Double-Duty Actions: Seizing Program and Policy Opportunities to Address Malnutrition in all its Forms

Double-Duty Actions

Authors/affiliation
Corinna Hawkes PhD*+, Centre for Food Policy, City, University of London
Marie T. Ruel PhD,* International Food Policy Research Institute
Leah Salm MSc, International Food Policy Research Institute
Bryony Sinclair MPH, World Cancer Research Fund International
Francesco Branca, MD, PhD, World Health Organization

*** Joint lead Authors**

+Corresponding author
Corinna Hawkes, Centre for Food Policy, City, University of London,
Northampton Square, London EC1V 0HB, UK
Tel: +44 207 040 8796
Email: corinna.hawkes@city.ac.uk

Acknowledgements: We thanks our funders and Madeleine Coste for her help in reviewing the literature.

Key messages

- Actions to address undernutrition and overweight/obesity have historically been developed and delivered separately from one another. There is some evidence that programmes addressing undernutrition have unintentionally increased risks for obesity/DR-NCDs in low- and middle-income countries where food environments are changing rapidly. Yet policies and interventions to address undernutrition typically fail to consider these risks.
- "Double duty actions" aim to simultaneously prevent or reduce the risk of both nutritional deficiencies leading to underweight, wasting, stunting and/or micronutrient deficiencies, and obesity/DR-NCDs, with the same intervention, programme or policy.
- Double duty actions are based on the rationale that all forms of malnutrition share common drivers which can be leveraged for double impact. These include early life nutrition; dietary quality; food environments; and socioeconomic factors.
- The available evidence indicates that there are ten strong candidates for double duty actions across different sectors. These actions include interventions delivered through health, social protection, education, and agriculture platforms.
- Operationalizing a double duty approach involves assessing the potential harm of existing actions and redesigning programmes and policies with a focus on double duty actions. Changes in governance, financing and capacity building will be needed to operationalize the approach.
- Double duty actions are urgently needed as part of a holistic approach to ending malnutrition in all its forms by 2030.

Acronyms

BCC	Behaviour change communication
BMI	Body mass index
CCT	Conditional cash transfer
DR-NCD	Diet-related non-communicable diseases
EsIAN	Integral Strategy for Nutrition Attention
GDP	Gross domestic product
FAO	Food and Agriculture Organization
HAZ	Height-for-age z-scores
HIC	High income countries
HIP	Health Incentives Pilot
ICN2	2nd International Conference on Nutrition
IFPRI	International Food Policy Research Institute
IYCF	Infant and Young Child Feeding
JUNJI	Junta Nacional de Jardines Infantiles (The National Nursery Schools Council Program)
LMIC	Low- and middle-income countries
LNS	Lipid-based nutrient supplements
MAM	Moderately acutely malnourished
NCD	Non-communicable disease
NHANES	National Health and Nutrition Examination Survey
NMNAP	Tanzania National Multisectoral Nutrition Action Plan
PAL	Programa de Apoyo Alimentario (The Food Support Program)
RUTF	Ready-to-use therapeutic Foods
SAM	Severe acute malnutrition
SBCC	Social behaviour change communication
SDG	Sustainable development goal
SEARO	South-East Asia Regional Office of the World Health Organization
SES	Socioeconomic status
SNAP	Supplementary Nutrition Assistance Program
SSB	Sugar sweetened beverages
UN	United Nations
UNICEF	United Nations Children's Fund
UNSCN	United Nations System Standing Committee on Nutrition
USDA	The United States Department of Agriculture
WFP	World Food Programme

ABSTRACT
Actions to address different forms of malnutrition are typically managed by separate communities, policies, programmes, governance structures, and funding streams. In contrast, double duty actions, which aim to simultaneously tackle both undernutrition and problems of overweight, obesity and diet-related non-communicable diseases (DR-NCDs) have been proposed as a way to effectively address malnutrition in all its forms in a more holsitic way. This paper identifies ten double duty actions that have strong potential to reduce the risk of both undernutrition and obesity/DR-NCDs. It does so by : 1) summarizing evidence on common drivers of different forms of malnutrition; 2) documenting examples of unintended harm caused by some undernutrition-focused programmes on obesity/DR-NCDs; and 3) highlighting a few examples of first double duty actions undertaken to tackle multiple forms of malnutrition. We find that undernutrition and obesity/DR-NCDs are intrinsically linked through early life nutrition; dietary quality; food environments; and socioeconomic factors. There is some evidence that undernutrition-focused programs have raised risks of poor quality diets and obesity/DR-NCDs, especially in countries undergoing a rapid nutrition transition. The paper builds on this evidence to develop a framework to guide the design of double duty approaches and strategies, and defines the first steps needed to deliver them. With a clear package of double duty actions now identified, there is an urgent need to move forward with double duty actions to address malnutrition in all its forms.

