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The Effectiveness of Large-scale Programmes and Interventions in Reducing Child Stunting Prevalence: A Systematic Review of the Literature

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Abstract

The Effectiveness of Large-scale Programmes and Interventions in Reducing Child Stunting Prevalence: A Systematic Review of the Literature

By Mihaela Dan

Although child stunting has decreased in recent decades (from 195 million to 165 million in 2011), the current trend suggests that the child stunting rate is still too high, thus, it remains an alarming burden in many regions of the world, especially developing countries that have limited access to proper health services, and are income and food insecure. Numerous large-scale programmes and interventions that vary in design scheme and focus have been implemented around the world. Unfortunately, there is still a wide gap in the current literature on the effectiveness of these programmes and interventions on child stunting prevalence of these regions. In this study, a systematic literature review was conducted to synthesize research on the large-scale programmes and interventions. This review focused on the effectiveness of these programmes and interventions on reducing child stunting prevalence. To carry out this systematic review, the Child Epidemiology Reference Group (CHERG) guidelines were utilized. The search engines used were PubMed, Popline, Econ-Lit, WorldBank Library, Cochrane Library, IFPRI, and the International Initiative for impact Evaluation Food Policy Research. A systematic review of peer-reviewed scientific articles and manual literature search were conducted to ascertain the effectiveness of large-scale programmes and interventions on child growth and stunting outcomes. Results found 62 studies that met inclusion criteria. The overall quality of evidence was very low, except for social safety net programmes that distribute cash/food transfers to programme beneficiaries which were graded as high quality of evidence. Most of the programmes and interventions evaluated were located in Central and South America and in South Asia. Evidence was not able to decipher what individual components of programmes resulted in their success in improving child growth and reducing stunting prevalence. This literature review demonstrates that there is a lack of high quality evidence that evaluates large-scale programmes and interventions and their effectiveness on child growth outcomes. Magnitude of the effects of these programmes and interventions could not be estimated due to the lack of high quality data. In the future, more systematic monitoring and evaluation studies need to be conducted and a greater dissemination of results is needed.

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ABBREVIATIONS

BDH	*Bono de Desarrollo Humano*
BFP	*Bolsa Familia*
BINP	Bangladesh Integrated Nutrition Project
BMI	Body-mass index
CCT	Conditional cash transfer
CNP	Community nutrition project
DALY	Disability-adjusted life-year
DAP	Development assistance programme
DHS	Demographic and Health Survey
DID	Difference-in-Difference
FA	*Familias en Acción*
FFA	Food for Asset Creation
FFE	Food-for-education
FPHSP	Family planning-health service project
FSP	Food supplement programme
FSVGD	Food Security Vulnerable Group Development
HAZ	Height-for-age z-score
HCB	*Hogares Comunitarios de Bienestar Familiar*
HSNP	Hunger Safety Net Programme
HWP	Handwashing project
HWSP	Handwashing and sanitation promotion
HWWS	Handwashing with soap
ICDS	Integrated child development services
IGVGD	Income-Generating Vulnerable Group Development
IMCI	Integrated management of childhood illness
ITT	Intention-to-treat
IUP	Universal Immunization Program
IV	Instrumental variables
LAZ	Length-for-age z-score
MDM	Midday Meal programme
MVP	Millennium village project
NNP	National nutrition programme
P4P	Pay-for-performance
PEI	*Programe de Estancias Infantiles para Apoyar a Madres Trabajadoras*
PIDI	*Proyecto Integral de Desarrollo Infantil* (Integrated Child Development Project), Bolivia
PROGRESA	*Programa Nacional de Educación, Salud y Alimentación* (National Program for Education, Health and Nutrition), Mexico (now *Oportunidades*)
PSM	Propensity score matching
RCT	Randomized control trial
RMP	Rural Maintenance Program
RPHC	Rural primary health care project
RPS	*Red de Protección Social*
SCF	Save the Children Federation

SD	Standard deviation
SEECALINE	*Projet de Surveillance et Education des Écoles et des Communautés en Matière d'Alimentation et de Nutrition Élargi*
SFP	School feeding programme
SNP	School nutrition programme
TSC	Total sanitation campaign
UCT	Unconditional cash transfer
UNICEF	United Nations Children's Fund
VHI	Vietnam health insurance
WFP	World Food Programme
WHO	World Health Organization
WIC	Women, Infants and Children
WWMP	Wawa-Wasi national programme

INTRODUCTION

The increased efforts, from government and nongovernment agencies alike, along with immense allocation of resources over the past few decades has had limited success in improving the prevalence of child malnutrition, especially that of global child (Independent Evaluation Group, 2010; Bhutta et al, 2013). Child stunting, a condition defined as the failure to reach adequate height potential, is a result of nutritional, such as continued lack of proper nutrients, and non-nutritional causes, such as repeated bouts of disease (Black et al, 2008). Unlike other different forms of malnutrition, such as wasting, which can be easily detected over a short period of time, child stunting often times goes undetected as it takes a longer period of time to observe inadequate growth in height in children; thus, it has rightfully earned the name the "silent emergency" (UNICEF, 2012). Child stunting is therefore utilized as an indicator of long-term malnutrition or chronic malnutrition in a given population (Independent Evaluation Group, 2010; Bhutta et al, 2013). The high rate of child stunting worldwide indicates that this still remains a global burden, especially in developing nations.

Although the global child stunting rate has been slowly declining, a minimal decrease from 195 million, in 2009, to 165 million stunted children in 2011 (UNICEF, 2009; UNICEF, 2013). This represents a 15% reduction; however, the decline is occurring at a much slower pace than desired. Prevalence of child stunting is also unequally distributed as some regions of the world face a higher burden of child stunting when compared to others; predominantly, a higher prevalence of stunting in children has been observed in east and west Africa with a prevalence of 36%, and South-central Asia with a prevalence of 42%. The majority of children affected by stunting (69 million) live in South-central Asia (Black et at, 2013). Furthermore, there is also unequal distribution within a

country with child stunting almost always affecting more of those in the lower socioeconomic status groups than the higher socioeconomic groups and those living in rural regions than urban (Black et al, 2013). Black et al (2013) estimated that stunting amongst children living in the poorest quintile of households is 2.47 times higher than the richest quintile, and stunting was 1.45 times higher in rural than urban areas.

Child stunting can cause impaired immune, cognitive and physical development and function, which can lead to a domino effect of life-threatening consequences, ultimately causing one to remain in a food and income insecure state resulting in a decreased quality of life and life expectancy (Black et al, 2008; Victora et al, 2008; Independent Evaluation Group, 2010; Bhutta et al, 2013). Not only does this domino effect occur at the individual level but at the national/country level as well. In countries where prevalence of stunting is high, this outcome can have devastating impacts on the labor force, ultimately diminishing a country's overall GDP and productivity potential; thus, just like the individual is unable to escape the cycle of poverty, the country as a whole cannot hold a place in the global economy (Black et al, 2008; Victora et al, 2008; IEG, 2010; Bhutta et al, 2013).

A myriad of programmes and interventions have been developed and implemented in various areas of the world, especially in regions where prevalence of child stunting remains high, in hopes to combat this burden. Recent efforts have especially focused on implementing these programmes and interventions at scale in order to reach as many malnourished individuals as possible (Bhutta et al, 2008; Bhutta et al, 2013). These types of programmes are usually referred to as being "large-scale," a term used to define geographic and population coverage (Shapiro, 1982). Although many of these types of programmes and interventions have been implemented globally, the success of these efforts is not well understood or documented. The success of these programmes and interventions in

reducing child stunting prevalence is also unclear. Furthermore, there is a great lack of understanding in what drives these programmes and interventions to succeed in their setting.

This systematic review will examine the impact of large-scale programmes and interventions that have been implemented, on child stunting outcomes; more specifically, this review will attempt to decipher which programmes and intervention have been successful and what components of these programmes and interventions have contributed to their success. In order to assess the available literature, this review will utilize the Child Health Epidemiology Reference Group (CHERG) guidelines to measure the overall quality of individual studies (Walker et al, 2010).

By gathering evidence of the current literature on the evaluation of large-scale programmes and interventions, it will provide vital and useful information to better understand what types of programmes and interventions have been implemented, in what regions they were most successful and effective, and document the components of successful large-scale programmes. This review fills a gap in the literature by addressing the effectiveness of already implemented large-scale programmes and interventions in reducing child-stunting prevalence. Furthermore, this review will attempt to assess if any common themes in successful large-scale programmes exist across contexts. This information could then be utilized in designing future successful programmes. Thus, this knowledge can be used by stakeholders to support and facilitate the implementation of programmes and interventions that are more likely to succeed.

BACKGROUND

Approximately, 165 million children are stunted globally, with an overwhelming amount of countries in African and Asia encompassing the majority of the global burden; low income countries have a higher prevalence of child stunting compared to high income countries (Black et al, 2008; Black et al, 2013). Also, there exists great inequality within countries, such as Brazil, where indigenous populations have higher rates of undernutrition compared to non-indigenous (Horta et al, 2013). Together these two regions of the world account for 61% of the total stunted children. Alarmingly, India has an estimated prevalence of 51%, equating to more than 61 million stunted children, making up 34% of the total global prevalence. Within these low income countries, stunting prevalence is generally higher in populations that are of lower socioeconomic status (Black et al, 2008). Furthermore, evidence illustrates that 11 of the 36 countries that hold the highest prevalence of child stunting, children living in poorest households have about twice as much stunting as the children living in wealthier households (Black et al, 2008). A framework developed by UNICEF identifies the basic underlying causes of undernutrition, illustrating environmental, economic, and sociopolitical factors, with poverty having an essential role (Black et al, 2008; UNICEF) as shown in Figure 1.

The framework explains the relationship between poverty, food insecurity, and other underlying and immediate causes that ultimately lead to child undernutrition as well as the short-term and long-term consequences of undernutrition (UNICEF). Underlying causes are those that influence households and communities, basic causes are those that influence the structure and process of societies and immediate causes are those that operate at the individual level (UNICEF). More specifically, underlying causes of undernutrition are identified as household food insecurity, inadequate care, and environmental factors that impede access to health services (UNICEF). These factors, therefore, play a crucial role in determining whether a child is consuming enough food to sustain proper

growth and development, has access to adequate health care services, and their vulnerability to infection and disease (UNICEF). Immediate causes of undernutrition are a consequence of improper diet such as one that lacks in essential nutrients and intake. Infection can increases requirements, further inhibiting the body from absorbing nutrients consumed (UNICEF). Basic causes of undernutrition refer to what resources are available and how these resources are utilized. The political infrastructure as well as cultural factors may make it difficult for households to attain adequate food (UNICEF). The next sections will provide a detailed explanation as to how these underlying causes can result in child stunting and the consequences of child stunting at the individual, household, and national level.

CAUSES OF CHILD STUNTING

Maternal health status and nutrition. The nutritional status of women, prior to pregnancy and after, plays a crucial role in the health outcomes of their offspring. Evidence from prior studies suggests that maternal anthropometry, more specifically maternal body mass index (BMI) and low height, can lead to various adverse nutritional impairments in their children (Felisbino-Mendes et al, 2014). Having a lower maternal BMI index has been shown to be associated with intrauterine growth restriction. This can predispose neonates to a plethora of negative health and birth outcomes. Inadequate space availability in the womb not only limits the space within which the fetus can grow and develop to its full potential, but also inhibits the amount of nutrients a fetus can absorb (Black et al, 2013, Felisbino-Mendes et al, 2014). A study done in Guatemala indicated intrauterine growth retardation and growth during early childhood to be significant determinants of height and body composition later in life (Rivera et al, 1996). In other words, young girls who were

stunted during early childhood grew to be shorter adults and in turn gave birth to smaller babies, due to the lack of adequate space for the fetus to grow appropriately (Ramakrishnan et al, 1999).

A woman's stature and nutritional status is reflective of her current socio-economic wellbeing as well as her cumulative developmental experience. In other words, the material circumstances of the mother's own early environment including being in her mother's womb, highly influences the development of the fetus in its first environment, the mother's body (Hart, 1993). If a mother experiences a thriving environment comprised of privileged material circumstances during her growth and development during childhood, she will most likely give birth to healthier offspring. This was seen in the data collected during the famine that occurred in the Netherlands during World War II, where mothers from privileged backgrounds gave birth to healthy offspring despite conceiving during a widespread famine (Hart, 1993). Another study (Lumey et al, 1995) also concluded that the maternal environment during the prenatal period has potential to modify the genetic disposition of the fetus and these long-term effects can pass from one generation to the next. This intergenerational transfer of poor health as well as poor socioeconomic status from mother to child continues with the failure to improve nutritional and socioeconomic circumstances (Black et al, 2013; Ramakrishnan et al, 1999).

Even more so, the nutritional status of adolescent girls is crucial and highly relevant to maternal health especially in low-to-middle income countries where adolescent fertility is three times higher than in high-income countries (Black et al, 2013). Adolescent girls face higher risk of complications, mortality and poorer birth outcomes during pregnancy than women of older age (Black et al, 2013). Two recent reviews provide evidence that adolescent girls (under the age of 18) are at increased risk

of more adverse pregnancy outcomes, such as low birthweight and preterm birth (Gibbs et al, 2012; Kozuki et al, 2013). Moreover, pregnancy in adolescence contributes to slowing of a girl's linear growth, resulting in stunting. As data collected from some countries shows that as many as half of adolescents are stunted, this presents serious implications for birth outcomes and nutritional status of the next generation (Black et al, 2013). Unique complications, such as difficulty in proper nutrient absorption, during pregnancy occurs especially in adolescent girls that enter pregnancy with a poor nutritional status as seen in a large proportion of adolescent girls in developing countries (Rah et al, 2008). For example, severe maternal nutritional depletion and impaired growth of the fetus occurs simultaneously as the competition for nutrients between the growing mother and fetus occurs (Rah et al, 2008). Thus, it is of crucial importance for there to be a specific focus on young girl and adolescent girl nutrition along with nutrition of older women prior, during and after pregnancy.

Nutrition and feeding practices. An essential part of proper growth and development of infants and children is proper feeding practices that allows for the most efficient route of absorption of vital nutrients necessary for optimum health. Infancy, especially the first year of life, is the time period where a child experiences the most rapid growth requiring optimum nutrient absorption to feed growing muscle and tissue (Black et al, 2008; Victora et al, 2008; Black et al, 2013; WHO, 2013). It is vital for infants to receive the proper nutrition and care they need to grow and develop to their full potential. Breast milk provides all the essential nutrients needed to sustain positive growth and survival in young infants; however, it soon becomes insufficient to support a growing infant towards the middle of the first year (WHO, 1995). The WHO recommends exclusive breastfeeding for the first 6 months followed by an early initiation and continuation of breastfeeding for 2 years or more together with nutrient dense complementary feeding starting at 6 months to ensure proper growth

and development (WHO, 1995). An evaluation done on infant and children feeding practices in Bangladesh following these guidelines resulted in positive exponential growth in weight and length in the sample population during infancy, 1 to 12 month of age (Saha et al, 2008). However, in many countries, mothers practice exclusive breastfeeding for a shorter duration of time, less than 6 months, than recommended followed by the introduction of complementary foods too soon into the infant's life. The complementary foods are usually not nutrient dense to provide adequate nutrition or the infant has not reached the point in development to properly digest and absorb nutrients from the complementary food resulting in gastrointestinal issues that can lead to various outcomes of malnutrition including stunting (Saha et al, 2008; Mamiro et al, 2005). The replacement of exclusive breastfeeding with complementary foods can significantly alter the health, growth, and development of infants.

Environment. Populations who live in poor sectors are more prone to be exposed to a multitude of environmental exposures that heighten their risk for infection, illness, and disease (Bartlett, 2003). This risk is heightened greatly when an individual living in this setting is also of poor health status; their vulnerability to infection increases and their ability to properly fight off infection is greatly inhibited (Bartlett, 2003). Furthermore, risk of vulnerability to infection, illness, and disease is dramatically heightened for children of poor nutritional status, that live in poor environments that contain various exposures; poor practices of hygiene and sanitation within the household is also a factor (Bartlett, 2003). A weakened immune system due to the prior existence of poor nutritional status makes it more difficult for children to combat pathogens, such as intestinal parasites, and illnesses, that cause diarrheal events, which act to further deplete their bodies of nutrients through

lack of food consumption and poor nutrient absorption (Bartlett, 2003); thus, developing a vicious cycle of poor nutritional and health status in children.

It has been estimated that children under the age of 5 in developing countries will experience an average of three episodes of diarrhea per year and up to an alarming 19 episodes for those that live in the poorest areas (Moore et al, 2001). Most often, diarrhea occurs from the ingestion of pathogens from feces contaminated water or from lack of hygiene (Moore et al, 2001). Poor access to clean water along with poor hygiene and sanitation practices can thus increase the likeability of the consumption of contaminated water by children. Open defecation is widely practiced in India, where a majority of children are stunted; open defecation areas are usually in close proximity to a major or primary source of water for communities (Spears, 2013). Communities use this contaminated water for various purposes, drinking and cooking being the primary uses. Ingestion of this water poses many threats to child health as most often, diarrhea occurs from the ingestion of pathogens from feces contaminated water or from lack of hygiene (Morre et al, 2001). These episodes of diarrhea present a series of concerns related to nutritional outcomes in children, especially in terms of reduced food intake and nutrient absorption (Moore et al, 2001). Humphrey (2009) documented that as much as a quarter of child stunting is attributed to the occurrence of five or more diarrheal events before the age of two. Thus, continuation or frequent episodes of diarrhea can significantly increase the risk of growth retardation or stunting in young children (Ricci et al, 2006). Furthermore, a vicious cycle develops as children who are malnourished and experience diarrhea as diarrhea leads to poorer nutritional status and poorer nutritional status increases episodes of diarrhea.

Socioeconomic status of households and education level. Poor households frequently experience a devastating limitation in resources, food, low levels of education and nutritional knowledge, and poor health status along with poor access and utilization of healthcare (World Bank, 2010; Pena & Bacallao, 2002; FAO, 1997;Pena & Bacallao, 2002; Pettelier et al, 1995; UNICEF, 1990; Fotso et al, 2012). As mentioned above, infants require a surplus of nutrients in the form of carbohydrates, proteins, and fats to grow and develop normally. This requires a varied and diverse diet that will provide the necessary macronutrients as well as micronutrients that support proper growth. When taking into account household level income and the high cost of foods, especially animal food products, many households are faced with the reality that they are not able to purchase or consume nutrient dense foods frequently enough to obtain these important macronutrients and micronutrients that are recommended to sustain and promote proper growth. Thus, many households consume foods that they can afford, most often than not these foods are of low nutrient quality and diversity (World Bank, 2010; Pena & Bacallao, 2002; FAO, 1997;Pena & Bacallao, 2002; Pettelier et al, 1995; UNICEF, 1990; Fotso et al, 2012). A study conducted in Bangladesh demonstrated that showed that low diet diversity was a strong indicator of child stunting. Several studies confirm these findings of an inverse association between stunting and dietary diversity (Rah et al , 2010). A different study done using data from multiple countries in Africa, Asia, and Latin America demonstrated that higher height for age z-scores were associated with improvements made in diet diversity (Arimond & Ruel, 2004). In order to achieve diversification of the household diet, this requires that the household is capable and has obtained the means to not only afford various foods but also have access to these foods (Torheim et al, 2004). Furthermore, poor households face high vulnerability to shocks, such as rising food prices, health hazards, natural disasters, and injury or loss of livelihood, which make it even more difficult to provide children in these households with

the essential things they need to grow and develop to reach their full potential as adults (Torheim et al, 2004).

Female-headed households also face inequalities and disadvantages such as access to land, livestock and other assets, little educational opportunities and cultural norms of the status of girls and women that inhibit the attainment of a livelihood that will bring economic support and growth as well as health care access (Kassie et al 2012). The cumulative effect results in diminished earning opportunities and greater vulnerability to being food and income insecure. For example, a case study in Kenya indicated that female-headed households are twice as likely to be suffer from chronic food insecurity as opposed to male-headed households. This was largely due to cultural beliefs that benefited men, giving men more employment opportunities rather than women (Kassie et al 2012).

Females living in poor households are also less likely to be educated. Several studies have shown that there is a positive association between maternal education level and child nutritional status. Evidence provided by Makoka (2013) revealed that in the three countries studied (Malawi, Tanzania, and Zimbabwe) the three measures of child nutrition (stunting, wasting and underweight) significantly decreased with increased levels of the mother's education. With a greater level of education, women are more likely to be knowledgeable about proper health behaviors and practices during pregnancy and are more likely to adopt modern medical practices (Boyle et al, 2006). Maternal education also leads to delayed childbirth, fewer children, and improved economic opportunities (Boyle et al, 2006). Thus, lack of adequate income at the household level, caused by various social and economic factors, as well as poor education level and female social status leads to an increase in vulnerabilities

and food insecurity, resulting in a decrease in the purchasing power and consumption of high quality nutrient foods, ultimately leading to the development of child growth retardation.

CONSEQUENCES OF CHILD STUNTING

Health in childhood and adulthood. Children who are stunted early in life are more likely to face a higher burden of poor health than those who were not stunted and received proper nutrition (Victora et al, 2008). Without the necessary nutrients to grow and develop properly, stunted children are more likely to have an impaired immune system, leaving them more vulnerable to recurrent infections and diseases, especially for those that live in areas that have poor hygiene and sanitation (Victora et al, 2008). It has been estimated that stunted children, due to lack of proper nutrition, are five times more likely than non-stunted to die from diarrhea. Stunted children also face a multitude of poor health complications when they reach adulthood such as metabolic disturbances such as high glucose concentrations, high blood pressure, harmful lipid profiles, hypertension, and obesity (Black et al, 2008; Victora et al, 2008; Branca & Ferrari, 2002).

