Title: Interventions to Tackle Malnutrition and its Risk Factors in Children living in Slums – a scoping review

Corresponding author's name, address, telephone/fax numbers and e-mail address:

Sophie Goudet, SSEHS, Loughborough University, Leicestershire, UK, LE11 3TU

07887351142 Email: s.goudet@lboro.ac.uk

Each author's affiliation and qualifications:

Sophie Goudet, Loughborough University, Dr

Paula Griffiths, Loughborough University, Dr

Barry Bogin, Loughborough University, Prof

Nyovani Madise, Southampton University, Prof

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Abstract (200 words)

Context: Children living in slums are at high risk of being malnourished. There are no published reviews on existing interventions promoting better nutrition for children living in slums and the risks factors for children's malnutrition. Improved understanding of the risks factors for malnutrition in slums communities and the impact of interventions on children's health can provide guidance to practitioners and decision-makers. The present review is designed to provide this information.

Methods: The search included 30 electronic bibliographic databases, and relevant eligible studies published up to December 2013.

Results: The search located 1,512 citations. Full text relevance screening was conducted on 226 studies and on abstracts for 16 studies. The final 58 unique studies included 22 on interventions and 38 on risk. All of the interventions were nutrition-specific with nutritional intervention being the most dominant type. Seventy three percent of the interventions were assessed effective.

Conclusion: The findings stressed the gaps in knowledge in terms of quality assessment and programmatic recommendations to identify children who are the most at risk of malnutrition to appropriately target interventions. Finally, the review helped to inform a systematic review (Cochrane Systematic review protocol 2015) that will examine the impact of interventions on outcome measures.

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None declared.

Declarations of Interest

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Introduction

Globally, approximately one in four children under the age of five years is too short for his/her age, a condition known as stunting (defined later in the paper). The prevalence of stunting in a population is a commonly used public health indicator of malnutrition. Malnutrition is responsible for 3.1 million deaths of children younger than 5 years annually, representing about 45% of all deaths in this group (Bhutta 2008). In 2012, approximately 33% of urban residents in the developing world live in slums and by 2030, slum populations of less developed countries are expected to double to almost two billion people (UNHABITAT 2003a; UNHABITAT 2003b; UNITED NATIONS 2012). Evidence shows that children living in slums are likely to be malnourished (Unger 2013; Ruel 1999; Ghosh 2004; Pryer et al 2002; Hussain et al 1999; Haddad et al 1999). Achieving 2025 WHO global health targets to reduce stunting by 40% in children under 5 years old will depend on continuous efforts to prevent and treat malnutrition within slums.

Malnourished children have lower chances of survival than well-nourished ones and have higher risk of morbidity. In the long term, malnutrition in children may affect adult size, intellectual ability, economic productivity, reproductive ability, and may increase the risk of metabolic disorders and cardiovascular disease (Black 2008). Undernutrition in pregnant women can cause poor foetal growth (intra-uterine growth retardation) and low birthweight. This can lead to increased

risks of malnutrition in their children and contribute to the intergenerational cycle of malnutrition (Varela-Silva et al 2009). Stunting and micronutrient deficiencies are associated with suboptimal brain development, which is likely to have long-lasting harmful consequences for cognitive ability. Long term consequences of malnutrition can be averted or minimised in adult life if it is prevented in the first 1,000 days' (the first two years of children's life and in the 9 months of life in their mother's womb). This is a window of opportunity to prevent long lasting consequences of malnutrition (Adair 2014, Martorell et al 2012, Bhutta et al 2008, Bhutta et al 2013, UNICEF 2013).

The determinants or risk factors of malnutrition in the UNICEF conceptual framework (UNICEF 2013) are multi-sectoral, including food, health and care practices and are classified as immediate (individual level), underlying (household or family level) and basic (societal level). The two immediate causes are inadequate dietary intake and diseases. Underlying these, immediate causes are food security, childcare practices, maternal education, access to health services and water, hygiene and sanitation conditions. Ultimately, these factors are embedded in the larger political, economic, social and cultural environment.

There are no published reviews on existing interventions promoting better nutrition for children living in slums and the risks factors for children's malnutrition. The present review is designed to provide this information and complement previous reviews focusing on specific interventions such as infrastructural interventions or housing improvement in slums and their impact on health (Thomson et al 2013, Turley et al 2013).

The present article is a scoping review (Arksey and O'Mallet 2005, Mitton et al 2009, Ridde and Morestin 2011, Rahman et al 2014, Deen et al 2013). The purpose of this scoping review is: 1) to determine the value of undertaking a full systematic review by identifying and mapping literature that evaluated effects of interventions designed to tackle malnutrition and that identified risk factors of malnutrition in children in slums, 2) to help identify the appropriate parameters for a systematic review (Population Intervention Comparison Outcome or PICO).

Methods

Criteria for inclusion

Types of studies

Randomised (including cluster-randomised), quasi-randomised with either individual or cluster randomisation and non-randomised controlled trials, controlled before and after studies (cohort or cross-sectional), interrupted time series (ITS) and historically controlled studies as well asqualitative studies were included.

Demographic and Health Survey (DHS) studies were excluded as the representativeness of slums was not guaranteed.

Year of publication

From 1980 to 2013.

Types of participants

Children from birth to adolescence (<18 years old).

Location

Urban slums or semi/peri urban slums in low and middle income countries.

Urban areas were included if poverty or socio-economic status of households within urban areas were taken into account to reflect deprived areas or if the selected areas were considered as deprived.

Urban versus rural areas studies were excluded when the two previous conditions were not met.

Types of intervention

The interventions included were any intervention that has an impact on children's nutritional status.

Risks

The risk studies included were the ones that reported on statistical association of variables with children's nutritional status. The variables were considered here as risk factors / determinants of malnutrition and can be potential confounders.

Outcome measures

The term malnutrition includes both over- and under-nutrition. Here the authors use it to refer only to undernutrition (wasting, stunting and underweight).

Child nutritional status was assessed using anthropometric indicators including

- 1) Weight expressed in kg or weight-for-age / underweight (WFA) z-score' 2) Height expressed in cm or height for age / stunting (HFA) z-score,

3) Weight and Height combined expressed in weight-for-height / wasting (WFH) z-score, and 4) Mid upper arm circumference (MUAC) expressed in cm/mm.

Methods for identifying studies

As this is a scoping review, it has used a limited search strategy of 30 electronic bibliographic databases, bibliographies of included articles and grey literature sources using several key-word combinations (and truncations): [‘‘malnutrition*’’] and [‘‘urban’’ or ‘‘slum*’’ or ‘‘urban slum*’’] and [‘‘child*’’] (Annexe 1). As it is a scoping review, only a few keywords for slums are used. Alerts in Google Scholar and ZETOC were created using the same search terms. Alerts received were routinely checked and studies were screened for eligibility during the search duration. Language was restricted to English and French. The websites of agencies, academic institutions and technical bodies were also searched using the same search strategy (Annexe 1).

