SAM and -2.7(0.56) in children with MAM respectively.	On average, children with severe malnutrition gained 3.5 g/kg/day (SD= 4.1) and children with moderate malnutrition gained 4.6 g/kg/day (SD= 4.1) Recovery was 89% in children with SAM and 85% in children with MAM. Thirty-four (4%) of the moderately malnourished children failed, with 20 (2%) deaths, and 61 (3%) of the severely malnourished children failed, with 29 (1%) deaths. Centre location along a road was associated with a poor outcome. Outcomes for severely malnourished children were acceptable with respect to both the Sphere guidelines and the Prudhon case fatality index.	Home-based therapy with RUTF yields acceptable results without requiring formally medically trained personnel; further implementation in comparable settings should be considered.

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Author of study	Objective of Study	Setting	Study design, Statistics	Survey population	Indicator / outcome	Impact	Conclusion
Belachew and Nekatibeb (2007)	To document the experiences and lessons for rolling out of the OTP service at the wider scale with the aim of assessing the strengths and weaknesses of the project and suggest recommendations for future programming. <i>(Ethiopia is an area with chronic food insecurity and nutritional problems caused by successive droughts).</i>	OTP pilot programme implemented in 3 regions namely; South Nations and Nationalities Peoples Regions (SPNNR), Addis Ababa and Oromia regions of Ethiopia (16-25 Nov 2006)	Qualitative study - Qualitative methods of data collection including focus group discussion, observation and in-depth interview of key informants. - Review of health facility, reports and programme documents.	Subjects included 36 key informants and 30 focus group discussants	- Attitude change - Utilisation of existing health equipments - Awareness of malnutrition and its treatment - Reduction in the burden of malnutrition and associated mortality	OTP has enhanced community's understanding of malnutrition as a health problem through an excellent entry point it created for BCC on optimal IYCF.  It has also enhanced utilisation of the existing equipments of the respective health services to promote nutrition and increased mental satisfaction of the providers who observed rapid recovery of malnourished children taking the plumpy nut.  OTP resulted in increased awareness of the community about malnutrition and its treatment, resulting in increased need-based demand for the OTP and self-referral of children to health facilities.  Shift in the thinking of providers on the fact that malnutrition can be treated without admitting the child and reduction in the burden of malnutrition and associated mortality are other positive findings of the study.	While it was observed that the programme was very effective in treating case of SAM and is highly acceptable by planners, health care providers and beneficiaries, there were different operational issues that needed to be strengthened.  The irregularity and incompleteness of supply availability, high attrition of trained human power, inadequate supportive supervision especially from local MOH, inadequate community mobilisations are some of the shortcomings identified. Based on these findings recommendations were forwarded.
Rossi <i>et al</i> (2008)	To evaluate the impact and appropriateness of programmes for the management and treatment of severe malnutrition in an emergency situation in Burundi.	Nutrition centres in Burundi (1999 – 2004) - But mostly specific on 2004 data	<i>Impact of previous nutrition programmes</i>  Longitudinal data collected in a cross-sectional population-based survey  <i>This evaluation</i> National estimates using cluster surveys and standardised methodology for data collection	All age groups  <i>From 1999-2004</i> N= 1,054,210 severely malnourished patients of which 131,668 were treated in TFC and 922,542 in SFC.  <i>For 2004 only</i> Twenty TFCs and 224 SFCs were active in Burundi N= 127,420 patients of which 15309 were treated in TFC and 112,111 in SFC. Children < 5y accounted for 62% of beneficiaries in TFC and 76% in SFC.	- Under 5s mortality rates - Acute malnutrition - Coverage - Recovery rate, % - Defaulter rate, %  <b>Baseline info</b> In 2000, under-5s mortality rate was estimated at 6 deaths/10,000/d while prevalence of acute malnutrition was 8% and its severe form was 0.5%  No CIs or p values were reported	- The most convincing impact of the nutritional programme in Burundi was the reduction of mortality rate in children <5y to rates of between 3.1 to 4.9 deaths/ 10000/d.  - There was a small reduction on the rates of acute malnutrition to 7% and a worsening of the prevalence of severe forms to 1.1%  - <b>Coverage</b> Nutritional programmes were present in every province with a coverage rate of 55%.  - TFC performance indicators (results shown as a bar graph) fulfilled the minimum standards in disaster response while SFC had a low recovery rate (69% v >80%) and a high non- respondent rate (10% v < 5%).  - Combining coverage and cure rates, the programme met 44% of the assessed needs in 2004.	An impact on the prevalence of acute malnutrition could not be demonstrated.  In Burundi, the stabilisation of security conditions permitted a combination of humanitarian responses ranging from emergency activities to strengthening of community-based initiatives that could correct the coverage and impact limitations.
Dubray <i>et al</i> (2008)	To compare the effectiveness of two systemic antimicrobial treatments administered to children with SAM on admission in a TFC in an IDP area in south Sudan.	Mayo TFC, Khartoum-Sudan. (Jan 2002-Sept 2003).	- A randomised, unblinded, superiority-controlled trial comparing: once daily injection of intramuscular (IM) ceftriaxone for 2 days vs twice daily oral amoxicillin over 5 days (10 doses).  - No control group  - Nutrition rehabilitation took place in 3 phases; stabilization, rehabilitation and administration of drugs	From an internally displaced population, children aged 6 to 59 mo with SAM (defined as W-H% < 70% of the reference median using NCHS/CDC 1977 growth reference curves) and/or presence of oedema and/or MUAC < 110mm.  N= 458 of which 230 = amoxicillin group and 228 in the ceftriaxone group.	- Weight gain (WG) (Treatment was defined as successful when children had gained $\geq 10$ g/kg/day by the 14th day of WG). - Recovery rate - Case fatality ratio (CFR) - Defaulter rate - Referral rate  <b>Baseline info</b> In the amoxicillin group, 72.1% had W-H% < 70% without oedema, 15.7% had MUAC < 110mm without oedema and 12.2% had bilateral oedema. In the ceftriaxone group, it was 74.1%, 15.8% and 10.1% respectively.	In the intension to treat analysis, 53.5% (123/230) in the amoxicillin group and 55.7% (127/228) in the ceftriaxone group (difference 2.2% 95%CI, -6.9 to 11.3) had a WG $\geq 10$ g/kg/day during a 14-day period.  Recovery rates were 70% and 74.6% in the amoxicillin and ceftriaxone groups respectively with CFR being 3.9% and 3.1% respectively.	In the absence of severe complications, either ceftriaxone or amoxicillin is appropriate for malnourished children.  However in ambulatory programmes, especially where there are large numbers, ceftriaxone should facilitate the work of medical personnel.

Author of study	Objective of Study	Setting	Study design, Statistics	Survey population	Indicator / outcome	Impact	Conclusion
Colombatti <i>et al</i> (2008)	To determine (i) the extent of malnutrition and the risk factors for severe malnutrition in Guinea Bissau, a post-conflict country experiencing long term consequences of civil war and (ii) the feasibility and effectiveness of a short-term intervention characterized by outpatient treatment with locally produced food for the treatment of severe malnutrition during the rainy season.	Outpatient clinic in Bissau, Guinea Bissau (July 1- Aug 12, 2003)	Intervention study Intervention= local semi porridge which consisted of black millet, wheat, dry banana, cabaceira, powdered milk, dry egg yolk, sugar, salt and a vitamin mix. It was cooked every day in water and oil was added to reach an energy density of 1808 kJ/100 g (432 kcal/100 g).  - No control group - Some statistics presented	N= 2642 children, age range: 1mo -17y. Severely malnourished children were  <i>Results for objective (i)</i> 2272 (85.9%) of the examined children had a certain degree of malnutrition (shown as a bar graph) Weight-for-age was < -2SD in 23% of the children and <-3SD in 10.3%. 1.4% were severely malnourished (defined as W/A < -3 SD using NCHS/ WHO reference) and admitted for day care [nutritional outpatient unit (NOU)]. - N=37  Significant differences between the general population and the severely malnourished children observed were severely malnourished children in poor health status were mainly infants (P<0.001), part of large families (P<0.001), did not have a bathroom at home (P<0.001), did not use aqueduct water (P<0.001) and lived in mud houses (P<0.001). Mother's illiteracy was higher in the malnourished group (P<0.001).	Weight gain Length of stay Cost	All 37 children recovered with a weight gain of 4.45 g/kg/d (range: 0.97-8.67 g/kg/d, with an overall weight increase that ranged from 1% to 25% of initial body weight.  Mean length of stay in NOU was 19d (range: 2-33d).  At 1y follow up, 36 children were alive, had maintained weight gain (with W/H of 0 to +1SD and W/A of 0 to +1SD) and avoided relapse. One child died from HIV-related TB.  <i>Costs</i> Mean cost of €5 per child. Overall cost of the intervention was €13448 of which foreign personnel cost €6219, local personnel salaries, medical supplies, drugs for 2642 children, health education materials for their mothers cost €7229.	Short-term interventions performed in post-conflict countries during seasons of high burden of disease and malnutrition, is feasible and successful at low cost.  Day-care treatment of severe malnutrition with locally produced food is an option that can be tested in other settings.
Amthor <i>et al</i> (2009)	To describe the impact of OTP in addressing the operational impasse of geographic distance and lack of existing health centre support in treating childhood malnutrition in a rural area during a food crises. This was as a result of the famine declared in Malawi in Jan of 2006 by the international community.	Machinga district, Malawi (March – July 2006)	- <i>Intervention study using RUTF for 8 weeks</i> - <i>No control group</i>	Severely malnourished children aged 6 to 60 mo with an adequate appetite presented to 1 of 5 OTP centres in Machinga district. N=826  (Severe malnutrition defined as either the presence of oedema or having a W/H < 70% of the 2006 WHO reference standard.	- Recovered, defined as reaching 85% or more of ideal weight-for-length  - Remained malnourished - Defaulted - Died  <i>Baseline info</i> Not provided	Out of 826 children 93.7% recovered, 1.8% remained malnourished, 3.6% defaulted and 0.9% died.  The fraction of children with severe malnutrition before and after treatment was significantly less, p<0.0001 using x2 test.  Mean weight gain was 2.7+/-3.7 g/kg/d, height gained 0.3+/-0.9mm/d, and MUAC gained 0.2 ± 0.3mm/d.  Using a paired t-test, all these outcomes were significantly different after treatment (p<0.0001).	Home-based therapy with RUTF administered by village health aides is an effective approach to treating malnutrition during food crises in areas lacking health services.
Guerrero <i>et al</i> (2010)	To identify the principle factors that negatively affects the coverage of CTC programmes. ( <i>Data are mostly from emergency situations</i> )	the DRC, Ethiopia, Malawi, Niger and North and South Sudan (2003-2006)	Retrospective analysis of quantitative & qualitative data.  Quantitative data was from Centric System Area Sampling (CSAS) Coverage Surveys.  Qualitative data was procured through socio-cultural assessments of these programmes.  - Questionnaire administered to carers of cases of malnutrition who were not enrolled in the programme has been used to investigate the reasons for non-attendance and to pinpoint issues undermining programme coverage	Caretakers of children N= 1,696	Reasons for non-attendance to CTC programmes - Fear of rejection - Distance to sites - Lack of awareness of the programme - Insecurity on route - Negative client experiences at sites - Condition not always recognised as malnutrition - Opportunity costs - Husband's refusal - Palatability of food - Shame - Elderly-headed household - No one to care for other children at home - Fear of cross-infection at the sites - Harvest obligations	- Previous rejection from programme was identified as a reason for non-attendance by CSAS survey questionnaires in 10 of the 12 programmes  - Awareness of the programme and the conditions that it treats, was also identified as a main determinant of coverage  - Distance to sites was found to be the primary barrier to access for 10.8% of severely malnourished cases not enrolled in CTC programmes.	- CTC programme coverage in emergencies can be improved by tackling three common factors; distance to sites, community awareness of the programme and the way in which rejections are handled at site, which together account for approximately 75% of non-attendance.

#### 4. Summary of published studies assessing the impact of micronutrients distribution programmes in emergency situations