Female stunted children will become stunted mothers who will have to deal with various complications, such as intrauterine growth restriction and obstructed labor, during the cycle of their pregnancy, ultimately giving birth to a stunted child who will have an increased risk of mortality (Victora et al, 2008; Black et al, 2013). Furthermore, stunted mothers have a greater risk of mortality from injuries caused by birthing complications such as failure to deliver through vaginal birth and failure to deliver by cesarean section (Alive&tThrive, 2010).

Cognitive development and growth. A multitude of studies have shown that children who suffer from stunting early in life, will have cognitive development issues that will continue into adulthood. Child stunting leads to delayed school entry, greater grade repetition and dropout rates, decreased graduation rates from primary and secondary school entry, and lower school performance (Victora et al, 2008; Alderman et al, 2006). A limited nutrient supply and frequent infections leads to structural and functional damage to the brain that results in restricted development of cognitive functions as well as permanent cognitive damage (Alive&tThrive, 2010). Evidence indicates that being stunted at 24 months of age was associated with a reduction in schooling of 0.9 year, an older age at school enrollment, and 16% increase in risk of failing at least one grade school (Victora et al, 2008). Furthermore, children who are stunted have more difficulty concentrating and develop behavioral problems more often; this results in lower test scores (Mendez and Adair, 1999). A study conducted on Filipino children who were severely stunted at the age of 2 demonstrated that stunted children experienced lower cognitive ability later in life (Mendez and Adair, 1999). Evidence from Haas et al (1996) revealed reduced school performance in stunted children in Guatemala. Similarly, Berkman et al (2002) demonstrated that chronic malnutrition during the first 2 years of life caused adverse effects on a child's cognitive development later in childhood.

Household and country economy. Children who are stunted in childhood will enter adulthood with a small stature; this has severe implications in terms of productivity. Being of small stature results in various functional limitations that reduce work capacity (Victora et al, 2008). For example, in societies where physical labor is necessary for subsistence, having a smaller stature can limit one's ability to do such work. This leads to that individual remaining in a state of continuous poverty

throughout their lives, as they are unable to provide and produce the income that is necessary (Victora et al, 2008). A study indicated that after adjusting for education, adult height was positively associated with income, especially in urban settings (Victora et al, 2008). A study done in Finland revealed a direct association between growth in infancy and adult income (Victora et al, 2008; Barker et al, 2005). Furthermore, studies done in Brazil, Guatemala, and India illustrated significant results between height-for-age where having a z-score of 1 was associated with a 7% increase in income in both Brazil and Guatemala, and an increase of 0.27 household assets in India (Victora et al, 2008). In Brazil and Guatemala, data also revealed a significant association between height-for-age and income for women in Brazil (8%) and Guatemala (25%) as well as number of assets in India (Victora et al, 2008). A cross-sectional study done in Brazil indicated that as little as a 1% increase in height was associated with a 2.4% increase in wages (Alive&Thrive, 2010). Even more convincing evidence is provided by a long-term follow-up study of a randomized trial of a nutritional supplement conducted in Guatemala, where men who received the nutritional supplement earned 46% more than men who were in the control group (Alive&Thrive, 2010).

At the national level, productivity of citizens is vital to the overall economy; countries that suffer from high prevalence of child or adult stunting as well as other forms of malnutrition have low productivity, resulting in low overall GDP (Victora et al, 2008). The impact of reduced human capital can result in an estimated decrease in GDP between 2%-11%. It has also been estimated that global malnutrition could cost the global economy up to $125 billion by the time today's children reach working age in 2030 (Save the Children, 2013). Furthermore, nations with higher burdens will also have to face the indirect costs of malnutrition such as greater health care and special education expenses (Alive&Thrive, 2010).

CURRENT INITIATIVES TO DECREASE CHILD STUNTING

The first 1,000 days. As more studies show the economic and long-term impact of child stunting, countries as well as organizations have grown a great interest in developing plans, initiatives, and programmes to combat child stunting to create a better and more productive future for all. Within the past decade, a plethora of studies have indicated the existence of a crucial window of opportunity that can ultimately impact current and future growth and development of a child to adulthood (Victora et al, 2008, Black et al, 2013). This so-called "window of opportunity" is often referred to as the first 1,000 days of life, which describes the critical period from conception to the child's second birthday (Black et al 2008; Victora et al, 2008; Black et al, 2013). Following the concept that "good nutrition is the bedrock of human well-being, before birth and throughout infancy," the 1,000 Days movement utilizes the importance of optimum nutrition early in life as the foundation to a healthy life in childhood and adulthood (IFPRI, 2014). This translates to not only proper growth and development in youth but a decreased risk in nutrition related complications, diseases, and illnesses, as well as other non-communicable diseases in life and an increase in productivity. Thus, evidence has thoroughly shown that the first 1,000 Days in an infant's life can transfer to the health and wellbeing they will experience as adults (IFPRI, 2014; Black et al, 2008; "Why 1,000 Days," 2014). Furthermore, in reaching adulthood with optimum health, this will increase the chance of economic growth capabilities, as these individuals will not be held back by mental or physical handicaps or other incapabilities that will prohibit them from seeking better employment opportunities and obtaining a more prosperous future. This can have a monumental impact at not only the individual and household level but at the country level as well, increasing productivity and overall GDP and economic growth and sustainability; it has been estimated that

this can contribute to can increase by at least 2-3% annually of a country's GDP (Why 1,000 Days, 2014; Scaling Up Nutrition, 2013; Black et al, 2008, Vitcora et al, 2008).

Current evidence and the SUN Movement. Large-scale programming has gained much popularity as more organizations and economists have realized the max potential and benefit of implementing nutrition programs at scale or scaling-up already existing nutrition programs. Large-scale programmes are unique from others in that they are implemented in a manner that reaches a large part of the population of a country or region, unlike community-based programmes that only reach individuals living within the vicinity of a participating community. In recent years the Scaling Up Nutrition movement, or SUN, has created an action plan to assist countries that are facing a large prevalence of child undernutrition to scale-up country level nutrition programmes (Scaling Up Nutrition, 2013; D'Agostino et al, 2014). According the SUN 2014 updates, 50 countries have signed on to improve and increase coverage of nutrition improving interventions (Scaling Up Nutition, 2013). The focus of this plan is to provide means and support country level programmes that are sustainable, cost effective, have proven efficacy and quality, and equity in properly targeting those that need the most assistance.

The maternal and child health series developed by the Lancet (2008, 2013) journal critically examined various types of interventions and determined what interventions would be more effective in improving both maternal and child health outcomes if implemented at scale. Researchers of these series concluded that the interventions with the most impact on health outcomes and thus most likely to succeed were those that focused on nutrition-specific services such as promotion of infant and child feeding and supplementation. Furthermore, researchers suggested that large-scale

nutrition-sensitive programmes that address underlying determinants of nutrition and enhance coverage and effectiveness of nutrition-specific interventions would accelerate progress in improving maternal and child health outcomes. However, there wasn't much evidence of what large-scale programmes and interventions improved child stunting specifically and how. Furthermore, few researchers have explored the direct impact of large-scale programmes and interventions on child stunting outcomes. This systematic review serves to fill the gap in knowledge about the effect of large-scale nutrition programmes and interventions on child stunting prevalence by taking a critical look at the current literature.

METHODS

ARTICLE SELECTION CRITERIA

The primary inclusion criteria used for the articles included in this systematic review are as follows:

1) Articles must include the child growth outcomes of interest (height, length, H/LAZ, stunting)

2) Programmes/interventions must be large-scale.

Child stunting is defined as having a length-for-age z-score (LAZ) or height-for-age z-score (HAZ) that is two standard deviations below the WHO Child Growth Standards median (WHO 2006). For children that are younger than 24 months, stature is measured in the recumbent position in the form of length while children that are older, stature is measured in height For the purpose of this systematic review, a programme or intervention had to meet a set of three conditions to be

considered large-scale. The three conditions pertain to geographic spread, coverage of target population, and implementation strategy.

In order to decide whether a programme or intervention was large-scale based on geographic spread, studies had to specifically state the amount of regions, communities, districts, provinces, municipalities, statues, etc. the programme or intervention was established in; country size was taken into consideration. If this information was not given, mention of the actual overage of target population of the programme or intervention was also acceptable. More specifically, the actual coverage of a programme or intervention had to successfully reach at least 10,000 individuals of the target population to be considered large-scale for this systematic review. The implementation strategy of a programme or intervention was also taken into consideration when determining its scale. Implementation strategy in this case refers to how the programme or intervention was implemented and delivered; more specifically, what organization or sector was involved in its implementation. Organizations such as large NGOs, country government agencies, public/private sector agencies, etc. and how large or influential that entity was in terms of funding capacity, resources, and societal importance or relevance. Studies had to meet two out of the three criteria of large-scale, described above, in order to be included in this review. Along with these criteria, studies had to also specifically look at child growth outcomes of interest to this review. These outcomes had to be in the form of rates, percentage, or prevalence of height, length and/or stunting or produce height/length-for-age z scores. These outcomes could either be a main or secondary outcome in order to be considered for inclusion in this review. Inclusion and exclusion criteria are summarized in Table 1.

Searches were conducted on the following search engines: PubMed, Econ-Lit, WorldBank Library, Cochrane Central Register of Controlled Trials (CENTRAL) in the Cochrane Library, Cochrane Database of Systematic Reviews (CDSR) in the Cochrane Library, Popline, International Food Policy Research Institute (IFPRI), and the International Initiative for Impact Evaluation database (3ieimpact). Combinations of the terms "national nutrition programme," "national nutrition programmes," "large scale nutrition programme," "large scale nutrition programmes," "nutrition intervention," "child," "children," "infants," "stunting," "growth," "length," "height," "impact," "evaluation," "effectiveness," and "assessment," were used to conduct an exhaustive search of the literature in these databases. Various combinations of these search terms were used with the preference to remain broad in order to obtain a wide range of articles. A manual literature search was also conducted utilizing the reference sections of articles that fulfilled all inclusion criteria described above.

The titles of articles generated in the search using the search terms were reviewed and articles fitting inclusion criteria were abstracted for possible inclusion in this systematic review. If article titles mentioned any of the keywords listed above or pertained to programmes, interventions, children, and growth outcomes, they were chosen for abstract review. Abstracts of articles chosen by title were read and articles were chosen for full text reading if inclusion criteria were met. Articles that met all inclusion criteria after full text reading were included in this systematic review. Abstracted data were tabulated and stored in an Excel Spreadsheet along with programme specific and study specific information. This review also utilized the software Review Manager 5.1 to organize study and programme/intervention details. A summary of the database specific search strategies used in this systematic review is presented in Table 2. Specific search strategies used in each database in described further in Annex A.

Study Quality Assessment

The main components of studies that were assessed to determine study quality were based on study design, comparability of control/comparison and intervention groups at baseline, loss to follow-up of study participants, and adjustment for confounding. The foundation for the creation of these stipulations were based on the prior research conducted by Walker, Fisher-Walker et al (2010) that created the Child Health Epidemiology Reference Group (CHERG) guidelines. Each trial was given a grade of "high," "moderate," and "low" based on these conditions. A grade of "high" distinguished the study as high quality while the grade of "low" distinguished the study as being of low quality. Table 3 presents a detailed explanation for each condition introduced above.

Based on the above criteria, studies were graded with a score ranging from "high," to "moderate," to "low." If a study received a grade of "high" for most of the criteria, the overall assessment of quality for that study was "high." In contrast, if a study received a grade of "low" on most or all criteria, or received a grade of "moderate" for most or all criteria, then the study would be assessed as being either "low" or "moderate." The determining factor that was taken into consideration when grading a study as "low" or "moderate" was the bias and limitations section; this section was used to decide to either upgrade or downgrade the study in question. Also, if a lot of criteria were missing or not available, studies were downgraded to "moderate" or "low" due to this missing information as determination of quality depended on these stipulations. Studies were downgraded in the overall assessment of quality if they received low scores. The overall estimates of child height and/or stunting outcomes were considered with and without a "low" graded study.

The overall quality of individual studies was assessed by the following components: study design, limitations of study, and consistency of findings, and generalizability to populations and programme/intervention of interest. According to the CHERG (Walker, Fischer-Walker et al. 2010) guidelines, randomized control trials are graded as 'high" in study design and observational studies are graded as "moderate" or "low," depending on certain criteria. Table 4 presents the specific conditions for the overall quality assessment of individual studies.

RESULTS

A total of 530 articles were identified and selected for full text reading from all databases and 62 articles, after elimination of duplicates, satisfied the inclusion criteria for this systematic review (Figure 2). This systematic review followed guidelines set for systematic reviews developed by the Cochrane Review (Julian PT Higgina 2011). The main reasons why articles were excluded from this systematic review were: (i) did not mention, measure, or present the child health outcomes of interest, , (ii) did not evaluate a large-scale programme/intervention, and (iii) articles with missing information on conditions of large-scale programmes/ interventions mentioned above .

Studies were organized based on type of programme or intervention evaluated in order to gain a better understanding of what kind of programmes were most implemented and evaluated. Of these 62 studies, 18 focused on the evaluation of conditional cash transfer/welfare programmes, 8 focused on the evaluation of school feeding programmes, 5 focused on the evaluation of sanitation programmes and interventions, 5 focused on the evaluation of supplementation programmes and interventions, 18 focused on the evaluation of maternal and child health/ community-based

programmes, 6 focused on the evaluation of daycare programmes, and 2 focused on the evaluation of national health care programmes. These programmes and interventions were predominantly implemented in Central and South America, Africa, South Africa, and South Asia. Results from studies will be presented in the organizational manner presented above.

CONDITIONAL CASH TRANSFER PROGRAMMES

A total of 18 studies out of the 62 articles identified for this systematic review, evaluated large-scale conditional cash transfer programmes that were carried out in Bangladesh, Brazil, Colombia, Ecuador, India, Kenya, Mexico, Nicaragua, South Africa, and Sri Lanka.

Of the cash/welfare programmes, the conditional cash programme in Brazil, *Bolsa Familia*, and in Mexico, *Oportunidades*, had the largest coverage with target population reaching in the millions. There were only two unconditional transfer programmes, *Bono de Desarrollo Humano* in Ecuador and Hunger Safety Net Programme in Kenya. Programme specific details are presented in Table 4.

A total of 13 studies used a randomized control trial design for programme evaluation while the rest of the studies (5) were observational studies. Studies (12) were concentrated in the Central and South American regions. A total of 10 studies presented significant improvements in child height outcomes. Study specific details are presented in Table 5. Country highlights of conditional and unconditional cash transfer programmes are described below.

Brazil and Mexico

The two largest conditional cash transfer programmes are *Bolsa Familia (BFP)* in Brazil and the *Oportunidades* programme in Mexico. The BFP programme reaches an estimated 46 million individuals, earning a position as the largest conditional cash transfer programme in the world with the *Oportunidades* programme coming in a close second reaching over 5.8 million beneficiaries households (Rivera et al, 2004; Santos et al, 2005; Leroy et al, 2008; Fernald et al, 2008; Fernald et al, 2009; Oliveira et al, 2011; Paes-Sousa et al, 2011). Another commonality between these programmes is that they are both government led and government implemented programmes. Beneficiaries in BFP received a cash transfer of R$ 22-220 per month (US$11-98) based on the conditionality that children (7 to 17 years of age) had a minimum school attendance of 85% and families with pregnant women, nursing mothers or children under 7 years of age had to follow a health and nutrition agenda (Santos et al, 2005; Oliveira et al, 2011, Paes-Sousa et al, 2011). Beneficiaries in the *Oportunidades* programme were given cash transfers that ranged from US$32.50-41.30 per month conditional on a number of obligatory preventive and primary curative health services; school scholarships were also offered along with supplementary foods in the form of milk based micronutrient fortified food provided to children 6-23 months of age suffering acute malnutrition under the age of 59 months (Rivera et al, 2004; Leroy et al, 2008; Fernald et al, 2008; Fernald et al, 2009). What is unique about this programme is that cash transfers were only given to female heads of households, unlike BFP.

A cross-sectional study (Paes-Sousa et al, 2011) illustrated that children that had families in BFP were 26% more likely to have normal height-for-age than non-exposed families. Furthermore,

stratification by age group showed that the age groups 12-35 months of age and 36-59 months of age had 19% and 41% higher odds of having normal height-for-age, respectively, while there was no difference found in the age group 0-11 months of age. Another cross-sectional study (Oliviera et al, 2011) that evaluated the programme found no statistically significant evidence in the improvement of child height or prevalence of stunting.

Out of all the programmes evaluated in this systematic review, the *Oportunidades* programme has been evaluated most rigorously using a randomized controlled trial design. A randomized control trial (Fernald et al, 2008) illustrated that a doubling in the cash transfer was associated with a higher HAZ score (β 0·20, 95% CI 0·09–0·30; p<0·0001), and a lower prevalence of stunting (−0·10, −0·16 to −0·05; p<0·0001) in children aged 24-68 months old. The same authors showed in another randomized controlled trial (Fernald et al, 2009) that an additional 18 months in the programme before the age of 3 for children aged 8-10 years, that have uneducated mothers, had improved growth in height by about 1.5 cm (β=0·23 [0·023–0·44] p=0·0290; this positive outcome was not related to how much money was received. Another study of the same programme also showed that children of indigenous populations benefited greatly from the programme while results for poor children from a non-indigenous background were mixed (Van de Gaer et al, 2013). Rivera et al, (2004), showed that infants younger than 6 months of age who lived in the poorest households increased in height by 1.1 cm. Similarly, another randomized control trial (Leroy et al, 2008) revealed that there was an association between programme participation and linear growth in children of poorest households, with an increase of 0.86 cm (p=0.095) and a HAZ score of 0.27 (p=0.070). These results were not significant except for the age group of children younger than 6 months (p=0.07). A study evaluating the effectiveness of the nutritional supplement on child health

outcomes presented no significance between intervention and control groups in adjusted mean HAZ scores thus, the nutritional supplement was not associated with improvements in child nutritional status (Rosado et al, 2010).

Colombia

Also in Latin America, Colombia implemented a successful cash transfer programme called *Familias en Accion* in 2001. This programme had 411,837 families enrolled as of 2004. In this programme, families received a monthly nutritional subsidy of $US15.38 if they had children aged 0-6 months who participated in the health components of the programme. If families had school-aged children (6-17 years of age), they were entitled to receive a school subsidy, dependent on level of school attendance. For primary-school children, the subsidy was $US4.61 while secondary school was $US9.23 per month (Attanasio and Vera-Hernandez, 2004). Mothers only received nutritional transfers if children met the conditions of the programme. According to the non-randomized control trial (Attanasio and Vera-Hernandez, 2004) revealed that the youngest children (under 24 months) benefited from the programme the most with a 0.161 increase in HAZ score, equivalent to an increase of 0.43 centimeters for a 12 month old and a decrease of 0.069 in the probability of being chronically malnourished. On the other hand, older children did not benefit in growth from the programme.

India

India, on the other hand, implemented a conditional cash transfer programme in the Indian state Haryana called *Apni Beti Apna Dhan,* in 1994, to encourage investment in daughters, especially in their education and health. Mothers who were beneficiaries in the programme received a cash transfer of Rs. 500 (US$11) upon the birth of a daughter, within 15 days of giving birth to cover post-delivery needs (Sinha and Yoong, 2009). Each daughter received a monetary investment of Rs.2, 500 (US$55) in government fixed-deposit securities that will be redeemable for a guaranteed sum of Rs 25,00 (US$550) on their 18th birthday, on the condition that she remains unmarried. Rewards of Rs 5000 were given if the daughter(s) received at least a standard 5 education and a further Rs 1000 reward if she has studied up to standard 8 (Sinha and Yoong, 2009). An observational study (Sinha and Yoong, 2009) using a difference-in-difference and intention-to-treat design suggested a better health status, however, results were not significant for child height outcomes, with HAZ scores of 0.391 and stunting: -0142 in children born within 36 months of the evaluation survey.

South Africa

The unconditional cash transfer programme in South Africa, the Old Age Pension programme, distributed a cash transfer to men above 65 years of age and to women above 60 years of age. The monthly cash transfer in 1993 was around R370 (Duflo, 2000). A cross-sectional study (Duflo, 2000) revealed that programme impacts resulted in a HAZ score increase of 0.68 SD for girls with an eligible household member, for boys it was an effect of 0.11 SD and insignificant. If the eligible

household member was a woman, this resulted in a HAZ score increase of 0.71 SD for younger girls while having an eligible man in the household resulted in a small, negative effect. Overall, HAZ scores for girls improved by 1.16 when a woman received the monthly pensions (Duflo, 2000).

Quality of Studies

Studies that evaluated cash/food transfers and welfare programmes/interventions ranged in quality from "low," to "high." A total of 6 studies received a grade of "high" in evidence quality (Maluccio and Flores, 2004; Fernald et al, 2008, Fernald et al, 2009; Merttens et al, 2013; Barham et al, 2014). These studies were assessed as being of high quality because of their study design, minor biases or limitations, high to moderate comparability of treatment and control groups at baseline and low to moderate loss to follow-up. Overall, these studies scored high on the required individuals components required to be fulfilled to determine study quality. A total of 8 studies received a grade of "moderate" (Attanasio and Vera-Hernandez, 2004; River et al, 2004; Himaz 2008; Leroy et al, 2008; Ahmed et al, 2009; Sinha and Yoong, 2009; Mascie-Taylor et al, 2010; Oliveira et al, 2011; Van de Gaer et al, 2013). These studies received a grade of "moderate" due to their study design, high loss to follow-up and major limitations or missing data. The rest of the studies received a grade of "low," (Duflo, 2000; Paes-Sousa et al, 2011). These studies had a combination or poor study designs, major limitations, or missing data in combination with low scores on criteria. These studies were conducted in South Africa and Brazil while the better quality studies were done in Mexico, Nicaragua, Ecuador, Sri Lanka, Kenya, Bangladesh, Brazil, Colombia and India. Table 6 presents the quality assessment of these studies.