The search was conducted from September to December 2013 until a saturation point was reached.

Data extraction and analysis

One author screened titles and abstracts of studies for inclusion, then retrieved the full text of potentially-eligible studies for screening, and, applied the inclusion criteria to those retrieved publications. Full texts were screened with the same words used for the search strategy. This was done by using the built-in search facility of PDF or Word documents. Studies excluded following full text reviews and reasons for exclusion were documented. The references list of systematic and / or literature reviews were screened for further inclusion. The final list of eligible studies and non-eligible studies was validated by two authors.

For all included studies, data were charted using an Excel spreadsheet for the following: publication year, city / country, study design, risks or Intervention (prevention and / or treatment), intervention type, target population (children’s

age), sample size, aims of the study, outcome measure, results, risks factors, effectiveness measure, and study recommendations in addition to the publication information (title and authors).

Results

Description of studies

A description of included studies with information regarding the author, year of publication, study title, location, slum or urban, study design, type of study (risk, intervention: prevention or treatment), classification of intervention, intervention type, target population, sample size, aim of the study, and outcome measure (supplementary material).

Results of the search

The search located 1,512 citations (Figure 1). Full text relevance screening was conducted on 226 studies and on abstracts for 16 studies.

Insert Figure 1 here.

Out of the 242studies screened for eligibility, 186 did not meet the inclusion criteria.

Included studies

The final 58 studies included 22 on interventions (4 treatment and 18 prevention) and 38 on risk factors (Table 1). Two studies (Neervoort et al 2013, Ahmed 2004) were considered for both risks and interventions. The literature found was predominantly very recent as 51% of the studies' results were published from 2010 onwards (Table 1).

Insert Table 1 here.

Location

India, Bangladesh, and Kenya were the most common study locations (27%, 23% and 12% respectively) (Table 1). The vast majority of the studies (80%) were conducted solely in slum settings with the rest conducted in urban versus rural areas for comparison purpose taking into consideration poverty levels.

Study design

The eligible studies included 12 randomized controlled trials, 33 cross sectional studies, 1 case study and 11 cohort studies.

Target population characteristics and unit of randomisation

In terms of target population, more than half of the studies (50%) focused on children under 5 years of age. The children's age range was from birth to 18 years, with 8 studies focusing on school aged children. In 45 studies, it was possible to extract sample size. The sample size ranged from 60 (min) to 138,956 (max) with a mean of 3,719 children. For the rest of the studies, the sample size was not available. In 4 studies, children were malnourished at baseline, with Moderate Acute Malnutrition (MAM) and Severe Acute Malnutrition (SAM) children (2 studies; Harris and Jack 2011, Dodd et al 2007), MAM children (1, Fauveau et al 1992) and SAM (1, Khanum et al 1988).

Outcome

The outcome measures were mainly stunting (in 34 studies), underweight (29), wasting (14) and BMI (4). The indices were presented using weight-for-height, height-for-age and weight-for-age z-scores and/or prevalence and/or mean. Anthropometric measurements such as height (n=4 studies), weight (n=2),

length (n=2) and mid upper arm circumference (n=3) were used less frequently. Micronutrient deficiencies measured were iron and zinc (both in Penny et al 2005, iron only in Berger et al 2008). The growth references / standards used for z-score calculation were mostly based on WHO (the WHO growth standards published in 2006 developed a new international standard for assessing the physical, nutritional and motor development in all children from birth to age five), and/or for the older studies the NCHS (1975) growth reference. Most of the studies carried out in India used the Indian Academy of Paediatric classification (IAP).One study used the composite index for anthropometric failure (CIAF) (Shit et al 2012) which subgrouped children with wasting and/or stunting and/or underweight in 6 different categories.

Interventions

All of the interventions can be categorised as nutrition-specific. Nutrition-specific interventions include promoting optimal nutrition practices, meeting micronutrient requirements and preventing and treating severe acute malnutrition which have been set as key goals for nutrition programming by UNICEF (UNICEF 2013). The approaches underlying these interventions can be promotion or counselling on nutrition using community based or communication for behaviour / social change models. Nutritional interventions were the most common type (77%) and included: school feeding, supplementation, nutrition promotion and treatment. The rest of the interventions were health interventions including Reproductive and Child Health (RCH)/ increased access to health (14%) and WASH including hygiene and sanitation components (9%) (Annexe 2).

Among nutritional interventions, supplementation was the leading intervention (35% of the interventions), then nutrition promotion (29%), school feeding (18%)and treatment of acute malnutrition (18%) (Annexe 2) . The micronutrient supplemented interventions were predominantly Vit A, zinc and iron. In only one study, pregnant women were the target group to study the impact on their baby's birth outcome (Osendarp et al 2000). Nutrition promotion interventions took various forms and were also conducted in parallel with other interventions; for example there was often nutrition education along with treatment of MAM in children. School feeding interventions varied in the provision of biscuits (Ahmed 2004) or lunch with health education plus micronutrient supplementation (Keidar et al 2008) or lunch only (Neervoort et al 2013). Treatment of acute malnutrition was for MAM and/or SAM children. For treatment of SAM children, there were two types of interventions; inpatient treatment (Khanum et al 1988) and community based management of acute malnutrition (CMAM) (Dodd et al 2007, Harris and Jack 2011).

The duration of the intervention varied from 1 to 84 months with an average of 16 months. In 8 cases, it was impossible to identify the intervention duration. In 3 studies, it was not applicable as the studies were cross sectional.

Twenty seven percent of the interventions were assessed non-effective. The results for non-effective interventions are also presented as the findings can be taken into consideration in intervention future design (Annexe 2).

Effects of interventions

73% of the interventions were assessed effective. Out of the 16 effective studies, 6 studies reported that intervention children were less wasted, 5 that

children were less underweight, 7 that children were less stunted, 5 that children gained weight, 3 that children were less anaemic, 1 that children were less zinc deficient, and 1 that children had increased height and arm circumference.

All of the interventions targeting treatment of acute malnutrition and health were assessed effective. The recommendations and eventual limitations presented by the study authors for each intervention are summarised below.

School feeding

The intervention which included lunch *(Neervoort et al 2013 [Kibera slums, Nairobi, Kenya])* was successful in reducing anaemia and malnutrition, but education level of the mother, family size and absence of a father diluted the effect of the school feeding programme. The sample size was small, and further large-scale research was encouraged on reviewing programmatic interventions to develop optimal feeding strategies and improve nutritional status of children. *Ahmed 2004 (Dhaka, Bangladesh) looked at school feeding with biscuits* revealed that biscuits supplemented children's diet and were not neutralized by the household reducing food at home. To achieve maximum benefit for the cost, it was recommended that the program covered areas where undernutrion is a serious problem, school enrolment and attendance rates are low, and dropout rates are high. Urban slums were designated as promising areas for expansion.