Author of study	Objective of Study	Setting	Study design, Statistics	Survey population	Indicator / outcome	Impact	Conclusion
Lopriore <i>et al</i> (2004)	To assess the effect of a highly nutrient-dense spread fortified with vitamins and minerals, and/or antiparasitic metronidazole treatment, in correcting retarded linear growth and reducing anaemia in stunted Saharawi refugee children. (After political changes during the 1970s, the Saharawi people fled their homeland in the Western Sahara desert and for more than 25y have lived in what can be defined as a permanent state of emergency).	Saharawi refugee camps, west Algeria (May 1998- Jan 1999)	<ul style="list-style-type: none"> <li>- Randomised, double-blind, placebo-controlled supplementation trial with or without anti-parasitic treatment. Children were assigned to 1 of 5 groups namely; Fortified spread (FS), Fortified spread and metronidazole (FS+M), Unfortified spread (US), Unfortified spread plus metronidazole (US+M), Or control.</li> <li>- Supervised supplementation was given daily for 6 months</li> <li>- Indicators were assessed at 0, 3 and 6 months.</li> <li>- Statistics presented</li> </ul>	Of 1144 children identified in the census conducted in the refugee camps, 374 children were eligible to enter the study. Stunted children aged 3-6y N= 374, a total of 75 children for each group (Stunting defined as HA < -2 z scores using WHO/NCHS reference). Intervention – 50g/d of a fat spread high in energy & proteins and fortified with vitamins and minerals.	<ul style="list-style-type: none"> <li>- Linear growth</li> <li>- Increase in Hb concn.</li> <li>- Anaemia</li> </ul> <p>Baseline info 254 children completed the study</p> <p>FS group N= 51 HAZ = -2.87 ± 0.56 Hb(g/L) = 92 ± 23 % with anaemia = 70.6%</p> <p>FS + M group N= 52 HAZ = -2.8 ± 0.62 Hb(g/L) = 90 ± 22 % with anaemia = 82.7%</p> <p>US group N= 52 HAZ = -2.73 ± 0.55 Hb(g/L) = 91 ± 19 % with anaemia = 82.7%</p> <p>US + M group N= 54 HAZ = -2.97 ± 0.84 Hb(g/L) = 89 ± 22 % with anaemia = 83.3%</p> <p>Control group N= 45 HAZ = -3.00 ± 0.71 Hb(g/L) = 91 ± 23 % with anaemia = 82.2%</p>	<ul style="list-style-type: none"> <li>- Linear growth of children fed FS was 30% faster at 3mo than in US and control groups, after which HAZ increased only slightly in the FS group and remained unchanged in the other groups.</li> <li>- At 6 mo, HAZ was significantly increased in the FS groups (0.15 ± 0.22), whereas it remained unchanged in the other groups (MANOVA, P &lt; 0.0001). The magnitude of the catch-up growth response was negatively associated with the age at baseline (<math>\beta = -0.034</math>; 95% CI: -0.045, -0.022); hence, the younger the age, the greater the growth increase. This effect remained after correcting for differences in treatment between groups, initial Hb concn, and baseline HAZ (<math>\beta = -0.0315</math>; 95% CI: -0.043, -0.020). Baseline HAZ was negatively associated with growth increase, but the effect was not significant (<math>\beta = -0.097</math>; 95% CI: -0.289, 0.096).</li> <li>- No additional benefits from metronidazole were observed.</li> <li>- Increase in Hb concn. in the FS group at 6mo was twofold that in the US and control groups (37 ± 40, 19 ± 15 and 16 ± 17 g/L respectively; p &lt; 0.0001) and anaemia was reduced by nearly 90%.</li> </ul>	<ul style="list-style-type: none"> <li>- FS, and not US, induces catch-up growth in stunted children whose diets are poor in micronutrients.</li> <li>- This trial provides support for delivering multiple micronutrients to reverse stunting and reduce anaemia in children up to age 6y.</li> </ul>
Moench-Pfanner <i>et al</i> (2005)	To assess the effect of food-for-work programs (a post crises response) on nutrition outcomes particularly anaemia. (Indonesia's economic crisis of late 1990's lowered consumption of micronutrient-rich foods, which increased the prevalence of micronutrient deficiencies, including anaemia).	Food-for-work (FFW) were implemented in 3 urban and 2 rural sites in Indonesia (Dec 2000- Sep 2003)	<ul style="list-style-type: none"> <li>- A quasi-experimental design in which both programme beneficiaries as well as non-participating comparison households (controls) were followed longitudinally.</li> <li>- Control group</li> <li>- Surveys were conducted at baseline and at 6mo intervals for 2.5y</li> <li>- Statistics presented</li> </ul>	Children aged and mothers N= 1500 randomly selected HH and 1500 controls in each site using interval sampling.	<ul style="list-style-type: none"> <li>- Mainly anaemia</li> <li>- To better understand the "income effect" of the FFW programs, HH expenditure data were collected by asking the respondents for the amount spent in the previous week on &gt;20 items and on categories of expenditure.</li> </ul> <p>Baseline info (Provided but in tabular form)</p>	<ul style="list-style-type: none"> <li>- Food-for-work programs had limited effect on anaemia.</li> <li>- Only among urban poor mothers in Subaraya were the odds of anaemia at endline lower when participating in the FFW programme (0.6, 95% CI [0.40-0.89]).</li> <li>- The poor were found to be appropriately targeted and programme participation ranged from 4 to 18 months.</li> <li>- The proportion of households with debts ranged from 32 to 70%; although it was higher among beneficiaries than controls, it increased among controls, but not beneficiaries.</li> </ul>	Micronutrient deficiencies should be addressed directly via supplements and fortified foods. Closer attention is required to the potential for affecting nutritional outcomes through FFW, including food aid quality and quantity and complementary non food interventions.

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Author of study	Objective of Study	Setting	Study design, Statistics	Survey population	Indicator / outcome	Impact	Conclusion
Nielsen <i>et al</i> (2005)	To evaluate the impact of vit A supplementation on childhood mortality during the war - emergency in Guinea-Bissau from June 1998 – May 1999. <i>Vit A supplementation is recommended by WHO in emergency situations but no reported study on the impact of Vit A in emergencies have been found.</i>	Bissau, Guinea Bissau (Oct 1, 1998- Mar 31, 1999) <i>Vit A supplementation had not been provided routinely in Guinea-Bissau in peacetime.</i>	<ul style="list-style-type: none"> <li>- Observational study. Since study couldn't be randomised, impact was evaluated in different ways;</li> <li>- Used variation in the delay of provision of vit A in a step-wedged design</li> <li>- Compared wartime with pre-wartime mortality</li> <li>- Examined whether vit A as a free commodity reduced cultural and social economic inequalities in childhood mortality.</li> <li>- No control group</li> <li>- Statistics presented</li> </ul> <p><i>Pre-war time (Oct 1, 1995- Mar 31, 1996 + Oct 1, 1996- Mar 31, 1997 + Oct 1, 1997- Mar 31, 1998)</i></p>	Children aged 6-59 mo living in Bissau. N= 5926 of which 2911 received at least one dose of vit A supplementation. Children aged 6-12 mo received at least one oral dose of 100,000 IU while older children received 200,000 at home every three months by a field worker.	<p>Mortality rates (deaths/ PY)</p> <p><u>Baseline info</u> Pre-war Mortality rates (deaths/ PY) = 0.02 (76/3399)</p>	<p>Using the variation in the provision of Vitamin A, a slight non-significant reduction in mortality for children between 6 months and 5 years of age (mortality ratio (MR) 0.49; 95% CI 0.09–2.70) was found.</p> <p>Comparing with a three-year period before the war, children offered Vitamin A at home during the war had a 12% reduction in mortality (MR 0.88; 0.41–1.87), whereas the overall impact of the war was an 89% increase in mortality (MR 1.89; 1.32–2.71).</p> <p>Vitamin A supplementation was associated with a reduction in cultural and socio-economic inequalities.</p>	Vit A supplementation may have a beneficial impact on childhood mortality in an emergency situation .
Menon <i>et al</i> (2007)	To assess the effectiveness of an intervention providing 2 mo of micronutrient Sprinkles (containing 12.5 mg iron and other key micronutrients) in reducing anaemia among children in rural Haiti. <i>(An area where more than one-half of children under the age of 2y are anaemic).</i>	Central Plateau region of Haiti (Mar-Sep 2005)	<p>A cluster randomized pre-post intervention design that compared before- and after-Hb measurements and prevalence of anaemia among children who received Sprinkles along with their Wheat-soy blend ration (S-WSB group) and children who received only WSB (WSB group).</p> <p><i>Sprinkles intervention included 2 parts: a 2-mo supply of Sprinkles and a BCC intervention, which conveyed information on appropriate use of the Sprinkles. There was a 2mo and 7mo follow up period.</i></p> <ul style="list-style-type: none"> <li>- <i>Untreated control group for 2 months</i></li> <li>- <i>Statistics presented</i></li> </ul>	Children aged 9 to 24 mo with Hb > 70g/L N= 415 of which 254 in S-WSB group and 161 in WSB group	<ul style="list-style-type: none"> <li>- Hb levels</li> <li>- Anaemia prevalence (Hb &lt; 100 g/L)</li> <li>- Cost</li> </ul> <p><u>Baseline info</u> At baseline, anaemia prevalence adjusted for age and sex, was 54% and 39% in S-WSB and WSB groups, respectively.</p>	<ul style="list-style-type: none"> <li>- After the 2-mo intervention (1st follow-up), anaemia, adjusted for baseline prevalence, age, and sex dropped to 24% in S-WSB (P&lt; 0.001) and increased to 43% in WSB (P=0.07).</li> <li>- At 7mo post intervention, anaemia in S-WSB declined to 14%; 92% of children who were non anaemic at 1st follow-up remained so without further Sprinkles consumption. From baseline to 1st follow-up, mean Hb increased by 5.5 g/L and dropped by 1.0 g/L in the S-WSB and WSB groups, respectively (P&lt;0.001). From baseline to 2nd follow-up, mean Hb increased by 10.9 g/L in S-WSB (P&lt;0.001). Changes in mean Hb were greater for younger children (&lt;21 mo at onset of intervention) (P&lt;0.05) and for children who were anaemic at baseline (P &lt; 0.001).</li> </ul> <p>The total cost of the 2-mo Sprinkles supply was \$2US.</p>	In populations with a high prevalence of anaemia, such as rural Haiti, 2 mo of Sprinkles are effective in reducing anaemia among 9- to 24-mo-old children.
Seal <i>et al</i> (2008)	To assess the impact of fortified maize meal on iron and vitamin A status of food aid dependent refugees	Nangweshi refugee camp, Zambia (July 2003, July 2004)	<ul style="list-style-type: none"> <li>- Pre- and post-intervention using a longitudinal cohort (subjects were followed up after 12 months.</li> <li>- No control group</li> <li>- Statistics presented</li> </ul>	<ul style="list-style-type: none"> <li>- Children aged 6-69 months. N= 157</li> <li>- Adolescents aged 10 -19y N= 212</li> <li>- Women aged 20 - 49y N= 118VBN ,M</li> </ul> <p><i>sTfR = Serum transferrin receptor</i></p>	<ul style="list-style-type: none"> <li>- Hb conc.</li> <li>- Anaemia defined as Hb &lt; 110g/l</li> <li>- Serum transferrin receptor</li> <li>- Vitamin A status</li> </ul> <p><u>Baseline info</u> (Means &amp; 95%CI are shown)</p> <p><i>Children n=155</i> Hb(g/dl) = 10.9 (10.6, 11.2); Anaemia (%) = 47.7 (39.7, 55.9); WHZ = -0.14(-0.27, -0.01); HAZ = -1.83 (-2.01, -1.64).</p> <p><i>Adolescents n=213</i> Hb(g/dl) = 12.9 (12.7, 13.2); Anaemia (%) = 19.2 (14.2, 25.2); Log10 sTfR (µg/ml) = 0.875 (0.849, 0.901); % Fe deficient (sTfR &gt; 8.3µg/ml) = 31.5(25.2, 38.4); Serum retinol (µmol/l) = 0.73 (0.69, 0.77); % vit A deficient (serum retinol &lt;0.7µmol/l) = 46.4 (39.4, 53.4).</p> <p><i>Women n= 91</i> Hb (g/dl) = 13.1 (12.7, 13.5); Anaemia (%) = 16.5 (9.8, 26.1).</p>	<p>During the intervention period, mean Hb increased in children (0.87g/dl; p&lt;0.001) and adolescents (0.24g/dl; p=0.043) but did not increase in women.</p> <p>Anaemia decreased in children by 23.4% (p&lt;0.001) but no significant change in adolescents or women.</p> <p>sTfR log<sub>10</sub>-transformed decreased by -0.082µg/ml (p=0.036) indicating an improvement in the Fe status of adolescents but there was no significant decrease in the prevalence of deficiency (-8.5%; p=0.079).</p> <p>In adolescents, serum retinol increased by 0.16µmol/l (p&lt;0.001) and vitamin A deficiency decreased by 26.1% (p&lt;0.001).</p>	The introduction of fortified maize meal led to a decrease in anaemia in children and a decrease in vitamin A deficiency in adolescents. Centralised , camp-level milling and fortification of maize meal is a feasible and pertinent intervention in food aid operation

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Author of study	Objective of Study	Setting	Study design, Statistics	Survey population	Indicator / outcome	Impact	Conclusion
Magoni <i>et al</i> (2008)	To evaluate the effectiveness of an emergency project (universal iron supplementation and food supplementation) for the reduction of iron deficiency and malnutrition among children in Palestine due to the emergency situation caused by the outburst of the second intifada in September 2000.	- Yatta area, West Bank (2002-2005) - Southern and South-Western areas of Hebron governorate, West Bank, Palestine (August 2004 – July 2005) later referred to as other areas	- Two cross sectional surveys to measure before and after intervention of two independent random samples of children living in target areas. - No control group - Statistics presented	<i>Before the project</i> Subjects aged 6–59 months were randomly selected from a list of children living in target areas N= 266 of which 152 was Yatta area and 114 other areas  <i>After the project</i> Subjects aged 9–59 months were randomly selected from a list of children living in target areas N= 367 of which 150 was Yatta area and 217 other areas  - Information about use of iron supplementation during project period was collected.	- Prevalence of anaemia (defined as Hb level < 11g/dl). - Wasting or acute malnutrition, stunting or chronic malnutrition and underweight (defined as W/H, H/A and W/A < -2 SD of NCHS reference respectively).  <u>Baseline info</u> Prevalence of anaemia, underweight and wasting for all children were 30.1% (CI 95%: 24.5–35.6%), 10.9% and 6.0% respectively. - Using geographical areas anaemia, wasting, stunting and underweight were 17.1%, 5.9%, 22.4% and 14.5% for Yatta respectively and 47.4%, 6.1%, 11.4% and 6.1% for other areas respectively.	The prevalence of anaemia for all children decreased from 30.1% (CI 95%: 24.5–35.6%) to 18.8% (CI 95%: 14.8–22.8%); decrease of 38%, p = 0.001). Levels and reduction in anaemia prevalence were different according to geographical areas: in Yatta area where prevention activities had been implemented in previous years, prevalence of anaemia was 17.1% and remained stable at lower levels (14.7%). In other areas it sharply declined from 47.4 to 21.7% (p < 0.0005); the decline was present only for children who received iron supplementation.  Comparison of anthropometrics index before versus after the project showed that underweight declined from 10.9 to 3.8% (p = 0.0006) and wasting declined from 6.0 to 1.4% after (p = 0.0025) for all children.	With simple epidemiological tools we could demonstrate and measure the effectiveness of our interventions on the health status of the general population: a 50% reduction of anaemia and a 70% reduction of global acute malnutrition.
Talley <i>et al</i> (2010)	To evaluate the effectiveness of stainless steel (Fe alloy) cooking pots in reducing Fe-deficiency anaemia in food-aid dependent populations	Two long-term refugee camps in western Tanzania (Dec 2001-Jan 2003)	- Pre- and post-intervention (stainless steel pots) with repeated cross-sectional surveys conducted at 0, 6 and 12 months post intervention.  One camp served as intervention while the other served as a control group (ie continued using aluminium and clay pots). - Statistics presented	Children aged 6 to 59 months N=approx 110  Non pregnant mothers N= approx 110  <i>sTfR = Serum transferrin receptor</i>  IQR= Interquartile range (25th, 75th percentiles).	- Hb conc. - Anaemia (defined as Hb < 11.4 g/dl and 12.4 g/dl (because of high altitude) for children and non pregnant mothers respectively)  <u>Baseline info</u> * = mean (SD) ° = Median & IQR.  <u>Intervention group</u> *Hb (g/dl) = 11.5 (1.6) and 14.5 (1.4) for children and mothers respectively while °sTfR (µg/ml) = 7.5 (6.0, 9.9) and 5.9 (4.8, 5.9).  <u>Control group</u> *Hb (g/dl) = 11.7 (1.4) and 13.7 (1.5) for children and mothers respectively while °sTfR (µg/ml) = 8.4 (6.5, 10.8) and 5.7 (3.6, 7.3).	<i>Children</i> There was no change in Hb conc. at 1 y; however, Fe status was lower in the intervention camp than the control camp (sTfR conc: 6.8 v 5.9 µg/ml; p<0.001).  <i>Non pregnant mothers</i> There was no change in Hb conc. at 1 y; however, Fe status was lower in the intervention camp than the control camp (sTfR conc: 5.8 v 4.7 µg/ml; p= 0.003).	Distribution of stainless steel pots did not increase Hb conc. or improve Fe status in children or their mothers.  The distribution of stainless steel pots in refugee context is not recommended as a strategy to control Fe deficiency.