SCHOOL FEEDING PROGRAMMES

School feeding programmes serve as a form of a social safe nets that provide both educational and health benefits to vulnerable children in a given area. The main focus of these types of programmes is to improve enrollment rates and improve food security at the household level (Greenhalgh et al, 2007). In this review a total of 7 different school feeding programmes were found with 8 studies that evaluate these programmes. The countries where these programmes were implemented include Bangladesh, Burkina Faso, Lao PDR, Jordan and Vietnam.

A total of 6 programmes were found in South Asia while one was found in Jordan. The programmes implemented in Bangladesh and India were initiated and implemented by the country government while the rest of the programmes requires on funding from outside sources (5). Table 7 presents descriptions of the school feeding programmes found in this review.

A total of 5 studies were randomized controlled trials while the rest of the studies (3) were observational studies. Significant outcomes in child height outcomes were found in 6 of the studies. Details on individual studies are presented in Table 8. Country highlights of specific programmes are described below.

India

The Midday Meal Scheme in India provided meals to children in all primary and upper-primary government and private-aided schools in the state of Andhra Pradesh. This programme was a government led initiative for the state, and reached nationwide coverage after a Supreme Court ruling in 2001 (Singh et al, 2012). During the time of a severe drought the programme had a protective effect on children over the age of 10 (0.43 SD HAZ) (Singh et al, 2012). Even though there seemed to be a decline in nutrition status of these children, outcomes would have been much worse had the programme never been implemented. A study (Sharma et al, 2010) evaluated this programme in the time that it was led by one of the largest NGOs in the country, the Akshay Patra Foundation, in the Mathura district of Uttar Pradesh. Results found a significant increase in height with time (β= 2.64 [95% CI: 2.56-2.72]; $p< 0.001$) in children 5-12 years old but no significant difference was found between the intervention and control groups (β=0.45; [95% CI: -0.87 – 1.78]; $p= 0.502$) (Sharma et al, 2010).

Vietnam

A school feeding programme funded by the International Development section of Land O'Lakes (LOL), a farmers' cooperative based in Minnesota and the USDA, was implemented in Vietnam to improve child nutrition status and school participation (Hall et al, 2007). In this programme schools were given free milk and biscuits each day, reaching about 33,000 children at the peak of the programme. A cluster evaluation study (Hall et al, 2007) concluded that the programme resulted in a

small increase in child height [8.15 cm in intervention group vs. 7.88 cm in control group (P=0.004)].

Quality of Studies

All studies that evaluated school feeding programmes were graded as "moderate" in evidence quality. Out of these studies, there were 4 studies that had the strongest study design when compared to the rest (Hijazi and Abdulatiff, 1986; Kazianga et al, 2009; Sharma et al, 2010; Buttenheim et al, 2011). The study Buttenheim et al (2011) was downgraded, as the comparability between treatment and control groups was "low" along with having a high loss to follow-up and various limitations and biases. A randomized control trial (Hijazi and Abdulatiff, 1986) although having a strong study design, was downgraded due to having significant differences between treatment and control groups along with using only minimal techniques to adjust for confounding and the study exhibited limitations. Along with these studies, another randomized control trial (Sharma et al, 2010) was downgraded due to major limitations to the study. On the other hand, the study Kazianga et al (2009) was graded as being of "high" quality as the study had a strong study design with no major limitations. A total of 4 studies (Ahmed and del Ninno, 2002; Hall et al, 2007; Singh 2008; Singh et al, 2012)were graded as having a "low" study design, as all of them were observational/cross-sectional studies with no major limitations. Table 9 presents the grading assessment of these studies in more detail.

SANITATION PROGRAMMES

In this systematic review, a total of 5 different sanitation programmes and interventions related to child health outcomes were ascertained, with 5 studies that evaluate these programmes and interventions. Sanitation programmes and interventions refer to those that focus on improving health outcomes though improved water sources, facilities, and behavior changes in sanitation and hygiene practices, such as decreasing open defecation and increasing hand washing in populations that live in areas where sanitation practices are poor (Patil et al, 2013). Studies were conducted in Burkina Faso, India, Lao PDR, Jordan, and Vietnam.

The sanitation programmes included in this review focused on promoting behavior changes in hygiene and sanitation practices and access to facilities, with efforts focused mainly in increasing toilet construction and increasing hand washing with soap. These programmes and interventions were found in various regions of the world with no generalizability. Table 10 presents descriptions of these programmes and interventions.

All evaluation studies employed a randomized control study design. Only 2 studies (Galiani et al, 2012; Cameron et al, 2013) found significant changes in child height outcomes. Table 11 presents descriptions of these evaluation studies. Country highlights of sanitation programmes are described below.

India, Indonesia, Tanzania, and Vietnam

The Water and Sanitation programme developed by the World Bank implemented a series of sanitation intervention programmes in India, Indonesia, Peru, Tanzania, and Vietnam. These programmes were implemented at large scale for an average duration of two years (Giliani et al, 2012; Cameron et al, 2013; Patil et al, 2013; Briceno et al, 2015). In India, the programme focused on changing community norms on open defecation. A cluster randomized trial (Patil et al, 2013) demonstrated a significant programme impact on the height of children less than 60 months old (Intervention: Mean LAZ/HAZ: -1.38. vs. Control: Mean LAZ/HAZ: -1.81; Intervention-Control: Mean LAZ/HAZ: 0.42 SE: 0.65). The programme in Indonesia focused on improving sanitation conditions at the community level through a large marketing campaign that resulted in an increase in HAZ scores for non-poor households that had no sanitation at baseline, with the (Treatment: HAZ -0.454 (p=0.815) vs. HAZ: -0.019 (p=0.376)), according to a randomized control trial (Cameron et al, 2013). The sanitation programmes in Peru, Tanzania, and Vietnam mainly focused on the promotion of hand washing. Child health outcomes from all programmes revealed no positive, significant impact on child height or stunting prevalence in these countries (Galiani et al, 2012; Cameron et al, 2013; Patil et al, 2013; Briceno et al, 2015).

Quality of Studies

All of the studies that evaluated sanitation programmes/interventions were graded as having an overall high quality of evidence. Initially, the studies (Chase and Do, 2012; Cameron et al, 2013;

Briceno et al, 2015) were graded as "high" since all three have a strong study design. However, all three studies has moderate to high loss to follow up and some major limitations that downgraded the quality of evidence. The studies (Cameron et al, 2013; Briceno et al, 2015) had low to moderate scores on the comparability between treatment and control groups at baseline. Both of the studies (Galiani et al, 2012; Patil et al, 2013) received an overall score of "high" as both had a strong study design with little to no biases or limitations as well as having treatment and control groups balanced at baseline. Table 12 presents the grading assessment of these studies.

SUPPLEMENTARY FEEDING PROGRAMMES

Supplementation programmes are programmes that provide extra food to children or families beyond the normal ration of their home diets (Shoham and Duffield, 2009). Complementary feeding programmes are those that provide food when breast milk is no longer sufficient to meet the nutritional requirements of infants; these foods transition infants from the consumption of breast milk to solid foods (Brown, 2000; Alive&Thrive, 2013). A total of 5 different programmes and 5 evaluation studies were found through this systematic review. These studies were based in Brazil, China, Peru and the USA.

The programmes varied in coverage with the highest coverage reached by programmes in South America and the US. Two programmes, on in Brazil and the other in Peru, distributed milk products to participants (Stifel and Alderman, 2003; Santos et al, 2005). The largest programme was

found in the US, Women, Infant and Children (WIC) , reaching over 7.5 million beneficiaries (Black et al, 2004). Table 13 presents descriptions of these programmes.

All evaluation studies employed an observational study design to evaluate programmes. Of these studies, 3 found significant results in child height outcomes (Romana, 2000; Black et al, 2004; Wang et al, 2013). Details of the individuals studies included in this review are presented in Table 14. Country programme highlights are described below.

Brazil and Peru

Both Brazil and Peru implemented a supplementation programme that distributed milk commodities to beneficiaries. In Brazil, beneficiaries of the Brazilian National Food Supplement programme were given 120g/day of powdered milk alongside 24ml/day of cooking oil to be added to prepared milk (Santos et al, 2005). Beneficiaries of the *Vaso de Leche* programme in Peru were given a combination of milk and cereal products to supplement the household diet (Stifel and Alderman, 2006). A study utilizing a prospective controlled study design (Santos et al, 2005), demonstrated that the supplement programme in Brazil showed no statistically significant differences in child height outcomes between intervention and control groups of children 6 months of age (6.34cm vs. 6.5 cm). On the other hand, programme impact in Peru revealed an insignificant drop in the child-stunting rate by 0.2 percentage points (26% to 25.8%) (Stifel and Alderman, 2005).

United States of America

The most successful supplementary programme found in this systematic review is the U.S. programme, the Nutrition Program for Women, Infants and Children (WIC). This programme takes the form of an assistance programme that provides food, nutrition counseling, health care screening and referrals to women during pregnancy, lactation, during the postpartum period, and children less than 5 years old (Black et al, 2004). This programme has successfully reached 7.5 million beneficiaries as of 2002. A study evaluating this programme (Black et al, 2004) revealed that the programme beneficiary children benefited in terms of increase in height than non-beneficiaries. Those who were not on WIC-assistance were more likely to be short (LAZ score= -0.23 vs. 0.02) when compared with WIC assistance recipients (Black et al, 2004).

Quality of Studies

The studies that evaluated supplemental programmes/interventions overall were graded as low quality of evidence. Santos et al (2005) received a score of "moderate" on study design; however, due to having some significant differences between treatment and control groups, a moderate level of loss to follow up, and no randomization, the study was downgraded to a score of "low." The study that evaluated the milk programme in Peru (Stifel and Alderman, 2006) had a weak study design along with no control group and missing information on loss of follow up, resulting in an overall score of "lo." Two studies (de Romaña 2000; Dong et al, 2013) also had weak study designs followed by no control group and major limitations resulting in an overall score of "low." Another

study (Black et al, 2004) had no control group along with a weak study design and missing information, also resulting in an overall score of "low." Table 15 presents the grading assessment of these studies in more detail.

MATERNAL CHILD HEALTH/COMMUNITY NUTRITION PROGRAMMES

Maternal and child health programmes specifically refer to programmes that provide medical and social services to mothers and children (Victora et al, 2011). A total of 16 different programmes and 18 evaluation studies were found through this systematic review. This kind of programme was implemented in Bangladesh, China, Ghana, Haiti, India, Indonesia, Madagascar, Malawi, Nepal, Senegal, and Sri Lanka.

Programmes and interventions employed various services that increased access of beneficiaries to health care, health and nutrition education and supplementary feeding. A majority of these programmes were implemented in the South Asia region mostly, with some programmes found in various parts of Africa. Table 16 presents descriptions of these programmes.

Many studies utilized a mixed method approach to evaluating these programmes. A total of 14 studies found some significant outcomes in child height after evaluation of programme was completed. A majority of studies were based in the South Asia region (11) while some were found in numerous countries in Africa (6). Table 17 presents descriptions of these evaluation studies.

Bangladesh

The Bangladesh Integrated Nutrition project (BINP) was implemented by the Government of Bangladesh Ministry of Health and Family Welfare with the objective of reducing the prevalence of severe underweight by 40%, and moderate underweight by 25% in young children between 1996 and 2002 with coverage of 15.6 million people (Hossain et al, 2005). To improve nutrition status of children, the programme's design was primarily focused on educating beneficiaries on proper care practices; supplementary food was given to children who were severely malnourished children or had growth failure (Hossain et al, 2005). A prospective randomized control trial that evaluated the programme concluded that there were no significant differences between the comparison group and education group, and in the comparison group and the education with supplementation group (Roy et al, 2005). Similarly, in a randomized control trial conducted by (Taylor 2005), results revealed that there were no significant improvements in severe low HAZ scores and moderate low HAZ scores of children in project and non-project areas. For severe low HAZ, the project area had a prevalence of 11.6% versus the non-project area prevalence of 12.4%, a 0.8% [CI -2.4 -4.0] difference in prevalence (Hossain et al, 2005). A prevalence of 27.5% for moderate low HAZ was observed in the project area while a prevalence of 27.6% was observed in the non-project area, a miniscule difference of 0.1% [CI 9-0.7 -0.9] in prevalence (Hossain et al, 2005).

The Integrated Management of Childhood Illness (IMCI) in Bangladesh, on the other hand, had a greater programme impact on the nutrition status of children living in the Matlab sub-districts of

rural Bangladesh. This programme was implemented through the collaborative effort between WHO and UNICEF in the mid-1990s. A cluster randomized study (Arifeen et al, 2009) yielded a positive, significant effect on child stunting. The study concluded that the prevalence of stunting in children aged 24-59 months decreased more rapidly (difference of differences −7·33, [95% CI −13·83 to −0·83]) than in comparison areas (Arifeen et al, 2009).

Haiti

World Vision-Haiti implemented a 5-year programme in the Central Plateau region of Haiti; this programme operated in 12 communes and served a population of 600,000. This programme offered a range of services for pregnant, lactating women and for children 0-59 months of age; services included health education, growth monitoring, food assistance and services for preventive maternal and child health and nutrition such as vitamin A supplementation (Ruel et al, 2008). Using a cluster-randomized trial (Ruel et al, 2008) evaluated two models of targeting food assistance to children, behavior change and communication intervention; one model focused on preventative care while the other on recuperative care. Interestingly, the group receiving preventative care services had a significantly higher mean HAZ score (+0.14) than the recuperative group (+0.018); furthermore, stunting was 4% lower in preventative communities than recuperative communities (Ruel et al, 2008).

India

The Indian government implemented the Indian Integrated Child Development Services (ICDS) programme in the late 1970s. This programme was implemented with the purpose of improving long-term nutrition and development of children by providing growth monitoring, supplementary feeding, and pre-school education for young children alongside basic health services to young children as well as pregnant and lactating women (Gupta et al, 2005; Kandpal 2011). A cross sectional study design to evaluate the impact of the programme on the nutritional status of children beneficiaries (Gupta et al, 2005). Overall, the results of the study indicated that the ICDS programme did not have a large impact on nutritional outcomes of children. The only significant effect that the study found was a positive effect on boy's stunting in 1992 with a difference of 0.151 between the treatment group and control group, however, there were no significant results seen in 1998 (Gupta et al, 2005). On the hand, stunting outcomes in girls showed no significant outcomes in 1992, with a difference of 0.012 between the treatment group and control group, nor 1998, with a difference of 0.095 between the treatment group and control group (Gupta et al, 2005). After results were disaggregated to understand regional impacts, there was a negative impact in stunting in poor Northern states and Northeastern states. A study that utilized Propensity Score Matching to evaluate the programme's impact with results indicating a positive impact of the programme on both young boys' and girls' HAZ scores (Kandpal, 2011). The ICDS programme had a greater impact on HAZ scores of boys living in ICDS villages with over 6% of boys being closer to the global average of HAZ than boys from non-ICDS villages. Girls living in ICDS villages were 4% closer to the mean than girls living in non-ICDS villages (Kandpal, 2011).

Indonesia

A public-health intervention in Indonesia utilized 54,000 graduates of nursing academies who completed one full year of midwifery training, between 1989 and 1998, to improve the nutrition status of children living in underserved communities. The government placed midwives in various villages where they would establish healthcare practices within the village and serve as a health resource for village members; the government paid the salaries of these midwives for three years with the hope that the work of the midwives would evolve into a sustainable and permanent private practice in those communities (Thomas 2005). An observational study (Frankenberg et al, 2005) found positive programme impacts on child health outcomes. Results indicated that children who lived in communities with a village midwife in 1993 were 1/3 of a standard deviation taller when compared to children who were never exposed to a midwife; this is equivalent to 1.5 cm in height for a 4-year-old child (Frankenberg et al, 2005). Furthermore, children whose mothers were less well educated benefited more from the midwife programme than those children whose mothers were of higher education.

Madagascar

SEECALINE was a large-scale community-based nutrition programme implemented in Madagascar in 1998-2004. The main objective of this programme was to improve the nutritional status of children under the age of three as well as pregnant and lactating women. The programme collaborated with local NGOs to maximize geographical coverage as well as assist in implementation at the local level. Services were delivered at the local level through a community nutrition worker

who was usually elected from the communities where the programme was implemented (Galasso and Umapathi, 2008). A study (Galasso and Umapathi, 2008) that utilized an ex-post study design to evaluate the programme impact on child nutritional status. The results of the study indicated that the programme yielded no significant results in child HAZ scores or stunting prevalence. In fact, both programme and non-programme areas showed deterioration over time for all cohorts up to age 4, however, programme areas exhibited this worsening trend only mildly (Galasso and Umapathi, 2008). The availability of services by the programme provided a protective affect for participating communities from worsening their long-term health outcomes. These worsening trends were accounted for by a lack of significant economic growth, severe weather shocks, and political crisis.

Malawi

World Vision-Malawi along with eleven government and NGO partners, implemented a community-based micronutrient and health (MICAH) programme from 1996-2005 with the objective of improving linear growth retardation in Malawian preschool children that were living in rural areas of the country. This programme reached coverage of about 270,000 beneficiaries with indirect benefits extending to 4.7 million people. The programme provided services to improve Fe and iron status, reduce the prevalence of disease contributing to anaemia, and to build local capacity for delivery systems to improve micronutrient status(Kalimbria et al, 2009). Kalimbria et al. (2009) concluded, using a prospective survey design, that the MICAH programme had a minimal impact on the prevalence of child stunting. Results indicated that children from the MICAH programme areas were less likely to be stunted than those from comparison areas in Phase I (OR=0.8; [95% CI 0.7, 0.9]) but not in Phase II of the programme (OR=0.9; [95% CI 0.8, 1.1]) (Kalimbria et al, 2009).

Africa

Through this systematic review, a unique multi-country, multi-intervention programme was found, with 2 different studies the evaluated its impacts on child health outcomes. This programme expanded over 9 different sub-Saharan African countries (Oraro, Ethiopia; Bonsaaso, Ghana; Sauri, Kenya; Mwandama, Malawi; Tiby, Mali; Pampaida, Nigeria; Potou, Senegal; Mbola, Tanzania; and Ruhiira, Uganda) with duration of 10 years (Remans et al, 2011. This programme implemented a concurrent package of evidence-based interventions in agriculture, health, education, and infrastructure. Two prospective observational studies were conducted to evaluate the impact of this programme in all 9 countries. The study (Berti et al, 2010) observed a reduction in stunting in all countries by ≥10%, except for Ethiopia. Similarly, the (Remans et al, 2011) concluded that the programme had a positive impact on child stunting prevalence. After 3 years of the programme, lower levels of stunting were observed relative to baseline [adjusted OR: 0.57; 95% CI: 0.38, 0.83]; concurrent improvement in average HAZ was also observed with an increase in the absolute value by 0.56 [95% CI: 0.25, 0.87] across all project sites (Remans et al, 2011). Overall there was a significant reduction in stunting (at $\alpha = 0.05$) prevalence at 5 of the sites (Ethiopia, Kenya, Malawi, Nigeria, Tanzania) and a non-significant reduction in 3 additional sites (Ghana, Mali, Senegal, Uganda) (Remans et al, 2011).

Quality of Studies

The studies that evaluated maternal child health and community-level programmes/interventions ranged in quality from "low" to "moderate" to "high" with only two studies receiving an overall score of "high" (Chaudhuri, 2008; Arifeen et al, 2009). The study (Arifeen et al, 2009) had a strong study design along with no loss to follow up with no major limitations or biases. The study (Chaudhuri, 2008) had a strong study design with no major limitations. The studies (Ruel et al, 2008; Bilukha et al, 2011) all received an overall score of "moderate" in evidence quality. The study (Bilukha et al, 2011) had a moderate level study design with no significant differences between treatment and controls, however, a significant loss to follow up. Originally, the study (Ruel et al, 2008) received a score of "high" for its strong study design and balanced comparison groups; however, having no control group downgraded the study to an overall score of "moderate." The rest of the studies received an overall score of "low" on quality of evidence. The studies (Karim et al, 2004; Gupta et al, 2005; Frankenberg et al, 2005; Galasso and Umapathi, 2008; Kandpal, 2011; Saaka and Galaa, 2011; Anekwe and Kumar, 2012; Jayatissa et al, 2012) all had significant differences between comparison groups or no comparison groups along with a weak study design and some minor to major limitations. The two studies that evaluated the multi-country, multi-level intervention in the Sub-Saharan region of Africa both received an overall score of "low." The study (Berti et al, 2010) used a weak study design along with having significant differences between comparison groups, not adjusting for confounding, and having some limitations. Similarly, the study Remans et al, 2011) also had a weak study design, with some significant differences between comparison groups, moderately high loss to follow up, along with some limitations. Table presents the grading assessment of these studies in more detail. Table 18 presents the grading assessment of quality of evidence of these studies.

DAYCARE PROGRAMMES

Daycare programmes mainly focus on providing child development and childcare services to young children of beneficiaries (Behrman et al, 2004). In this systematic review, a total of 4 daycare programmes were found, with 6 different studies that evaluate these programmes. The studies indicate that the following countries implemented this kind of program: Boliva, Colombia, Mexico and Peru.

Programmes were more specific to the region of Central and South America. These programmes mainly targeted mothers who were working or unemployed, and focused on not only child health but also on improving employment rates amongst mothers. Table 19 presents programme descriptions.

Studies mostly utilized an observational study design for programme evaluation. Significant outcomes in child height outcomes were found in 5 studies (Attanasio and Vera-Hernandez, 2004; Behrman et al, 2004; Cueto et al, 2009; Attanasio et al, 2012; Bernal and Fernandez, 2013). Description of these studies are presented in Table 20. Country highlights of programmes are described in greater detail below.