Supplementation

(Semba et al 2011 [Slums, Indonesia])

The intervention (Micronutrient fortified milk and noodles) decreased the odds of stunting among Indonesian children living in urban slums *(Semba et al 2011)* . These findings confirmed the potential benefits of multiple micronutrient fortification on child growth from previous research.

Zinc-deficient Bangladeshi infants showed improvements in growth rate and a reduced incidence of acute lower respiratory infection after newborns received zinc supplementation *(Osendarp et al 2002 [Dhaka slums, Bangladesh])*

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Lipid based nutrient supplementation over 6 months intervention was shown to significantly increase linear growth *and* effects were sustained 6 months post intervention *(Iannotti et al 2013 [Slums, Haiti])*.

In the urban slums of Indonesia, children who did not receive vitamin A supplementation tended to be slightly more malnourished and ill than children who received vitamin A *(Berger et al 2008)*. Higher rates of child mortality in non-participating households suggested that reaching preschoolers would yield significant survival benefit. Children who were not reached by the vitamin A programme were also unlikely to be reached by vaccination and other services, emphasizing the need to identify and extend efforts to reach non-participants.

Promotion

In an intervention of performance pay and nutritional promotion, providing performance pay alone was not assessed to be effective in improving health

outcomes *(Singh 2011 [Slums Chandigarh, India])*. While the workers did respond to incentives, it did not help improve child health. Performance pay combined with practical and specific information to the demand-side led to a significant increase in weight and reduction in child malnutrition. This was effective in increasing caloric and protein-rich food at home in the combined treatment relative to the incentive treatment. Future research should test interventions that target both the supply-side and demand-side.

Conditional cash transfer improved the nutritional status and morbidity of young children and increased their consumption of protein and vegetables *(Attanasio et al 2005 [Colombia])*. It also substantially increased attendance at growth-monitoring visits. The effect of the intervention on child nutrition was assessed varied with respect to the probability of participating in already-existing nutritional programmes.

Promoting nutrition at health facilities revealed the quality and coverage of existing nutrition education and introducing an accreditation nutrition system in six government health facilities was effective in improving complementary feeding, and decreasing iron and zinc deficiency *(Penny et al 2005 [Peru])*. Children in the intervention area were more likely to be less stunted than in the control area.

Treatment of acute malnutrition

Positive deviance approach

I A positive deviance approach was assessed as an effective 'learning by doing' approach when targeted at moderately- and severely-malnourished children *(Dodd et al 2007 [Dhaka slums, Bangladesh])*. It was not considered as a nutrition programme but an essential element of a larger integrated nutrition/health programme. The cost of the intervention was low with 81% supported by mothers through contribution.

Inpatient treatment of SAM resulted in weight gain, but not height gain, which tended to be lower in children who experienced more diarrhoea *(Khanum et al 1988 [Dhaka, Bangladesh])*. Fever and cough were not associated with either weight or height gain. The high prevalence of infections, particularly diarrhoea and pneumonia, indicated a need for improved living conditions and continuation of medical support through accessible facilities with well-trained personnel, and home visits. Supplementation with micronutrients was recommended to improve immune function and enhance linear growth. Income generation was also recommended to assist in diversifying diets and improving living conditions, together with improved educational opportunities

An intervention using home based treatment of acute malnutrition showed the overall rate of weight gain compared favourably with other home based rehabilitation programs *(Harris and Jack 2011 [Phnom Penh, Cambodia])*. During the 8-year study period of intervention, no siblings of children in the program were admitted, and this was presented as a sustained positive “ripple effect” of enhancing nutrition in siblings due to the home visiting and nutritional education given to mothers.

An intervention targeting food supplementation revealed that during the 1st 3 months of the intervention, the monthly weight gain of the supplemented children was significantly higher than the non-supplemented ones *(Fauveau et al 1992 [Dhaka slums, Bangladesh])*. In the following 3 months, differences in weight gain were no more significant. Several possible explanations for this transient impact are discussed. It is suggested that nutrition education in the control group may have been responsible for the limited difference between the two groups, but seasonal and epidemiological factors may also have played a part.

Health

Implementation of a Reproductive Child Health resulted in both nutritional and immunization status improvements in the study area compared to the control area because of the well-functioning RCH programme *(Kiran and Banapurmath 2011 [Slums, India])*.

Two doses of anthelminthic drug reduced prevalence and intensity of Ascaris infection more than one dose, and the reduction in Ascaris intensity was associated with a height increment while a decreased intensity of Trichuris, seen over a year period, was highly correlated with increases in mid arm circumferences *(Hadju et al 1997 [Ujung Pandang slums, Indonesia])*. Deworming should be provided to children in areas with a high transmission of helminth infections and a high prevalence of malnutrition.

WASH

Results of a Sanitation intervention(provision of hygienic/ improved latrines) suggested that the prevalence of improved latrines at the community level was a strong predictor of child weight-for-height *(Buttenheim 2007 [Dinajpur, Bangladesh])*. Sanitation upgrades were less effective in improving child health when implemented in individual households, but more effective when implemented in a clustered way. This implies that social networks and social processes may be as important in determining the health environment as the placement of services or investment in infrastructure.

Comparison

Seventy one percent of the interventions were designed with a control or trial arm for which there was no intervention. For the rest, the design was a comparison with rural areas, or comparison with a group and one intervention, or no control group.

Risks factors

The risks factors were grouped into child, mother, father, family and household factors. The child risks factors were the most reported ones, followed (in order of frequency of reporting) by household, mother, family and father factors. In terms of non-grouped risks factors, the mother's education was the most reported (12 times), then the child's age (10 times), the child's gender, the child's morbidity status, household income, and family size (8 times each). Details are provided here only for the 6 top risk factors.

Mother's education (12 times)

This factor included education level as well as literacy level. In all studies except one (Neervoort et al 2013), more educated mothers were associated with less risk of malnutrition in her child. Few studies took into account confounding factors. Neervort et al. (2013) showed an increase in child's wasting with the mother's being better educated. This study was not assessing specifically risk factors but was part of a school feeding programme in Kenya. The result is therefore only valid for children attending school.

The risk of malnutrition (stunting, wasting, underweight) was higher whenthe mother's education was less or equal to 6 years of primary school education (Srivastava et al 2013) or the level of literacy or schooling was lower (Damor et al 2013, Delpeuch et al, Abuya et al 2012, Semba et al 2008, Ahmed 2004, Maxwell et al 2000, , Shan et al 1997Mittal et al 2007, Shit et al 2012, andDeshmukh 2012). The study by Shit et al. 2012 used anthropometric failure (as defined in the outcome section) rather than malnutrition indices. Deshmukh (2012) looked specifically at adolescent girls.

In Indonesia, high levels of maternal and paternal education were both associated with protective caregiving behaviours, including vitamin A capsule receipt, complete childhood immunisations, better sanitation, and use of iodised salt.