Funding: Funding for the preparation of this Series was provided by the World Health Organization, through a grant provided by the Bill and Melinda Gates Foundation. The sponsor had no role in the process of developing and writing the paper**.** The CGIAR Research Program on Agriculture for Nutrition and Health (A4NH) led by the International Food Policy Research Institute (IFPRI) also provided funding.

INTRODUCTION

Most countries, at all levels of development, experience multiple forms of malnutrition.[1] This includes the coexistence of nutritional deficiencies and overweight or obesity and associated diet-related noncommunicable diseases (DR-NCDs) i.e. the double burden of malnutrition, which is observed within communities, households and individuals.[2]In high-income countries, where overweight/obesity affects more than half of the population, food insecurity among the poor manifests itself in low quality diets often dominated by high consumption of foods, snacks, and beverages high in energy, sugar, fat and/or salt,[3] in turn leading to excessive intakes of energy, NCDs and deficiencies in protein and/or essential micronutrients such as iron, folate, vitamins B6, B12, C, and D, and calcium.[4,5] At the other extreme, low-and middle-income countries (LMICs) still struggling with persistent problems of maternal undernutrition, child stunting and wasting, and widespread micronutrient deficiencies are experiencing rapid rises in overweight/obesity at lower levels of national income than experienced before.[2]

The double burden of malnutrition presents new challenges for policy and programming. In LMICs, national nutrition policies and donor funding have historically focused on undernutrition. Yet there is no longer just undernutrition, but overweight, obesity and diet-related NCDs to deal with. There has been increasing global recognition that all types of malnutrition need to be addressed **(Panel 1)**. Target 2.2 of the Sustainable Development Goals is to "end malnutrition in all its forms"[6] and the recent Lancet Commission on the global syndemic of obesity, undernutrition, and climate change highlights the need to tackle these inter-connected problems simultaneously.[7]

Nevertheless, actions to address the different manifestations of malnutrition are still isolated from each other, implemented through different governance and funding mechanisms (**Panel 1**)**.** Studies over a decade ago raised the concern that taking a siloed approach to tackling food insecurity and undernutrition could "do harm" to obesity,[8] and miss opportunities to use the same platforms for shared action.[9]

The objective of this paper is to explore the potential for a more holistic approach to address the double burden of malnutrition. "Double duty actions", a term coined in the 2015 Global Nutrition Report ,[10,11] are interventions, programmes, and policies that simultaneously prevent or reduce the risk of both nutritional deficiencies leading to underweight, wasting, stunting and/or micronutrient deficiencies and problems of obesity/DR-NCDs. Instead of narrowly focusing on one problem at a time, these actions aim to maximise the benefits of taking action on one form of nutrition for another, and minimise the risks of any form of malnutrition.[12,13] The term "triple duty" has also been used to refer to actions that address additional development problems, like climate change.[14,15]

This paper answers the call to identify priority double duty actions.[11] It does so, firstly, by setting out the rationale for double duty actions – that different forms of malnutrition share common drivers – and using this evidence to develop a simple framework of the factors that need to be considered when designing actions to address more than one form of malnutrition. Second, using this framework as a guide, we reviewed the literature to identify existing evidence that actions focused on undernutrition introduce risks or cause harm for obesity/DR-NCDs (see **Annex 1** for methodology); and third, we identified the

opportunities to "retrofit" existing, established actions focused on undernutrition to also address obesity/NCDs.[12] The paper ends by setting out the next steps for operationalising the double duty approach and identifying research priorities.

RATIONALE: COMMON DRIVERS OF THE DOUBLE BURDEN OF MALNUTRITION

The common drivers of different forms of malnutrition have been identified as biology, epigenetics, early-life nutrition, diets, socioeconomic factors, food environments and food systems, and governance. [10,12,14,16]. Wells (et al) and Popkin (et al) in this series provide evidence that biological and epigenetic factors and global food systems policies are common drivers, and the Lancet Commission on Obesity identifies shared systems drivers.[2,7,16]

Four intermediate (and modifiable) drivers for which there is evidence of influence on multiple forms of malnutrition are early-life nutrition, dietary quality, socioeconomic factors and food environments. The evidence indicates that actions that promote healthy growth in early life and nutritious diets throughout the life course, combined with healthy food environments, adequate income and education, and the knowledge and skills that support these goals have the potential to benefit multiple forms of malnutrition. **Figure 1** provides a simple depiction of how interventions could leverage these common drivers to deliver on multiple forms of malnutrition.