Bolivia

The government of Bolivia implemented an early childcare development programme, *Proyecto Integral de Desarrollo Infantil,* from 1994 to 2000. This programme provided daycare, nutrition and educational services to children between the ages of 6 and 72 months who live in poor, predominantly poor areas. The main objective of this programme was focused on improving the health and early cognitive/social development of children through the provision of nutrition, supervision, and stimulating environments (Behrman et al, 2004). A non-experimental design study (Behrman et al, 2004) evaluated the impact of the study on child developmental and nutritional outcomes. The study results were mixed for child height outcomes; children who were in 6-36 months of age had height estimates that were generally positive, with an impact of 11% for 6-24 months old and 17% impact for 25-36 months old; these results were not significant. However, children who were older than 36 months old had negative height estimates, with a negative impact of -9% for 37-41 months old and -11% for 42-58 months old (Behrman et al, 2004).

Colombia

Established in 1972, the home-based childcare programme, *Hogares Comunitarios de Bienestar ICBF (HCB)* was implemented by the government of Colombia and led by the National Institute of Family Welfare with the aim of providing childcare to vulnerable families to promote women's labor participation (Bernal et al, 2013). The HCB programme provides home-based childcare along with supplemental nutrition and psychosocial stimulation to a population of 783,399 low-income individuals under the age of 6 (Bernal et al, 2013). Utilizing a non-randomized study design (Bernal et al, 2013) concluded that there was a marginally significant benefit from the programme in child height outcomes with an increase of 0.1 standard deviations for children older than 49 months after

having 16 months of programme exposure (at 10% CI). A different study (Attanasio and Vera-Hernandez, 2004) used instrumental variables to indicate that participation in the programme was associated with an increase in 0.4486 standard deviations in HAZ score, an equivalent of 2.36 centimeters for boys and 2.39 centimeters for girls 72 months of age (Attanasio and Vera-Hernandez, 2004). Furthermore, the study concluded that participating in the programme as any point during a child's first 6 months of life was associated with a 3.78 centimeter increase in HAZ scores for boys and 3.83 centimeters increase for girls (Attanasio and Vera-Hernandez, 2004). A different study (Attanasio et al, 2013) utilized a cross-sectional design and also concluded positive results in child height outcomes. According to the study, if a child spent its entire life in the programme, they will be 88.5% of one standard deviation of height taller than non-participants while a child that is currently in the programme will on average be 40.5% taller than non-participants. It was estimated that if a 60-month-old child that has spent 24 months in a programme nursery, they would be 1.5% taller; these gains correspond to a 0.35 HAZ score (Attanasio et al, 2013).

Study Quality

The studies that evaluated daycare programmes/interventions ranged in quality from "moderate" to "low"; no studies received an overall score of "high." The only study that received an overall score of "moderate" was the study (Angeles et al, 2014). Although this study had a strong study design, it had significant differences between comparison groups, didn't utilize all techniques to adjust for confounding, and had major limitations. The rest of the studies had a study design that ranged from moderately strong to weak. The study (Bernal and Fernandez, 2013) was given a score of "moderate" on its study design as it was a non-randomized trial along with some significant

differences between comparison groups, only moderately adjusted for confounding, and had some limitations. The studies (Attanasio and Vera-Hernandez 2004; Behrman et al, 2004; Cueto, Guerrero et al. 2009, Attanasio et al, 2013) all had weak study designs along with significant differences between comparison groups at baseline, and major limitations; thus, they were given an overall score of "low." Table 21 presents the grading assessment of these studies.

NATIONAL HEALTH CARE

Programmes were categorized as being national health care programmes if they were implemented or utilized by the national health care system of a country. A total of 2 national health care programmes were ascertained in this systematic review, with 2 studies that evaluated the impacts of these programmes in Rwanda and Vietnam.

The programme in Rwanda focused on incentivizing performance of health clinics to improve quality of services (Gerlter and Vermeersch, 2012). The government of Vietnam implemented an insurance programme that targeted poor households to improve health status (Wagstaff and Pradhan, 2005). Table 22 presents description of these programmes. Gertlert and Vermeersch (2012) employed a randomized control study design while Wagstaff and Pradhan (2005) utilized a non-experimental study design for programme evaluation. Both studies found significant changes in child height outcomes. Table 23 presents description of these evaluation studies. Country specific programmes are highlighted below.

Rwanda

The Rwandan Ministry of Health implemented a Pay-for-Performance programme in its national health care system in 2005 that incentivized primary care facilities to improve maternal and child health services; each facility received a bonus based on the variety of services provided and the quality of those services. Payments represented an increase in funding by 24.6% above the base budget. These payments (77%) were used to compensate personnel resulting in an increase of 38% in staff compensation (Vermeersch 2012). A study (Gerlter and Vermeersch, 2012) used a randomized control study design to evaluate the impact of the programme on child health outcomes. The results of the study indicated that children who benefited from the programme for 23 months starting between ages 1 and 24 months after birth gained over 0.25 (P=0.00) of a standard deviation in height-for-age (Gerlter and Vermeersch, 2012).

Vietnam

In 1993, the government of Vietnam implemented a health insurance scheme known as Vietnam Health Insurance (VHI). Through this programme, civil servants, state enterprise workers, military, government officials and pensioners, and private firms with more than 10 employees were covered (Wagstaff and Pradhan, 2005). A cross sectional study (Wagstaff and Pradhan, 2005) that applied propensity score matching and difference-in-difference indicated that this health programme scheme

impacted child height outcomes favorably. Results of the study revealed that treatment effects translated into an increase in height of 2.35 centimeters; making the assumption that these effects occurred continuously following the time of the survey (1992-1993), these effects were equivalent to an extra 0.47 centimeters in height per year in young children (0-23 months: 0.154 (z-statistic: 3.34); 0-4 months: 0.456 (z-statistic: 4.06); 5-23 months: 0.031 (z-statistic: 0.69) (Wagstaff and Pradhan, 2005).

Study Quality

The range of quality of the studies that evaluated national health care programmes was between "moderate" to "low." The study (Gertler and Vermeersch, 2012) had a strong study design, however, there were some significant differences between comparison groups, high loss to follow-up, and only moderately adjusted for confounding. On the other hand, the study (Wagstaff and Pradhan 2005) conducted the evaluation using a non-experimental/quasi-experimental design; this study design was given a score of "low" for strength. Along with having a weak study design, there were also significant differences between comparison groups and major limitations. Table 24 presents the grading assessment of these studies in more detail.

Quality Assessment of the Body of Evidence

The overall assessment of studies that evaluated cash transfers programmes were graded as "high" due to more than half of the studies using a randomized control trial design, which was identified as being a strong study design according to the CHERG guidelines (Walker et al, 2010). A total of 10 studies showed a significant improvement in child height and/or stunting outcomes (Duflo, 2000, Attanasio and Vera-Hernandez 2004; Rivera et al, 2004; Himaz, 2008; Leroy et al, 2008; Fernald et al, 2008; Fernald et al, 2009; Mascie-Taylor et al, 2010; Paes-Sousa et al, 2011). More than half of the studies (12) evaluated programmes/interventions located in Central and South America. In this systematic review, a greater majority of the studies found evaluated cash transfer programmes (Table 25).

Studies (16) that evaluated the effectiveness of maternal child health community-based programmes and/or interventions received an overall assessment of score of "low" due to having a greater amount of studies with weak study designs and major limitations (cite the studies). Studies had a large loss to follow-up, non-randomization, missing data, and lack of control groups that resulted in downgrading of these studies. Within these studies, 12 showed significant improvements in child health outcomes of interest to this systematic review (Frankenberg et al, 2005; Agnes et al, 2007; Chaudhuri, 2008; Ruel et al , 2008; Arifeen et al, 2009; Kalimbria et al, 2009; Sakaa and Galaa, 2011; Bilukha et al, 2011; Kandpal, 2011; Anekwe and Kumar 2012; Jayatissa et al, 2012; Zhou et al, 2012). Furthermore, within these studies, 11 were conducted in Asia and South Asia while 4 studies were conducted in various parts of Africa.

Sanitation programmes and/or interventions evaluation studies, a total of 5 found in this systematic review, were initially given an overall score of "high' as all of these studies use a randomized control trial study design. However, due to lack of randomization along with other limitations the overall grade of 3 of the studies was downgraded to "moderate" (Chase and Do, 2012; Cameron et al, 2013; Briceno, 2015)Although there was no generalizability of studies as each study was conducted in a different country, the programmes/interventions were implemented in regions where poor sanitation practices were present, within these countries. Two of the studies showed a significant impact in child height and/or stunting while the rest of the studies had insignificant results (Galiani et al, 2012; Patil et al, 2013).

A total of 6 studies that evaluated daycare programmes were found through this systematic review. These programmes were given an overall assessment score of "low." Although two of these studies (Bernal et al, 2013; Angeles et al, 2014) had a strong study design the other 4 studies (Attanasio and Vera-Hernandez 2004; Behrman et al, 2004; Cueto et al, 2009; Attanasio et al, 2013) had weak designs with major limitations that downgraded them further in quality of evidence (cite studies). Even so, 5 of these studies found significant impacts in child height and/or stunting prevalence (Attanasio and Vera-Hernandez, 2004; Behrman et al, 2004; Cueto et al, 2009; Bernal et al, 2013; Attanasio et al, 2013). All of these studies were conducted in Central and South American countries, giving a high generalizability of these studies.

Five studies that evaluated supplemental feeding programmes were found through this systematic review. An overall assessment score of "low" was given to these studies. Of these studies, 3 showed significant improvements in child height and/or stunting prevalence (Romaña, 2000; Black et al,

2004; Dong et al, 2013). Only one study had a moderately strong study design (Santos et al, 2005) while the rest all had weak study designs . Studies are moderately generalizable as 3 of the studies (Romaña, 2000; Santos et al, 2005; Alderman et al, 2006) were conducted in Central and South American countries, while 1 study was conducted in the USA (Black et al, 2004)and the other in China (Dong et al, 2013).

An overall assessment score of "moderate" was given to the 8 studies that evaluated school feeding programmes and/or interventions. Of these 8 studies, 4 studies (Hijazi and Abdulatiff, 1986; Kazianga et al, 2009; Sharma et al, 2010; Buttenheim et al, 2011) had strong study designs while the rest utilized a weak study design to evaluate these programmes. Along with non-randomization, missing data and other limitations the rest of the studies were downgraded. Of these studies, 6 show significant results in child height and/or stunting prevalence (Hijazi and Abdulatiff, 1986; Hall, 2007; Singh 2008; Sharma et al, 2010; Buttenheim et al, 2011; Singh et al, 2012). There is high generalizability amongst these studies as 6 of these studies focused in regions of South Asia.

There were only two studies that evaluated national health care programmes; the overall assessment score given to these studies was "low" as there were limitations that downgraded these studies (Wagstaff and Pradhan, 2005; Gerter andVermeersch, 2012) The generalizability of these studies is also low as they both occur in different countries and there are only two studies that evaluate these kinds of programmes.

Two different studies evaluated the same multi-country, multi-level intervention (Kalimbria et al, 2010; Remans et al, 2011). The overall assessment score given to these studies was "low" as they were both observational studies with limitations. Both of these studies show significant improvement in child height and/or stunting prevalence. The generalizability in this case is high as both of these studies took place in the same regions.

DISCUSSION

Of the 62 studies identified through this systematic review, a majority of the studies utilized a study design considered by the CHERG methodology as lower in quality than an randomized control trial (Walker et al, 2010). The age or sexes of the children identified were not determining factors for inclusion or exclusion criteria for the purpose of this systematic review. Furthermore, no restrictions were placed on language, region of the world, type of programme or intervention, or time period for this systematic review. The overall quality of evidence was assessed as low for most of the programmes and interventions except for cash/welfare transfer programmes which was high (Table 25) and mostly based on evaluation methods that utilized a strong and well-designed methodology for programme evaluation; following the CHERG (Walker et al, 2010) guidelines, randomized control trials received the highest score for study design and observational studies received the lower score. Thus, compared to other programmes and interventions, cash/welfare transfer programmes received the highest scores of quality of evidence overall. Furthermore, a majority of the highest graded studies in this systematic review evaluated cash/welfare transfer programmes. This is a significant finding in that this indicates that this indicates that this particular type of programme has

been extensively evaluated and its effects on a myriad of outcomes has been well documented unlike other programmes and interventions. Thus, this high quality evidence can offer a great insight and knowledge of the routes of successes/failures of cash transfer programmes and interventions. Through this finding, it is also clear that high quality evidence is greatly lacking in the evaluation of other types of programmes and interventions and in their effectiveness in improving health outcomes.

The cash/welfare transfer programmes in this review were mostly initiated, funded, and implemented by country governments. This can indicate that having government support could be a crucial component that can lead to programme success in terms of self-sustainability, coverage, acceptance, and provision of culturally appropriate services. Another crucial component could be the amount in cash transfer that is given to households. Fernald et al (2008) demonstrated that that the doubling of cash transfers in the *Oportunidades* programme was associated with a higher HAZ score (β 0·20; [95% CI 0·09–0·30]; p<0·0001) and lower prevalence of stunting (−0·10, −0·16 to −0·05; p<0·0001. The transfer programme in Ecuador, BDH, on the other hand provided a small amount of cash (US$15) and still had positive health outcomes. It could be that the increase, even a minimal increase, in household income of poor and extreme poor households contributed to improved health outcomes in children. Evidence from studies indicates that poor and extremely poor households benefited the most. Leroy et al (2008) found an associated between programme participation and linear growth for the poorest households only, with children in intervention households growing 0.86 centimeters, HAZ 0.27 (P=0.070) more than comparisons. Maluccio et al (2005) revealed that extremely poor households participating in the RPS programme had significant HAZ scores while Rivera et al (2004) illustrated that children living in poor households had improved growth of 1.1 centimeters. Additionally, most programmes required participation in

interventions that focused on health, nutrition, and education in order to receive the cash transfer. Since these conditional cash transfers were primarily focused on health education and information, this could have potentially contributed to the improvement in child health. However evidence indicated that even unconditional cash transfer programmes such as HCB in Ecuador and the HSNP in Kenya were still successful in improving child health outcomes, although outcomes were not statistically significant. Evidence does indicate that children who entered this kind of programme early in life and stayed within the programme for a longer duration had better health outcomes than those who didn't. Leroy et al (2008) demonstrated that there was an association between child height and time of entrance into the *Oportunidades* programme as children that were 6 months of age had a 1.53 centimeters greater length gain. Fernaled et al (2009) revealed that an additional 18 months of participation in the *Oportunidades* programme before the age of 3 for children aged 8-10 years old resulted in an increase of 1.5 cm in child growth (β 0·23 [0·023–0·44] p=0·029). Attanasio et al (2003) exhibited that the youngest children (under 24 months) benefited the most from the FA programme by an increase of HAZ score of 0.161, an equivalent of 0.43 centimeters. Although evidence has indicated that cash/welfare transfer programmes have been successful, evidence is still lacking on what components contributed to the success of such programmes. It could be that the combination of the cash transfer and additional services provided results in the positive impacts; however, more high quality studies that investigate this focus area are necessary.

A majority of studies in this systematic review were conducted in Central and South America and South Asia. This indicates that these regions of the world have been participating in the implementation of various programmes to improve health outcomes in populations. Cash/welfare transfer programmes, supplemental feeding programmes, and daycare programmes were specific to the Central and South America region of the world while more community-based programmes and

school feeding programmes were indicative to the South Asia region of the world. This can indicate that perhaps countries respond to a particular type of approach, depending on rural or urban populations in these countries or cultural perspectives. It is clear that cash/welfare transfer programmes have been quite successful in Central and South America; however, no such programme has been as successful in the South region of the world. Both Mascie-Taylor et al (2007) and Ahmed et al (2009) show that various types of transfer programmes were not successful in improving child health outcomes in Bangladesh. Additionally, the cash transfer program *Apni Beti Apna Dhan* in India presented no significant improvement in height or health outcomes in young girls (Sinha and Yoong, 2009). Since the main population targeted for these programmes was rural, it is interesting to see that there were no improvements in child health outcomes in Bangladesh nor India while in rural populations in Central and South America, there were large improvements in child health outcomes. This poses more questions on how access to healthy foods, health services, consistency of programme coverage, and cultural practices play a role in determining health outcomes in South Asia when compared to Central and South America. Thus, this demonstrates an important outcome of this review and that is that context is crucial in determining success of programmes and intervention. Unfortunately, with the lack of evidence available, no clear pathway or explanation can be derived in this systematic review. Furthermore, the magnitude of the effects of these programmes and interventions on child stunting could not be calculated due to lack of evidence. In the future, more high quality monitoring and evaluation (M&E) studies need to be conducted along with a greater dissemination of results.

Cost of different programmes and interventions was also observed in this systematic review. The programmes that required large funding were those that utilized a cash/welfare transfer programme scheme. The *Oportunidades* in Mexico required an amount of 3.7 billion US dollars to reach

beneficiaries in 2007 (Fernald et al 2008; Fernald et al, 2009). Supplementary feeding programmes also required a large sum of money as observed in the milk supplementation programmes implemented in Brazil (US$ 57.5 million) and Peru (US$ 97 million) (Stifel and Alderman, 2003; Santos et al, 2005). However, the US WIC programme required the most out of all programmes with US$ 4.5 billion dollars in 2002 (Black et al, 2004). The Lancet (2013) series states that private sector support is important in changing nutrition outcomes of a country; however, evidence in this area is scarce and needs to be expanded (Black et al, 2013).

The findings of this systematic review confirm the need for more research to develop scalable interventions and to improve the effectiveness of existing interventions to have greater effect (Ruel et al, 2013; Gillepsie et al, 2013; Bhutta et al, 2013). More specifically, more evidence is needed to fill the gaps in understanding the most effective mode of delivering services to the hardest to reach populations as well as understanding the barriers to effective implementation along with costs and logistics of scaling up programmes and interventions. The *Lancet* series also called for more rigorous evidence that evaluated how the private sector can best support these initiatives and the drivers of country success (Bhutta et al, 2013; Gillepsie et al, 2013; Ruel et al, 2013). It is evident through this systematic review that evidence is still greatly lacking; however there is a stronger momentum in improving nutrition globally. The World Health Assembly has established nutrition targets for the reduction of child stunting and other health outcomes such as wasting, low birthweight, overweight and increase in exclusive breastfeeding by 2025. Additionally, the launch of the Scaling-Up Nutrition Movement (SUN), a movement that financially supports country-owned nutrition strategies and programmes, has set a stage for movement towards these global targets (Nabarro, 2013). Efforts of countries and agencies alike are now being focused in developing the best methods of evaluation, implementation, support, and scaling up of interventions that have been shown to be effective in

improving child health status (Bhutta et al, 2013; Gillepsie et al, 2013; Ruel et al, 2013). Furthermore, the Lancet 2013 series concludes that evidence in terms of what programmes or interventions have been most effective in improving child health outcomes are inconclusive. This systematic review has demonstrated that within the Central and South American region, cash/welfare transfer programmes have the potential to be successful, however, more evidence is required in understanding what mechanisms are involved in programme success. Furthermore, similar interventions have widely differing results in various settings, due to local context, and the routes and level of severity of malnutrition, and the capacity for programme implementation. This systematic review demonstrates this as cash/welfare programmes were found to be successful in Central and South America while not successful in South Asia. Thus, we shouldn't assume that a programme that is successful in once region would be successful in a different region (Independent Evaluation Group, 2010). Furthermore, it is important to take into account contextual factors, such as region, culture, social norms, etc. which vary across settings (Independent Evaluation Group, 2010).

LIMITATIONS

A major limitation encountered during this systematic review was having to define the meaning of the term "large-scale." Although, the term has been used widely it is not defined clearly and required us to develop an operational definition based on existing knowledge of programme implementation. The lack of a universal definition and the treatment of the term as being intuitive knowledge resulted in the exclusion of many studies that could have potentially evaluated a large-scale programme. Studies that did not fulfill criteria that we developed for a large-scale programme were excluded from the review; many studies lacked information on coverage of programmes or interventions.

Many studies of large-scale programmes were excluded for not including measurements of the child health outcomes of interest to this systematic review, further limiting the available evidence left for analysis. As child stunting is an indicator of nutrition status over a long period of time, unlike other measurements of nutrition status such as low-weight or wasting, it is imperative to remember that many of these studies were conducted over a short period of time that might have been too brief to properly evaluate long-term impacts. Variability in age of children may also have been an issue as the impact of programmes and interventions might have been sensitive to the age of the children. Also, there are numerous large-scale programmes and interventions out there that have yet to be properly evaluated, or have evaluation studies of these programmes and interventions made publicly available or available through the databases used in the search strategy in this systematic review.

CONCLUSION AND RECOMMENDATIONS

Although this systematic review has some limitations, it does bring to attention that there is an overall immense lack of high quality evidence in the current literature on the effectiveness of large-scale programmes and interventions on child growth and stunting outcomes. Findings indicate that safety net programmes in the form of cash/food transfer had the highest quality of evidence when compared to other programmes and interventions. Evidence demonstrated that these kinds of programmes were successful in the Central and South American region of the world, with no evidence indicating success in other regions. Evidence was inconclusive on what components or factors drove these programmes to be successful in this specific region when in South Asia; these kinds of programmes were not found to be effective. The evidence of the effectiveness of other types of programmes and interventions is greatly lacking. Overall, more rigorous evidence is

necessary to fill the gaps in knowledge of what programmes and interventions are effective in improving child health outcomes, which of these programmes and interventions would be effective at scale, as well as the implications of implementation, cost, and logistics of scaling up such programmes and interventions in different regions of the world. It is imperative to keep in mind that every country of the world is different and as the results of this review indicate, a programme successful in one region might not be successful in another.

FIGURES AND TABLES

Figure 1. UNICEF Conceptual Framework for causes of malnutrition.