Child's age (reported 11 times)

Although most of the studies reported that age is a risk factor, the age groups varied widely between studies. Only 2 studies agreed on the same age group 48 – 60 months associated with the risk of wasting (Alam et al 2011, Diawara et al

2013). The age groups at risk were older for stunting (starting at 36 months), and underweight (starting at 48 months) compared to wasting (starting at 6 months) (Table 2).

Insert Table 2 here.

Child's gender (reported 8 times)

In most studies, male children were more malnourished than girls (Rajesh and Balinga 2013, Kimani-Murage et al 2011); or more stunted than girls (Olack et al 2011, Abuya et al 2012, Semba et al 2008); or more at risks of being underweight and moderately wasted than girls (Francis et al 2012). Male children had a higher incidence of grade II and grade IV, and female children had a higher prevalence of grade I and grade III as defined in the outcome section in Bangladesh (Ahmad et al 2013). One study (Damor et al 2013) in the slums of Jamnagar city, Gujarat in India found that the prevalence of malnutrition was higher in female children with this finding similar to two other studies in urban India (Ray et al 1990, Bhalani and Kotecha 2002).

Child's morbidity status (reported 8 times)

The illnesses reported associated with malnutrition were diarrhoea, anaemia, dental cavities, throat infections, helminth infections and pneumonia. Diarrhoea was the illness mostly reported associated with malnutrition): more episodes of diarrhoea in the past 15 days were associated with negative deviance in malnutrition (Kanani et al 2012); diarrhoea was associated with underweight (Kiess, 1996) and stunting (De Melo er al 2008) in children; reported diarrhoea was associated with lower body weights and lengths even after adjusting for feeding patterns (Arifeen et al 2001). In the Srivastava study (2012), the most

reported illnesses were anaemia, dental cavities and throat infections associated with malnutrition. Francis et al (2012) revealed that 26.6%, 46% and 10.3% of incidences of stunting, underweight and MAM respectively were attributable to helminth infections. Severe malnutrition was higher in children with pneumonia and severe pneumonia (Yellanthoor et al 2013). Finally, Veiga et al (2010) reported that parasitized or anaemic children were significantly more at risk of being severely undernourished.

Household income (reported 8 times)

The odds for better nutritional status were higher at higher income levels (per capita, monthly income, economic level or poverty line). Four studies reported on the link between income and reduced risk of stunting (Pryer et al 2004, Delpeuch et al 2000, Rode 2011, Shan 1997). Shan's study showed that a 10% increase in income would close 3.3% of the gap between the mean HFA z-score of the population and the mean of the reference standards but this was not the case for younger children (children less than 2 years old). Higher per capita income was associated with the household's ability to purchase better nutrition (Rode 2011, Maxwell et al 2000). Household income was reported as a risk factor in the Deshmukh (2012) study, although the majority of households of adolescent girls were under the poverty line, no test was conducted to test the significance. A linear trend between nutritional status and monthly family income was observed in Mian et al (2002) with malnutrition being present in 49% of families in the lowest bracket (< Indian RS 3000). Rajesh and Balinga (2013) used a social class scale and showed that the prevalence of malnutrition was higher in the lower social classes.

Family size (reported 8 times)

All of the studies found that living in a large family was a predictor of malnutrition (Ahmed 2004, Veiga et al 2010 , Shit et al 2012 , Diawara et al 2013 , Kanani et al 2012 , Singh et al 2011, Neervoort et al 2013, Mian et al 2002). The likelihood of children being severely undernourished increased significantly in families with 7–12 children (Veiga et al 2010). A much higher proportion of anthropometric failure was found among children with 3 plus siblings compared with those with 1 or 2 (Shit et al 2012). In the Diawara et al study, parity >=5 was associated with wasting in children. In the Kanani et al (2012) study, living in a small family (5-7 versus > 7 members) was associated with improved nutritional status in children. Living in a small family overruled the effect of the school feeding intervention on malnutrition in Kenya (Neervoort et al 2013). Mian et al (2002) found that malnutrition prevalences were higher in larger families, although the finding was not statistically significant.

Discussion

There are limited reviews on interventions to tackle children's malnutrition and its associated risks specifically in the context of urban slums (BRC 2012, FANTA 2008, Mohiddin et al 2012); previous reviews were either nutrition-specific (Bhutta et al 2008, 2013, De-Regil et al 2011, 2012, Sguassero et al 2012, Mori et al 2012, Dickson et al 2000, Dangour et al 2013), or slum-specific but non-nutrition specific (Thomson et al 2013; Turley et al 2013). The search strategy included 30 electronic bibliographic databases, grey literature, and relevant eligible studies, and 1512 studies matched the search. The search term 'slum' was limitative, as only 4% of the initial 1512 titles met the selection criteria. Most studies (65%) were conducted in India, Bangladesh and Kenya. The slums in Bangladesh and

Kenya were the well-known ones of Dhaka (Mohammedpur, Kamrangirchar) and Nairobi (Kibera, Viwandani and Korogocho). In India, studies were conducted in various cities. This shows a lack of representativeness of the findings and should promote additional research in under researched slums. Only one study used qualitative methods, which is surprising, as qualitative or mixed methods provide the opportunity to gain a better understanding of the environment This scoping review has found a limited number of publications on intervention; only 22 compared to 38 for risks. This is even more limited taking into consideration that there was no age limit for the target population (children from birth to adolescence). The wide age group limits comparison of findings across studies. The interventions were all nutrition-specific with a 16 month average implementation time-span; 16 months is a short duration compared to most development interventions that last several years. The fact that slums are often rapidly changing environments where participants and slums themselves can disappear is likely to explain this short duration. Twenty-nine percent of interventions were unsuccessful in promoting nutritional outcomes in children. The recommendations resulting from these were mostly that an intervention alone is not sufficient to tackle malnutrition. The root causes of malnutrition are multidimensional and research as well as practitioners in the aid / development sector, have recommended multisectorial approaches to effectively tackle the root causes of malnutrition (Bhutta et al 2013, 2008). Such recommendations suggest that interventions should target household, community and societal levels to address the underlying social determinants (Pridmore 2007, 2010). Interventions that were reported to be successful had a positive impact on stunting, underweight, wasting, gain in mid upper arm circumference and anaemia.

Although we categorised the interventions, those within one category took various forms (e.g. school feeding was either with lunch or with fortified biscuits with or without promotion). It is important to note that we did not assess the level of impact these interventions had and we also did not conduct any cost effectiveness analysis as this was a scoping review. An intervention may be successful but if the cost per child is very high, it may be difficult to implement on a large scale. All of the interventions in health and treatment of acute malnutrition were assessed successful. Some of the interventions combined different types of approach; for example school feeding + supplementation + promotion. The majority had health/nutrition promotion in addition to the intervention itself. This finding will need to be explored further to assess what makes an intervention successful; whether it is the benefits of the added intervention or the synergistic effect of the combined interventions.