Early-life nutrition

Nutrition in mothers during pregnancy and lactation, and in infants and young children during their first few years of life, has profound implications for all forms of malnutrition

throughout the life-course. Inadequate nutrient intake in early life not only leads to undernutrition among infants but also predisposes them to a more central distribution of body fat if they gain weight later in life. This in turn increases the "toxicity" of obesity i.e., compared to adults who did not experience early undernutrition, NCDs manifest at lower BMI thresholds for those who did.[16] This may explain, at least in part, the recent explosion of DR-NCDs in LMICs as they continue to develop. There is also extensive evidence that rapid weight gain during early life (which may occur in response to interventions aimed at treating or preventing undernutrition) increases the risk of adult obesity/DR-NCDs.[16] Another way early life is important is through the tastes infants are exposed to - exposure to varied tastes during early life has been shown to facilitate acceptance of nutritious foods both at the time and in later life.[17–19] Promotion of good nutrition during early life is thus unique opportunity to tackle all forms of malnutrition.

Diet quality

High quality diets reduce the risk of all forms of malnutrition by promoting healthy growth, development and immunity, and preventing obesity/DR-NCDs at all stages of the life cycle. The components of healthy diets are: optimal breastfeeding practices in the first two years; a diversity and abundance of fruits and vegetables, wholegrains, fibre, nuts and seeds; modest amounts of animal source foods; and minimal amounts of processed meats and foods, high in energy, free sugar, saturated fat, trans fat and/or salt.[20,21] A diverse diet combining starchy staples, vitamin A-rich and other fruits and vegetables, and animal source foods is associated with lower levels of stunting,[22] while diets containing plenty of wholegrains, nuts, vegetables,and fruits, and limited amounts of animal source foods along with low levels of salt, can make significant contributions to reducing the burden of diet-

related diseases[23] Conversely, inadequate consumption of fruits and vegetables is a risk for both micronutrient deficiencies and DR-NCDs. High consumption of fast foods, highly processed foods, and sugary drinks has been associated with increased risks of obesity in children, adolescents, and adults and with gestational diabetes in pregnant women in high-income countries.[24–28] There is less evidence on how foods, snacks, and beverages high in energy, sugar, fat and/or salt are associated with undernutrition. Studies from LMICs indicate associations with lower micronutrient intake, micronutrient deficiencies in children, lower length-for-age Z-scores among high-consumers, and the co-existence of child stunting and maternal overweight.[29–33] Actions that reduce intake of these foods while promoting fruits, vegetables, wholegrains, nuts, seeds, and adhering to recommended levels of animal source foods, therefore provides an opportunity to tackle multiple forms of malnutrition.

Food environments

The foods available to people, the cost of these foods, and how they are marketed and promoted—often termed "food environments"—emerge as a common driver of the double burden owing to their role in shaping what people eat. Evidence indicates that healthier food environments are associated with greater intake of nutritious foods.[34] Yet as described in the companion paper by Popkin et al (2019), worldwide availability of unhealthy processed foods, snacks, and beverages high in energy, sugar, fat and/or salt, has soared since 2004.[2] Sales of breastmilk substitutes, including follow on formulae, are also growing at an unprecedented pace.[1] Manufacturers, supermarkets, food vendors, and restaurants make these foods easily accessible and affordable, often using aggressive marketing techniques.[35] Heavy promotion of breastmilk substitutes and follow on formula, and of

inappropriate complementary foods, snacks and sweetened beverages targeted to children influences consumption.[36,37] Companies promote foods such as biscuits, snacks, instant noodles, sugary breakfast cereals and drinks fortified with micronutrients as "healthy" by including a nutrient claim, or other suggestive indicators on the food packaging.[38–40] Very young children in LMICs are regularly consuming these snacks and foods high in fat, added sugar, and salt, and little nutritional value. [37,41–45] Acting on food environments to ensure they make healthy diets available, affordable and appealing and discourage promotion and marketing is thus a shared opportunity to prevent all forms of malnutrition.

Socioeconomic factors

Income and education are important drivers of both undernutrition and obesity/DR-NCD risks. Rises in income per capita are associated with reductions in child stunting.[46,47] Wealth, however, is a double edged sword for malnutrition since its effects on increasing overweight/obesity are larger than its effects on reducing childhood stunting.[48] Popkin et al. (in this series) describe how the effects of wealth on different forms of malnutrition differ by the countries' level of economic development.[2] Education is closely associated with income and wealth and generally has positive influences on nutrition.[49] Enhancing both education and income while mitigating the risks associated with the latter will be a key element of addressing all forms of malnutrition.