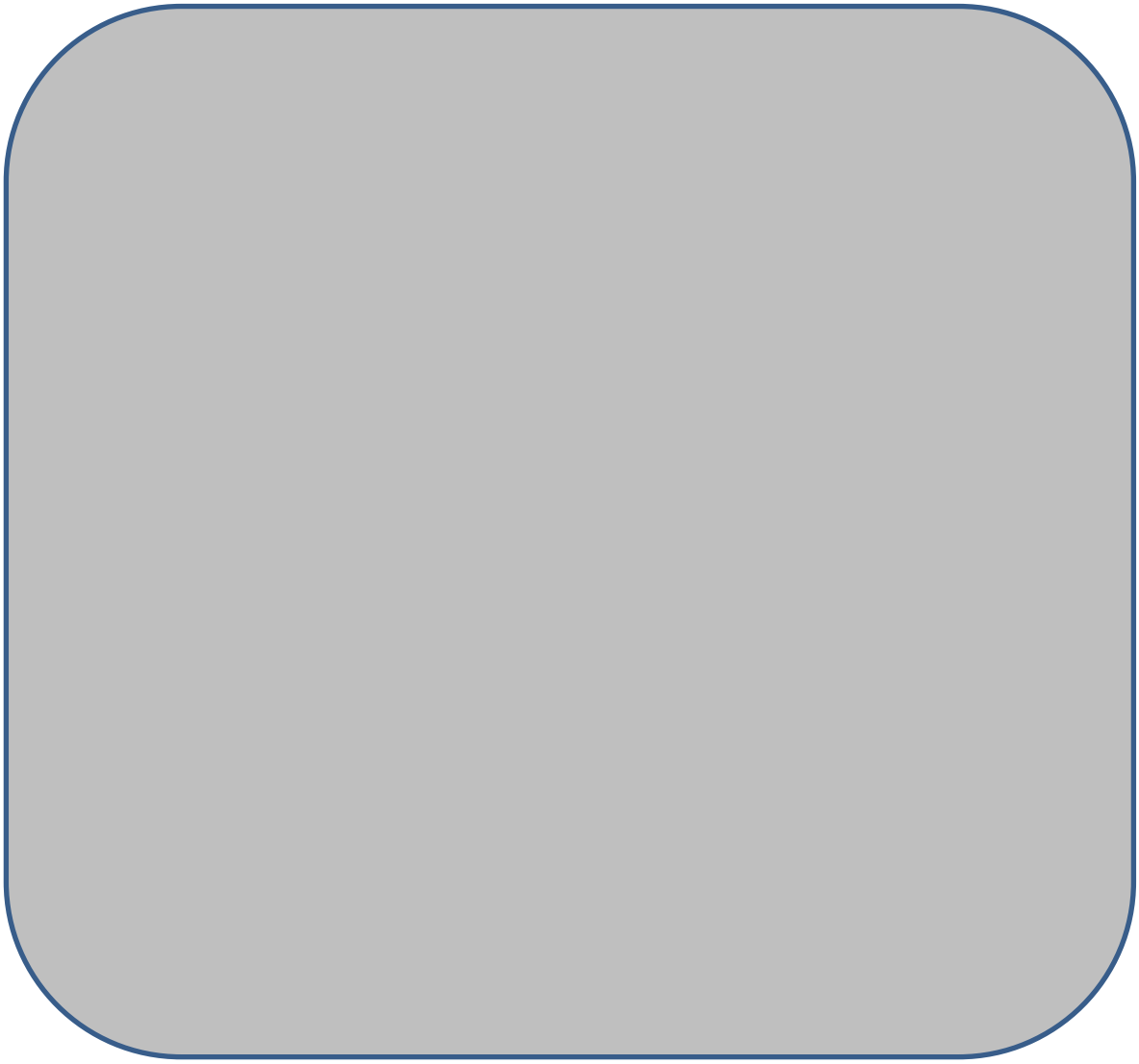

Image redacted due to copyright restriction. Graphic demonstrates the routes that cause maternal and child undernutrition and the short and long-term consequences.

Source: (UNICEF, 1990) as modified by Black et al, 2008.
http://www.thelancet.com/cms/attachment/2000991395/2003657374/gr1_lrg.jpg.

Figure 2. PRISMA diagram for search strategy and outcomes

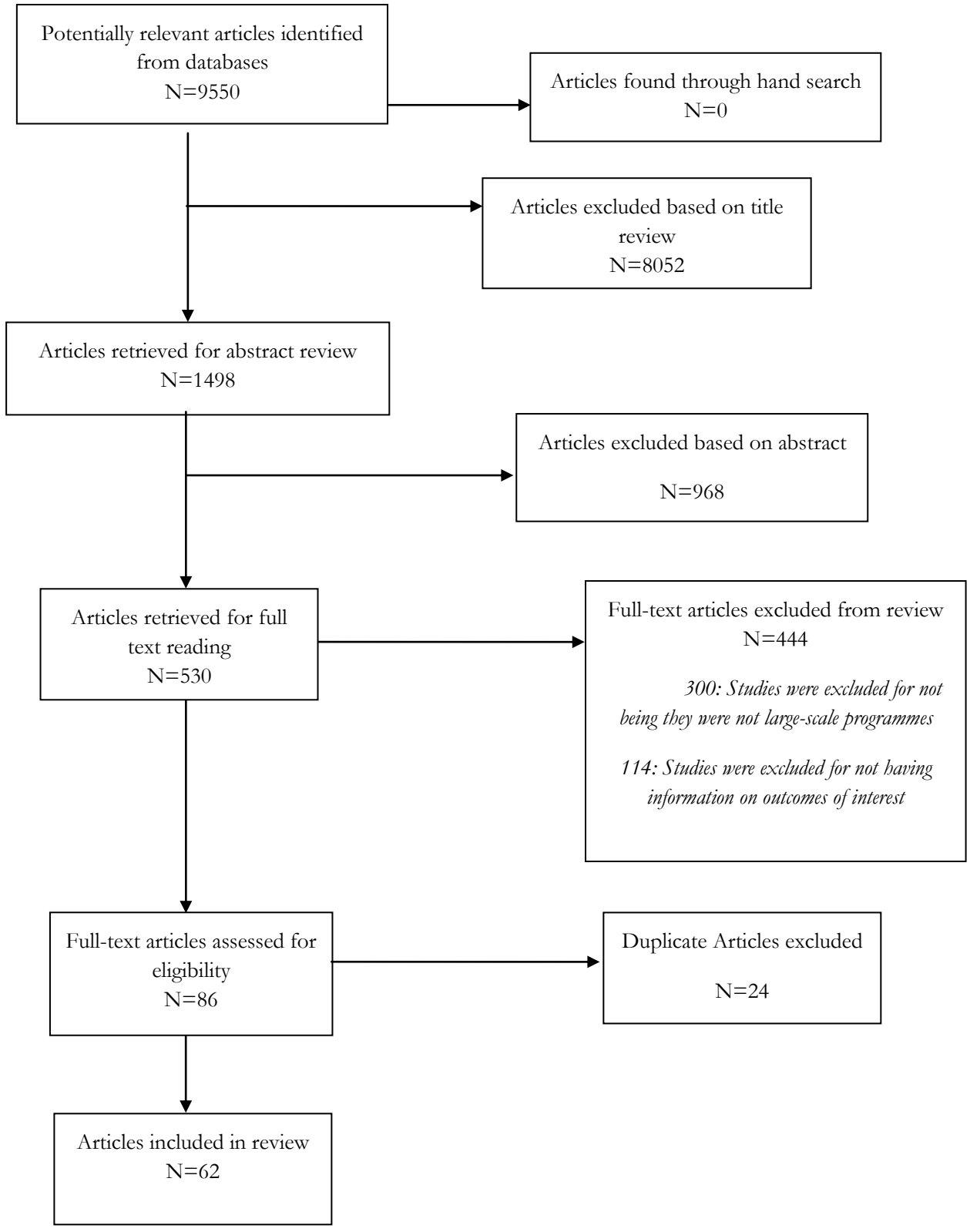

Table 1. Inclusion and exclusion criteria for selection of evaluation studies

Articles were included if:	
Large-Scale Programme/Intervention Defined (articles had to meet 2/3 conditions):	• Geographic spread (communities, districts, provinces, municipalities, states, etc.) • Target population coverage (at least 10,000 programme beneficiaries) • Implementation strategy (large NGO, public/private sector, government, etc.)
Child Health Outcomes:	• Height/length-for-age z-scores • Height/Length measurements • Stunting (rates, prevalence, percentage)
Restrictions:	*No restrictions made on:* • Child age/sex • Time period of study • Written language • Type of programme/intervention
Articles were excluded if:	• Non-human studies • Did not mentions, measure, present child health outcomes of interest (L/HAZ, height, length, stunting) • Missing data on child health outcomes of interest • Not large-scale programme/intervention • Review articles, commentary letter or editorial

Table 2. Components of the database search strategy for potential articles to be included in this systematic review

Database	Search Strategy	Number of Hits	Articles that met criteria
PubMed	(National nutrition programme OR national nutrition programmes OR Large scale nutrition programme OR Large scale nutrition programmes OR Nutrition intervention) AND (child OR children OR infants) AND (stunting OR growth OR length OR height) AND (impact OR evaluation OR effectiveness OR assessment)	1,798	18
Econ-Lit	(Nutrition programmes OR Nutrition programme OR Large-scale nutrition programmes OR Large scale nutrition programme) AND (child OR children)	1,392	6
World Bank	(Large-scale programmes OR National nutrition programmes) AND (children) AND (evaluation OR effectiveness OR assessment OR impact)	1,098	15
Cochrane (CENTRAL)	(Large-scale nutrition programmes OR National nutrition programmes OR Nutrition interventions) AND (children)	1,034	9
Cochrane (CDSR)	(Large-scale nutrition programmes OR National nutrition programmes OR Nutrition interventions) AND (children)	40	0
POPLINE	(Nutrition programs OR programmes) AND (children)	903	12
IFPRI	(Large-scale nutrition program OR National nutrition program) AND (child stunting)	2880	2
3IEIMPACT	Nutrition programmes	405	24
TOTAL		9550	62

Table 3. Conditionality for assessing the quality of individual studies (Walker et al, 2010; Balshem et al, 2011).

Criteria	Quality Assessment
Design	**High**: Randomized control trials with no major limitations **Moderate:** Observational studies with a comparison group and no limitations **Low:** Observational studies with no comparison group, no randomization and/or other limitations
Comparability of treatment and control groups at baseline	**High:** Characteristics between groups were balanced, and/or differences were adjusted upon analysis **Moderate:** Groups were similar on most baseline characteristics **Low:** Groups were different on a majority of baseline characteristics
Loss to follow-up	**High:** Low levels of loss to follow-up (5% or below) **Moderate:** Loss to follow-up was above 5% but <=10% **Low:** Loss to follow-up was greater than 10%
Adjustment for confounding	**High:** Adjusted for clustering, stratification of data, loss to follow-up, or baseline differences between treatment and control groups **Moderate:** Adjustment for clustering **Low:** No adjustments for confounding were made

Table 4. Description of cash/welfare transfer programmes

Name	Reference	Year	Implementation Strategy	Program Content	Coverage	Limitations
IGVGD (Bangladesh)	(Ahmed et al, 2009)	1975-	Government of Bangladesh	Gives monthly food ration over a period of 24 months; also has a built in mechanism to provide credit to participants. 60% of food is rice; NGOs provide development support consisting of training in IGAs (such as rearing poultry, raising livestock, maintaining fisheries, and sericulture); raising awareness on social, legal, health, and nutrition issues; offering basic literacy and numeracy training; and providing access to credit; 30 kilograms of rice or 30 kilograms of wheat or a 25-kilogram sealed bag of micronutrient- fortified Atta (whole-wheat flour) per month	640,000 beneficiaries; Poor Women; selection committee selects VGD participants on the basis of set criteria	Irregularity or delay in cash/food transfers these programs rely in part on selection criteria that are neither observable nor verifiable. IGVGD: US$49.58 million/ Loans from NGO. FSVGD: US$7.02 million
FSVGD (Bangladesh)		2001-2006	Government of Bangladesh	Provides a combination of food and cash to participants; NGOs provide development support consisting of providing training in IGAs (such as rearing poultry, raising livestock, maintaining fisheries, and sericulture); raising awareness on social, legal, health, and nutrition issues; offering basic literacy and numeracy training; and providing access to credit; : Monthly entitlements are a 15-kilogram sealed bag of micronutrient- fortified Atta and Tk 150 per beneficiary;	109,379 beneficiaries; Poor Women; selection committee selects VGD participants on the basis of set criteria	IFS: US$5.83 Million. RMP: US$11.05 million
FFA (Bangladesh)		2002-	Government of Bangladesh, WFP	Distributes a combination of food and cash as wage payments to workers in labor-intensive public works programmes. Rice is the only food given. Half of payment is in food and the other half in cash. After a project starts, workers receive periodic payments in	39,200 beneficiaries; Both men and women (requires that at least 70% to be women)	

				food on a piece-rate basis. Once the project is completed, the total remaining food payment is calculated and provided. The outstanding cash segment of the wage is then paid to workers; 2 kilograms of rice or wheat and Tk 15 per working day, subject to the accomplishment of a minimum amount of work. A participant's monthly entitlements for the training period are 20 kilograms of wheat or rice and Tk 100. FFA participants are required to save Tk 25 per month.		
RMP (Bangladesh)		1983-	CARE; Government of Bangladesh	Cash wages for maintaining rural roads.	41,540 beneficiaries; women only	
Chars Livelihood (Bangladesh)	(Mascie-Taylor et al, 2010)	2007	UK Dept. for International Development	Households are provided with a raised earthen plinth on which their homes are reconstructed and homestead gardens can be established. In part, a labor-intensive earthmoving process that involves members of poor chars households creates these plinths. Both men and women received 36 taka (about US$ 0.50) for each cubic meter of soil moved in the construction of the earthen plinths.	100,000 men and women; Poor households, victims of severe flood in northern Bangladesh	Short-term Intervention; dependent on Outside funding and support.
BFP (Brazil)	(Oliveira et al 2011); (Paes-Sousa et al, 2011)	2003-	Government of Brazil	Direct cash transfer to: families in poverty or extreme poverty (household income per capita below 44.00 United States dollars, US$, and below US$ 22.00, respectively, in 2005–06); (ii) families composed of children from 0 to 15 years of age; and (iii) families with a pregnant or lactating woman. In 2008, the age group for the children was extended to 17 years. Cash transfer is conditional on (i) a minimum school attendance of 85% of the monthly school hours for children 7 to 17 years old; (ii) a health and	5564 municipalities, 27 states, 11 million families, 46 million people	

				nutrition agenda for beneficiary families with pregnant women, nursing mothers or children under 7 years of age (pre-natal care, vaccination, health and nutrition surveillance); Amount of transfer is R$ 22-220 (US$11-98)		
FA (Colombia)	(Attanasio et al, 2004)	2001-	Government of Colombia	Families have to meet certain criteria to participate; municipalities needs to have 100,000 or less populations; Mothers receive cash transfer and children receive nutritional transfers if they comply with conditions required by the programme; 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. For primary-school children, the subsidy is $US4.61, while for those in secondary school, it is $US9.23.	650 municipalities; 411,837 families (2004); Poor households (poorest 25%)	
BDH (Ecuador)	(Paxson and Schady, 2007)	2003-	Government of Ecuador	A cash transfer is made per month per family, non-conditional basis; $15 per month per family	85% of rural families; Poor families and children	Urban families had less exposure
***Apni Beti Apna Dhan* (India)**	(Sinha and Yoong, 2009)	1994-	Government of India	Immediate cash grant and a long-term savings bond redeemable on the daughter's 18th birthday provided she is unmarried, with additional bonuses for education. Upon the birth of a daughter, mothers are entitled to a monetary award of Rs. 500 (approximately $11) within 15 days of each birth, to cover post-delivery needs. It also endows each girl with a longer-term monetary investment of Rs.	State wide (Haryana); families upon birth of a girl	Did not have a large impact on the treatment of daughters, needs more research.

				2,500,3 (approximately $55) in government fixed-deposit securities; redeemable for a guaranteed sum of Rs 25,000 (approximately $550) on her 18th birthday provided she remains unmarried. This yields an implicit annual return of approximately 13%. A bonus of Rs. 5000 is awarded is if the girl has received at least a Standard 5 education, and a further Rs 1000 is awarded if she has studied up to Standard 8.		
HSNP (Kenya)	(Merttens et al, 2013)	2000s-	Government of Kenya	Delivers regular cash transfers to beneficiary households or individuals in four counties; 11 or 12 bi-monthly transfers (initially KES 2,150, increased to KES 3,500 by the end of the evaluation period). Not conditional.	300,000 beneficiaries (60,000 households)	
***Oportunidades* (Mexico)**	(River et al, 2004) (Fernald et al, 2008); (Leroy et al, 2008); Fernald et al, 2009); (Rosado et al, 2011); (Van de Gaer et al, 2011)	1997-	Federal Government of Mexico	Program benefits are conditional on regular attendance at all services appropriate for household demographics. Additionally, scholarships, prorated for male vs. female students (higher for female) and grade level, are provided, conditional on enrollment and regular attendance at school. The female heads of household receive all program benefits. Transfers to the poor total 25 percent average increase in income of households living in extreme poverty; households receive the equivalent of 32.5 to 41.3 US dollars, constituting 19 to 24% of mean household consumption. The program also provides milk-based micronutrient fortified foods targeted to children 6–23 mo of age, to children 2–4 y of age with low weight (weight-for-age < −1 SD), and to pregnant and lactating women.	5.8 million; women and children-poor households	Supplementation did not contribute to child health outcomes; In 2004, the budget was $2·2 billion for a total coverage of 4 million families; by 2007, this had reached $3·7 billion to cover over 5 million families.

RPS (Nicaragua)	(Barham et al, 2014); (Maluccio and Flores, 2005)	2000-2005	Government of Nicaragua	Cash transfers targeted to households living in poverty in rural Nicaragua; two household-level transfers – one for health and nutrition and the other for schooling – in households with eligible school-age children; 18 per cent of pre-programme expenditures.	Nationwide	US$22 million (2002); IADB loan financed the program
Old Age Pension (South Africa)	(Duflo, 2000)	1920s-	Government of South Africa	Pensions distributed to women above 60 and men above 65, monthly; Monthly benefits in 1993 were R370 (1992 rands)	National	
Samurdhi (Sri Lanka)	(Himaz, 2008)	1989	Government of Sri Lanka	Income transfer in form of a grant to target to families in poverty; creation of employment opportunities for youth; monthly coupons that can be exchanged for goods from local co-operative store. Average grant received Rs. 365.10 (25% of monthly per capita household income of grant-receiving household)	National	Criticized with respect to targeting (with the coexistence of large leak- age errors, and under-coverage), and as being partly a camouflaged attempt at reducing the problem of youth unemployment by recruiting unemployed youth to feed its colossal administrative structure