The findings on the risk factors were difficult to analyse. Although the studies may agree on a risk factor, they sometimes disagreed if it was a risk or a protective factor. Gender is one example, as male infants and young children are shown to be more at risk for stunting and underweight, except for some studies in India where girls are at greater risk. The review findings showed that mother's education was the most reported protective factor even before a child's own characteristics. This is important to take into consideration in designing interventions in slums. The child's age was the second most reported factor. However the results are challenging to analyse as the age groups varied significantly between studies. Nevertheless the results match in terms of the occurrence of malnutrition depending on its form; stunting and underweight occurred at a later age compared to wasting. The findings on morbidity showed

that diarrhoea was the most reported illnesses associated with malnutrition, although this could also be because it is the most studied morbidity indicator. This shows that the vicious cycle between diarrhoea and malnutrition must be tackled in through hygiene promotion to facilitate improvement of malnutrition in this context. The findings on household income are consistent with wealthier households having better nourished infants and children showing the importance of targeting intervention at the most impoverished children even within the slum setting.

The second aim of this scoping review was to evaluate the value of undertaking a full systematic review. The Cochrane Public Health Group acknowledges that a scoping review is a critical step in defining a systematic review question. The results of the scoping exercises presented here allow for initial mapping of the interventions in urban slum nutrition into the classifications of school feeding, supplementation, promotion, treatment of acute malnutrition, health and WASH. We were able to extract in most studies enough information to assess a nutritional outcome and to measure efficiency (e.g. costs and Disability Adjusted Life Years). The evidence we have found suggests that it would be useful to conduct a full systematic review with a more detailed search strategy, to assess the quality of the studies (not done here) and to conduct meta-analyses to calculate the effect of one type of intervention, e.g., nutrition or WASH, on children's nutritional health. This scoping review has facilitated identification of appropriate Population, Intervention, Comparison and Outcome (PICO) parameters for a full systematic review:

Population

Under 5 year olds would be a sensible target group as this age group was the population in 50% of the studies. Furthermore, prior research showed that it is key to intervene on children's malnutrition as early as possible in a child's life (Bhutta et al 2008).

Intervention

As nutritional intervention was the most reported type, we will limit the parameter to this category.

Comparison

In this scoping review, the comparison groups were either: control, no control, intervention, or rural areas. We have decided to exclude comparisons with rural areas as this will not help to draw conclusions in terms of programmatic implications. The rural studies typically are nutritional surveillance programmes with children randomly sampled at one time point. Consequently the intervention duration, and the change in anthropometric measurements are not taken into consideration. We also will exclude comparison with another intervention group rather than a control group (e.g. In Fauveau' study, it was suggested that nutrition education in the control group may have been responsible for the limited difference between the two groups) as it makes it difficult to assess what makes the intervention successful. It would be complex to determine if it was the additional intervention or the combined effects of both interventions which have an impact on child's nutritional health.

Outcome

Height expressed in cm or change in height z-score will be included. Low birth weight will be included as birth length is not usually available, birth weight serves as a proxy for small size at birth, itself a proxy for inadequate fetal nutrition and growth. We will not include measurement of micronutrient deficiencies as the literature in this area is more limited.

Conclusion

This scoping review sought to identify and map literature that has evaluated the effects of interventions to reduce children's malnutrition and its associated risks in urban slums. The review identified 60 eligible studies with fewer studies on interventions than risks. Nutrition-specific interventions were identified to have an impact on a child's nutritional health and decreased stunting, wasting and underweight in slum children. Nutritional interventions were the most common intervention including school feeding, supplementation, promotion and treatment of acute malnutrition. The associated risks factors showed that the mother's education, the child's age, the child's morbidity status, household income, and family size were important factors for a child's nutritional health in slums. This is important information for the future design of slum interventions targeting reduction of malnutrition. This scoping review supported the value of undertaking a full systematic review (Cochrane Systematic review protocol 2015) and helped inform the PICO parameters for that review.

While this scoping review identified types of interventions and classified reported risks, there are still gaps in knowledge that need to be addressed with further research. Firstly, additional research on interventions in terms of quality and effect analysis should be conducted through a systematic review. Secondly, further analysis on the risk factors identified here (the mother's education, the

child's age, the child's morbidity status, household income, and family size) which will lead to programmatic recommendations and, perhaps, a tool embedding these risk factors to be used to identify children who are the most at risk of malnutrition is required in order to appropriately target interventions.

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Tables

Table 1: Descriptive search results

Total number of eligible studies	**58**	**% out of total studies**
Intervention	22	38%
Prevention	*18*	
Treatment	*4*	
Risks	38	66%
Year of publication 2010+	29	51%
Location		
Bangladesh	14	24%
India	16	28%
Kenya	7	12%
Pakistan	2	3%
Indonesia	5	9%
Brazil	2	3%
Others	12	21%
Study setting		
Slum	47	81%

Urban	11	19%
Intervention type		
Nutrition	17	77%
- school feeding	*3*	18%
- supplementation	*6*	35%
- promotion	*5*	29%
- treatment	*3*	18%
Health	3	14%
Wash	2	9%
Target population		
Children <5	30	52%
Effective		
Yes	16	73%
Studies type	**58**	**% out of total studies**
Cohort studies	11	19%
Prospective	8	
Retrospective	1	

Cross-sectional studies	33	58%
RCT	13	21%
Non randomized	2	
Cluster	4	
Case study	1	2%

Table 2 – Age group at risk of undernutrition in relation to the age group studied and health outcomes

Study reference	Age group studied (in months)	Age group at risk	Health outcomes
Olack et al 2011	6 – 59 months	36 – 47 months	Stunting
		24 – 35 months	Underweight
		6 - 11 months	Wasting
Alam et al 2011	24 – 60 months	48 – 60 months	Stunting, underweight, wasting
Francis et al 2012	6 – 14 years	10 – 14 years	Stunting, wasting
Srivastava et al 2012	5 – 15 years	5 – 6 years, 11 - 12 years	Stunting, underweight
		7 - 8 years	Wasting
Diawara et al 2013	6 – 59 months	12 – 23 months, 48 – 59 months	Wasting
Mian et al 2002	5 – 10 years	8 – 9 years 9 – 10 years	Stunting, underweight, wasting
Kanani et al 2012	6 – 18 months	6 – 11 months	Underweight
Pryer et al 2003	3 – 59 months	16 – 59 months	Stunting