## 5. Summary of published studies assessing the impact of food security or agricultural intervention in emergency situations

Author of study	Objective of Study	Setting	Study design, Statistics	Survey population	Indicator / outcome	Impact	Conclusion
Doocy <i>et al</i> (2005)	To assess the impact of a microfinance programme on nutritional status and assessment of coping capacity in chronic drought conditions. A severe drought affected the study areas in 2002/2003	Two rural sites (Adama site & Sodo site in Ethiopia (May 2003)	<ul style="list-style-type: none"> <li>- Observational study (A three group cross-sectional survey)</li> <li>This study compared two groups of clients that received loans with a control group.</li> <li>i) <i>established clients</i>- have completed two or more loan cycles</li> <li>ii) <i>incoming clients</i>- have completed one loan cycle or less and been participating in the programme for no more than 10 mo)</li> <li>iii) <i>Community controls</i>- had not received a loan within the past year and were not seeking a loan.</li> </ul> <p><i>The sample was stratified by survey site and client sex.</i></p> <ul style="list-style-type: none"> <li>- Statistics presented</li> </ul>	<p>Total of 819 households</p> <p>Children aged 6-59 months N = 608</p> <p>Female respondents N=352</p> <p>Male respondents N=456</p>	<ul style="list-style-type: none"> <li>- Severe and moderate to severe acute malnutrition using MUAC of &lt;11.0cm and &lt; 12.5cm respectively for children</li> <li>- Acute malnutrition for females and males using MUAC of &lt; 22.0cm and &lt;23.0cm respectively</li> </ul> <p><b>Baseline info</b> None provided</p> <p><b>*Study limitations</b></p> <ul style="list-style-type: none"> <li>i) non randomization of subjects to experimental &amp; control groups</li> <li>ii) Cross sectional design's Inability to control for secular trends or directional changes in characteristics of the population over long periods of time.</li> </ul>	<p>In the total sample, 5.8% of children were severely wasted and 10.2% of children were moderately wasted. The prevalence of oedema was 1.8%, and 17.8% of children were classified as having global acute malnutrition.</p> <p>In the primary survey site, Sodo, female clients and their children had significantly better nutritional status than other comparison groups: the odds of malnourishment in female community controls compared to established female clients was 3.2 (95% CI: 1.1–9.8) and the odds of acute malnutrition in children 6–59 mo were 1.6 times greater in children of both male clients and community controls (95% CI: .78–3.32).</p> <p>Male clients and community controls were 1.94 (95%CI:1.05-3.66) and 2.08 (95% CI:1.10- 4.00) times respectively more likely to have received food aid during the past year than female clients</p>	<p>Findings of the study suggest that microfinance programs may have an important impact on the nutritional status and well-being of female clients and their families especially in the context of drought and food insecurity.</p>
Abebe <i>et al</i> (2008)	To describe an emergency livestock-related intervention (commercial destocking) in place of food aid in a drought ravaged area	Moyale district, southern Ethiopia (2006)	<ul style="list-style-type: none"> <li>- Intervention study</li> <li>Intervention = destocking. An estimated 20,000 cattle valued at USD 1.01 million was purchased</li> <li>- Impact was assessed using both participatory approaches and conventional sampling with statistical analysis</li> <li>- Statistics presented</li> </ul>	<p>Pastoralists households, N=approx 5,405 HH</p> <p>For impact assessment Seven kebeles &amp; out of the 570 HH that had destocked, 20% were randomly selected <b>N= 114 HH.</b></p> <p>(A kebele is a cluster of villages representing the smallest administrative unit in Ethiopia).</p>	<ul style="list-style-type: none"> <li>- Saves human lives</li> <li>- Helps fast recovery and herd rebuilding</li> <li>- Helps to cope with effect of the drought</li> <li>- Helps the livestock to survive</li> <li>- Benefits the poor the most</li> <li>- Socially and culturally acceptable</li> <li>- Timely and available</li> <li>- Overall preference</li> </ul> <p><i>Means and 95%CI provided in graph forms</i></p>	<p><b>Impact on livelihoods: income and expenditure</b></p> <ul style="list-style-type: none"> <li>- On average, destocked households received USD 186 from the sale of cattle</li> <li>- Destocking was considered to be the most useful intervention with mean score 9.1 (95% CI:8.5, 9.7) than any other intervention.</li> <li>- Income from destocking accounted for 54.2% of HH income (<i>which was significantly higher than any other source at 95% confidence level</i>) of which 79% was used to buy food, care for livestock, meet various domestic expenses, support relatives, and either pay off debts or augment savings.</li> <li>- Expenditure on livestock care amounted to 36.5% of local spending.</li> <li>- Informants confirmed they were able to buy their own food (as well as other things like medicine and clothes) with money obtained from destocking instead of having to wait for food aid as in previous years.</li> <li>- Food aid was perceived as the third most preferred option and was a particularly important type of support for poorer HH</li> </ul> <p><b>Cost-benefit</b> The cost-benefit ratio was 41:1</p>	<p>Commercial destocking is a viable and useful drought intervention.</p> <p>The potential for commercial destocking to reach the most vulnerable pastoralist HH requires further research, as does the most appropriate combinations of livelihoods-based interventions such as destocking and food aid.</p>

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Author of study	Objective of Study	Setting	Study design, Statistics	Survey population	Indicator / outcome	Impact	Conclusion
Bezner <i>et al</i> (2010)	To investigate whether children in households involved in a participatory agriculture and nutrition intervention had improved growth compared to children in matched comparable households and whether the level of involvement and length of time in the project had an effect on child growth.  (An area with chronic food insecurity, high levels of child malnutrition and high levels of HIV prevalence)	A rural area in northern Malawi (2001-2007)  A participatory agriculture and nutrition project (the Soils, Food and Healthy Communities (SFHC) project) was initiated by Ekwendeni Hospital aimed at improving child nutritional status with smallholder farmers	A prospective quasi-experimental study  - Compared baseline and follow up data in 'intervention' villages with matched subjects in 'comparison' villages. Mixed model analyses were conducted on standardized child growth scores (weight- and height-for-age Z-scores), controlling for child age and testing for effects of length of time and intensity of village involvement in the intervention.  - Agricultural interventions involved intercropping legumes and visits from farmer researchers, while nutrition education involved home visits and group meetings.	Participants in intervention villages were self-selected, and control participants were matched by age and household food security status of the child. Over a 6-year period, nine surveys were conducted, taking 3838 height and weight measures of children under the age of 3 years	- Child growth pattern  Baseline info Control and intervention households showed no significant differences in landholding size (average of 1.1 ha), formal education (86–87% with some primary education), livestock ownership (72% v. 78% of households) or child nutritional status (47% v. 48% of children stunted).	There was an improvement over initial conditions of up to 0.6 in WAZ (from -0.4 (SD 0.5) to 0.3 (SD 0.4)) for children in the longest involved villages, and an improvement over initial conditions of 0.8 in WAZ for children in the most intensely involved villages (from -0.6 (SD 0.4) to 0.2 (SD 0.4)).	Long-term efforts to improve child nutrition through participatory agricultural interventions had a significant effect on child growth.

## 6. Summary of published studies assessing the impact of general ration distribution programmes in emergency situations

Author of study	Objective of Study	Setting	Study design, Statistics	Survey population	Indicator / outcome	Impact	Conclusion
De Waal <i>et al</i> (2006)	To investigate whether a vast, semi-nationwide distribution of general rations, improved the survival chances of children in the general population.  <i>(Distribution of general rations was in response to the 2002/2003 drought)</i>	Rural and urban and drought-affected and unaffected localities in Ethiopia (Apr-Jun 2004)	Observational study (cross-sectional surveys) Data were collected on patterns of mortality, socio-economic determinants of child survival, and the food, water, and livelihood security of households in the study sample.  The Trussell equations of the Brass method with Coale-Demeny West Model life tables were used to estimate child survivorship and backward extrapolation to estimate child mortality rates at dates in the recent past.  - Some statistics presented	Children aged 0 to 5 years N= 4816 households	Infant and child mortality  Receipt of food aid  Determinants of child survival	Infant and child mortality rates were 94/1000 and 134/1000 respectively.  HH-level demographic factors, HH-level food and livelihood security, community-level economic production, and access to potable water were predictive of child survival.  HH receipt of food aid had a small but significant positive association with child survival, although either the underlying causal mechanisms of this association or the role of confounding factors cannot be determined	It is remarkable that the most extensive drought in the country's modern history passed without a measurable increase in child mortality among the general population.



## 7. Summary of published studies assessing the impact of conditional cash transfers or vouchers in emergency situations

Author of study	Objective of Study	Setting	Study design, Statistics	Survey population	Indicator / outcome	Impact	Conclusion
Mascue-Taylor <i>et al</i> (2010)	To determine whether a cash-for-work programme during the annual food insecurity period in Bangladesh improved nutritional status in poor rural women and children.  <i>[In August and September 2007, widespread severe flooding across northern Bangladesh intensified and prolonged the impact of the food insecurity period (between mid-September and mid-November) for chars (large flat islands in the main river channels) dwellers].</i>	Char dwelling areas in northern Bangladesh (Sep- Dec 2007)	A panel study which involved a random sample of households from over 50 000 enrolled in a cash-for-work programme and similar control households. The height, weight and MUAC of a woman and child from each household were measured at baseline and at the end of the study (mean time: 10 weeks).  Women reported 7-day household food expenditure and consumption on both occasions. Changes in parameters were compared between the two groups.  - Statistics presented	Women and children aged < 5y from landless households who were living on chars N= 895 households participating in the programme (intervention)  N= 921 non participating HH (control group)	Weight gain MUAC gain HAZ, WAZ, WHZ  <u>Baseline info</u> At baseline, no significant difference existed between the groups.	By the end of the study, the difference in mean MUAC between women in the intervention and control groups had widened by 2.29 mm and the difference in mean weight, by 0.88 kg. Among children, the difference in means between the two groups had also widened in favour of the intervention group for : height (0.08 cm; P < 0.05), weight (0.22 kg; P < 0.001), MUAC (1.41 mm; P < 0.001) and z-scores for height-for-age (0.02; P < 0.001), weight-for-age (0.17; P < 0.001), weight-for-height (0.23; P < 0.001) and mid-upper arm circumference (0.12; P < 0.001). Intervention households spent more on food and consumed more protein-rich food at the end of the study.	The cash-for-work programme led to greater household food expenditure and consumption and women's and children's nutritional status improved.