Table 5. Description of individual cash/welfare transfer programme studies

Study and Year	Programme (Country)	Design	Sample Size	L/HAZ/Height/Stunting	Limitation/Bias
(Ahmed et al, 2009)	IGVGD, FSVGD,FFA RMP (Bangladesh)	Non-RCT, PSM	1,200 households of beneficiaries of the four programs (300 households per program), 400 house-holds in control groups, and 400 former beneficiaries of the four programs	58% stunted, no significant impact on stunting	Couldn't do a randomized control trial because the programs had already been implemented before the evaluation; quantitative indicators, which are commonly collected in surveys, may underestimate the potential impact of such programs on gender relations; budgetary constraints did not permit us to complete two survey rounds; compared the control and treatment groups at a given point in time rather than comparing changes through time.
(Attanasio et al, 2003)	FA (Colombia)	Non-RCT, DD	The sample universe was the municipalities with fewer than 100,000 individuals.	Youngest children (under 24 months) benefited from the programme, Z-score increased by 0.161. For a 12-month-old child, this would be equivalent to 0.43 centimeters. This translates into a 0.069 decrease in the probability of being chronically undernourished. Older children do not seem to have benefited from the programme in terms of nutritional status.[a]	Non-randomized
(Barham et al, 2014)	RPS (Nicaragua)	RCT, PSM	42 targeted localities	Height: -0.0629 (0.100); no significant differences between groups	
(Duflo, 2000)	Old Age Pension Plan (South Africa)	Cross-sectional, IV	9,000 households surveyed	Increase of 0.68 SD HAZ for girls with an eligible household member; for boys the effect is 0.11 and insignificant. Eligible woman in household increase HAZ of young girls to older ones by 0.71 SD, eligible man in household has small, negative effect. HAZ improved by 1.16 for girls when pensions received by woman.[a]	Targeting of population, leakage from other government programmes, other aspects not measured that could possibly be affected by pensions received by men
(Fernald et al 2008)	*Oportunidades* (Mexico)	RCT	320 rural communities intervention group; 186 rural communities control group	A doubling of cash transfers was associated with higher HAZ score (β 0·20, 95% CI 0·09–0·30; p<0·0001), lower prevalence of stunting (−0·10, −0·16 to −0·05; p<0·0001)[a]	Lack of a good measure of cognitive stimulation or parental responsiveness; unable to adjust for any differences in baseline levels of development or physical size between those who received more or fewer cash transfers over the entire observation period; used tests to

					assess cognition and language ability that are ordinarily used in highly standardized laboratory conditions; all children came from communities with more than ten children, also don't know if children adhered to programme requirements.
(Fernald et al, 2009)	*Oportunidades* (Mexico)	RCT	320 rural communities intervention group; 186 rural communities control group	No difference between groups for mean HAZ scores (−1·12 [0·96] vs −1·14 [0·97]; p=0·88); additional 18 months of the programme before age 3 years for children aged 8–10 years whose mothers had no education resulted in improved child growth of about 1·5 cm assessed as height-for-age Z score (β 0·23 [0·023–0·44] p=0·029), independently of cash received.[a]	Loss to follow-up over the 10-year study was fairly high. Authors had to impute some household data. At least 8 years passed since all families were incorporated into programme and many factors might affect outcomes.
(Himaz, 2008)	Samurdhi (Sri Lanka)	PSM	853 children aged 6-60 mo	Improved HAZ by 0.4 standard deviations (calculated as the average of the effect estimated using the three different algorithms, and specification 1), compared to what their health status would have been had they not received the grant. High impact on the height-for-age of younger children aged 6–36 months, showing a positive, and significant improvement of over 0.5 standard deviations.[a]	Unclear about as to how much of the improvement in health can be attributed to the programme
(Leroy et al, 2008)	*Oportunidades* (Mexico)	RCT, DD, PSM	Children <24mo (n=432)	In children younger than 6 mo in 2002, program participation was associated with a 1.53-cm (P = 0.015) greater length gain or 0.41 Z-scores (P=0.035). In children 6 to 12 mo of age at baseline, the direction of the relationship was similar (0.73 cm or 0.23 Z-scores) but results were not sta- tactically significant (P = 0.13 and P = 0.11, respectively). An association between program participation and linear growth was found for the poorest households only, although this did not reach statistical significance (0.05 , P , 0.10). In the lowest SES tertile of the sample, children in intervention house- holds grew 0.86 cm (P= 0.095) or 0.27 Z-scores (P = 0.070) more than children in comparison households.[a]	Authors did not know which component or components of the program are most likely responsible for the impact on child linear growth; comparison group for this study consisted of eligible households that did not enroll in the program but lived in the same communities as the enrolled households; Another possible source of selection bias is the loss to follow- up.
(Maluccio	RPS	RCT, DD	21 comarcas in control	Estimated double-difference effect of programme	Program was in pilot stage of the time of

and Flores, 2005)	(Nicaragua)		group and 21 comarcas in treatment group	on HAZ among extremely poor was 0.22 (significant at 10%)[a]	the evaluation; sample might not be completely representative of the entire population; Selection bias in comparison group, high loss to follow-up, small sample size
(Mascie-Taylor et al, 2010)	Chars Livelihood (Bangladesh)	RCT	895 intervention household; 921 control households	In children, difference in means between the two groups had also widened in favor of the intervention group for: height (0.08 cm; P < 0.05) and z-scores for height- for-age (0.02; P < 0.001); prevalence of stunting at the end of the study was much higher than the national average in both groups: it was 60.6% in children from intervention households and 64.5% in those from control house-holds. Moreover, it had increased during the study: by 10.7% in the intervention group and by 11.9% in the control group. [a]	Short-term intervention; Tests of statistical power showed sample size was insufficient to demonstrate significant differences at P<0.01 and to provide a power of 90%.
(Merttens et al, 2013)	HSNP (Kenya)	RCT	Baseline: 5,108; Follow-up 1: 4,637; Follow-up 2: 2,436	Stunting rates: 30%, not significant	Concern about quality of anthropometric data collected at baseline and follow-up. Spillover effects of programme, reduction in sample size at final follow-up, report bias of anthropometric measures
(Oliveira et al 2011)	BFP (Brazil)	Cross-sectional	446 children aged between 6 and 84 months: 262 non-Beneficiaries and 184 Beneficiaries	No statistical difference	Small sample size, sample size not representative of whole population, some loss to follow up
(Paes-Sousa, 2011)	BFP (Brazil)	Cross-sectional	22,375 impoverished children under 5	Height-for-age (below -2.00 SD): All Children: 12.6 Exposed: 14.5 Not exposed: 11.1 Difference in % points: -3.4 Pvalue: <0.000. Children from families exposed to the BFP were 26% more likely to have normal height for age than those from non-exposed families. Stratification by age group revealed 19% and 41% higher odds of having normal height for age at 12–35 and 36–59 months of age, respectively, in children receiving BF, and no difference at 0–11 months of age. [a]	Length of exposure to BFP cash transfers was not determined, and neither were the possible biases related to enrolment in cash transfer programmes other than the BFP, however unlikely. In addition, some variables that could not be measured, such as family income, food consumption and nutritional status before BFP enrollment, may account for some of the residual confounding.
(Paxson, Schady,	BDH (Ecuador)	RCT	3,426 families and 5,547 children	Average effect size for the measures of physical outcomes (hemoglobin, height, and final motor	Poor sample of children, restrict results to children aged 3–7 years, because

2007)				control) is 10.6 percent of a standard deviation with a standard error of 4.9 percent.	younger children could not be given cognitive tests, and to rural households, because BDH had no significant impact on outcomes in the urban intent-to-treat households. This is likely because urban families had less exposure to programme effects by the time of the September 2005 follow-up survey.
(River et al, 2004)	*Oportunidades* (Mexico)	Randomized effectiveness	347 communities (Intervention group; n=250/ crossover intervention group; n=142). Children (N = 650) 12 months of age or younger (n = 373 intervention group; n = 277 crossover intervention group)	Age- and length-adjusted height was greater by 1.1 cm (26.4 cm in the intervention group vs 25.3 cm in the crossover intervention group) among infants younger than 6 months at baseline and who lived in the poorest households	Selection bias caused by loss to follow-up, results may underestimate real effects of programme, programme leakage reached 10% of children
(Rosado et al, 2011)	*Oportunidades* (Mexico)	Randomized-placebo-controlled longitudinal trial	186 children 22.4 (SD 5.9) months	OFS groups: Adjusted change Mean HAZ: -1.2 (SD 0.6); Height (cm): Adjusted change Mean: 6.5, (SD 1.5). PM Group: Adjusted change Mean HAZ: 0.1 (SD 0.6). PL group: Adjusted change Mean: 0.1 (SD 0.6). No significance between groups.	Small sample size, short duration of study, implications of study limited to children 12 to 24 mo
(Sinha and Yoong, 2009)	*Apni Beti Apna Dhan* (India)	Observational, DD, ITT	Not specified	HAZ 0.391 (0.279); stunting: -0142 (0.101), not significant	Sample size afforded by the Haryana sub-sample of the NFHS is small; this work may be immediately extended to the estimation of heterogeneous treatment effects by individual or household type, given that various interest groups are affected; more research needed.
(Van de Gaer, et al, 2011)	*Oportunidades* (Mexico)	RCT, PSM	Control: 1859; Treatment 1: 1843; Treatment 2: 1351	Stunted: Treatment 1-Control: (all): 0.04; Treatment 2-Control (all): 0.01	Didn't have data on all the children of the households that started the program. Controls were not similar at baseline.

a Reported significant outcomes

Table 6. Quality assessment of cash/welfare transfer programmes studies

Author, year	Region	Design	Comparability of groups at baseline	Loss to follow up	Adjustment for confounding	Other biases/limitations	Overall Grade
(Ahmed et al 2009)	Bangladesh	High--RCT, PSM	High-groups were non-randomized; controls were also exposed to programme	N/A	High-Yes	Measures of quantitative indicators; compared control and treatment group at a given point in time	Moderate
(Attanasio, et al 2003)	Colombia	High--RCT, DD	Moderate-groups were similar on basis of geographical region, education and health infrastructure, population size, proportion of population living in urban part of municipality and QLI.	N/A	Moderate-Yes	Non-randomized	Moderate
(Barham et al, 2014)	Nicaragua	High-RCT, PSM	High-sample was balanced at baseline	Moderate-less than 7%	High-Yes	N/A	High
(Duflo, 2000)	South Africa	Low-Cross-sectional, IV	N/A	N/A	High-Yes	Targeting of population, leakage from other government programmes, other aspects not measured that could possibly be affected by pensions received by men	Low
(Fernald et al, 2008)	Mexico	High-RCT	High-balanced in terms of baseline socioeconomic and demographic characteristics	N/A	High-Yes	Lack of a good measure of cognitive stimulation or parental responsiveness, unable to adjust for any differences in baseline levels of development or physical size between those who received more or fewer cash transfers over the entire observation period, used tests to assess cognition and language ability that are ordinarily used in highly standardized laboratory conditions, children were possibly not representative of children from smaller rural communities	High
(Fernald et al, 2009)	Mexico	High-RCT	High-groups were very similar in characteristics	Low-39% of intervention participants, 39% of control participants	High-Yes	Had to input some household data, 8 years passed since all families were incorporated into programme and many factors might have affected outcome	High

(Himaz, 2008)	Sri Lanka	Moderate-Cross-sectional; PSM	Moderate-some differences between groups	N/A	High-Yes	Unclear about as to how much of the improvement in health can be attributed to the programme	Moderate
(Leroy et al, 2008)	Mexico	High-RCT, DD, PSM	Moderate-some differences between groups	Low-41% lost to follow-up	High-Yes	Selection bias in comparison group, high loss to follow-up, small sample size	Moderate
(Maluccio and Flores, 2005)	Nicaragua	High-RCT, DD	High-no statistical difference between groups	Moderate-8.1% less from baseline	High-Yes	Purposive selection of programme areas (less certain for generalizability), outcomes might be overestimated, sample might not be fully representative of overall population	High
(Mascie-Taylor et al, 2010)	Bangladesh	High-RCT	High-groups were comparable in household size, adults' occupations, age of adult female family member, female heads of household/child anthropometric measurements, household food consumption	N/A	Low-No	Short intervention	Moderate
(Merttens et al, 2013)	Kenya	High-RCT	Moderate- some differences were observed, control groups had better outcomes at baseline.	N/A	High-Yes	Spillover effects of programme, reduction in sample size at final follow-up, report bias of anthropometric measures	High
(Oliveira et al 2011)	Brazil	Moderate-Cross-sectional	Moderate-no difference between groups observed, control group was better off	Moderate-Intervention group (2.7%) parents and (1.3%) mothers; control group (1.3%) parents	High-Yes	Small sample size, sample size not representative of whole population	Moderate
(Paes-Sousa et al, 2011)	Brazil	Low-Cross-sectional	Low-no control group	N/A	Low-No	No control group, Length of exposure to BFP cash transfers was not determined, and neither was the possible biases related to enrolment in cash transfer programmes other than the BFP. In addition, some variables that could not be measured, such as family income, food consumption and nutritional status before BFP enrollment, may account for some of the residual confounding.	Low
(Paxson and Schady, 2007)	Ecuador	High-RCT, ITT	Moderate-groups were similar on some characteristics	Moderate-5.9% families	High-Yes	Provinces were not randomly selected; sample not representative of all programme eligible families	High

(Rivera et al, 2004)	Mexico	High-RCT	High-groups were similar	Low-26% among infants aged 5 months or younger, 10% among those aged 6 to 12 months	High-Yes	Selection bias caused by loss to follow-up, results may underestimate real effects of programme, programme leakage reached 10% of children	Moderate
(Rosado et al, 2010)	Mexico	High-Randomized-placebo-controlled longitudinal trial	High-groups were similar	Low-16% of children lost to follow-up	High-Yes	Small sample size, short duration of study, implications of study limited to children 12 to 24 mo	High
(Sinha and Yoong, 2009)	India	Low-Cross-sectional, DD, ITT	Moderate-slight difference, controls had better outcomes at baseline	N/A	High-Yes	Did not have explicit individual/household level measures of actual programme participation; unable to exploit any time variation in the programme's introduction to identify effects, no proper treatment or control groups, assumptions had to be made to match data to criteria	Moderate
(Van de gaer et al, 2011)	Mexico	High-RCT, PSM	Low-groups were different on most baseline characteristics	N/A	High-Yes	Controls were not similar at baseline.	Moderate

Table 7. Description of school feeding programmes and interventions

Name	Year	Reference	Implementation Strategy	Program Content	Coverage	Impact	Limitations
FFE (Bangladesh)	1993-2002	(Ahmed and del Ninno, 2002)	Government of India	Makes transfer of food resources to poor families contingent upon school enrollment of their children in primary schools	2.1 million students	Increased enrollment for girls, led to creation of nongovernment and government schools.	
SFP (Burkina Faso)	2005-	(Kazianga, de Walque, Alderman, 2009)	Catholic Relief Service (2005-2006); WFP	Distribute food to children at school; distribute take home rations of 10 kg of cereal flour each month to children contingent on 90% attendance for girls	Sahel region	Girls: [0.137] 0.123; no significant impact on height-for-age.	Outside support
MDM (India)	2003-	(Sharma, Singh, Meena, Kannan, 2010); (Singh, Park, Dercon, 2012)	Government of India	Provide meals to school children	State-wide	Protective against negative nutritional factors, improvements in cognitive skills, gains in school participation	
MDM (India)	NGO	(Buttenheim, Alderman, Friedman, 2011)	Government of India; Akshay Patra Foundation (NGO) support distribution of food	Provide meals to school children	State-wide	Reduced prevalence of vitamin deficiency; no improvements in child growth	Failed to improve child growth
SFP (Laos PDR)	2002-	(Hall et al, 2007)	WFP	WFP program originally provided a daily snack made from corn-soya blend at school, and additional take-home rations of canned fish and rice for girls and for informal boarders to encourage their enrollment and continued attendance. Take- home rations are meant to be conditional on	12 districts in 3 provinces	No consistent effect of school feeding on either enrollment or nutritional status	Outside support , not significant impact

				attending school at least 80% of the time. To participate in the school feeding program, villages were required to convene a school feeding committee, build food storage facilities, provide labor for food preparation and, in some cases, travel to WFP food distribution points to pick up food allocations.			
SFFE (Jordan)	1978	(Hijazi and Abdulatiff, 1986)	Ministry of Education	WFP provided daily ration per child. This ration provides approximately 690 calories, 31 g protein and 10 g fat. Since there was a problem with the acceptability of the milk, 10 g sugar was added to the original daily ration to sweeten the milk.	47,000 children	Benefits not well understood	Needs more evaluation
SNP (Vietnam)	2002-	(Singh, 2008)	International Development of Land O'Lakes farmers' cooperative based in Minnesota	Schools in chosen areas were given free milk and biscuits each day	33,000 children and 2075 schools in 2002	Small but significant weight gain, but most undernourished children benefited the least	Minimal child health impact; outside support

Table 8. Description of individual school feeding programme and intervention studies

Study and Year	Programme (Country)	Design	Sample Size	L/HAZ/Height/Stunting	Limitation/Bias
(Ahmed and del Ninno, 2002)	FFE (Bangladesh)	RCT, IV	600 households; 3,369 students	No significant outcomes	
(Kazianga, de Walque, Alderman, 2009)	SFP (Burkina Faso)	Prospective RCT		Girls: [0.137] 0.123; no significant impact on height-for-age.	
(Sharma, Singh, Meena, Kannan, 2010)	MDM (India)	RCT	558 children (189 intervention; 369 control)	A significant increase in height with time (b= 2.64; 95% CI: 2.56-2.72; p< 0.001) but no significant difference was found between the intervention and control groups (b=0.45; 95% CI: -0.87 – 1.78; p= 0.502).[a]	Data from village panchayat run program not available so comparisons could not be made between NGO run programme and the panchayat run programme; age of students were not known so comparisons with any commonly available age based standard measurements may not have high level of scientific accuracy.
(Buttenheim, Alderman, Friedman, 2011)	SFP (Lao PDR)	RCT, DD, PSM	Baseline survey (2006): 10, 748 children aged 3-14; Follow-up survey (2008): 9,810 children aged 3-14.	Nhot Ou (take home rations group): significant increase of 0.29 standard deviations in between-district analyses, driven by large and significant gains for both younger boys and younger girls; for young boys: the within-district analysis shows a large negative coefficient, driven by large secular gain for non- takeup villages. A similar picture emerged in within-district analyses for girls ages 6-10 in Phongsaly (on site feeding); results inconclusive.[a]	District-level (rather than village-level) randomization of interventions; selective take-up of the intervention within district; and inconsistent implementation of the program in terms of intensity and conditionality
(Hall et al, 2007)	SFP (Vietnam)	Proximate cluster evaluation	1080 children in grade 1 of 21 primary schools, and a cross-sectional interview of 400 children in grade 3.	Height between groups: 8.15 vs. 7.88 cm (P=0.004)-small increase.[a]	Schools could not be randomized; cut in funding resulted in 70% loss of programme schools in evaluation

(Hijazi and Abdulatiff, 1986)	SFP (Jordan)	RCT	2554 Student: 630 males and 978 females (a total of 1608 children) ; control group 497 males and 449 females (a total of 946 children)	Height measurements in males and females were significantly (P <0.05) higher in almost all classes in Madaba.[a]	Programme was less than 1 yr old at time of study; study was only 3
(Singh, 2008)	MDM (India)	Cross-sectional, PSM, IV	1st cohort: 2,011 children born between January 2001 and June 2002. 2ndcohort: 1,008 children born between January 1994 and June 1995	Younger cohort: HAZ ATT: Total Sample: .10 (1.59 t-statistic); Drought group: .264 (2.05 t-statistic); Without Drought group: .089 (1.25 t-statistic) Old cohort: Height for age ATT: Total Sample: .02 (.0 56 t-statistic); Drought group: .207 (1.11 t-statistic); Without Drought group: -0.013 (-0.23 t-statistic).[a]	Non-randomized programme placement
(Singh, Park, Dercon, 2012)	MDM (India)	Cross-sectional, IV	1st cohort: 2,011 children born between January 2001 and June 2002. 2ndcohort: 1,008 children born between January 1994 and June 1995. Second round 2006-7: ,950 children from the Younger Cohort and 994 children from the Older Cohort were traced and resurveyed	HAZ: 2006-7: OLS: 0.59 (5.00 z-statistic); IV: 0.59 (5.49 z-statistic) p=<0.01[a]	Non-randomized programme placement

a Reported significant outcomes

Table 9. Quality assessment of school feeding programmes and intervention studies

Author, year	Region	Design	Comparability of groups at baseline	Loss to follow up	Adjustment for confounding	Other biases/limitations	Overall Grade
(Ahmed and del Ninno, 2002)	Bangladesh	Moderate-Cross-sectional, IV	High-baseline characteristics are balanced	N/A	High-Yes	N/A	Moderate
(Buttenheim, Alderman, Friedman, 2011)	Laos PDR	High-RCT, DD, PSM	Low-Significant differences found between treatment and controls	Low-4% villages, 13% households	High-Yes	Self-selection, inconsistent implementation of programme	Moderate
(Hall et al, 2007)	Vietnam	Low-Proximate cluster evaluation	High-no statistical differences between treatment and control groups	N/A	High-Yes	Schools were not randomized	Moderate
(Hijazi and Abdulatiff, 1986)	Jordan	High-RCT	Low-significant difference between treatment and control groups	N/A	Moderate-Yes	Information bias, short duration of programme	Moderate
(Kazianga, de Walque, Alderman, 2009)	Burkina Faso	High-Prospective RCT	Moderate-some statistically significant differences between groups at baseline	N/A	High-Yes	N/A	Moderate
(Sharma, Singh, Meena, Kannan, 2010)	India	High-RCT	High-baseline characteristics were balanced on height and weight	N/A	Moderate-Yes	Missing data, recall bias, age of students unknown	Moderate
(Singh, 2008)	India	Low-Cross-Sectional, PSM, IV	Low-Significant differences between treatment and control groups	High-3% young cohort, 1% old cohort	High-Yes	Non-randomized programme placement, reliable baseline data for older cohort not available, self-selection	Moderate

(Singh, Park, Dercon, 2012)	India	Low-Cross-sectional, IV	Low-Significant differences between treatment and control groups	N/A	High-Yes	Non-randomized programme placement, self-selection	Moderate

Table 10. Description of sanitation programmes and interventions

Name	Year	Reference	Implementation Strategy	Program Content	Coverage	Impact	Limitation
TSC (India)	1999-	(Briceno et al, 2015)	World Bank's Water and Sanitation Program (WSP); government of India	Included subsidies for and promotion of individual household latrines, school sanitation and hygiene education, construction of toilets, and community sanitation complexes	Universal coverage (2012)	Improvement in sanitation and hygiene practices	Outside funding and support
TSC (Indonesia)	2007-	(Cameron, Shah, Olivia, 2013)	WSP, government of Indonesia	Community-led Total Sanitation (CLTS), Social Marketing of Sanitation, Strengthening the Enabling Environment	East Java districts (n=29)	Sanitation improvements, increase use o toilets significant child health outcomes	Outside funding and support
HWP (Peru)	2008-2010	(Chase and Do, 2012)	Government of Peru, WSP	a province-level mass media campaign; and comprehensive district-level community treatment that included, in addition to the media campaign, training of community agents; capacity building of mothers, caregivers, and children; and the inclusion of handwashing promotion as part of primary school curricula.	National: 800 districts (104 provinces)	Media campaign alone was not effective in reaching target audience; district level interventions were effective in reaching target audience; improved caregivers' knowledge; increase in availability of soap and water in households; no significant impacts on child health.	Outside funding and support
HWSP (Tanzania)	2009-2011	(Galiani et al, 2012)	Government of Tanzania	Handwashing wards were provided with a package of intensive social marketing interventions, including training of community activists, direct consumer contact through road shows, mass media campaigns and promotional activities, and technical assistance to build handwashing stations with local materials. Sanitation wards received a similar package of marketing efforts coupled with a community-led total sanitation triggering event geared towards increasing demand for improved sanitation facilities and promoting open defecation free (ODF) communities, followed by the creation of a village sanitation committee in charge of ensuring sustained behavior change. This was complemented with supply side interventions to train local masons	10 districts; 181 wards	Increase in latrine construction, decrease in open defecation, handwashing behavior improvements related to food preparation only; inconsistent impacts on child health	Inconsistent impacts on children health

				in latrine construction and marketing. In both cases, sanitation marketing messages concentrated on positive aspirational messages rather than shame tactics.		
HWWS (Vietnam)	2006	(Patil et al, 2013)	WSP	Handwashing mass media campaign, training programme for village health workers, teachers, and Women's Union members on how to promote group and household level IPC activities	7 provinces	No significant impacts found

Table 11. Description of individual sanitation programme and intervention studies