Figures

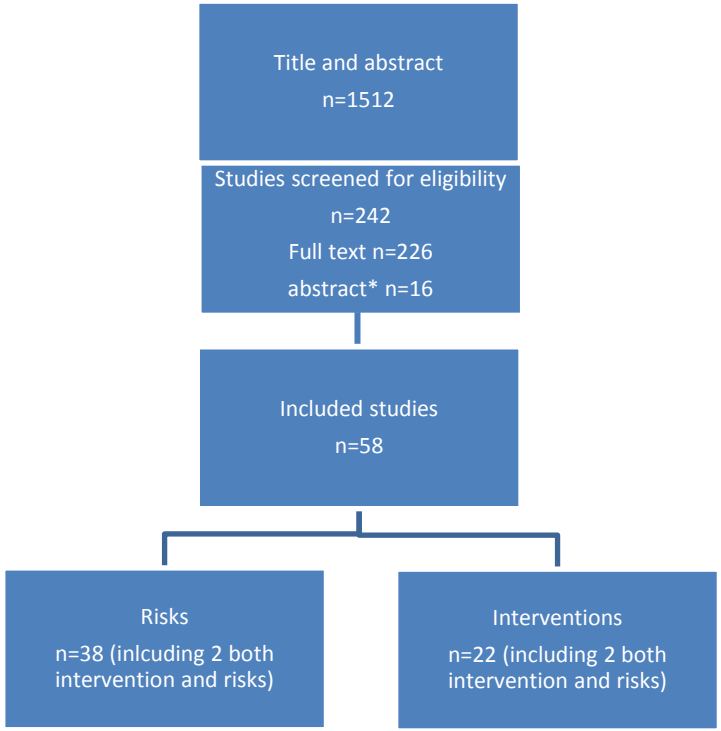

Figure 1: Search results (* full text was not available)

Annex 1: Databases selected for review, of grey literature or combined sources selected for review, List of agencies, academic institutions and technical bodies grouped

Database	**URL Links**
Web of Science	http://apps.webofknowledge.com/
Biosis Citation Index	http://apps.webofknowledge.com/
MEDLINE	http://apps.webofknowledge.com/
IBECS (english)	http://ibecs.isciii.es/
Pubmed	http://www.ncbi.nlm.nih.gov/
Ovid medline	http://ovidsp.uk.ovid.com/
Embase	https://www.embase.com/login
COCHRANE (Public health group special register)	http://ph.cochrane.org/our-publications
CENTRAL	http://www.thecochranelibrary.com/view/0/index.html
WORLDCAT (OCLC)	http://www.oclc.org/en-UK/home.html?redirect=true
CINAHL (EBSCO)	http://www.ebscohost.com/academic/cinahl-plus-with-full-text
Popline	http://www.popline.org/
BIBLIOMAP	http://eppi.ioe.ac.uk/webdatabases/Search.aspx
ZETOC	http://zetoc.mimas.ac.uk/
WHO International Clinical Trials Registry Platform	http://www.who.int/ictrp/en/
MetaRegister of Controlled Trials (mRCT)	http://www.controlled-trials.com/mrct
African Index Medicus	http://indexmedicus.afro.who.int/cgi-bin/wxis.exe/iah/
ClinicalTrials.gov	http://www.clinicaltrials.gov/
Global Health Library	http://www.globalhealthlibrary.net/php/index.php
WHOLIS - the WHO Library Information System	http://dosei.who.int/uhtbin/cgisirsi/Thu+Jul++5+16:26:22+MEST+2012/0/49
Health management ProQuest	http://search.proquest.com/advanced
Loughborough Catalogue Plus	http://www.lboro.ac.uk/library/
Google Scholar	http://scholar.google.co.uk/
Database of grey literature or combined sources	**URL Links**
Grey literature report	www.nyam.org/library/online-resources/grey-literature-report
Virtual health library	http://www.bireme.br/php/index.php?lang=en
Index Medicus for South-East Asia Region (IMSEAR)	www.hellis.org
Virtual Health Sciences Library (VHSL)	www.emro.who.int/HIS/VHSL/
3ie impact	http://www.3ieimpact.org/en/
eLENA e-Library of Evidence for Nutrition Actions	http://www.who.int/elena/en/
Gina Global database on the implementation of nutrition actions	https://extranet.who.int/nutrition/gina/
List of agencies, academic institutions and technical bodies grouped	
UN agencies	The World Health Organization (WHO) Department of Child and Adolescent Health and Development (WHO); the United Nation Children's Fund (UNICEF); the World Food Program (WFP); the World Bank (WB); the United Nations

	Standing Committee on Nutrition (UNSCN); The United Nations Refugee Agency (UNHCR), The World Bank
Technical bodies focussing on Nutrition	The Food and Nutrition Technical Assistance Project (FANTA-2); the Emergency Nutrition Network (ENN) (publication Field Exchange); the International Malnutrition Task Force (IMTF); the Humanitarian Practice Network (HPN); the Community-Based Management of Acute Malnutrition (CMAM) Forum; the Global Nutrition Cluster (GNC); the Global Alliance for Improved Nutrition (GAIN), Helen Keller International (HKI); Food security and livelihoods in urban settings working group
Technical bodies SLUMS	UN-HABITAT; Slum Dwellers International (SDI); CitiesAlliances
Specialist Academic institutions	Centers for Disease Control and Prevention (CDC), the International Centre for Diarrhoeal Disease Research (ICDDR); the Institute of Child Health London (ICH); the London School of Hygiene and Tropical Medicine (LSHTM); and the Institute of Tropical Medicine (ITP) Antwerp, Belgium; Jameel Poverty Action Lab (J-PAL)
International non-government organizations (NGOs)	Save the Children (STC); Doctors without Borders (MSF); Valid international; Concern Worldwide; Action Against Hunger (ACF); NutritionWorks; Medecins du Monde (MDM); OXFAM; Red Cross movement; WorldVision; BRAC; Plan; Family Health International and others
National departments for international development and non-institutional donors	USAID, UK Department for International Development (DFID), Swedish International Cooperation Development Agency (SIDA) and French agency for International Development (AFD); Comic Relief

Annexe 2 – details of successful intervention grouped per type (duration and measure of effectiveness)

			Nb of studies	Intervention details	Duration in months	Measure of effectiveness (in brackets details provided for change in wasting, stunting, underweight or weight – intervention first vs control)
Type	**Study reference**	**School feeding**	**3**			
Nutrition	Ahmed 2004	School feeding with fortified biscuits	1	The school feeding programme provides a mid-morning snack consisting of eight fortified wheat biscuits to four slum areas in Dhaka City. At a cost of U.S. 6 cents per packet of eight, the biscuits provide 300 kilocalories and 75 percent of the recommended daily allowance of vitamins and minerals.	?	**Less wasted** (increase BMI of participating children by an average of 0.62 points)
Nutrition	Keidar et al 2008	School feeding	1	Not enough information available.		Not effective.
Nutrition	Neervoort et al 2013	School feeding combined with health education and, when clinically indicated, vitamin or iron supplements	1	The programme consisted of a lunch combined with health education and, when clinically indicated, vitamin or iron supplements for a period of 3 months. Before the study, all caretakers were informed about the programme and its research purposes, and they agreed to participate. The lunch programme was weekly delivered by local transport services. All children were given an anti-worm treatment from the school.	12	**Less stunted** (12% intervention vs 22% control), less wasted (0% vs 11%), less incidence of anaemia (19% vs 42%) (cofounding factors: having no father, family size)
		Supplementation	**6**			