## Non-emergency situations

### 1. Summary of published studies assessing the impact of conditional cash transfers or vouchers in non-emergencies

Author of study	Objective of Study	Setting	Study design, Statistics	Survey population	Indicator / outcome	Impact	Conclusion
Morris <i>et al</i> (2004)	To assess the impact of conditional cash transfer programme on growth of children of beneficiary households compared to children of households accidentally prevented from receiving the benefit. <i>(In Brazil, a national health-related conditional cash transfer programme, Bolsa Alimentac, a "o, aimed to reduce nutritional deficiencies and to ensure that high-risk households were effectively linked into the National Health Service).</i>	Four municipalities in northeast Brazil (Oct 2001 – Apr 2002)	- Observational study (cross sectional survey at the end of programme ie after 6 mo. A retrospective cohort analysis used a regression model to determine whether children's growth velocity accelerated at the time their families began to receive programme benefits.  Programme beneficiaries were compared with matched individuals from households that were originally selected to receive the benefit but who subsequently were excluded due to 1 of 3 quasi-random, administrative errors  Monthly transfers ranged from 15 to 45 Brazilian reais (US\$6.25 to US\$18.70) per household per month, depending on the number of eligible individuals for 6 months.	All children < 36 mo were included for assessing impact (programme included children <7y) N= 630 of which beneficiaries= 472 and non beneficiaries= 158	Weight gain Baseline info Non provided	- Anthropometric status was assessed 6 mo after benefits began to be distributed, and beneficiary children were 0.13 Z-scores lighter (weight-for-age) than excluded children, after adjusting for confounders (P = 0.024).  - The children's growth trajectories were reconstructed by copying up to 10 recorded weights from their Ministry of Health growth monitoring cards and by relating each weight to the child's age, gender, and duration of receipt of the programme benefit in a random effects regression model. Each additional month of exposure to the programme was associated with a rate of weight gain 31 g lower than that observed in excluded children of the same age (P < 0.001).	This failure to respond positively to the programme may have been due to a perception that benefits would be discontinued if the child started to grow well. Nutrition programs should guard against giving the impression that poor growth will be rewarded.
Barber and Gertler (2008)	To evaluate the impact of <i>Oportunidades</i> , a large-scale, conditional cash transfer programme in Mexico, on birthweight.  <i>The programme provides cash transfers to low-income, rural households in Mexico, conditional on accepting nutritional supplements health education, and health care.</i>	Seven Mexican states (2003)	Retrospective reports on randomly assigned communities to treatment or control group.  Intervention - Monthly health stipend was fixed at approximately US\$ 15 per household per month  Multivariate and instrumental variable analyses was used to estimate the impact of the programme on birthweight in grams and low birthweight (<2500 g), receipt of any pre-natal care, and number of pre-natal visits.  - Control group - Statistics presented	Pregnant women (15-49y)  N= 506 communities of which 306 made up treatment group.	Impact on birthweight in grams  The probability of low birthweight.  Baseline info provided	<i>Oportunidades</i> beneficiary status was associated with 127.3g higher birthweight among participating women and a 4.6 percentage point reduction in low birthweight.  <i>No p values or CI given</i>	The <i>Oportunidades</i> conditional cash transfer programme improved birthweight outcomes. This finding is relevant to countries implementing conditional cash transfer programmes.
Lagard <i>et al</i> (2009)	To assess the effectiveness of conditional cash transfers (CCT) in improving access to care and health outcomes, in particular for poorer populations in low and middle income countries.	<i>Search strategy</i> - A wide range of international databases, including the Cochrane Central Register of Controlled Trials (CENTRAL), MEDLINE and EMBASE, in addition to development studies and economic databases were searched. Websites and online resources of numerous international agencies, organisations and universities were searched to find relevant grey literature. (The original searches Nov 2005 - Apr 2006. An updated search in MEDLINE was carried out in May 2009).	A qualitative analysis of the evidence was performed.  <i>Selection criteria</i> CCT were defined as monetary transfers made to households on the condition that they comply with some pre-determined requirements in relation to health care. Studies had to include an objective measure of at least one of the following outcomes: health care utilisation, health expenditure, health outcomes or equity outcomes. Eligible study designs were: randomised controlled trial, interrupted time series analysis, or controlled before-after study of the impact of health financing policies following criteria used by the Cochrane Effective Practice and Organisation of Care Group.	Mostly children but also pregnant and lactating women  - Papers reporting results from six intervention studies.  N= 10 papers  Overall, design quality and analysis limited the risks of bias.	- Changes in use of health services  - Changes in health outcomes.	Several CCT programmes provided strong evidence of a positive impact on the use of health services, nutritional status and health outcomes, respectively assessed by anthropometric measurements and self-reported episodes of illness.  - It is hard to attribute these positive effects to the cash incentives specifically because other components may also contribute. Several studies provide evidence of positive impacts on the uptake of preventive services by children and pregnant women. We found no evidence about effects on health care expenditure.	Conditional cash transfer programmes have been the subject of some well-designed evaluations, which strongly suggest that they could be an effective approach to improving access to preventive services. Their replicability under different conditions - particularly in more deprived settings - is still unclear because they depend on effective primary health care and mechanisms to disburse payments.  Further rigorous evaluative research is needed, particularly where CCTs are being introduced in low income countries, for example in Sub-Saharan Africa or South Asia

## 2. Summary of published studies of nutrition-related community-level interventions in non-emergency situations

Author of study	Objective of Study	Setting	Study design, Statistics	Survey population	Indicator / outcome	Impact	Conclusion
Colecraft <i>et al</i> (2004)	To examine the adoption of feeding recommendations among caregivers of children recuperating from malnutrition and assess the determinants of growth of children attending a nutrition rehabilitation centre (NRC) in Accra, Ghana.	NRCs at four polyclinics and participants' homes in Accra, Ghana. (Nov 1999- Jul 2000).	<ul style="list-style-type: none"> <li>- Longitudinal study in which attendance and maternal programme participation were recorded daily and children's anthropometry and dietary intake were measured at four time points (admission, interim, exit, post-exit) at the NRC and participants' homes.</li> <li>- Post exit/follow up was for up to 4 months after leaving the programme.</li> <li>- No control group</li> <li>- Statistics presented</li> </ul>	Caregivers and their children referred to an NRC N= 108 caregivers and 116 children	<p>Attendance</p> <p>Weight gain</p> <p>Baseline info</p> <p>Children's age was 12.7 ± 0.5 months</p> <p>There were no significant centre differences in children's age, gender or breast-feeding status. The majority of children were underweight. There were no significant centre differences in the rates of wasting and underweight; however, children referred to NRC 1 and 4 were significantly more likely to be stunted than those referred to NRC 2 and 3 (P = 0.004).</p>	<p>Most caregivers attended the NRC sporadically (effective length of stay was 1.4 ± 0.1 months). Use of NRC-promoted foods in the home after discharge was low due to inaccessibility of the food items, lack of preparation knowledge or money, child preferences and the common practice of purchasing ready-to-eat foods.</p> <p>Although there were significant increases in children's weight-for-age (P = 0.048) and weight-for-height (P = 0.002) Z-scores between enrolment and discharge, most children discontinued programme participation before adequate recuperation.</p>	<p>The NRC education did not address the use of street foods for child feeding and was unsuccessful in changing in-home feeding behaviour.</p> <p>The prominence of street foods in children's diets warrants re-evaluation of the NRC's educational approaches to enhance their responsiveness to caregivers' needs and effectiveness for the continued recuperation of malnourished children at home. NRC feeding strategies need improvement to ensure adequate provision of energy and nutrients to support catch-up growth in children.</p>
Bushamuka <i>et al</i> (2005)	To assess the additional benefits of a homestead gardening programme designed to control vitamin A deficiency in Bangladesh  <i>Hellen Keller International(HKI) initiated a programme called, "NGO Gardening and Nutrition Education Surveillance Project", in 1993 which aimed at encouraging poor households with very limited land to start gardening, producing vegetables year-round, and increasing the number and production of vitamin A-rich crops grown per garden.</i>	Rural Bangladesh (Feb-Mar 2002)	<p>Observational study</p> <p>According to the level of household participation in the programme, three groups;</p> <ul style="list-style-type: none"> <li>- Active-participant (receiving technical and material assistance from HKI for &lt; 3y),</li> <li>- Former-participant (completed the programme and operating without HKI assistance for at least 3y), and</li> <li>- Control HH—were included in the study</li> </ul> <p>Data was collected on food security and social status of women.</p> <ul style="list-style-type: none"> <li>- Control group</li> <li>- Statistics presented</li> <li>- Household food security was determined by assessing the availability of food to households, the ability of households to access food, and the utilization of food by households.</li> <li>- The social impact of the programme was determined by the changes, as perceived by women, in their ability to contribute to household livelihoods and participate in household decision-making.</li> </ul>	Poor rural women N= 2160 HH with approx 720 in each group.	<ul style="list-style-type: none"> <li>- Homestead garden production used to assess the effect of the project on food availability.</li> <li>- Ability of households to access food - measured by the consumption levels of garden produce</li> <li>- Social impact of the programme</li> </ul>	<p>In a three-month period, the households of active participants produced a median of 135 kg and consumed a median of 85 kg of vegetables, while the control households produced a median of 46 kg and consumed a median of 38 kg (p &lt; 0.001).</p> <p>About 64% of the active-participant households generated a median garden income of 347 taka (US\$1 = 51 taka), which was spent mainly on food, and 25% of the control households generated 200 taka in the same period (p &lt; .001). The garden production and income levels of formerly participating households three years after withdrawal of programme support were much higher than those of the control households, illustrating the sustainability of the programme and its ability to increase household food security.</p> <p>Significantly more women in active- and former-participant households than in control households perceived that they had increased their economic contribution to their households since the time the programme was launched in their sub districts (&gt; 85% vs. 52%). Similar results were found for the level of influence gained by women on household decision-making.</p>	These results highlight the multiple benefits that homestead gardening programs can bring and demonstrate that these benefits should be considered when selecting nutritional and development approaches targeting poor households.

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Author of study	Objective of Study	Setting	Study design, Statistics	Survey population	Indicator / outcome	Impact	Conclusion
Pappas <i>et al</i> (2008)	To evaluate the impact of a large-scale intervention on the nutritional status and school enrolment of primary school girls.	Twenty nine poor rural districts in Pakistan (Apr 2003 – Oct 2005) <i>The primary strategy was empowerment of women in the community who volunteered to plan the meals, purchase the food, and cook and serve the meals.</i>	Pre and post intervention study  Intervention provided freshly prepared meals in 4035 government primary girls' schools over a 2 year period.  Data was collected from growth monitoring, attendance records, pre- and post-intervention community based cross sectional surveys, focus group discussions, and the use of other ethnographic methods.  A study on changes in the levels of malnutrition was based on an analytical sample of girls who received at least two sets of body measurements at least 6 months apart.	Primary school aged girls  N= 203 116	Stunting (HAZ < -2) Underweight (WAZ < -2) Wasting (WHZ < -2)  - School enrolment  - Dietary knowledge  <u>Baseline info</u> At baseline, 23.2% girls were stunted and 14.3% wasted. Reports of hunger from the schools were common.	Over the study period, improvements were observed in the three measures of nutritional status; wasting decreased by 45% (p < 0.001), underweight girls declined by 21.7% (p < .001) and stunting decreased by 6% (p < .001).  Dietary knowledge increased  School enrolment increased by 40%. Girls who entered the programme early were found to have similar levels of malnutrition to girls who entered late, suggesting that factors external to the programme were not associated with the decrease in malnutrition.	This study demonstrates the potential success and scalability of school feeding programs in Pakistan. Lessons learned include that synergies are found when working across sectors (health, education, and empowerment) and that there are challenges to intersectoral projects.  Globalization may undermine this successful model as Pakistan considers expanded school feeding programs
Kidney <i>et al</i> (2009)	To provide a systematic review of the effectiveness of community level interventions to reduce maternal mortality.	Worldwide	Published papers were searched using Medline, Embase, Cochrane library, CINAHL, BNI, CAB ABSTRACTS, IBSS, Web of Science, LILACS and African Index Medicus from inception or at least 1982 to June 2006; Unpublished works were searched using National Research Register website, meta Register and the WHO International Trial Registry portal. Major references were hand searched.	Maternity or childbearing age women	- Community-level interventions  - Maternal mortality	Five cluster randomised controlled trials (RCT) and eight cohort studies of community-level interventions were found. Results were summarised as odds ratios (OR) and confidence intervals (CI), combined using the Peto method for meta-analysis. Two high quality cluster RCTs, aimed at improving perinatal care practices, showed a reduction in maternal mortality reaching statistical significance (OR 0.62, 95% CI 0.39 to 0.98). Three equivalence RCTs of minimal goal oriented versus usual antenatal care showed no difference in maternal mortality (1.09, 95% CI: 0.53, 2.25). The cohort studies were of low quality and did not contribute further evidence.	Community-level interventions of improved perinatal care practices can bring about a reduction in maternal mortality. This challenges the view that investment in such interventions is not worthwhile. Programmes to improve maternal mortality should be evaluated using randomised controlled techniques to generate further evidence.
Guyon <i>et al</i> (2009)	To improve infant and young child feeding practices, increase uptake of micronutrient supplements, and improve women's dietary practices through implementation of a nutrition project based on the Essential Nutrition Actions (ENA) framework.	Six districts in two highland provinces of Madagascar (Feb 2000- Nov 2005)	Observational uncontrolled intervention study (Two cross sectional surveys from representative households were conducted; one at baseline and the other at the end of the programme),  Interventions included training, interpersonal communication, community mobilization, and mass media.  Changes in practices were assessed through a comparison of baseline data and endline data.  - No control group  - Statistics presented	Children under 2 years of age N = 1,200 HH at baseline and N = 1,760 HH at the end of programme implementation in 2005	- Rate of initiation of breastfeeding within 1 hour of birth.  - Rate of exclusive breastfeeding of infants  - Iron-folic acid supplementation during pregnancy and postpartum Vit A supplementation  - Maternal dietary practises	The rate of initiation of breastfeeding within 1 hour of birth increased from 32% to 68%, the rate of exclusive breastfeeding of infants under 6 months of age increased from 42% to 70%, the rate of continuation of breastfeeding at 20 to 23 months increased from 43% to 73%, the rate of feeding children the minimum recommended number of meals per day at 6 to 23 months increased from 87% to 93%, the rate of iron-folic acid supplementation during pregnancy increased from 32% to 76%, and the rate of postpartum vitamin A supplementation increased from 17% to 54% (p < 0.001 for all changes).  Modest improvement was achieved in maternal dietary practices during lactation and feeding of the sick child after illness. The results were inconclusive regarding food diversity for complementary feeding.  No improvements were reported in increasing food intake during child illness or pregnancy.	The ENA framework allows broad-scale improvement of nutritional practices to be achieved through the maximization of contacts using multiple programme opportunities within existing health systems and community structures and through mass media.