Study and Year	Programme (Country)	Design	Sample Size	L/HAZ/Height/Stunting	Limitation/Bias
(Briceno et al, 2015)	HWSP (Tanzania)	RCT	181 Rural wards; 3,619 households and 5,768 children under five at end line survey in 2012	HAZ: p-value: 0.515 ($\beta1 = \beta2$); F-test: pvalue: 0.476 ($\beta1 = \beta3$), pvalue: 0.961 ($\beta2 = \beta3$); no significant outcomes.	The 10 districts conduct in the study were selected by government based on political priority rather than random selection, affecting the external validity of the study; study lacked a baseline of pre-intervention characteristics
(Cameron, Shah, Olivia, 2013)	TSC (Indonesia)	RCT	2,087 households	Difference between treatment and Control group: Height: -0.454 (0.815 P-value); HAZ: -0.019 (0.376 P-value); significant for non-poor households.[a]	Biased outcomes reporting
(Chase and Do, 2012)	HWWS (Vietnam)	Cluster RCT	Baseline survey: 3,149 households End line survey: 3,147 households	No significant outcomes.	Contamination of other project impacts in control areas
(Galiani et al, 2012)	HWP (Peru)	RCT	80 provinces were randomly selected, with 40 assigned to a first group and 40 to a second	No significant outcomes.	
(Patil et al, 2013)	TSC (India)	Cluster RCT	3,039 households and 5,206 children under five years of age.	For children less than 60 mo: Intervention (I): Mean LAZ/HAZ: -1.38. Control (C): mean LAZ/HAZ: -1.81; I-C: Mean LAZ/HAZ: 0.42 SE: 0.65 (significant at 0.05).[a]	Report bias

a Reported significant outcome

Table 12. Quality assessment of sanitation programme and intervention studies

Author, year	Region	Design	Comparability of groups at baseline	Loss to follow up	Adjustment for confounding	Other biases/limitations	Overall Grade
(Briceno et al, 2015)	Tanzania	High-RCT	Low-no baseline data available, retrospective response	High->5% lost	High-Yes	Districts not randomly selected, lack baseline of pre-intervention characteristics, recall bias	Moderate
(Cameron, Shah, Olivia, 2013)	Indonesia	High-RCT	Moderate-some characteristics between groups are statistically different	Moderate-8.5% at follow-up	High-Yes	Biased outcomes reporting	Moderate
(Chase and Do, 2012)	Vietnam	High-Cluster RCT	High-baseline characteristics of treatment and control groups are balanced	Moderate-5.7% lost	High-Yes	Contamination of other project impacts in control areas	Moderate
(Galiani et al, 2012)	Peru	High-RCT	High-baseline characteristics between treatment and control groups were balanced	Low-30% loss at follow-up	High-Yes	N/A	High
(Patil et al, 2013)	India	High-Cluster RCT	High- baseline characteristics between groups were balanced	Low-16% lost at follow-up	High-Yes	Report bias	High

Table 13. Description of supplementary programmes and interventions

Name	Year	Reference	Implementation Strategy	Program Content	Coverage	Impact	Limitations
***Alli Alimentu* (Peru)**	1 yr	(Romana, 2000)	Government of Peru	Product produced locally and distributed to communities.	50,000 children 6 to 36 mo living in Department of Ancash	Micronutrient deficiencies decreased	
FSP (China)	2010-2011	(Dong, Ge, Ren, Wang, Fan, Yan, Yin, 2013)	National Institute of Nutrition and Food Safety, Chinese CDC (NINFS-CCDC)	Distribution of Yingyang Bao, supplementary food, across all sites	20 townships (200,000+ residents)	Improved growth and anemia status of infants and children	Required outside Source.
Milk Supplementation Program (Brazil)	1993-	(Santos et al, 2005)	Federal government	Distribution of 120g/day of powdered milk plus 24ml/day of cooking oil to be added to the prepared milk, aimed at boosting its energy content. The supplement has been estimated to provide more than 100.0% of the protein and about 60.0% of the daily energy needs of children from 6 to 23 months of age. Half liter of pasteurized whole milk/day (or 60g/day of milk powder) is also supposed to be distributed to all household members under 5 years of age to avoid intra-family distribution of the supplement for the undernourished child.	856614 beneficiaries; children 6 to 23 months of age below 10th percentile in weight for age index	Program failed to compensate for nutritional deficiencies in undernourished children in Northeast Brazil	Poor targeting; US$ 57.5 million
***Vaso de Leche* (Peru)**	1984-	(Stifel and Alderman, 2003)	Government of Peru	Distributes milk and cereals or combination of commodities distributed instead of or in addition to milk products. Priority is given to households with children six years old or younger or with pregnant or lactating women. Once these first-tier beneficiaries are attended to, households with children aged from 7 to 13 and people with tuberculosis	National	Successful at targeting poor households, no evidence of positive impact on child growth	Failed to improve Nutritional status US$97 million (20

				may participate. Within both categories, priority is based on need.			
WIC (USA)	1974	(Black et al, 2004)	Government of USA	Provides food, nutrition counseling, and health care screening and referrals to women during pregnancy, lactation, and the postpartum period, infants, and children <5 years of age.	7.5 million beneficiaries (2002)	Infants ≤12 months of age benefit from WIC participation	Can be voted agai US$4.5 billion (20 US Government;

Table 14. Descriptive of individual supplementary feeding programme and intervention studies

Study and Year	Programme (Country)	Design	Sample Size	L/HAZ/Height/Stunting	Limitation/Bias
(Black et al, 2004)	WIC (USA)	Cross-sectional	5923 WIC-eligible caregivers of infants <12 months of age	Infants who did not receive WIC assistance because of access problems were more likely to be short (length-for-age z score= -0.23 vs -0.02) compared with WIC assistance recipients.[a]	Did not have information on prenatal or life- time WIC participation and as a result could examine only current WIC participation. No information on income eligibility, as a result used private insurance as a proxy for ineligibility.
(Dong, Ge, Ren, Wang, Fan, Yan, Yin, 2013)	FSP (China)	Prospective, pre/post design with no control group	250 to 300 children	Significance between age groups, no significance between boys and girls. Percentage of stunting (LAZ) decreased from 8.9% to 5.0%.[a]	No control group; inconsistency in sample sizes at monitoring points
(Romana, 2000)	*Alli Alimentu* (Peru)	RCT	Intervention group: 60; Control group: 47	Prevalence of stunting had increased to 57% in the younger group and had improved some- 55% in the older group. Growth pattern did not change between groups.[a]	Small sample size
(Santos et al, 2005)	Milk Supplement Program (Brazil)	Prospective controlled study with intervention and control areas compared before and after the intervention	219 children aged 6-18 mo; 114 receiving the supplement and 105 controls	Adjusted analyses by multilevel modelling showed height and average HAZ scores at 6 months, of 6.34cm, 0.05 among supplemented children as compared to 6.5cm, 0.07 among controls, not significant	Ethical reasons prevented randomization
(Stifel and Alderman, 2003)	*Vaso de Leche* (Peru)	DD		Between 1996 to 2000, insignificant drop of stunting rate to 0.2 percentage points from 26% to 25.8%.	

a Reported significant outcomes

Table 15. Quality assessment of supplementary feeding programme and intervention studies

Author, year	Region	Design	Comparability of groups at baseline	Loss to follow up	Adjustment for confounding	Other biases/limitations	Overall Grade
(Black et al, 2004)	USA	Low-Cross-sectional	N/A	N/A	High-Yes	N/A	Low
(Dong, Ge, Ren, Wang, Fan, Yan, Yin, 2013)	China	Low-Observational pre/post	N/A	N/A	High-Yes	No control group	Low
(Romana, 2000)	Peru	Low-Observational, pre/post	N/A	N/A	Low-No	Information bias, recall bias, confounding, contamination of samples	Low
(Santos et al, 2005)	Brazil	Moderate-Prospective RCT	Moderate-significant differences in socioeconomic characteristics between groups	Moderate-8.9%	High-Yes	Small sample size, no randomization of groups,	Low
(Stifel and Alderman, 2003)	Peru	Low-Cross-sectional, DD	N/A	N/A	High-Yes	N/A	Low

Table 16. Descriptive of maternal and child health/community-based programmes and interventions

Name	Year	Reference	Implementation Strategy	Program Content	Coverage	Impact	Limitation
BINP (Bangladesh)	1996-2002	(Hossain, Duffield, and Taylor, 2005); (Roy et al, 2005)	Government of Bangladesh	Counseling on health, family planning, breastfeeding, caring practices, personal hygiene and use of iodized salt; growth monitoring and promotion, supplementary foods, emphasized visits to community-based nutrition centers	15.6 million in 59 thanas (locality with a population of approximately 2000,000-450,000); Young children; Pregnant and lactating women; impoverished populations	No significant improvements	Failed to improve child nutritional Status; Bangladesh government through US$59.8 million loan from International Development Association
CNP (Senegal)	1996	(Gartner et al, 2007)	Government of Senegal	Provided monthly growth monitoring and promotion and weekly food supplementation for a period of 6 mo for cohorts of underweight or nutritionally at risk 6- to 35-mo-old children provided their mothers attended weekly nutrition education sessions and severely malnourished children were referred to health services	National; Children under 3 yrs living in poor urban neighborhoods	No significant outcomes observed.	Failed to improve child nutritional Status.
DAP (Ghana)	2004	(Saaka and Galaa, 2011)	Catholic Relief Services	Education, health and nutrition and safety net.	221 communities; Women and children living in food insecure households in rural communities	Improvements over time in health seeking behaviors, practices and coverage of health and nutrition services	Used outside source for Programme.
FPHSP (Bangladesh)	1977-	(Chaudhuri, 2008)	ICDDR,B	Community health workers deliver family planning and basic health information through door-to-door delivery mechanism	Matlab District; Pregnant women and children below the age of 5	Significantly improved the health of boys and girls in the treatment area. Mother's education has a positive impact on child's health, more so for girls than boys. The program is a substitute for maternal education	Didn't use the best method to Diffuse information

						in improving boys' health, whereas it is a complement to household wealth in improving girls' nutritional status.	
ICDS (India)	1977-	(Kandpal, 2012); (Gupta, Lokshin, Gragnolati, Ivaschenko, 2005)	Government of India	Village ICDS centers provide food supplements, health care including immunizations and referral services, and information on nutrition and health. Centers also provide early childhood care, daycare and preschool education; delivery of anthelmintics or micronutrient supplementation	National; Children younger than 6 in most vulnerable and economically disadvantaged sections	Significantly increases HAZ scores	Program placement fails to target villages in most need, and political alliances play an important role in budget allocation; US1.5 billion (2008)
IMCI (Bangladesh)	2002-2007	(Arifeen et al, 2009)	WHO, UNICEF	Developed 2-day training for local health workers on management of sick children, avoidance of harmful treatment practices and referral of severely ill children. Implemented health-system interventions such as the provision of IMCI training in health facilities and the implementation of revised case management guidelines for severe pneumonia. Family and community activities were designed to expand the reach of the programme.	350,000 people, 800,000 families; children less than 5 yrs old.	Improvement in stunting, mortality rate, health worker skills, health-system support and family and community practices, translating into increased care-seeking for illnesses; increase in breastfeeding	Failed to improve mortality rates In children; outside funding and Support.
Micronutrient Distribution (Nepal)	2007-2010	(Bilukha, et al 2011)		Children aged 6 to 59 months with moderate acute malnutrition were enrolled in a supplementary feeding program and received 200 g of Unilito mixed with 20 g of oil	mid-2010, of approximately 112,000 refugees registered; 80,000 in camps; Bhutanese refugee children	Positive impact on child height and anemia	Limited trained health workers/ Support staff, outside support

				daily. All refugees had free access to health services, including immunizations. Children aged 6 to 59 months received vitamin A supplements (200,000 IU) twice a year, and children aged 12 to 59 months were dewormed with albendazole following the same twice a year schedule. Home gardening program implemented on a wide scale in all camps, refugee families were encouraged, educated, and supported to grow fresh fruits and vegetables for personal consumption in small kitchen gardens.			
Midwife Programme (Indonesia)	1989-	(Frankenberg, Suriastini, Thomas, 2007)	Government of Indonesia	Village midwives establish healthcare practices within the community and serve as health resource to residents; selective programme placement.	54,000 midwives (1989-1998)	Positive impact on children's height. Moreover, the benefits have been greatest for children from the lower three-quarters of the socio-economic spectrum	
NNP (Bangladesh)	2001-	(Karim, Khan, Arkhtaruzzaman, 2004)	Government of Bangladesh, Community Nutrition Promoter	Provides monthly growth monitoring and promotion to under two-year-old children; daily supplementary feeding to severely malnourished and growth faltered children and low BMI pregnant and postpartum mothers; micronutrient supplementation; home visits; and referral of infectious and complicated cases to hospitals.	105 upazilas; Pregnant and lactating women; children	Fewer children moderately underweight and significantly more children not stunted	Children still worse off than National average

Nutrition Rehabilitation Programme (Sri Lanka)	2006	(Jayatissa et al, 2012)	Ministry of Health	.Children with SAM were given ready-to-use therapeutic food (RUTF), and children with MAM were given 100 g (450 kcal) of high-energy biscuits (HEBs) provided by UNICEF. All children received daily supplementary food consisting of locally produced Thriposha or 50 g of corn–soya blend provided by the World Food Programme that provides approximately 200 kcal in addition to the general food ration	Jaffina District: 599,000 population; district wide; Children under 5 yrs	Decrease in child acute malnutrition	
RPHC (China)	2001-2005	(Pei, Wang, Ren, Yan, 2012)	Chinese Ministry of Health, UNICEF	Rural health care network in target counties with the county hospitals as technology support, township hospitals as hubs and village clinics as service bases; nutritional consultation to families through town and village clinics, and carrying out the community nutrition intervention in programme counties; monitored the trend in child (<3 years old) development via a growth curve and offer feeding and dietary instruction for individuals with low birth weight.	10, 415 and 9,916 children under 3 living in rural areas; children under 3 yrs old in rural areas of western China	Effective in reducing childhood undernutrition rates to some extent	Did not address equity of Undernutrition
SEECALINE (Madagascar)	1999	(Galasso and Umapathi, 2009)	NGOS, community nutrition worker	Monthly growth monitoring and promotion activity as a focal point. The participating communities are mobilized towards becoming aware of the problem of malnutrition	More than half of country's districts; Children under 3 yrs old and pregnant and lactating women	Improved the weight of children under the age of 5 and had a significant impact on the height for age and incidence of stunting.	Outside financial support

				and are taught and encouraged to improve hygiene, childcare and nutrition practices; awareness of the importance of exclusive breastfeeding (at least until 6 months of age), on the timing and composition of the introduction of complementary food, on appropriate feeding practices and child care during illnesses.		Gains were larger for more educated mothers and villages with better infrastructure	
UIP (India)	1986-	(Anekwe and Kumar, 2012)	Government of India	UIP's immunization schedule called for children to be vaccinated by 12 months of age with one dose each of BCG and measles vaccines, three doses of polio vaccine (polio3) and three doses of diphtheria-tetanus-pertussis vaccine (DTP3).	Universal in 1990; All infant and young children	Improved child growth and long term health benefits	
World Vision (Haiti)	5 years	(Reul et al, 2008)	World Vision	(a) rally posts, where beneficiary identification is done, and where health education, growth monitoring, and services for preventive maternal and child health and nutrition are provided; for children 0–5 years of age; (b) mothers' clubs; (c) food-distribution points, where beneficiaries collect their monthly food rations; (d) prenatal and postnatal consultations; and (e) home visits for newborn infants or severely undernourished children.	12 communes, 600,000 people; Pregnant/lactating women and children	The preventive model is more effective for the reduction of childhood undernutrition	Required outside funding and Support

World Vision (Malawi)	1996	(Kalimbria, MacDonald, and Simpson, 2009)	World Vision, 11 government and NGO partners	Weekly iron supplementation in children under the age of 5 years; promotion and support of child immunization; provision and support of protected water (boreholes) and latrines; improving infant and young child feeding practices; prevention, control and treatment of parasitic infections (malaria, hookworms and schistosomiasis); increasing nutrition knowledge and practices related to micronutrients and health.	270,000 beneficiaries; indirectly benefited 4.7 million; Children 6 to 59 mo old and pregnant and lactating women	Decreased prevalence of stunting	Outside funding and su
MVP (Koraro, Ethiopia; Bonsaaso, Ghana; Sauri, Kenya; Mwandama, Malawi; Tiby, Mali; Pampaida, Nigeria; Potou, Senegal; Mbola, Tanzania; and Ruhiira, Uganda)	10 yrs	(Remans et al, 2011); (Berti et al, 2009) (also use this for grey lit)		Implemented a concurrent package of evidence-based interventions in agriculture, health, education, and infrastructure sustained over a 10-y period	Rural sites averaged ~40,000 people and were drawn from hunger hot spots with a baseline prevalence of child undernutrition of ≥20%	Improvements were observed in household food security and diet diversity, whereas coverage with child care and disease-control interventions improved for most outcomes. The prevalence of stunting in children <2 y old at year 3 of the program (2008–2009) was 43% lower (adjusted OR: 0.57; 95% CI: 0.38, 0.83) than at baseline.	Not sustainable

Table 17. Description of individual maternal and child health/community-based programme and intervention studies

Study and Year	Programme (Country)	Design	Sample Size	L/HAZ/Height/Stunting	Limitations/Bias
(Anekwe and Kumar, 2012)	UIP (India)	Cross-sectional		Increased HAZ (0.50 z-scores, p = 0.001); Because the average child was 2.24 z-scores below the norm for HAZ, the UIP effect (ranging from 0.49–0.56 z-scores across all analyses) translates into a 22–25% reduction in HAZ deficit for the average Indian child. Led to smaller gains in HAZ (21.06 z-scores, p =0.015) for children in third wealth quintile compared to children in first (poorest) quintile. Larger gains in height-for-age (1.19 z-scores, p=0.005) for children in SCs compared with children not in an SC or ST.[a]	A district fixed-effects method cannot control for district characteristics that vary over time and affect the outcomes of interest; could not test assumption about body size due to lack of data; control group was too small; FFHS 1992-1993 data might be outdated.
(Arifeen et al, 2009)	IMCI (Bangladesh)	Cluster RCT	Approximately 2,000 children	Prevalence of stunting in children aged 24–59 months decreased more rapidly (difference of differences −7·33, 95% CI −13·83 to −0·83) than in comparison areas.[a]	Low statistical power, contamination between intervention and control areas.
(Berti et al, 2009)	MVP (Koraro, Ethiopia; Bonsaaso, Ghana; Sauri, Kenya; Mwandama, Malawi; Tiby, Mali; Pampaida, Nigeria; Potou, Senegal; Mbola, Tanzania; and Ruhiira, Uganda)	Observational	Per country: 900-4801	Stunting reduced in all countries reduced by ≥10%, except Ethiopia.[a]	Subjective rating of quality of data, limitations in data collection method
(Bilukha, et al 2011)	Micronutrient Distribution (Nepal)	Pre/Post with no control group	2007: 497 children; 2008: 502 children; 2009: 568; 2010: 569.	Prevalence of Stunting: 39.2% (2007); to 23.4% (2010), (p<0.001), relative decrease of 40%. Prevalence of severe stunting: 8.0% (2007) to 3.2% (2010), relative decrease of 60%. Mean HAZ increased over same period from -1.63 to -1.33.[a]	Study had no age appropriate control group, no survey conducted immediately before the start of programme, did not measure biochemical

					indicators of iron status or of any other micronutrients, report bias from caregivers and mothers.
(Chaudhuri, 2008)[a]	FPHSP (Bangladesh)	RCT; Quasi-experimental	3,255 children	59 % of the children in the dataset were stunted (z-score < –2); Children in treatment areas were on average less stunted than those in control areas. (Mean and SD).[a]	Selective migration, programme leakage, lack of data on deceased children (selection bias), other programmes implemented prior to this programme in treatment areas
(Frankenberg, Suriastini, Thomas, 2007)	Village Midwife (Indonesia)	DD; Cross-sectional	7,224 households surveyed	Children in communities with a village midwife in 1993 are about 1/3 of a standard deviation taller compared to communities that don't have a midwife. (This is equivalent to 1.5 cm in height for a 4 yr old child). Children whose mothers were less well educated benefited more than other children from having a midwife in the village.[a]	Purpose/ selective placement of programme in areas where health is likely to be the poorest can lead to potential bias
(Galasso and Umpathi, 2009)	SEECALINE (Madagascar)	Ex-post, DD, PSM	14,000 Households	Programme had protective effect; stunting did not increase even though shocks occurred due to programme benefits.	Selection bias, spillover effects
(Gartner et al, 2007)	CNP (Senegal)	Before/After and intervention/control, quasi-experimental	Control zone: n=895 (before), 917 (after) Intervention zone: n=912 (before), n=759 (after)	Changes in stunting did not differ between zones (18.8% to 14.5% versus 15.1% to 14.7%, *P* = 0.21). In iZ zone, severe stunting disappeared in children 6-11 mo of age.[a]	Measurement of impact affected by high rate of mobility of population; external events could've had indirect effect on evaluation design and targeting
(Gupta, Lokshin, Gragnolati, Ivaschenko, 2005)	ICDS (India)	Cross-sectional	90,000 households in each survey	Only significant effect of the program was a positive effect on boys' stunting in the data from the 1992 survey, but not in 1998. For girls, the effect was not significant.	Absence of panel data, confounding
(Hossain,	BINP	RCT; ex-post Cross-	Participants were 6820	No significant outcomes	Ex-post study design