Nutrition	Oelofse et al 2003	Micronutrient fortified complementary food (Vit A, iron and zinc)	1	The experimental group received a micronutrient-fortified complementary food. The complementary food given to the experimental group was similar to what was well-known and used in the community. The quantity prescribed for use per day during the intervention was 60 g of dry cereal and would ensure consumption of 100% of RDA for vitamin A, 80% for iron, and more than 100% for zinc. They received demonstrations on how to prepare the porridge and a measuring spoon to ensure the correct amount of porridge to be consumed. Each child was expected to consume 60 g of dry porridge mixed with cooled boiled water per day for six months.	6	Not effective on growth, zinc. Effective on serum retinol and iron.
Nutrition	Osendarp et al 2000	Supplementation (zinc) (new borns)	1	Infants were randomly allocated to receive 5 mL/d of a liquid with 5 mg elemental Zn (as zinc acetate). Health workers delivered a bottle containing a 1-wk supply of 40 mL of the supplement to the houses of the participants and instructed the mothers to give a daily dose to their infants, when possible in between feedings, using a marked dropper or feeding spoon. Compliance with supplement consumption was 85% (of total days), and the average (± SD) daily consumption was 4.2 ± 1.3 mL, as assessed by measuring liquid levels at the weekly visits.	5	**Weight gain** (3.15+/- 0.77 intervention vs 2.66+/-0.80 kg control)
Nutrition	Osendarp et al 2002	Supplementation (zinc) (pregnant mothers)	1	The amount of zinc given was based on twice the recommended daily intake for zinc during the last 2 trimesters of pregnancy, assuming low or moderate bioavailability (24, 25). The zinc content of the zinc tablets (x – : 31.0 mg Zn/tablet; range: 28.6–32.6; n = 20) and placebo tablets (x – : 0.0 mg Zn/tablet; range: 0.0–0.1; n = 20). The women were prospectively followed up and supplementation continued until delivery	6	Not effective
Nutrition	Semba et al 2013 [Indonesia]	Micronutrient fortified milk and fortified noodles (Milk products fortified with Vit A, C, D, E, K, B12, thiamin, and riboflavin; Noodles fortified with Vit A, B6, B12, thiamin, niacin, folate, and iron)	1	Children and families were participant of the national nutrition surveillance programme. For each child in the family, data were collected on whether the child had consumed industrially produced milk products in the previous week (brand and cost). Similar data were collected on whether the child had consumed instant noodles in the previous week, the brand of the product (which allowed classification of noodles as fortified or not), and how much was spent on the noodles in the previous week. Milk products were fortified with vitamin A, vitamin C, vitamin D, vitamin E, vitamin K, vitamin B12, thiamin, and riboflavin. Noodles were fortified with vitamin A, vitamin B6, vitamin B12, thiamin, niacin, folate, and iron.	N/A	**Less stunted** (fortified milk :Intervention vs control, OR = 0.80; 95% CI, 0.76 to 0.85; p < .0001, fortified noodles: OR = 0.95; 95% CI, 0.91 to 1.01; p = .08).

Nutrition	Berger et al 2008	Micronutrient supplementation (Vit A)	1	Children and families were participant of the national nutrition surveillance programme. For each child over the age of 6 months, the mother, father or guardian was asked whether the child had received a vitamin A capsule within the last 6 months and about receipt of diphtheriapertussis- tetanus (DPT), oral poliovirus vaccine (OPV) and measles vaccine. Axillary temperature was recorded. Morbidity histories were obtained for each child, including history of diarrhoea in the previous week and diarrhoea on the survey day.	N/A	**Less underweight** (z score – 3**,** 7.8% vs 8.6% (P<0.0001)**, less stunted** (7.8% vs 8.6% (P<0.0001)**, less anaemic, less episodes of diarrhoea**
Nutrition	Iannotti et al 2013	Lipid based nutrient supplement LNS, micronutrient supplementation Vit A, B12, iron and zinc)	1	Infants were recruited from an urban slum of Cap Haitian and randomly assigned to receive: 1) a control; 2) a 3-mo LNS; or 3) a 6-mo LNS. The LNS provided 108 kcal and other nutrients including vitamins A, vitamin B-12, iron, and zinc at ≥80% than recommended amounts.	6	**Less stunted** (increased the length-for-age z score (±SE) by 0.13 ± 0.05) **less underweight** (increased weight-for-age z score by 0.12 ± 0.02.)
		Promotion	**5**			
Nutrition	Waihenya 1996	Nutrition promotion on recognition of clinical signs of malnutrition, frequency of feeding, weaning process and dietary management during sickness.	1	This is not an intervention per se. Mothers had access to nutritional information and the study assessed if nutritional knowledge was associated with better nutritional health.	N/A	Not effective.
Nutrition	Shahrawat et al 2012	Interpersonal communication promoting children feeding practices	1	The mothers were asked about the childcare practices they are following since birth for their youngest child. The authors inquired about the information regarding Infant and Young Children Feeding Practices, provided by the Anganwadi worker (AWW). They were asked about any contact with a healthcare provider and information received about the childcare practices. Role of IPC for nutrition education by the AWW and health worker was explored. Findings were supplemented with observation and examination of records wherever possible.	N/A	Not effective.
Nutrition / Health	Singh 2011	Performance pay (government health worker) and nutritional information	1	Three separate models; 1) change in compensation for childcare workers from wages to performance pay, 2) provide mothers with information without incentivizing the workers, 3) combine the first two treatments, where along with the change in compensation for workers, plus nutritional	?	**Less underweight** (reduced weight-for-age

				information to mothers directly.		malnutrition by 4.2%).
Nutrition	Penny et al 2005	Nutritional education at health facilities	1	The intervention consisted in enhancing the quality of nutrition counselling through training and provision of simple, standardised, age-appropriate messages to be used at all points of contact with young children in health facilities.	18	**Less stunted** (at 18 months 16% in intervention *vs* 5% in control; adjusted odds ratio 3·04 [95% CI 1·21–7·64]), **less energy, iron and zinc deficient.**
Nutrition	Attanasio et al 2005	Conditional Cash Transfer (mothers receive cash if their school-aged children attend school and preventive healthcare visits).	1	A family is eligible only if it satisfies the following criteria: (i) it lives in a municipality where the programme is implemented; (ii) it holds a Colombian citizen card; (iii) it has children under 18; and (iv) it is formally classified as being in the lowest level of the official socio-economic classification. Mothers who enrol in the programme will receive a cash transfer if they comply with the conditions required by the programme. They will receive a monthly nutritional subsidy of about $US15.38 if they have children aged 0–6 who participate in the health component of the programme. If they have school-age children (6– 17), they are also entitled to a school subsidy which depends on the level of school attended. For primary-school children, the subsidy is $US4.61, while for those in secondary school, it is $US9.23. These are the figures for 2002; the levels are updated annually for inflation. The nutritional subsidy is per mother, independent of the number of children; the schooling subsidy is per child.	?	**Less stunted** (Z-score increased by 0.161) **Weight gain** (0.578 kg).
		Treatment of acute malnutrition of MAM and SAM children	**4**			