THE EVIDENCE: WHAT ARE THE OPPORTUNITIES AND RISKS OF UNDERNUTRITION-FOCUSED ACTIONS FOR OBESITY/DR-NCDS?

We now present evidence on how interventions already designed to address undernutrition through multiple sectors – health, social safety nets, education, and agriculture – could be

designed to take account of the four reviewed drivers to leverage opportunities or "do no harm".

Health platforms

Opportunities

Table 1 summarises the basic preventive health interventions targeting undernutrition delivered through health service facilities and networks of community-based health workers at different stages of the life cycle.[50,51] Since most target maternal and early life nutrition, they offer a prime opportunity to prevent and treat malnutrition in all its forms, especially given that they require regular contact between health workers and women/caregivers.

Table 1. Health system interventions to promote and support maternal and child health during the first 1,000 days

Target group	Intervention
Mothers during pregnancy and post-natal period	Promotion of and support for healthy maternal diets
	Supplementation with food and/or micronutrients in food insecure environments
Lactating mothers and their infant/young child	Promotion of optimal breastfeeding and complementary feeding practices (including food and/or micronutrient supplementation for children 0-24 months of age)
Infants and young children (< 5 years of age)	Growth monitoring and promotion
Infants and young children < 5 years of age	Detection and treatment of acute malnutrition

Antenatal care during pregnancy is a key intervention designed to support optimal growth of the foetus and positive birth outcomes. The 2017 WHO antenatal care recommendations

include a focus on dietary interventions to promote healthy diets and prevent both undernutrition and obesity, making them a double duty action (Table 1).[52]

For lactating mothers and their infants, one very widely adopted intervention around the world is the protection and promotion of optimal breastfeeding practices.[53] Evidence shows that breastfeeding helps prevent undernutrition and stimulates immunity and cognitive development, while also reducing the risk of overweight/obesity in childhood, obesity/DR-NCDs later in life, and, for the mother, delays future pregnancies and reduces the risk of breast cancer.[54–57] Scaling up efforts to promote and protect optimal breastfeeding practices is thus a second, unequivocal opportunity for a double duty action, providing benefits — and no risks — to both mother and child in the short- and long-term (**Table 2**). Proven interventions to promote breastfeeding through the health system include social behavior change communication techniques (SBCC) combining facility- and community-based nutrition counselling interventions and mass media.[58,59]

Promotion of complementary feeding practices is also a widespread intervention in LMICs,[60] for which well-designed SBCC strategies – with or without food and/or micronutrient supplementation – have been shown to be effective.[61–63]The timely introduction of nutritious, diverse fresh foods in sufficient quantity and quality at 6 months not only fosters children's growth and cognitive development but it can also prevent overweight/obesity during early childhood and obesity/DR-NCDs at adulthood.[64] Guidance on complementary feeding has, however, tended to focus on undernutrition and ignored the growth of unhealthy food environments. A third double duty action is thus to redesign complementary feeding guidance and actions to ensure they include not just the foods that should be consumed, but those to be avoided (**Table 2**).

Another traditional primary health care program designed originally to address undernutrition is growth monitoring and promotion (GMP).[65] The main purpose of growth monitoring is to identify children who are failing to thrive by regularly measuring their weight and then provide nutrition and health counselling to promote optimal growth. WHO recommends some modifications of GMP programmes to include detection of overweight and related counselling, making it a fourth option for a specific double duty action (see **Table 2**). The feasibility of adding these components should be carefully assessed, given the well-documented operational challenges and inconclusive evidence of effectiveness of GMP programmes on child growth.[66–68]

Risks

Supplementation with energy, protein, and micronutrients is another action with proven benefits maternal or child micronutrient status, birth outcomes, and child growth, especially in food insecure environments.[51,69–72] A study of food supplementation during pregnancy and early childhood in Guatemala found, for example, that it improved early child nutrition and growth and had long-term positive impacts on a myriad of outcomes later in life, including height, cognitive development, schooling achievement, economic productivity and reproductive health in women and significantly lower risks of diabetes at adulthood.[73] The study, however, also showed that the group who received the high energy/protein supplement, compared with a group that received a low energy/no protein supplement in early life, had greater adiposity and a more atherogenic blood lipid profile at adulthood (37-54 y).[74] The study signals the potentially negative effects of food (energy) supplementation in populations who suffer from poverty and food insecurity in early life

but who may be exposed to rapidly changing and increasingly obesogenic food environments as they move into adult life in countries undergoing rapid income growth and an accelerated nutrition transition.