Duffield, and Taylor, 2005)	(Bangladesh)	sectional survey	households (4554 in the project areas and 2266 in the non-project areas) including 7183 children aged 6–59 months selected using a two-stage stratified cluster-sampling frame.		is inherently weak as it is not possible to control for any differences in the rates of malnutrition between project and non-project areas at the start of the intervention
(Jayatissa et al, 2012)	Nutrition Rehabilitation (Sri Lanka)	Pre/Post	Phase I: 3,538 (18.4&) children screened. Phase II: 3,440.7 (16.2%) children screened. Phase III: 37, 090 (85.8%) children screened.	Prevalence of stunting reduced from 18.2% to 15.2% (16.5%).[a]	Information bias
(Kalimbria, MacDonald, and Simpson, 2009)	World Vision (Malawi)	Prospective Cross-sectional	Preschool children, 474 from the 1996 baseline survey; 1264 from 2000 MICAH areas; 1500 from 2000 Comparison areas; 1959 from 2004 MICAH areas; and 1008 from 2004 Comparison areas	Overall, from 1996 to 2004, the prevalence of stunting decreased by 17.2 % (MICAH) and 15.1% (Comparison)($P < 0.05$).[a]	Contamination of comparisons areas
(Kandpal, 2012)	ICDS (India)	PSM	31,556 women; 41,306 of their children	Increased HAZ scores by 6%.[a]	No control groups, information bias, selection bias
(Karim, Khan, Arkhtaruzzaman, 2004)	NNP (Bangladesh)	Observational	528 households; 402 children 6- among statistically aged 59month	No significant outcomes	Possible information bias
(Pei, Wang, Ren, Yan, 2012)	RPHC (China)	DD	10 415 and 9916 children under 3 yrs	Proportion of child stunting decreased from 20.8% to 10.2%. The results from the difference-in-difference	Country and province selection was not

				estimation with stunting adjusting for socio-demographic characteristics showed that the intervention had significantly improved the child-stunting rate by 0.4%. [a]	random, control and intervention groups not randomly allocated, confounding, conclusions may not be generalizable
(Remans et al, 2011)	MVP (Koraro, Ethiopia; Bonsaaso, Ghana; Sauri, Kenya; Mwandama, Malawi; Tiby, Mali; Pampaida, Nigeria; Potou, Senegal; Mbola, Tanzania; and Ruhiira, Uganda)	Observational	300 households	After differences in demographic and socioeconomic variables were adjusted for, lower levels of stunting were observed at year 3 relative to at baseline (adjusted OR: 0.57; 95% CI: 0.38, 0.83). There was a concurrent improvement in the average HAZ with an increase in the absolute value by 0.56 (95% CI: 0.25, 0.87) across project sites. Stunting prevalence at baseline ranged from 25% to 77%. There was a significant (at $\alpha = 0.05$) reduction in stunting prevalence at 5 of the sites (Ethiopia, Kenya, Malawi, Nigeria, Tanzania) and a non-significant reduction in 3 additional sites (Ghana, Mali, Senegal, Uganda).[a]	Limited high quality data from various sites, information bias
(Reul et al, 2008)	World Vision (Haiti)	Cluster RCT	1,500 children	Compared with recuperation programmes, preventive programmes improved height for age indicator in 0.14 Z scores (height for age; p=0·07); not statistically significant.[a]	No control group, evaluation compared two packages of interventions not specific contributions of different intervention components.
(Saaka and Galaa, 2011)	DAP (Ghana)	Pre/Test involving two Cross-Sectional surveys	30 clusters	Among children aged 0–59 months, the pre- valence of chronic malnutrition (HAZ, 22 SD) reduced by 7.7 percentage points at the end of the project; Baseline % (n): 22.0 (342/1554) Final % (n): 14.3 (154/1080). Observed difference (95% CI): 27.7 (4.8–10.6).[a]	Lack of control over external factors, confounding,

a Reported significant outcomes

Table 18. Quality assessment of maternal and child health/community-based programme and intervention studies

Author, year	Region	Design	Comparability of groups at baseline	Loss to follow up	Adjustment for confounding	Other biases/limitations	Overall Grade
(Anekwe and Kumar, 2012)	India	Moderate-Cross-sectional	Low-differences/similarities not understood	N/A	High-Yes	Underestimation of impact, confounding, control group might have benefited from herd immunization and other vaccination programme	Low
(Arifeen et al, 2009)	Bangladesh	High-Cluster RCT, ITT, DD	Moderate-groups were similar at baseline with significantly higher use of sanitary latrines in intervention group	High-no loss to follow up	High-Yes	Low statistical power, contamination between intervention and control areas.	High
(Berti et al, 2009)	Africa	Low-Cross-sectional	Low-various differences between sites	N/A	Low-No	Subjective rating of quality of data, limitations in data collection method	Low
(Bilukha, et al 2011)	Nepal	Moderate-Observational	High- no significant differences in the distributions of age, sex, or camp of residence between the initially selected and the final samples in any of the surveys.	Low-12.7%, 15.9%, 15.7%	High-Yes	N/A	Moderate
(Chaudhuri, 2008)	Bangladesh	Moderate-RCT; quasi-experimental	Moderate-similar on socioeconomic characteristics mainly.	N/A	Moderate-Yes	Selective migration, programme leakage, lack of data on deceased children (selection bias), other programmes implemented prior to this programme in treatment areas	Moderate
(Frankenberg et al, 2007)	Indonesia	Low-Cross-sectional, DD	N/A	N/A	High-Yes	Bias caused by non-random placement of programme	Low
(Galasso and Umapathi, 2009)	Madagascar	Low-Ex-post, DD, PSM	N/A	N/A	High-Yes	Selection bias, spillover effects	Low
(Gartner et al, 2007)	Senegal	Low-Observational	Moderate-both zone were balanced on various characteristics, but the intervention group had a higher rate of Wolof ethnic group vs. the Serer ethnic group	Low-over 50%	Moderate-Yes	High mobility of sample, information bias, confounding	Low
(Gupta et al	India	Low-Cross-sectional	N/A	N/A	High-Yes	Absence of panel data,	Low

2005)						confounding	
(Hossain et al, 2005)	Bangladesh	Moderate-Ex-post cross-sectional survey, observational	Moderate-non-project and project areas could not be matched on malnutrition, but were similar in anthropometric measurements of children, socioeconomic variables	Moderate-5.8% of children	Moderate-Yes	Not possible to control for any differences in rates of malnutrition between project and non-project areas at start of intervention, no baseline data available	Low
(Jayatissa et al, 2012)	Sri Lanka	Low-Observational	N/A	N/A	Moderate-Yes	Information bias	Low
(Kalimbria et al, 2009)	Malawi	Moderate-Prospective study of three large cross-sectional surveys	Moderate-not all characteristics of groups were balanced	N/A	High-Yes	Contamination of comparisons areas	Low
(Kandpal, 2011)	India	Low- Observational, uses cross-sectional data, PSM	N/A	N/A	High-Yes	No control groups, information bias, selection bias	Low
(Karim et al, 2004)	Bangladesh	Low-Observational	N/A	N/A	Low-No	Possible information bias	Low
(Pei et al, 2012)	China	Low-Observational, DD	Moderate-groups were similar on some characteristics	N/A	High-Yes	Country and province selection was not random, control and intervention groups not randomly allocated, confounding, conclusions may not be generalizable	Low
(Remans et al, 2011)	Africa	Low-Prospective, observational	Moderate-some statistical differences between sites	Moderate-9.6% households	High-Yes	Limited high quality data from various sites, information bias	Low
(Reul et al, 2008)	Haiti	Moderate-Cluster-RCT	High-groups were very similar in anthropometric measures, household characteristics, child and maternal characteristics.	N/A	High-Yes	No control group, evaluation compared two packages of interventions not specific contributions of different intervention components.	Moderate
(Saaka and Galaa, 2011)	Ghana	Low--Observational involving cross-sectional surveys	Moderate- some differences between groups	N/A	High-Yes	Lack of control over external factors, confounding,	Moderate

Table 19. Description of daycare programmes

Name	Year	Reference	Implementation Strategy	Program Content	Coverage	Impact	Limitations
PIDI (Bolivia)	1994-2000	(Behrman, Cheng, Todd, 2004)	Government of Bolivia	Provides day-care, nutritional, and educational services to children between the ages of 6 months and 72 months who live in poor, predominantly urban areas.	100,000 children	Improvements in test scores; positive height estimates for short durations of programme; counterintuitive results of negative impact of on weight	US $140.2 million; World Bank US$50.7 million
HCB (Colombia)	1986-	(Attanasio and Vera-Hernandez, 2004); (Bernal and Fernandez, 2013)	Government of Colombia	Provides subsidies to nurseries and food(food supplement), cost of utilities, pedagogic material, monthly payments to the *madre comunitaria*	80,000 HC nurseries; 800,000 low-income children under 6 yrs old	Participation increased child height; improvements in development scores; increased school attendance	US$250 million
PEI (Mexico)	2007-	(Angeles et al, 2012)	Government of Mexico	Provides subsidized care and childcare services (of a value of up to US$55 per child or US$111 per child with disabilities) to mothers and single fathers who are working, seeking employment or studying, thereby enabling them to enter or remain in the labor market or in education. In addition, the programme provides financial support to those willing to create and operate daycare centers in order to increase childcare availability for low-income families.	249,282 mothers and 265,415 children in 9,255 daycare centers across country	Improved child HAZ scores; improved WHZ; increased in proportion of work/employment for mothers	
WWMP (Peru)	1993-	(Cueto et al, 2009)	Government of Peru	Includes safety initiatives, early childhood learning, nutrition, health, and parental practice	510 Management Committees, 6,005 Wawa Wasis; 6,678 Mother-Carers; 52,199 children (2006)	Some improvements in child health status	Little effectiveness on child development,

Table 20. Description of daycare programme studies

Study and Year	Programme (Country)	Design	Sample Size	L/HAZ/Height/Stunting	Limitation/Bias
(Angeles et al, 2012)	PEI (Mexico)	RCT	1,255 beneficiaries; 318 controls	No statistical significance	Limited data, lack of baseline measures to control influence on follow-up, confounding factors
(Attanasio and Vera-Hernandez, 2004)	HCB (Colombia)	Observational	4,689 households	An increase in 0.4486 standard deviations in HA equivalent to 2.36 centimeters for boys and 2.39 centimeters for girls aged 72 months; instrumental variables estimates indicate that participating in the programme at any point during the first six years of life was associated with a 3.78 centimeter increase in height-for-age in boys and a 3.83 centimeter increase for girls.[a]	Spillover effects of another programme , results cannot be extrapolated to different contexts
(Attanasio, Maro, Vera-Hernandez, 2012)	HCB (Colombia)	Observational, Cross-sectional	Not specified	A child that spends his/her entire life in a HC (so exposure equals 1) will be 88.5% of one standard deviation of height taller; and a child that currently attends a HC will be, on average, 40.5% of one standard deviation of height taller. A 60 month old child that has spent 24 months in a HC nursery would be 1.5% taller in the FeA sample; z-scores, these gains in height correspond to 0.35 z-scores in the FeA sample.[a]	
(Behrman, Cheng, Todd, 2004)	PIDI (Bolivia)	Observational, PSM, Non-experimental	Not specified	For younger children, the height estimates for short durations are large and positive; counterintuitive result of a negative impact of the program on height; no significant effect on height.[a]	Samples might not be comparable, no pre-program baseline data for all the groups
(Bernal and Fernandez, 2013)	HCB (Colombia)	Non-RCT	10,173 children (ages 3-6)	An increase of 0.1 SD in height for age for children older than 49 months after 16 months of program exposure (at 10% confidence level).[a]	Self-selection, non-randomized
(Cueto et al, 2009)	WWMP (Peru)	Observational, PSM	38 treatment children; 56 comparison children	79.4% of children showed no stunting after evaluation 58 per cent of children who had been in the programme for at least six months had a higher HAZ.[a]	No control group, lack of baseline information

a Reported significant outcomes

Table 21. Quality assessment of daycare programme studies

Author, year		Design	Comparability of groups at baseline	Loss to follow up	Adjustment for confounding	Other biases/limitations	Overall Grade
(Angeles et al, 2012)	Mexico	High-RCT	Low-not enough adequate data	N/A	Moderate-Yes	Limited data, lack of baseline measures to control influence on follow-up, confounding factors	Moderate
(Attanasio et al, 2004)	Colombia	Low-Observational, IV	Moderate-some statistical differences between groups	Moderate-5.6% of households	Moderate-Yes	Spillover effects of another programme , results cannot be extrapolated to different contexts	Low
(Attanasio et al 2012)	Colombia	Low-Cross-sectional	N/A	N/A	High-Yes	N/A	Low
(Behrman et al, 2004)	Bolivia	Low-Non-experimental, PSM	Low-significant differences between treatment and control groups	N/A	High-Yes	Samples might not be comparable, no pre-program baseline data for all the groups	Low
(Bernal and Fernandez, 2013)	Colombia	Moderate-Non-randomized trail	Moderate-some difference between groups	N/A	Moderate-Yes	Self-selection, non-randomized	Low
(Cueto et al, 2009)	Peru	Low-Observational, PSM	Low-lack of adequate data	N/A	Moderate-Yes	No control group, lack of baseline information	Low

Table 22. Description of national programmes

Name	Year	Reference	Implementation Strategy	Program Content	Coverage	Impact	Limitation
P4P (Rwanda)	2005-	(Gertler and Vermeersch, 2012)	Rwanda Ministry of Health	Provides bonus payments to primary care facilities based on provision of various types of services and the quality of those services. P4P payments go directly to facilities and are used at each facility's discretion	National	A large and significant effect on the weight-for-age of children 0–11 months and on the HAZ age of children 24–49 months; increased WAZ by 0.53 SD for children 0-11 mo; The incentives reduced the gap between provider knowledge and actual practice of the appropriate clinical procedures by approximately 20 percent.	
VHI (Vietnam)	1993-	(Wagstaff and Pradhan, 2005)	Government of Vietnam	Civil servants, state enterprise workers, the military, Communist party officials and pensioners who were (and continue to be) covered, and private firms with more than 10 employees were (and still are) required to enroll their workers.	National	Treatment effects translate into increases in height of 2.35 cm. Assuming the effects occurred continuously throughout the five years following the 1992/93 survey, these effects are equivalent to an extra 0.47 cm extra in height per year. Treatment effects translate into increases in weight of 0.75 kg; Assuming the effects occurred continuously throughout the five years following the 1992/93 survey, these effects are equivalent to an extra 0.15 kg per year.	Could potential miss vulnerable people

Table 23. Description of national programme studies

Study and Year	Programme(Country)	Design	Sample Size	L/HAZ/Height/Stunting	Limitation/Bias
(Gertler and Vermeersch, 2012)	P4P (Rwanda)	RCT	166 of Rwanda's 401 primary care facilities, 80 in treatment districts and 86 in comparison districts	Increased HAZ by 0.25 SD for children 24-49 mo. [a]	
(Wagstaff and Pradhan, 2005)	VHI (Vietnam)	Non-experimental, quasi-experimental, PSM, DD PSM, DD	Not specified	Treatment effects translate into increases in height of 2.35 cm. Assuming the effects occurred continuously throughout the five years following the 1992/93 survey, these effects are equivalent to an extra 0.47 cm extra in height per year. [a]	Insurance not assigned randomly, self-selection

a Reported significant outcome

Table 24. Quality assessment of national programme studies

Author, year	Region	Design	Comparability of groups at baseline	Loss to follow up	Adjustment for confounding	Other biases/limitations	Overall Grade
(Gertler and Vermeersch, 2012)	Rwanda	High-RCT	Moderate-groups balanced at baseline on outcomes and characteristics, but reassignment of districts was correlated with something unobservable	Low-12% of households	Moderate-Yes	N/A	High
(Wagstaff and Pradhan, 2005)	Vietnam	Low-Non-experimental, quasi-experimental, PSM, DD	Moderate- some differences between households	N/A	High-Yes	Insurance not assigned randomly, self-selection	Moderate

Table 25. Overall quality assessment of individual programme and intervention studies identified through systematic review of the impact of large-scale programmes and interventions on child stunting

Quality Assessment						
No. of Studies	**Design**	**Limitations**	**Consistency**	**Generalizability to population of interest/region**	**Generalizability to programmes/interventions of interest**	**Qualitative summary of findings**
Cash Transfer/Welfare Programmes: Overall quality of evidence=High						
18	High-13 RCT studies; 5-Cross sectional/observational studies	Some studies used a non-randomized approach, unclear if impacts were due to programmes, loss to follow-up	Moderate-10 studies showed a significant increase or slight improvement in child height and stunting outcomes from programme/intervention. 8 studies showed no significance.	High-12 studies were in Central/South America and effects may be generalizable to children in urban/rural areas of that setting. All programmes targeted poor, vulnerable populations of women and children.	High-all studies focused on measuring health outcomes of transfers on target population over some period of time using HAZ scores and stunting prevalence/rates. One can conclude that this type of programme/ intervention should be used to improve child health outcomes of interest	Over half of the studies showed positive improvement in child height and stunting outcomes due to cash/food transfer programmes/interventions.
Multi-Service Maternal and Child Health/Community-based Programmes and Interventions: Overall quality of evidence=Low						
18	Low- 3 RCT studies, 4 moderate observational studies; 11 low observation studies	Large loss to follow-up, confounding, information bias, missing data low randomization, lack of control groups	High-14 studies showed a significant or slight improvement in child height and stunting outcomes from programme/intervention	High-11 studies were in Asia/Southeastern Asia and 6 studies were in various parts of Africa and effects may be generalizable to children in urban/rural areas of that setting. All programmes targeted poor, vulnerable populations of women and children.	High-all studies focused on measuring health outcomes of various services provided by programmes/interventions on target population over some period of time using HAZ scores and stunting prevalence/ rates. One can conclude that this type of programme/ intervention should be used to improve child health outcomes	Over half of the studies showed a positive improvement in child height and stunting outcomes due to these kinds of programmes.
Sanitation Programmes and Interventions: Overall quality of evidence=Moderate						
5	High-5 RCT studies	Some lack of randomization, some contamination of control	Low-2 studies show significant or slight improvements in child height/stunting outcomes	Low-All studies are from different regions of the world, however all regions consist of areas that	High-all studies use treatment vs. control groups to determine impact from sanitation practices	Only 2 studies showed some positive improvement in child height/stunting outcomes due to improvements in sanitation

		groups, report bias		have poor sanitation practices		practices.
Daycare Programmes: Overall quality of evidence=Low						
6	Low-2 RCT study, 4 observational studies	Limited/lack of data, no control groups, self-selection bias, non-randomized	High-5 studies show significant or slight improvement in child height/stunting outcomes	High-all studies are from Central/South America and effects may be generalizable to children in urban/rural areas of that setting. All programmes targeted poor, vulnerable populations of women and children.	High-5 studies show improvement in child height/stunting outcomes. One can conclude that this kind of programme/ intervention can be used to improve child health outcomes of interest.	Almost all studies show some improvement in child height/stunting outcomes of this kind of programme/intervention.
Supplemental Feeding Programmes and Interventions: Overall quality of evidence=Low						
5	Low-1 RCT study, 4 low quality observational studies	No control groups, small sample sizes, no randomization	High-3 studies show significant or slight improvement in child height/stunting outcomes	Moderate-3 studies are in Central/South America (1 in the USA, and 1 in China) and effects may be generalizable to children in urban/rural areas of that setting. All programmes targeted poor, vulnerable populations of women and children.	Low-more studies failed to randomize groups and had missing data that complicates interpretation of results	More than half of studies show a positive improvement in child health outcomes of interest; however, these studies are mostly low quality.
School Feeding Programmes: Overall quality of evidence=Moderate						
8	Moderate-3 RCT studies, 5 moderate/ low quality observational studies	No randomization, missing data, recall bias, missing data	High-6 studies show significant or slight improvement in child height/stunting outcomes	High-6 studies were in Southeast Asia and effects may be generalizable to children in urban/rural areas of that setting. All	Moderate-some studies use a low quality study design to evaluate with many not using a proper control group, results of studies are difficult to interpret as well as extrapolate to other contexts	More than half of studies show improvements in child health outcomes of interest, however, the limitations of the study make it difficult to extrapolate to other

				programmes targeted poor, vulnerable populations of women and children.		populations or regions
National Health Care Programmes: Overall quality of evidence=Low						
2	High-1 RCT and 1 non-experimental	Non-randomization of programme, self-selection	High-both studies show significant or slight improvement in child height/stunting outcomes	Low- 1 in Vietnam, 1 in Rwanda; might be more region/country specific	High-both studies evaluated programmes by measuring child health outcomes of interest.	Both studies showed significant improvement in child height and stunting prevalence, this type of programme might be successful at national level.

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ANNEX A

SEARCH STRATEGY

PubMed Database. Pre-set search methods were used to search and retrieve studies using the electronic database PubMed. The combination of search terms, "(National nutrition programme OR national nutrition programmes (Title, Abstract, or Keywords) OR Large scale nutrition programme OR Large scale nutrition programmes (Title, Abstract, or Keywords) OR Nutrition intervention) AND (child OR children OR infants) AND (stunting OR growth OR length OR height) AND (impact OR evaluation OR effectiveness OR assessment)," was search strategy was used.

Econ-Lit Database. The combination of search terms used in this electronic database, "(Nutrition programmes OR Nutrition programme OR Large-scale nutrition programmes OR Large scale nutrition programme) AND (child or children)," using the "All Text Option."

World Bank Publications Database. The search strategy comprised of the combination of terms, "(Large-scale programmes OR National nutrition programmes) AND (children) AND (evaluation OR effectiveness OR assessment OR impact)."

Cochrane Central Register of Controlled Trials in the Cochrane Library. The following search strategy, "(Large-scale nutrition programmes OR National nutrition programmes OR Nutrition interventions) AND (children)."

Cochrane Database of Systematic Reviews in the Cochrane Library. The search strategy used in this database, "(Large-scale nutrition programmes OR National programmes OR Nutrition interventions) AND (children).

Popline. The search strategy used for this database was "(Nutrition programs OR programmes) AND (children)."

International Food Policy Research Institute Database (IFPRI). The search strategy utilized for this database was "(Large-scale nutrition program OR National nutrition program) AND (child stunting)."

International Initiative for Impact Evaluation Database (3ieimpact). The search strategy used in this database was "Nutrition programmes."