Nutrition	Khanum et al 1988	Inpatient treatment of SAM children	1	All three groups received health and nutrition education during treatment, but the amount and mode of instruction differed. Mothers or caregivers of inpatients and those attending daycare received 20 min of instruction and 20 min of practical guidance every day except Friday. The daycare group received slightly more days of instruction because of their longer recovery time. The domiciliary group attended these sessions but only during their initial week of daycare. Mothers and caregivers of the daycare and domiciliary groups were given additional instruction on what to feed their children at home, how much, and how often. This included a practical exercise in which each caregiver prepared a meal for his or her whole family, keeping in mind the special needs of the malnourished child. Specific instruction was necessary because after the first week children in the domiciliary group were entirely dependent on home-prepared meals for their rehabilitation, and the daycare group were also expected to receive extra meals at home and all meals on Fridays. The domiciliary group was visited at home weekly for 1 mo and then twice a month until they reached 80% of weight-for-height. If necessary, mothers were reminded about the feeding instructions. Ad hoc advice was given if any deleterious practices were observed during the visit		**Less wasted** (z-score +0.68)
Nutrition	Dodd 2007	Positive deviance approach - nutritional education and rehabilitation of MAM and SAM through demonstrative feeding , followed by home-visits to the caregivers	1	The positive deviance approach consisted of nutritional education and rehabilitation through demonstrative feeding by the mother/caretaker over a 12-day period in a comfortable home-like situation, followed by home-visits to the caregivers by volunteer mothers or community nutrition promoters over next 18 days.	1	**Weight gain** (one-third of the children gained more than 500 g weight).

Nutrition	Harris and Jack 2011	Home based treatment of MAM and SAM children. Community based nutrition intervention (nutritional education, regular home visiting, and food support).	1	Standard treatment on admission to the program consisted of oral broad-spectrum antibiotics, antihelminthics, vitamin A, multivitamins, and oral rehydration sachets if diarrhoea was present. New patients came to the outpatient clinic weekly for the first 4 weeks, then once or twice per month. Beginning at admission, mothers were given education on nutrition and health issues at every clinic attendance and also during the home visits, following key family practices determined by the hearth/positive deviance model. Cooking demonstrations were held each clinic day, with an emphasis on teaching mothers to increase the thickness and nutritious value of the staple rice porridge by the addition of extra rice, vegetables, and sources of animal protein. Each child on the program was visited at home by one of the nurses; severely malnourished children were visited at least twice per month (or on occasions, daily if they were acutely unwell and the parents had refused hospital admission), and moderately acutely malnourished children were visited at least monthly. During these visits, the nurse checked the general health of the child, the hygiene conditions in the home, the vaccination record, and the dosages of any current medications and reviewed previous health and nutrition lessons. Food support was given to the mother each month, consisting of 10 kg of white rice, five 155-g cans of fish, and 1 L of cooking oil. For each child in the program, the mother was given one 100-g sachet per day of a locally produced nutritional mix that contained approximately 440 kcal, 28.7 g of protein, 22.6 of g fat, and 35.4 g of carbohydrates. Breastfeeding was strongly encouraged, but if the mother had stopped breastfeeding and relactation was not possible, commercial milk formula powder was given if the child was under 12 months of age and soy milk powder if the child was 12 months of age or older. Transport and hospitalization costs were also reimbursed.	84	**Less wasted** (increase from z-score of –3.3 to –1.5), **weight gain** (overall rate of weight gain 4 g/kg/day)**.**
Nutrition	Fauveau et al 1992	Targeted food supplementation for MAM children (energy-dense supplementary food, together with nutrition education)	1	An energy-dense supplementary food, together with nutrition education, was given to a group of moderately malnourished children aged 6-12 months in a poor slum community of urban Bangladesh. An age- and sex-matched control group received only nutrition education.	?	**Weight gain** (205 g vs 159 g).
		Nutritional Intervention Total	**18**			

Health	Hadju et al 1997	Treatment of helminth infection	1	Randomization was performed based on sex and egg count of A. lumhricoides. A lumhricoides was chosen since the anthelmintic drugs used in the study are highly effective in treating A. lumbricoides infection. These five groups consisted of placebo, pyrantel once (pyr.l x), pyrantel twice (pyr.2x), albcndazole once (alb.lx) and albendazole twice (alb.2x).	12	**Height gain, arm circumference gain** (no data available).
Nutrition / Health	Singh 2011	Performance pay (government health worker) and nutritional information	1	Three separate models; 1) change in compensation for childcare workers from wages to performance pay, 2) provide mothers with information without incentivizing the workers, 3) combine the first two treatments, where along with the change in compensation for workers, plus nutritional information to mothers directly.	?	**Less underweight** (reduced weight-for-age malnutrition by 4.2% in 3 months).
Health	Kiran 2011	Reproductive and Child Health (RCH) (immunization, antenatal care, skilled attendance during delivery, and treatment of common childhood elements)	1	The RCH programme consists of regular health check-up camps conducted once a week; nutritional assessment of children (0-5 yrs), immunization to all children and pregnant mothers along with regular antenatal check-ups, nutrition counselling of mothers about importance of exclusive breastfeeding, proper complementary feeding practices and immunization of all under five children.	?	**Less stunted, less wasted, less underweight** (73.3% of children with Grade III PEM vs 35%)
		Health Intervention Total	**3**			
WASH	Langford et al 2011	Hygiene - Community based handwashing programme	1	The hand-washing intervention was informed by a systematic body of work assessing previous community-based hand-washing interventions in developing countries and was underpinned the Theory of Planned Behaviour which focuses on the social and psychological determinants of behavioural change. This theory suggests that an intention to perform certain behaviour is a product of the interaction between a person's attitudes, subjective norms, and perceptions of self-efficacy. The intervention thus aimed to promote a positive attitude towards hand washing, establish hand-washing as a social norm and remove barriers that might hinder hand-washing practices.		Not effective on stunting, wasting, underweight
WASH	Buttenheim 2007	Sanitation - Sanitation programme (provision of hygienic latrines)	1	The program was designed to strengthen the food and livelihood security of high-risk urban slum populations in Bangladesh. The main components of the program were sanitation infrastructure; health, hygiene and nutrition education; income-generating activities; and community mobilization. Specific activities included filling ditches, installing hygienic latrines, and developing local Community Resources Management Committees.	12	**Less wasted (**increased weight-for-height by .341 SD)

		WASH Intervention Total	**2**			

Non effective interventions

. The intervention types were school feeding, supplementation (micronutrient fortified, zinc supplementation), promotion intervention (nutrition promotion on recognition, interpersonal communication) and hygiene (hand-washing).