### 3. Summary of published studies assessing the impact of moderate acute malnutrition programmes in non-emergencies

Author of study	Objective of Study	Setting	Study design, Statistics	Survey population	Indicator / outcome	Impact	Conclusion
Agha (2004)	To evaluate the effectiveness of a supplementary feeding programme in northern Iraq	Nine primary healthcare centres, Dohuk province, northern Iraq (Jan - July 2001)	Observational intervention study with seven months follow up. Intervention – children received high-protein high-energy biscuits in the first month and a monthly child ration for preparing soyabean mix throughout. Their families received food rations in the first 4 months. (A smaller cohort ie some children were evaluated right after receiving the high-protein high-energy biscuits for the first month).  - No control group (but there was a control for the smaller cohort) - Inadequate statistics presented	Malnourished children (child weight 2SD below WHO standard weight-for-age) aged 6mo to 3y  N= 159 of which (27=intervention group and 27= normal group) for the small cohort	Weight-for-age  <i>Cohort</i> Increase in weight	- Improvement was noticed for all children, particularly in the first month.  - Problems with the rations and within the growth monitoring units resulted in significant drop-out. Use of standard growth charts may be a way to overcome this problem.  <i>Cohort</i> N= 24 in each group. The mean difference in weight increase between intervention and control group was 152.1g, 95%CI: 16.4 to 287.8, t-value = 2.241, p<0.05)	High energy biscuits should be distributed throughout instead of the mix.
Hossain <i>et al</i> (2005)	To assess the effect on food intake of adding amylase-rich flour (ARF) from germinated wheat to supplementary food among children in nine rural Community Nutrition Centres under the Bangladesh Integrated Nutrition Project (BINP). (Inadequate dietary intake is a major contributor to protein-energy malnutrition)	Nine BINP Community Nutrition Centres, Narshingdi District, Bangladesh (Dec 1998- Apr 1999)	- Observational intervention study  - The centres were selected randomly from all Community Nutrition Centres in the district, and were randomized in equal numbers to three different diets: <i>Diet 1</i> The standard supplementary food (S-SF), <i>Diet 2</i> Supplementary food with added water (W-SF). <i>Diet 3</i> Supplementary food with added ARF (ARF-SF). (The composition of the diets was the same; however, the consistency and calorie density were altered by adding either ARF or water).  - Intervention lasted for 6 weeks and diet was given 6 days per week.  - No control group  - Statistics presented	Children aged 6 to 24 mo who are severely malnourished (defined as W/A < 60% of the NCHS median, or faltering in growth i.e., weight gain during the previous 2 months < 500 g for infants and < 300 g for children 13 to 24 months). but without clinical evidence of any acute infectious disease or morbid condition that could interfere with the intake of study diets,  N= 166 of which S-SF group = 35, W-SF group = 66 ARF-SF group= 65	- Supplementary food intake  - Vomiting  - Weight gain  - weight-for-length z score increment  - Cost  <u>Baseline info</u> The mean $\pm$ SD weight-for-length z scores for S-SF, W-SF and ARF-SF groups were $-1.11 \pm 1.03$ , $-1.34 \pm 0.78$ , $1.59 \pm 1.02$ respectively	The mean $\pm$ SD intake of supplementary food from a single meal by children completing six weeks on the diets was higher for children receiving ARF-SF ( $33.91 \pm 8.25$ g) than for those receiving S-SF ( $25.66 \pm 6.73$ g) or W-SF ( $30.26 \pm 8.39$ g) ( $p < 0.05$ for both comparisons).  The weight of vomited food was significantly higher for children receiving W-SF than for children in the other two groups ( $p < 0.05$ ).  Weight gain and increments in length and weight-for-height were higher for children who received ARF-SF than for children in the other two groups, but the differences were not statistically significant. The acceptability of ARF-SF was higher than that of the two other diets.  The additional cost of adding 2 g of ARF to the diet was about Taka 0.25 (US\$1 = Taka 48).	Addition of ARF to existing standard supplementary food, as used under the BINP programme, is a simple and effective means to increase the intake of food by changing its consistency, thus making it easier for malnourished children to ingest.
Kuusipalo <i>et al</i> (2006)	To examine acceptability, growth and change in blood haemoglobin concentration among moderately underweight ambulatory infants given fortified spread (FS).	Lungwena, a rural area in Malawi (Nov 2002- Mar 2003)	A randomised, controlled, parallel- group, investigator-blind clinical trial.  Intervention: milk-based or soy-based fortified spread group into 8 supplementation schemes; Nothing, 5, 25, 50 or 75 g/day milk-based FS or 25, 50 or 75 g/day soy-based FS.  <i>Supplementation was administered at home weekly for the first 4 weeks and fortnightly thereafter for the intervention period of 12 weeks.</i>  - Control group  - Statistics presented	Underweight infants aged 6 to 17 months (W/A < -2), whose weight is > 5.5kg and WHZ > -3.  N= 126	- Changes in weight, length and blood Hb concentration.  <u>Baseline info</u> Information is presented as mean (SD) for Hb (g/L), weight (kg), Length (cm) respectively for Nothing 84(14), 7.7 (0.8), 69.7 (3.2); 5g milk-based FS 79 (15), 7.3(1.0), 69.1 (3.4); 25g milk-based FS 79 (12), 7.3 (1.0), 69.0(3.9); 50g milk-based FS 77 (10), 7.3(1.3), 69.0 (4.6); 75g milk-based FS 81(16), 7.7 (0.4), 71.1 (1.5); 25g soy-based FS 77(20), 7.5 (0.9), 69.9 (3.7); 50g soy-based FS 73(11), 7.4(0.9), 69.1(3.4); 75g soy-based FS 79(22), 7.6 (0.4), 69.9 (1.7).	One hundred and twenty five infants completed the intervention. All infants accepted the spread well, and no intolerance was recorded.  Average weight and length gains were higher among infants receiving daily 25 to 75 g FS than among those receiving only 0 to 5 g FS.  Mean Hb conc remained unchanged among unsupplemented controls but increased by 10 to 17 g/L among infants receiving any FS. All average gains were largest among infants receiving 50 g of FS daily: mean difference (95% confidence interval) in the 12-week gain between infants in 50g milk-based FS group and the unsupplemented group was 290 g (range, -130 to 700 g), 0.9 cm (range, -0.3 to 2.2 cm), and 17 g/L (range, 0 to 34 g/L) for weight, length and blood Hb concn, respectively.  In soy- vs milk-based FS groups, average outcomes were comparable.	Supplementation with 25 to 75 g/day of highly fortified spread is feasible and may promote growth and alleviate anaemia among moderately malnourished infants.  Further trials should test this hypothesis.

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Author of study	Objective of Study	Setting	Study design, Statistics	Survey population	Indicator / outcome	Impact	Conclusion
Gartner <i>et al</i> (2006)	To assess individual determinants of differential benefit from the Senegal Community Nutrition Project (CNP) by monitoring improvement in children's weight-for-age index or underweight status (W/A < -2 Z-scores) during participation.  <i>(One of the objectives of the CNP nutrition components was to halt further deterioration in children's nutritional status in poor urban neighbourhoods)</i>	Diourbel, Senegal (dates not specified)	Follow-up study using the CNP child monitoring data. Linear general models compared variations in W/A according to 14 factors describing the beneficiaries and CNP services.  Intervention – provided targeted children with monthly growth monitoring and promotion as well as weekly food supplementation provided that mothers attended weekly nutrition education sessions.  Intervention lasted for 6 months.  - No control group - Statistics presented	Underweight children (W/A < -2 z scores of WHO/NCHS reference median) or nutritionally at-risk (sibling of an underweight child or not having gained weight during the last three months) aged 6–35 mo who participated in the first two years of the project N= 4084.	- Recovery  - Characteristics of participating children and their mothers which could influence the effect of the CNP services on the main process outcome (improvement in anthropometric status of participating children)  Baseline info Twenty eight percent of children (6–35mo) in the area were underweight	Mean W/A varied from 22.13 (SD 0.82) to 21.58 (SD 0.81) Z-scores between recruitment and the end of the follow-up. The lower the child's initial W/A, the greater was their increase in W/A but the lower was the probability of recovery from underweight. Only 60.7% (95% CI: 58.6–62.9%) of underweight children recovered.  Six months of CNP services may not be sufficient for catch-up growth of severely underweight children. The number of food supplement rations received was not a direct indicator of the probability of recovery. After adjustment for services received and initial W/A, probability of recovery was lower in girls, in younger children, in twins and when mothers belonged to a specific ethnic group.	Determinants of benefit from CNP differed from the risk factors for underweight. Identification of participants with a lower probability of recovery can help improve outcome. Moreover, an explanation for the lack of recovery could be that many underweight children are stunted but not necessarily wasted.
Nahar <i>et al</i> (2008)	To i) assess whether the Bangladesh Integrated Nutrition Programme (BINP) correctly identified which pregnant women should be enrolled in the food supplementation programme, if supplementation commenced on time and was taken on a regular basis. ii) determine whether food supplementation led to enhanced pregnancy weight gain and reduction in the prevalence of low birth weight.	A rural union of Bhaluka Upazila, Mymensingh, Bangladesh (From 1995, end date not stated)	- A one-year community-based longitudinal study. - The food supplement provides 2512 kJ (600 kcal)/d - Supplement food was prepared at the village level. Pregnant mothers had to consume the supplement at a local CNC. - Control group (non supplemented pregnant women) - Statistics presented	Normotensive, non-smoking pregnant women who registered between 2nd and 6th month of gestation. N= 1104 of which supplemented women = 358 and non supplemented women = 746	<i>BINP programmatic issues</i> (i) receiving supplementation if BMI < 18.5 kg/m <sup>2</sup> (ii) commencing supplementation at the correct time (iii) receiving daily supplementation six days a week until the birth of the child (iv) achieving targeted weight gain set by BINP of > 1 kg per month or > 7 kg at the end of pregnancy.	Pregnant women who had a BMI of < 18.5 kg/m <sup>2</sup> on first presentation should have been selected for supplementary feeding (2512 kJ (600 kcal)/d for six days per week) starting at month 4 (16 weeks) of pregnancy. However, of the 526 women who had BMI < 18.5 kg/m <sup>2</sup> , only 335 received supplementation; so the failure rate was 36.3%. In addition, of those receiving supplementation, only 193 women (36.7% of 526 women) commenced supplementation at the correct time, of whom thirty-two (9.6% of 335 women) received supplementation for the correct number of days (100% days).  There were no significant differences in mean weight gain between BMI < 18.5 kg/m <sup>2</sup> supplemented or non-supplemented groups or between the equivalent groups with BMI ≥ 18.5 kg/m <sup>2</sup> . Weight gain was inversely related to initial weight, so lighter women gained relatively more weight during their pregnancy than heavier women. The mean birth weight in the supplemented and non-supplemented groups was 2.63 kg and 2.72 kg, respectively. Mothers with BMI < 18.5 kg/m <sup>2</sup> who were or were not supplemented had almost equal percentages of low-birth-weight babies (21% and 22 %, respectively).	The study raises doubt about the efficiency of the BINP to correctly target food supplementation to pregnant women. It also shows that food supplementation does not lead to enhanced pregnancy weight gain nor does it provide any evidence of a reduction in prevalence of low birth weight.

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Author of study	Objective of Study	Setting	Study design, Statistics	Survey population	Indicator / outcome	Impact	Conclusion
Augusto et al (2010)	To evaluate the effectiveness of a governmental supplementary feeding programme (fortified milk distribution programme) on child weight gain.	São Paulo, South eastern Brazil (Jan 2003 to Sep 2008).	A cohort study including secondary data on 25,433 low-income children. Children were divided into three z-score groups when starting the programme: <b>Group 1</b> Weight gain not compromised (WNC) ( $z > -1$ ) <b>Group 2</b> Risk of low weight (RLW) ( $-2 \leq z < -1$ ) <b>Group 3</b> Low weight (LW) ( $z < -2$ ).  <i>Intervention</i> - 15 litres of milk per month per participating child, equivalent to 500 mL/day.  - Children were measured every 4 mo until the end of the programme  - No control group  - Some statistics presented	Children aged 6 to 24 mo (with no health problems) from families with a monthly income lower than two minimum wages.  N= 25,433	- Weight gain, measured using weight-for-age z-score values  Baseline info (weight-for-age z-score) when registering WNC group = 82.4%, RLW group = 14.3% LW group = 3.3%	The programme had a positive effect on child weight gain, varying according to child nutritional status when starting this programme; among those who started it with weight gain not compromised, the mean adjusted gain z-score was 0.183 95% CI (0.175, 0.191); among those with risk of low weight, 0.566 95% CI (0.546, 0.586); and among those with low weight, 1.005 95% CI (0.954, 1.056).	The programme was effective for weight gain in children younger than two years, with a more pronounced effect on children who start the programme under less favourable weight conditions.
Flax et al (2010)	a) To compare child food consumption patterns and caregiver and child feeding behaviours in two study groups receiving either lipid-based nutrient supplements (LNS) or corn-soy blend (CSB).  b) To examine behaviours related to the use of plain LNS versus LNS mixed with porridge.  <i>(the way caregivers use supplementary food for undernourished children and integrate it into feeding patterns may influence the benefits achieved by supplementation)</i>	Mangochi district, southern Malawi (April to July 2005)	Intervention trial in which children were randomised into 2 groups  Intervention -supplementation with either LNS or CSB for 12 weeks.  - Observational data were collected during one 11h home visit per participant.  - Semi-structured forms were used to collect information about child and caregiver behaviour during supplement feeding episodes.  - No control group  - Statistics presented	Underweight children aged 6–17 mo (WAZ < -2) N= 170 of which LNS group = 85 and CSB = 85  <u>Baseline info</u> Mean (SD) WAZ was -2.9 (0.7) in the LNS group and -3.1 (0.8) in the CSB group.	- Number of feeding episodes which include: start and end times of feeding and type of food given.  - Caregivers' behaviours measured included: hand washing before the feeding episode, person feeding the child, utensil used, whether supplement was shared, whether there was any leftover at the end of the feeding episode, and the proportion shared and leftover.  - Weight gain	There was no observed difference between the CSB and LNS groups in mean number of feeding episodes per day or mean daily feeding time.  - Caregivers in the CSB group were significantly more likely than those in the LNS group to serve the supplement as meal, wash their hands before feeding, and feed the child with a spoon.  - The mean proportion of the offered supplement that was eaten by participants was slightly higher in the LNS group (CSB 94%, LNS 98%, difference (95% CI) 4% (1%, 7%), $p = 0.003$ ).  There were significantly more instances of leftovers and the mean proportion leftover was higher in the CSB than the LNS group (CSB 19%, LNS 6%, difference (95% CI) 12% (9%, 15%), $p < 0.001$ ).  - Sub-group comparisons of behaviours related to the use of LNS mixed and plain generally mirrored the results of CSB compared to LNS  - Presence of leftovers was negatively associated with change in child's WAZ. The other explanatory variables entered to the model (number of feedings, caregiver hand washing, and supplement sharing) did not predict change in child's WAZ.	Programs promoting LNS in Malawi should consider behaviours related to mode of serving and provide advice to caregivers in order to minimize leftovers during supplement use.