Concerns have also been raised about food supplements designed to treat and prevent acute malnutrition. Ready-to-use therapeutic foods (RUTF), a type of lipid-based nutrient supplement (LNS) high in energy, fat, and sugar, high-quality protein and micronutrients, is a proven life-saving treatment for severe acute malnutrition (SAM).[75,76] Other LNS products with lower concentrations of energy, fat, and sugar, are used in small doses as a preventive measure to improve nutrition and growth in young children in food insecure areas, or to treat children with moderate acute malnutrition (MAM). Concerns raised (and still to be fully substantiated) about the intake of these products are fourfold:

- Rapid weight gain during early childhood may lead to excess adiposity, and metabolic syndrome later in life, especially in countries undergoing a rapid nutrition transition.[77–80]
- Intake over several months may affect recipients gut microbiome and may also influence their taste preferences and later life consumption patterns.[80,81]
- Potential mis-targeting of supplements due to errors in the detection of MAM or SAM children, or sharing with siblings, may lead to excess energy intakes among children who are not energy deficient or suffering from acute malnutrition.[77]
- The distribution of supplements may displace nutrition counselling programmes aimed at promoting optimal complementary feeding practices and healthy diets.

Research on the long-term impacts of the regular use of these different products in early childhood is needed to better evaluate the risks. It remains, however, that for SAM

treatment, there is currently no alternative product that is equally safe, convenient, and effective for use at the community level. A fifth double duty action would thus be to continue SAM treatment but to establish clear criteria and manage the potential long-term risks of energy-dense micronutrient-fortified foods and products used for prevention and treatment of different forms of undernutrition (**Table 2**).

Social safety nets

Opportunities

Common social safety net programmes include income support (cash transfers; benefits/welfare programmes) and food transfers/subsidy programmes (providing vouchers or subsidised prices on select foods). Their goal is generally to reduce poverty among poor and marginalised groups and reduce food insecurity. Some, particularly conditional cash transfer (CCT) programmes promote the use of health, nutrition, and education services as conditions for receipt of income, in an effort to build human capital.[82]

Social safety programmes have been found to have positive impacts on undernutrition outcomes. As described in detail in **Panel 2** and **Annexes 3-4**, CCT and food transfer/subsidy programmes in Mexico, Egypt and the US , have been found to improve elements of diet quality, food insecurity, poverty and/or undernutrition outcomes and, in some cases, the use of health and education services [83–86] Since these programmes reach millions of poor people and provide cash that can be spent on nutritious foods, increase access to education on healthy eating, and/or provide direct food subsidies or packages, they present an important opportunity for a sixth double duty action to enhance diets, education and

resources that could reduce the risk of obesity and NCDs while also improving undernutrition outcomes **(Table 2).**

Risks

The above evidence makes it clear that social protection programmes are an important and effective poverty and food insecurity reduction tool. However, despite their benefits, some programmes have had unintended negative impacts on some aspects of diet quality and/or obesity/DR-NCD risks (**Panel 3, Annex 3).** [87–90] These effects appear to be either because they directly provided or subsidized foods, snacks, and beverages high in energy, sugar, fat and/or salt, or because they provided income that could be used to purchase these types of foods which were readily accessible in their food environments. For example, Mexico's CCT program *Oportunidades* was associated with excessive weight gain among women in urban areas already overweight or obese before entering the programme,[91,92] and the PAL program, increased total energy intake in a population that already consumed excess energy at baseline (**Panel 2**).[84,93] Similar evidence from Guatemala shows that a food assistance program that provided food rations to mothers and children during the first 1,000 days reduced child stunting by 11% but increased women's weight (+ 600 g) at 24 months postpartum in a population where more than 42.5 % of women (non- pregnant/lactating) were overweight or obese.[94] Further evidence of harm from Latin America comes from non-experimental evaluations of CCTs in Brazil and Colombia and various food assistance programmes in Peru (**Annex 2**). Urban mothers receiving food rations under Egypt's food subsidy programme (providing bread and flour and a targeted ration card that provided subsidies for rice, sugar, cooking oil, and black tea) had higher BMI and their children were more likely to be stunted or obese than non-beneficiaries (**Annex 3**).[95] Urban beneficiaries

also had poorer diet diversity and lower frequencies of vegetable, meat, and fish consumption compared to non-beneficiaries. The evidence therefore suggests that the subsidy programme may have caused double harm — increasing both chronic undernutrition and overweight in children and exacerbating the existing problem of overweight/obesity in women.