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Author of study	Objective of Study	Setting	Study design, Statistics	Survey population	Indicator / outcome	Impact	Conclusion
Singh <i>et al</i> (2010)	To evaluate the effectiveness of a locally made ready-to-use therapeutic food (RUTF) in decreasing mild to moderate malnutrition.	Vellore, India (Jan to May, 2008)	A randomized open label, controlled trial. <i>Intervention</i> - A locally produced energy-dense supplement (RUTF) administered in pre-schools by teachers, compared to the current standard of care [teaching caregivers how to make a fortified cereal-milk supplement called High Calorie Cereal Milk (HCCM)]. 3 months follow-up from date of recruitment. Measurements were taken on day 1, day 30, 60 and 90, with a window of 5 days after the scheduled date  - No control group - Statistics presented	Children aged 18-60 months with W/A $\leq$ 2 SD. N= 118 of which RUTF= 61 and HCCM= 57	- Increase in WAZ > -2 - Increase in levels of plasma zinc, vitamin B12, serum albumin and haemoglobin.  Baseline info Mean (SD) weight (kg)= 10.79 (1.28) for RUTF group and 10.98 (1.34) for HCCM group	The Mean (SD) weight gain at 3 months was higher in the RUTF group: RUTF (n=51): 0.54 kg; (SE = 0.05; 95% CI = 0.44 – 0.65) vs HCCM (n=45): 0.38 kg; (SE = 0.06; 95% CI = 0.25 – 0.51), P = 0.047.  - The weight gain per kilogram of body weight was directly proportional to the severity of malnutrition.  Significant increases in serum albumin was seen in both the RUTF [P=0.045] and the HCCM [P=0.027] groups, as were changes related to anaemia, with improvement in both groups.  - The cost of one month's supply of RUTF, at the rate of 250 g per week, or 50 g per week day, for each child was calculated to be approximately INR 135 (USD 2.95).	Community-based treatment showed weight gain in both groups, the gain being higher with RUTF. The cost-effectiveness of this method of therapy needs to be evaluated.
Jillcot <i>et al</i> (2010)	To describe the development, implementation, evaluation, and subsequent improvements of a supplemental feeding programme that provides community-based care to underweight children in a rural East African setting, using a locally-sourced and produced ready-to-use food (RUF)	Bundibugyo, Uganda (Oct-Nov 2007)	Observational intervention study. <i>Intervention</i> - ground soybeans and groundnuts (peanuts) mixed with moringa oleifera leaf powder to form an energy-dense supplemental food, designed for use as an RUF for 5 weeks.  Programme was evaluated by examining RUF nutrient composition, weight gain velocity, and qualitative data from key-informant interviews and home feeding observations.  - No control group - Statistics presented	Children aged 6 to 59mo with W/A < the 3rd percentile line on the standard Ugandan immunization card (which includes a growth chart) and/or MUAC < 12 cm.  N= Approximately 20	- RUF Nutrient Composition - Weight gain - Feeding observations  Baseline info Provided in a tabular form but too cumbersome to be presented here	- Locally-produced RUF had similar energy density 5.3 kcal/g (21.5 kJ/g) but higher protein content than commercial RUTF (22 kJ/g).  - Mean weight gain of children was 2.5 g/kg/day (range 0.9–6.0).  - Feeding observations revealed that caregivers were diluting the RUF fed to children. Production team members desired increased financial compensation for their work but were enthusiastic about the programme as helpful to malnourished children.	Locally-produced RUF is a promising strategy for community-based care of moderately malnourished children. Through the production team's entrepreneurship, a small business was formed, whereby financial incentives encouraged continued RUF production. Future efforts are needed to educate caregivers on correct RUF use and improve commercial viability in local markets.
Lagrone <i>et al</i> (2010)	To determine the operational effectiveness of treating moderate acute malnutrition with ready-to-use supplementary food.  (A randomised clinical effectiveness trial in 2007 showed corn-soy blend to be less effective than RUSF)	Rural southern Malawi	Observational intervention study  Each child received 65 kcal/kg/d of locally produced soy/peanut RUSF, a product that provided about 1 RDA of each micronutrient.  - Anthropometric measurements were taken every 2 weeks and additional rations of RUSF were distributed at this time if the child remained wasted.  - Study participation lasted up to 8 weeks.  - No control group - Statistics presented	Children aged 6-59 mo with MAM (WHZ between -2 & -3 without bilateral pedal oedema) N= 2417	Recovery Defaulted Failed Died  Cost  Baseline info Mean (SD) of WHZ was -2.4 (0.6).	Eighty percent recovered, 4% defaulted, 0.4% died, 12% remained moderately wasted and 3% developed SAM.  Weight, length and MUAC gain were 2.6g/kg/d, 0.2mm/d and 0.1mm/d respectively.  Cost per child treated was \$5.39	This intervention proved to be robust, maintaining high recovery rates and low default rates when instituted without the additional supervision and beneficiary incentives of a research setting.



#### 4. Summary of published studies assessing the impact of severe acute malnutrition programmes in non-emergency situations

Author of study	Objective of Study	Setting	Study design, Statistics	Survey population	Indicator / outcome	Impact	Conclusion
Amadi <i>et al</i> (2005)	To assess the effect of an exclusive diet of amino acid-based elemental feed (AAF) to standard nutritional rehabilitation for the treatment of persistent diarrhoea-malnutrition syndrome (PDM).	University Teaching Hospital in Lusaka, Zambia (1998-2000)	<ul style="list-style-type: none"> <li>- Randomised controlled trial. Treatment was given for 4 weeks in a single-blind study.</li> <li>- Statistical tests presented</li> </ul>	Malnourished children (defined using the Wellcome classification) with persistent diarrhoea (defined as duration of 14 days or more) aged 6 to 24 mo. N= 200	<ul style="list-style-type: none"> <li>- Weight gain</li> <li>- Recovery from diarrhoea</li> <li>- Mortality</li> </ul> <p><u>Baseline info</u> At randomization, median baseline WAZ was -4.0 (interquartile range, IQR -4.4, -3.5); 9% were underweight, 23% had marasmus, 47% kwashiorkor and 21% had marasmic-kwashiorkor.</p>	<p>Weight gain was greater in the AAF group (median gain in WAZ was 1.23, IQR 0.89-1.57) compared with the control group (0.87, IQR 0.47-1.25; P=0.002), although calorie intakes were higher in the control group.</p> <p>The increase in Hb conc. was also greater in the AAF group (0.8 g/dl, IQR 0-1.8) than in the control group (0.3, IQR -0.6,-1.6; p=0.04).</p> <p>Diarrhoea frequency and global recovery scores improved equally in both treatment groups and mortality did not differ.</p>	<p>A diet of reduced molecular complexity was associated with significantly improved weight gain.</p> <p>Elemental feeds should not be adopted for treatment of these children due to their expense; rather it is now important to establish whether locally produced feeds of reduced molecular complexity can achieve the same beneficial effect as a synthetic elemental feed.</p>
Ciliberto <i>et al</i> (2006)	To assess the effect of exclusive home-based therapy on children with oedematous malnutrition.	Malawi (Dec 2002- June 2004 or Nov 2003 - Apr 2004)	<ul style="list-style-type: none"> <li>- Prospective uncontrolled case series of 2 therapeutic nutritional studies. (Participants were drawn from 2 large previously reported community-based malnutrition studies, one in which oedematous malnutrition cases were detected passively and another actively).</li> <li>- Intervention was RUTF and participation lasted 8 weeks. Length was measured every 4 weeks</li> <li>- No control group</li> <li>- Statistics presented</li> </ul>	<p>Oedematous malnourished children aged 12 to 60 months.</p> <p>N=219 of which 171 were from passive detection and 48 from active detection</p> <p>Wasting was defined as WHZ &lt; -2.</p> <p>- All children with mild oedema (defined as &lt; 0.5 cm of pitting oedema on the dorsum of the foot) and a good appetite were treated exclusively as outpatients and included.</p>	<ul style="list-style-type: none"> <li>- Recovery defined as resolution of the oedema for 4 wks and attainment of WHZ &gt; -2</li> <li>- Failure to gain weight or relapse</li> <li>- Death</li> </ul> <p><u>Baseline info</u> Not given</p>	<ul style="list-style-type: none"> <li>- The overall recovery rate was 83% (182/219), and the case-fatality rate was 5% (11/219).</li> <li>- For children with wasting and oedematous malnutrition, 65% (55/85) recovered and 7% (6/85) died.</li> <li>- The average weight gain was 2.8 ± 3.2 g/kg/d (mean ± SD).</li> <li>- Enrolment WHZ was identified as a significant risk factor for death using regression modelling (standardized coefficient β=0.16, t stat =2.85, p&lt;0.01).</li> <li>- The estimated number of deaths using the method of Prudhon was 7 (95%CI: 3-11).</li> </ul>	This preliminary observation suggests that children with oedematous malnutrition and good appetite may be successfully treated with home-based therapy; a RCT to evaluate this is warranted.
McLennan and Mills (2006)	To assess the impact of an existing partial day realimentation programme on the growth of children with protein energy malnutrition (PEM). It was hypothesized that at least 50% of the children would achieve a minimum recommended growth rate of 5 g/kg/day and would attend at least 50% of the possible treatment days.	A day hospital in Santo Domingo, Dominican Republic. This programme operates Mon through Fri, 8 a.m. to 12:30 p.m. (2 Jul 2004 - 30 Nov, 2005).	<ul style="list-style-type: none"> <li>- Observational intervention study.</li> <li>- Caregivers were interviewed and child anthropometrics were obtained at baseline and follow-up.</li> <li>- Clinical attendance patterns were extracted from medical records.</li> <li>- Intervention – treatment was as per WHO guidelines. Children consumed 2–3 feeds at the centre and an additional 2–3 feeds were sent home with the guardian for afternoon and early evening feeding. No supplies were distributed for weekends.</li> <li>- Intervention lasted until child attained ≥ -1 SD of median W/H</li> <li>- A follow-up feedback questionnaire was completed at 12 weeks post admission.</li> <li>- No control group</li> <li>- Statistics presented</li> </ul>	All children consecutively admitted to the partial day treatment programme with severe or moderate wasting (Age not specified) N= 88	<ul style="list-style-type: none"> <li>- Weight gain</li> <li>- Attendance</li> </ul> <p><u>Baseline info</u> Mean (SD) child age (months) was 29.6 (29.8). W/H ≤ -1Z, ≥ -2Z and W/H ≤ -2Z was 10.2 (9) and 78.4 (69) respectively</p>	<p>Mean rate of weight gain in the rehabilitation phase up to 4 weeks following admission was 3.9 (SD 4.5) g/kg/day with only 27% of the children achieving a minimum recommended rate of &gt; or = 5.0 g/kg/day. On consecutive clinic attendance days, the mean growth rate was 4.2 (SD 8.6) g/kg/day, while on non-attendance days it was approximately 3.7 (SD 4.5) g/kg/day.</p> <p>Children attended 80% of the possible clinic days during the first 4 weeks of treatment. Within this time, 20% achieved the target of &gt; or = -1 SD of the median weight for height. Caregivers reported having difficulty finding caretakers for their other children and their own illnesses as barriers to regular attendance.</p>	There was a substantial variation in growth rates of children attending the clinic with mean growth rates failing to achieve minimal standards. Though some children may have benefited from the partial day treatment programme, alternative strategies should be considered at this clinic to improve resource utilization and outcomes including the use of a home recovery option and an enhanced day treatment programme.

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Author of study	Objective of Study	Setting	Study design, Statistics	Survey population	Indicator / outcome	Impact	Conclusion
Ashworth (2006)	To examine the effectiveness of rehabilitating severely malnourished children in the community in nonemergency situations.	The context is a routine health system with primary health-care provision and referral opportunities, in a nonemergency setting.	A literature search was conducted (using a combination of database searches and hand-searching) of community-based rehabilitation programs delivered by day-care nutrition centers, residential nutrition centers, primary health clinics, and domiciliary care with or without provision of food, for the period 1980–2005.	Severely malnourished children (WHZ < -3 SD using WHO definition or the presence of oedema). Age not specified N= 33 studies of community-based rehabilitation	- Effectiveness (defined as mortality of less than 5% and an average weight gain of at least 5 g/kg/day).	Eleven (33%) programs were considered effective.  Of the subsample of programs reported since 1995, 8 of 13 (62%) were effective. None of the programs operating within routine health systems without external assistance was effective.  <i>Conclusion</i> With careful planning and resources, all four delivery systems can be effective. It is unlikely that a single delivery system would suit all situations worldwide. The choice of a system depends on local factors. High energy intakes (> 150 kcal/kg/day), high protein intakes (4–6 g/kg/day), and provision of micronutrients are essential for success.	When done well, rehabilitation at home with family foods is more cost-effective than inpatient care, but the cost effectiveness of ready-to-use therapeutic foods (RUTF) versus family foods has not been studied.  Where children have access to a functioning primary health-care system and can be monitored, the rehabilitation phase of treatment of severe malnutrition should take place in the community rather than in the hospital but only if caregivers can make energy- and protein-dense food mixtures or are given RUTF.  For routine health services, the cost of RUTF, logistics of procurement and distribution, and sustainability need to be carefully considered.
Ashraf et al (2007)	To evaluate a day-care clinic approach that provided antibiotics, micronutrients and feeding during the day with continued care by parents at home at night in treating severe malnutrition as an alternative to hospitalization.  (Some children are unable to be admitted to a hospital despite appropriate referral, for various reasons including lack of hospital beds, inability of the parents to visit a hospital due to long distance or financial or other domestic reasons such as the need to care for siblings at home, and the need for the mother to work).	Dhakar, Bangladesh (Feb 2001 - Nov 2003)	- A prospective observational study - Participants denied admission to hospital were enrolled at the day-care nutrition rehabilitation (NR) unit of Radda Clinic and received protocolized management with antibiotics, micronutrients and milk-based diet from 8:00 am to 5:00 pm daily while mothers were educated on continuation of care at home. This continued until children attained 80% weight-for-length. - Follow up was each week for 2 weeks, then every 2 weeks up to 3 months; the last 50% of enrolled children was monthly for 6 mo.  <i>*The management at the Radda Clinic was carried out in three phases: acute phase, NR phase and follow-up phase</i> - No control group - Statistics presented	Severely malnourished children (weight-for-length $\leq$ -3 SD and/or, bi-pedal nutritional oedema or W/A $\leq$ -3 SD with acute illness) aged 6–23 mo N= 264	Duration of stay Weight gain  <i>Baseline info</i> Mean (SD) of weight-for-length z score and WAZ was -2.7 (0.9) and -4.5 (0.8) respectively. Also 52% were boys and 78%, 21% and 1% had marasmus, marasmus-kwashiorkor and kwashiorkor, respectively. Only 13% had severe malnutrition alone while 35% had pneumonia, 35% had diarrhoea and 17% had both pneumonia and diarrhoea.	At discharge, mean (SD) of weight-for-length z score and WAZ was -1.7 (0.5) and -3.9 (0.7) respectively.  Mean (SD) duration of acute and NR phases were 8 (4) and 14 (13) days, respectively.  Children gained weight [mean (SD) g/kg day] more rapidly during acute 10 (7) than NR phase 6 (5). Successful management was possible in 82% (95% CI: 77–86%) children, 12% discontinued treatment and 6% referred to hospitals. Only one child died during NR phase.	Severely malnourished children can be successfully managed at existing day-care clinics using a protocolized approach.
Hossain et al (2009)	To compare the effectiveness of locally adapted Institute of Child and Mother Health (ICMH) protocol with the WHO protocol for the management of severely malnourished children in Bangladesh.	Two hospitals in Dhaka, Bangladesh (Jun-Dec 2003)	- Quasi-experimental non-randomized clinical trial.  <i>Intervention</i> - children treated with either WHO protocol (Group I) or ICMH protocol (Group II). - No control group - Statistics presented	Severely malnourished children (2-59 mo) with weight for height <70% of WHO/NCHS reference with or without bilateral pitting oedema  N= 60 of which group I =30 and group II = 30.	- Clinical improvement - Weight gain - Time taken to achieve target weight gain and - Mortality  <i>Baseline info</i> Marasmus, marasmus-kwashiorkor and kwashiorkor were 66.8%, 13.3% and 20% in group I and 66.8%, 16.7%, 16.7% in group II respectively.	Mean (SD) weight related to gain in Group I and Group II was 11.2 (4.1) and 11.1 (3.9) g/kg/day, respectively. The weight gain was not related to the age group or type of malnutrition. The time taken for oedema to subside (7.3 d vs 8 d) and for improvement of appetite (6.5 d to 7.3 d vs 6.7 d to 8.4 d) was similar between the groups.  The target weight gain was achieved in 28.3 (11.5) days in Group I against 27.9 (6.2) days in Group II (P=0.88). The mortality rate was 6.7% in each group.	Treatment of severe malnutrition with locally adapted ICMH protocol using locally available foods is as efficacious as the WHO protocol.

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Bachman (2009)	To (i) describe the outcomes of CTC in Lusaka (ii) estimate the cost of CTC and (iii) estimate the effectiveness and cost effectiveness of CTC for treating children with SAM compared with no treatment.	Primary health care centres in Lusaka, Zambia (2005-2008)	- Cohort study Cost effectiveness was based on a decision tree model considered from the perspective of health services. - The existing model of care was compared to a hypothetical alternative of providing no treatment (control group) - Statistics presented.	- Severely malnourished children <5y (defined as MUAC $\leq$ 11cm or bilateral pitting oedema). N= 21 Lusaka District Health Management Team.	- Costs <i>Probabilities of outcomes</i> - Mortality up to year after developing SAM - Expected DALYs after surviving one year.	The mean cost of CTC per child was \$203 (95%CI: \$139-\$274), of which RUTF cost 36%, health centre visits cost 13%, hospital admissions cost 17% and technical support while establishing the programme cost 34%.  Expected death rates within 1y of presentation were 9.2% with CTC and 20% with no treatment (risk difference 11.5% (95%CI: 0.4 – 23.0).  CTC cost \$1760 (95%CI: \$592-\$10142) per life saved and \$53 (95%CI: \$18-\$306) per DALY gained.  CTC was at least 80% likely to be cost effective if society was willing to pay at least \$88 per DALY gained.	CTC is relatively cost effective compared to other priority health care interventions in developing countries, for a wide range of assumptions.
Bahwere et al (2009)	To assess acceptability and effectiveness of a locally made ready-to-use therapeutic food (RUTF) in HIV-infected chronically sick adults (CSA) with mid-upper-arm circumference < 210 mm or pitting oedema.	Home-based care organizations (HBC) in the central region of Malawi (May-Oct 2005)	A prospective descriptive study - Participants were prescribed 500 g representing ~2600 kcal/day of locally made RUTF for three months and routine cotrimoxazole. Weight, height, MUAC, Karnofsky score and morbidity were measured at admission and at monthly intervals. The amount of RUTF intake and acceptability were assessed monthly. - No control group - Statistics presented	Wasted AIDS adults (MUAC < 210, BMI < 17 kg/m <sup>2</sup> bilateral pitting oedema of the feet or legs or bedridden for > 50% of the daytime for more than one month. N= 60	- Total RUTF intake - Weight, MUAC, BMI gain - Physical activity performance <i>Baseline info</i> The median age of the patients was 37.7 years (29.7–44) and 63.3% of them were female. Clinically, 75% had WHO HIV stage 4 and 25% HIV stage 3, but HIV infection was confirmed serologically at the time of inclusion in only 55% (33/60). All patients had reduced physical activity performance.  Overall average weight was 41.6 (7.3) kg, 23.3% (14/60) of patients had oedema, 78.3% (47/60) had a MUAC of less than 210 mm (overall mean $\pm$ SD of 195.0 $\pm$ 18.8 mm), 69% (40/58) had a BMI of less than 17 kg/m <sup>2</sup> (overall mean $\pm$ SD of 16.1 $\pm$ 1.7 kg/m <sup>2</sup> ) and 50% (29/58) a BMI less than 16 kg/m <sup>2</sup> .	- Mean daily intake was 300 g/person/day (~1590 Kcal and 40g of protein) - Overall, 73.3% (44/60) gained weight, BMI, and MUAC. The median weight, MUAC and BMI gains after three months were 3.0 kg, 25.4 mm, and 1.1 kg/m <sup>2</sup> , respectively. - The total RUTF intake predicted the MUAC, weight and BMI changes (Pearson correlation coefficient = 0.503 (p < 0.001), 0.481 (p < 0.001) and 0.458 (p = 0.001), respectively). The intervention improved the physical activity performance of participants and 78.3% (47/60) regained sufficient strength to walk to the nearest health facility. Mortality at three months was 18.3% (11/60).	Locally made RUTF was acceptable to patients and was associated with a rapid weight gain and physical activity performance. The intervention is likely to be more cost effective than nutritional support using usual food-aid commodities.
Fergusson and Tomkins (2009)	To explore HIV prevalence and mortality in children with SAM in sub-Saharan Africa by systematically reviewing the relevant published literature and pooling data for meta-analysis	All studies reporting on HIV infection within a sample of children with SAM (Searches were conducted from Feb-Jun 2008)	This review was conducted with reference to the Meta-analysis Of Observational Studies in Epidemiology (MOOSE) group's recommendations. Electronic searches were undertaken in MEDLINE, EMBASE, Science Citation Index (SCI) and the Cochrane Library  Reference lists of selected articles were searched as well as relevant conference abstracts, editorials, expert opinions and letters to journal editors. A draft of the article was circulated among the authors cited to check for data accuracy and completeness.	Children with SAM having HIV infection (HIV status was assessed using a blood test and SAM was defined using the WHO, Gomez, Wellcome or Waterlow definitions). N= 4891 children from 17 peer-reviewed papers from 15 studies.	- HIV prevalence - Mortality - Inpatient care versus CTC	Of the 4891 children included in the analysis, 29.2% were HIV-infected.  HIV-infected children were significantly more likely to die than HIV-uninfected children (30.4% vs. 8.4%; P < 0.001; relative risk = 2.81, 95% CI: 2.04–3.87).  HIV negative children treated within community-based therapeutic care (CTC) programmes had lower mortality (4.3%) than those treated within an inpatient nutrition rehabilitation unit (NRU) (15.1%), (p < 0.001).  There was no significant difference in mortality for HIV-infected children with SAM treated in the CTC (30.0%) or NRU (31.3%) settings.	HIV prevalence is high in children with SAM in sub-Saharan Africa, and HIV-infected children are at significantly increased risk of mortality. There is an urgent need to integrate HIV testing and treatment into care for children with SAM in regions of high HIV prevalence.

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Giugliani <i>et al</i> (2010)	To measure the impact of practice review and in-service supervision based on WHO guidelines on outcomes of severely malnourished children in a rural facility with minimal resources staffed only by nurses.	TFC in rural Bailundo, Angola (Jan to August 2006)	<ul style="list-style-type: none"> <li>- Intervention study with historical comparison of outcomes (January to August 2005).</li> <li>- No control group</li> </ul> <p>Intervention = weekly physician supervision of staff activities and establishment of a study group composed of nurses in the centre.</p>	<ul style="list-style-type: none"> <li>- All children aged 0 to 12y admitted to the feeding centre during the study period with severe malnutrition (defined as WHZ &lt; -3% or &lt;70% of NCHS reference median and/or associated oedema.</li> </ul> <p>N=379 during intervention N= 358 before intervention</p>	<ul style="list-style-type: none"> <li>- Routine practices in the centre.</li> <li>- Successful treatment, withdrawal, death, discharge without progress and transfer to another ward were compared to indicators before the intervention.</li> </ul> <p><i>Info before intervention (Jan- Aug 2005)</i> Successful treatment=73.2%, Withdrawal=7.8%, Death= 15.6%, Discharge without progress= 0.8%, Transfer to another ward= 2.5%</p>	<ul style="list-style-type: none"> <li>- Improved delivery of important tasks such as frequent feeding and avoidance of intravenous rehydration was observed.</li> <li>- Among the 379 children admitted during the intervention, compared to the 358 children admitted previously, successful treatment increased from 73.2% to 82.6% (RR 1.13; 95% CI 1.04 to 1.22) and fatalities decreased from 15.6% to 8.7% (RR 0.56; 95% CI 0.37 to 0.83). Also withdrawals decreased from 7.8% to 5.8% (RR 0.74; 95% CI 0.43 to 1.27) and discharge without progress decreased from 0.8% to 0% (RR 0.16; 95% CI 0.01 to 3.13).</li> </ul>	<ul style="list-style-type: none"> <li>- This short-term intervention with in-service supervision based on the WHO guidelines in a setting of limited resources apparently contributed to a reduction in fatality rates.</li> </ul> <p>These findings support the view that such guidelines can be effectively implemented in under-resourced facilities in Angola and similar settings if they are introduced using an interactive approach and if in-service supervision continues to be provided.</p>
Gera (2010)	To a) assess the efficacy & safety of home based management of SAM using therapeutic nutrition products (TNPs) or RUTFs, b) assess the efficiency of these products in comparison with F-100 and home-based diet, to extend its application in India.	India (April 2010)	<p>Systematic review. Electronic database of Pubmed and Cochrane Controlled Trials Register were scanned, information was extracted from identified papers and graded according to the CEBM guidelines.</p> <p><i>Interventions:</i> TNPs, basically derived from F-100 formulation but should have these properties; i) does not need to be prepared in any form before consumption, ii) resists microbial contamination, iii) can be stored at ambient temperature.</p> <p><i>Control:</i> No intervention or alternative intervention such as home based dietary management or facility based standard treatment.</p>	<p>Children with severe acute malnutrition. (Age group not defined)</p> <p>Trials included Systematic Reviews; before and after observational studies; individual, cluster, and quasi randomized and non-randomized controlled trials as well as consensus statements.</p>	<p><i>For efficacy</i></p> <ul style="list-style-type: none"> <li>- Recovery rate (as defined by the authors)</li> <li>- Weight gain (g/kg/day)</li> <li>- Relapse.</li> </ul> <p><i>For Safety</i></p> <p>Morbidities like diarrhoea, malaria and respiratory infections</p> <ul style="list-style-type: none"> <li>- Mortality.</li> </ul>	<ul style="list-style-type: none"> <li>- Eighteen published papers (2 systematic reviews, 7 controlled trials, 7 observational trials and 2 consensus statements) were identified.</li> <li>- Systematic reviews and RCTs showed RUTF to be at least as efficacious as F-100 in increasing weight (WMD=3.0 g/kg/day; 95% CI -1.70, 7.70) and more effective in comparison to home based dietary therapies. Locally made RUTFs were as effective as imported RUTFs (WMD=0.07 g/kg/d; 95% CI=-0.15, 0.29). Data from observational studies showed the energy intake with RUTF to be comparable to F-100. The pooled recovery rate, mortality and default in treatment with RUTF was 88.3%, 0.7% and 3.6%, respectively with a mean weight gain of 3.2 g/kg/day. The two consensus statements supported the use of RUTF for home based management of uncomplicated SAM.</li> </ul>	<p>The use of therapeutic nutrition products like RUTF for home based management of uncomplicated SAM appears to be safe and efficacious. However, most of the evidence on this promising strategy has emerged from observational studies conducted in emergency settings in Africa. There is need to generate more robust evidence, design similar products locally and establish their efficacy and cost-effectiveness in a 'non-emergency' setting, particularly in the Indian context.</p>
Mamidi <i>et al</i> (2010)	To examine the catch up growth in severely wasted children using energy dense local foods at a hospital based nutrition rehabilitation unit.	Nutrition ward in a hospital in Hyderabad, India (Jan 2001 to Dec 2005)	<p>Retrospective cohort study</p> <p>Intervention A diet based on energy dense local foods along with multivitamin-multimineral supplements.</p> <ul style="list-style-type: none"> <li>- No control group</li> <li>- Statistics presented</li> </ul>	<p>Children &lt; 5y with severe wasting (WHZ score &lt; -3) or nutritional oedema admitted to nutrition ward N=309</p> <p>Case sheets of children who stayed for ≥ 7 days at the nutrition ward were selected.</p>	<ul style="list-style-type: none"> <li>- Catch up growth (g/kg/day) during each week of hospital stay</li> </ul> <p><i>Baseline info</i> Mean age of the children was 25 mo (range 2-60). Mean WHZ was -4.1</p>	<p>Mean weight gain was moderate (5g/kg/day) and baseline WHZ score had a significant negative relationship to the weight gain.</p> <p>The prevalence of morbidities was high and the commonest morbidity was fever.</p> <p>Weight gain was higher by almost 40% in the absence of morbidities in any week.</p>	<p>The diet based on local energy dense foods was found to be suitable for the nutrition rehabilitation of severely malnourished children though the rate of weight gain was moderate.</p>