In spite of their documented unintended negative impacts, these safety net programmes also provide prime examples of how redesigning programmes can leverage opportunities for double duty. For example, the Mexico CCT program incorporated a new health component designed to track both child undernutrition and overweight and obesity; regular check-ups for the detection of diabetes, hypertension, overweight, and obesity in adults; and a revamped SBCC strategy that includes counselling on healthy diets to prevent obesity/DR-NCD risks (**Panel 2**).[96] In Egypt, the government reform of the programme in 2014, included the basket of subsidised foods expanded to a variety of micronutrient-rich foods such as lentils, fava beans, meat, chicken, fish, milk, and cheese; and restricted the bread subsidy to ration-card holders (**Annex 3**). Enhancements have also been made to the to the PAL programme in Mexico and the US SNAP programmes to reduce their risk of exacerbating obesity/DR-NCD risks (**Panel 2, Annex 4).** These examples confirm the large potential of social safety net programmes to serve double duty (**Table 2, double duty action 6**).

Educational settings

Opportunities

"School feeding programmes" that offer meals, snacks, or take-home rations exist in at least 150 countries, serving at least 368 million children.[97,98] In LMICs, school feeding programmes are established to improve nutrition, cognitive and psychosocial development, and dietary behaviours. [99,100] In HICs, direct provision of nutritious foods or standards to limit the availability of foods, snacks, and beverages high in energy, sugar, fat and/or salt has been shown to improve targeted dietary behaviours.[34]

By providing the opportunity to provide a healthy diet directly to children, combined with the possibility of school-based food and nutrition education, healthy school meals emerge as a seventh opportunity for double duty action.[101] This opportunity, however, has yet to be fully leveraged. Nutritional guidelines for schools rarely appear to consider all forms of malnutrition, having been developed either for contexts where undernutrition historically dominates or for contexts with high rates of obesity. [102,103]

Risks

Providing food or meals in schools becomes a risk if it increases the accessibility of unhealthy snacks and foods high in fat, added sugar, and salt and provides little nutritional value. There is surprisingly little information on the quality of school meals in LMICs but there is evidence that foods eaten in schools and sold in the vicinity are of poor nutritional quality. Evidence from Brazil, Iran, Mexico, Haiti, Guatemala, India, South Africa, and the Philippines shows that foods sold by vendors in and outside of schools include chips, cookies, crackers, ice cream, fried foods, sugary drinks, hamburgers, pizza and confectionary.[39,104–111] A review of school food policies in eight countries in Latin America also reported widespread availability of these foods in kiosks in and out of schools.[112]

Studies also found that significant proportions of students consume snacks and sugar sweetened beverages (SSBs) on and off school property,[109,113] and that there is widespread promotion of snack foods and drinks inside schools,[39,113] such as signage boards with the school's name advertising a food/beverage.[114] Double duty actions for schools thus also need to consider not just the quality of the food available through official channels in schools, but the unhealthy food environments in and around schools.

The review identified one example where schools had taken the opportunity to retrofit an established programme. The National Nursery Schools Council Program (JUNJI) in Chile is a free day care programme that provides two meals and a snack to low-income children less than 6 years of age. Concerned by the high rates of obesity, the programme reduced the energy content of the meals by 100 kcal.[115] The intervention was unsuccessful in reducing obesity, but a follow-up pilot study tested a new approach involving parents and focusing on improving diets at home and school. Significant reductions in energy and fat intakes and snack consumption were achieved, as well as increases in fruit and vegetable intakes and physical activity.[116] The example emphasises the potential of using educational platforms for double duty action by focusing on both home and school environment (**Table 2**).

Agricultural development programmes

Opportunities

In recent years, there has been a concerted effort in LMICs to build nutrition goals into agricultural development programmmes. Such programmes— often termed "nutrition sensitive agriculture" —include biofortification, homestead food production, aquaculture, livestock and dairy programmes, agriculture extension services, nutrition-sensitive value

chains, and irrigation interventions.[117] Their aim is typically to promote diversity in production of nutritious foods for direct consumption and possibly for income from the sale of surplus production. A recent review found that they consistently improve food environments by enhancing household access to nutritious foods, thereby leading to increased quality of mothers' and young children's diets.[117] Thus, these agricultural development programmes have the potential to promote nutritious diets that benefit multiple forms of malnutrition, making their scale up an eighth candidate for double duty actions in all settings.