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Akram <i>et al</i> (2010)	To improve nutrition of malnourished children in the community, using home based treatment.	Squatter settlement, Karachi, Pakistan (Aug 2006 to Mar 2007)	A prospective cohort study Intervention – locally prepared high density diet (HDD) which provides 1.4 calories per ml and has a shelf life of one week.  - Prepared HDD was taken to children's respective homes by community health workers and first feed given under direct supervision.  For the first 4-5 days, 100cal/kg/day was provided which gradually increased to 120cal/kg/day over a week.  - No control group - No statistics presented	All children < 5 years who were < -3SD W/H as per WHO classification N= 24  Children with complications were referred to a hospital for initial stabilization	- Daily weight - Amount of HDD consumed  <u>Baseline info</u> The mean weight of the children was 7.5 ± 1.84 kg	Eleven children (45.8%) reached -1 SD at the end of 3 months while 10 patients (41.6%) took 4 months. Twenty two patients (91.6%) were at the median weight-for-height by the end of 5 months.	Home based treatment with locally available foods can be used successfully to rehabilitate severely malnourished children.
Patel <i>et al</i> (2010)	To evaluate the feasibility and outcome of home-based rehabilitation of severely malnourished children.	Tertiary care hospital in Delhi, North India. (Nov 2006-Feb 2008)	Prospective and observational study Intervention -rehabilitation at home (16 weeks) following initial assessment or/and stabilization at hospital. Mothers were given advice about type of food, quantity of food, and feeding frequency.  - No external support for procuring or making food was provided to the families. Home based foods were advised to provide 150 kcal/kg/day and 2-3 g/kg/day of proteins which was gradually increased so as to provide approximately 150-220 kcal/kg/day and proteins 4-5 g/kg/day. Daily multivitamin supplement was continued till 16 weeks.  - Frequency of follow-up visits were: 2 contacts/ week separated by at least 48 hours in first two weeks, then once a week for 3-8 weeks and from 8 weeks till 16 weeks, every 4 weeks.  - No control group - Statistics presented	Severely malnourished (weight for length <70% of WHO reference) children aged 6 mo to 5 years.  N= 34 of which 19 children were admitted in hospital and 15 children were sent home after initial assessment in hospital. Five did not clear the initial stabilization phase (2 died, 3 left hospital).	- Complete recovery (if child achieved weight for length >80% at the end of 16 weeks). - Partial recovery (if the weight for length remained between 70% to 80% after 16 weeks of follow-up). - Weight gain  <u>Baseline info</u> Incorporated in results. Out of 29 children who qualified for home based rehabilitation, 26 completed 16 week follow-up.	During the home based management phase, the reported mean (±SD) calorie intake increased from 100 (±5) kcal/kg/d at entry point to 243 (±13) kcal/kg/d at 16 weeks (P=0.000). Similarly, reported protein intake increased from 1.1 (±0.3) g/kg/d to 4.8 (±0.3) g/kg/d (P=0.000). During hospital stay (n=19), children had weight gain of 9.0 (±5.3) g/kg/d, while during home based follow up (n=29), weight gain was 3.2 (±1.5) g/kg/d only. During home based rehabilitation, only 3 (11.5%) children had weight gain of more than 5 g/kg/d by the end of 16 weeks. W/H% increased from an average of 62.9% (±6.0%) to 80.3% (±5.7%) after the completion of 16 weeks (P=0.000). Thirteen (45%) children recovered completely from malnutrition whereas 15 (51.7%) recovered partially.  There was no death during the home stabilization.	Home based management using home prepared food and hospital based follow up is associated with sub-optimal and slower recovery.
Trehan <i>et al</i> (2010)	To determine whether the inclusion of amoxicillin correlates with better recovery rates in the home-based treatment of severe acute malnutrition with ready-to-use therapeutic food.	Malnutrition clinics at Dowa, Chiradzulu, and Machinga districts, Malawi (2003-2005)	- Retrospective cohort study comparing two groups of children with uncomplicated SAM. - The standard protocol group received a 7-day course of amoxicillin at the onset of treatment while the alternate protocol group received no antibiotics. All children were treated with the same ready-to-use therapeutic food up to a total of 12 weeks. Reassessment was done every 1 to 2 weeks.  - Control group - Statistics presented	Children with uncomplicated SAM (WHZ ≤ -3 of WHO reference and/or the presence of bilateral pitting oedema) aged 6-59 months.  N= 2543 of which standard protocol group= 498 and alternate protocol group= 1955	- Recovery rate (defined as achieving WHZ > -2 without oedema).  <u>Baseline info</u> Mean ± SD WHZ was 1.99 ± 1.26 and 1.91 ± 1.45 in the standard protocol group and alternate protocol group respectively.  Children in the standard protocol group were slightly older and more stunted.	The recovery rate for children who received amoxicillin was worse at 4 weeks (40% vs. 71%) but similar after up to 12 weeks of therapy (84% vs. 86%), compared to the children treated without antibiotics. Regression modelling indicated that this difference at 4 weeks was most strongly associated with the receipt of amoxicillin.	This review of two therapeutic feeding programmes suggests that children with severe acute malnutrition who were treated without amoxicillin did not have an inferior rate of recovery. Given the limitations of this retrospective analysis, a prospective trial is warranted to determine the effect of antibiotics on recovery from uncomplicated malnutrition with home-based therapy.

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Author of study	Objective of Study	Setting	Study design, Statistics	Survey population	Indicator / outcome	Impact	Conclusion
Oakley <i>et al</i> (2010)	To determine whether treating children with SAM with 10% milk RUTF containing soy would result in a similar recovery rate compared with the 25% milk RUTF.	Fifteen rural sites in southern region of Malawi (Jul 2008 to Apr 2009)	<p>A randomised, double-blind, clinical, quasi-effectiveness trial of 2 locally produced foods for the treatment of SAM.</p> <p>Children were randomly assigned with equal probability to either 25% milk RUTF or 10% milk RUTF as home-based therapy for up to 8 weeks.</p> <p>Children were assessed every fortnight and participated in the study until they clinically recovered or received 8 wk of treatment.</p> <ul style="list-style-type: none"> <li>- No control group</li> <li>- Statistics presented</li> </ul>	<p>Severely malnourished (WHZ &lt; -3 and/or having bipedal pitting oedema, WHO reference) children aged 6-59mo with a good appetite</p> <p>N= 1874 of which 25% milk RUTF group= 945 and 10% milk group= 929</p>	<p>Recovery (defined as WHZ &gt; -2 and no oedema)</p> <p>Weight and height gain</p> <p><u>Baseline info</u> Mean (SD) WHZ was -2.1(1.2) and -2.0(1.2) in the 25% milk and 10% milk RUTF groups respectively.</p>	<p>Recovery among children receiving 25% milk RUTF was greater than children receiving 10% milk RUTF, 64% compared with 57% after 4 wk, and 84% compared with 81% after 8 wk (p&lt; 0.001)</p> <p>Children receiving 25% milk RUTF also had higher rates of weight and height gain compared with children receiving 10% milk RUTF.</p>	<p>Treating children with SAM with 10% milk RUTF is less effective compared with treatment with the standard 25% milk RUTF. These findings also emphasize that clinical evidence should be examined before recommending any changes to the formulation of RUTF.</p>

## 5. Summary of published studies assessing the impact of micronutrients distribution programmes in non-emergencies

Author of study	Objective of Study	Setting	Study design, Statistics	Survey population	Indicator / outcome	Impact	Conclusion
Smuts <i>et al</i> (2005)	To investigate whether improving status for multiple micronutrients prevented growth faltering and anaemia during infancy.  (The Four Country IRIS Trial Pooled Data Analysis)	Indonesia, Peru, South Africa, and Vietnam (dates given elsewhere)	A randomized placebo controlled trial.  Participants were randomized to 4 treatment groups; daily placebo (P), weekly multiple micronutrient supplement (WMM), daily multiple micronutrient (DMM) supplement, and daily iron (DI) supplements.  Each child had 2 measurements, at baseline (pre) and 6 mo (post) intervention.  - Control group - Statistics presented	Infants aged 6-11mo not born prematurely (<37 wk gestation), not born low birth weight (<2500 g), not severely wasted (< -3 Z-scores), not severely anaemic (haemoglobin <80 g/L), and no fever (> 39°C). N= 1134 of which P group= 283, WMM group= 283, DMM group= 280 and DI group= 288.	Weight gain Height gain Anaemia prevalence <u>Baseline info</u> The prevalence of multiple micronutrient deficiencies at baseline was high, with anaemia affecting the majority,	The DMM group had a significantly greater weight gain ( $p= 0.036$ ), growing at an average rate of 207 g/mo compared with 192 g/mo for the WMM group, and 186 g/mo for the DI and P groups.  There were no differences in height gain.  DMM was also the most effective treatment for controlling anaemia and iron deficiency, besides improving zinc, retinol, tocopherol, and riboflavin status.  DI supplementation alone increased zinc deficiency.  The prevalence of anaemia was not fully controlled even after 6 mo of supplementation.	These positive results indicate the need for larger effectiveness trials to examine how to deliver supplements at the programme scale and to estimate cost benefits.  Consideration should also be given to increasing the dosages of micronutrients being delivered in the foodlets.
Giovannini <i>et al</i> (2006)	To assess and compare efficacy of two micronutrient sprinkle supplementation on growth, anaemia, and iron deficiency in Cambodian infants.	Kompong Chhnang Province, Cambodia	- Double-blind, placebo-controlled, comparative longitudinal trial  - Participants were randomly assigned to receive daily supplements of either iron (12.5 mg) plus folic acid (150 Kg) plus zinc (5 mg) (MMN), or iron (12.5 mg) plus folic acid (150 Kg) alone (FFA), or placebo for a 12 month period in powder form as sprinkles  - Reassessment was performed weekly - Control group - Statistics presented	Infants aged 6 months with haemoglobin $\geq 70$ g/L. N= 204 of which MMN group = 68, FFA group= 68 placebo group= 68	Growth pattern Anaemia Iron deficiency <u>Baseline info</u> Mean (SD; range) of Hb (g/L) was 99.4 (9.9; 76-119) 101.0 (10.1; 81-128) and 102.9 (10.2; 80-123) for MMN, FFA and placebo groups respectively.	No difference among groups was found for growth pattern. Significant decline was observed for WAZ and HAZ in any group ( $P < 0.0001$ ).  The rate of recovery from anaemia was significant ( $P < 0.001$ ) and comparable between MMN (54%) and FFA (53%) groups and higher than in the placebo group (22%, $P < 0.0001$ ).  Through the study period, no significant change in the rate of iron deficiency was found in MMN and FFA groups, whereas it increased in the placebo group (31%, baseline vs. 52%, end of study; $P < 0.0001$ ).	Both MMN and FFA supplements were effective for preventing or treating anaemia in Cambodian infants and stabilizing plasma levels of ferritin. Use of micronutrients in a controlled home setting, as sprinkled daily supplements, may be promising in preventing and treating anemia in developing countries.
Ip <i>et al</i> (2009)	To compare the effectiveness of daily and flexible administration of micronutrient Sprinkles on adherence, acceptability and haematological status among young children in rural Bangladesh.	the Kaliganj sub-district of Gazipur district Bangladesh (May - Sep 2004)	A cluster randomised trial  Children were cluster-randomized according to their village (cluster) to receive 60 sachets of Sprinkles either (i) daily over 2 months; (ii) flexibly over 3 months; or (iii) flexibly over 4 months. With a flexible regimen, mothers/caregivers decided how frequently to use Sprinkles without exceeding one sachet per day. Adherence was assessed monthly by counting the number of sachets used and acceptability was evaluated through focus group discussions. Haemoglobin was measured at baseline, at the end of each intervention period and 6 months post-intervention.  - No control group - Statistics presented	Children aged 6–24 months with haemoglobin $\geq 70$ g/L. N= 362 children from 16 villages	Group adherence Hb levels Anaemia (defined as Hb <110 g/l) prevalence <u>Baseline info</u> Gender, mean Hb and anaemia prevalence were similar among the three groups at baseline. Overall, mean Hb was $99 \pm 14$ g/l and 278/362 (77%) children were anaemic and prevalence of stunting (29%), underweight (41.7%) and wasting (13.8%).	Mean percent adherence was significantly higher in the flexible-4-month group (98%) compared to the flexible-3-month (93%) and daily-2-month (88%) groups ( $P < 0.01$ ).  Most mothers found flexible administration to be more acceptable than daily due to perceived benefits of use. Hb at the end of intervention was significantly higher in the flexible-4-month group compared to the daily group ( $P= 0.03$ ).  Anaemia prevalence decreased by 65% in the flexible-4-month group compared to 54% in the flexible-3-month and 51% in the daily-2-month groups. Percent of cured children who maintained a non-anaemic status 6 months post-intervention was significantly higher in the flexible-4-month (82%) and flexible-3-month (80%) groups than the daily-2-month (53%) group ( $P < 0.05$ ).	The adherence, acceptability and haematological response to flexible administration over 4 months were found preferable to daily.



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