School gardens also have the potential to shape attitudes and behaviours of school aged children around diet and indirectly by influencing attitudes at home, and improving food environments.[118–120] Other types of agricultural programmes in cities, such as urban agriculture, school gardens and direct farm-consumer markets may have some potential to improve food environments in cities and household food security. Evidence indicates they can increase diet diversity but require sustained support if they are to play a significant role in improving food environments.[121]

Risks

The review by Ruel et al (2018) identified no risks from nutrition-sensitive agricultural programmes, though it should be noted that the programmes reviewed were implemented in extremely poor rural communities. One potential risk of these types of programmes for obesity/DR-NCDs is their potential effect on increasing income from the sale of agricultural products. If this additional income is used to purchase foods, snacks, and beverages high in

energy, sugar, fat and/or salt available in food environments, the programmes could inadvertently increase the risks of obesity.[122]

Larger agricultural development investments have typically been implemented without any specific nutrition objectives and their historical focus has been on delivering enough dietary energy to prevent hunger and food insecurity.[123] Historically policies have incentivised the production of grains, oilseeds and sugar.[124] Breeding programmes designed to increase yield of staple crops initially funded in the 1940s took off in Latin America and Asia, to become the "Green Revolution." Still today, the Consultative Group of International Agricultural Research Centers (CGIAR) allocates about half of its resources to rice and maize.[125] The concern has been voiced that the narrow focus on dietary energy has created risks for other aspects of diets.[126] For example, while the Green Revolution is credited with boosting overall energy consumption from basic cereals – rice, wheat – it did little to improve dietary diversity and micronutrient intake, and may have even worsened trends.[127] The crops also provided the basis of cheap feed for livestock and cheap inputs for processed foods, arguably introducing a risk for obesity/DR-NCDs by providing low cost ingredients used by manufacturers in industrially processed foods.[124,126] A ninth double duty action is thus to explore how agriculture and food systems policies can incentivise larger scale shifts to transform the dynamics of the food supply which underpins food environments.[125]

This example, along with all the other priority candidates for double duty actions, build on the evidence of the importance of food environments in supporting a double duty approach. A tenth double duty action, cross cutting 1-9, therefore relates to policies to reduce the availability and appeal of foods, snacks, and beverages high in energy, sugar, fat

and/or salt in food environments, and vice versa for nutritious foods (**Table 2**). These policies have typically been introduced as means of tackling obesity, but they need to be adapted to tackle malnutrition in all its forms. There is an urgent need to conduct research to better understand the role of foods typically targeted with food environment policies - foods, snacks, and beverages high in energy, sugar, fat and/or salt - in undernutrition as well as obesity and DR-NCDs (**Table 3**).[128]

NEXT STEPS: OPERATIONALISING A DOUBLE DUTY APPROACH

The evidence presented in this paper indicates that continuing with business as usual with existing nutrition programmes and policies is not fit for purpose in the new nutrition reality. The ten identified double duty actions are a means of leveraging shared opportunity and reducing risks of established programmes and policies currently addressing undernutrition (Table 2). Two steps are needed: designing a double duty strategy; and then delivering it.

Design a double duty strategy

This should include the three following processes[12]:

1) *Review existing programmes and policies* targeting undernutrition to assess if they are doing harm or provide opportunities to be retrofitted as double duty actions. The framework in **Figure 1** provides a starting point for how this could be done. This should include a characterisation of the food environment in which the actions are being delivered to understand how the results of actions is affected by this context.

2) *Redesign programmes and policies* to take a double duty approach using the ideas laid out in **Table 2** and build in evaluations to assess impacts on double burden outcomes and possible unintended outcomes (**Table 3**).

3) *Design new actions,* as needed, purposively to tackle malnutrition in all its forms at all stages of the lifecycle and especially for women during pregnancy and lactation and infants, preschoolers, and school age children and adolescents.

Step 2: Delivering a double duty strategy

To enable the delivery of the double duty strategy, more fundamental changes will be needed in governance, funding, capacity and research. There are encouraging signs that countries are improving the governance of nutrition, with an increasing numbers of countries having created a nutrition coordination mechanisms in high governmental offices including one third now in the president or prime minister's office.[1] These now need to incorporate all forms of malnutrition and one minister or ministry be made responsible for all.

The stimulus for a change in governance is unlikely unless there are changes in funding. Financing of nutrition action is still largely channeled to undernutrition programmes, and obesity is typically excluded from global estimates of the cost of eliminating malnutrition.[129] At the national level, it is unclear if and how actions designed to address overweight and obesity are costed in national nutrition plans in double burden countries.[130] In countries with costed nutrition plans that include overweight and obesity and DR-NCDs, examples indicate that funding is not available to deliver these actions.[1] Double duty actions provide an opportunity for these donors to continue with existing programming while building in considerations for the new nutrition reality.[14] This will likely require new strategic alignments by donors towards malnutrition in all its forms along with altered funding

streams. Understanding the costs of double duty actions, as well as their cost-effectiveness could help inform this process, as addressed by Nugent et al. in this series.[131]

Given the entrenched nature of existing approaches, individual and institutional capacity strengthening will be needed to change mindsets and enable action. For example, educational institutions and professional bodies should teach the knowledge and build the skills needed to tackle all forms of malnutrition simultaneously. Policy makers – nutrition policy leads and those working in other ministries responsible for relevant programmes – and implementers, such as health workers delivering nutrition counselling, will also need training on the double duty approach. The capacity to deliver double duty does not yet exist; it will need to be built and appropriately funded. To guide and justify the allocation of resources, research will also be needed to assess what works and at what cost and how capacity can be most effectively built, as indicated in **Table 3**.

To accelerate progress, the nutrition community needs to take ownership of the double duty agenda and adopt a new paradigm and mindset that favours a more holistic approach to designing actions to address the whole spectrum of malnutrition problems. The evidence presented in this paper highlights the urgency of moving forward with double duty actions if the world is to have any hope of attaining the SDG target of ending malnutrition in all its forms.

References

1 Development Initiatives. 2018 Global Nutrition Report: Shining a light to spur action on nutrition. Bristol, UK: Development Initiatives, 2018.

2 Popkin BM, Corvalan C, Grummer-Strawn LM. Dynamics of the Double Burden of Malnutrition and the Changing Nutrition Reality. *Lancet*.

3 Drewnowski A. The Economics of Food Choice Behavior: Why Poverty and Obesity Are Linked. In: Drewnowski A, Rolls B, eds. Obesity Treatment and Prevention: New Directions. Nestlé Nutrition Institute Workshop Series, Vol. 73. Basil: Nestec Ltd., Vevey/S. Karger AG., 2012: 95–112.

4 Ritchie H, Roser M. Micronutrient Deficiency. OurWorldInData.org. 2018. https://ourworldindata.org/micronutrient-deficiency' (accessed May 4, 2018).

5 Martínez Steele E, Raubenheimer D, Simpson SJ, Baraldi LG, Monteiro CA. Ultra-processed foods, protein leverage and energy intake in the USA. *Public Health Nutr* 2018; **21**: 114–24.

6 FAO/WHO. Second International Conference on Nutrition - Conference Outcome Document: Rome Declaration on Nutrition. Rome, Italy, 2014 DOI:10.1044/leader.PPL.19102014.18.

7 Swinburn BA, Kraak VI, Allender S, *et al.* The Global Syndemic of Obesity, Undernutrition, and Climate Change: The Lancet Commission report. *Lancet* 2019; **393**: 791–846.

8 Uauy R, Kain J. The epidemiological transition: need to incorporate obesity prevention into nutrition programmes. *Public Health Nutr* 2002; **5**: 223–9.

9 Hawkes C. From What to How: The role of double-duty actions in addressing the double burden. https://sightandlife.org/wp-content/uploads/2018/12/17_SALMZ_0218_Perspectives_04.pdf. *Sight Life* 2018; **32**. https://sightandlife.org/wp-content/uploads/2018/12/17_SALMZ_0218_Perspectives_04.pdf.

10 IFPRI. Global Nutrition Report 2015: Actions and accountability to advance nutrition and sustainable development. International Food Policy Research Institute, 2015.

11 Hawkes Corinna, Haddad Lawrence. The challenge to nutrition researchers everywhere: identify a set of actions that reduce malnutrition in all its forms. Lancet Glob. Heal. Blog. 2015.

12 WHO. Double-duty actions. Policy brief. Geneva: World Health Organization (WHO), 2017.

13 Hawkes C. From What to How: The role of double-duty actions in addressing the double burden. *Sight Life* 2018; **32**. https://sightandlife.org/wp-content/uploads/2018/12/17_SALMZ_0218_Perspectives_04.pdf.

14 DI. Global Nutrition Report 2017: Nourishing the SDGs. Development Initiative, 2017.

15 Swinburn BA, Kraak VI, Allender S, *et al.* The Global Syndemic of Obesity,

Undernutrition, and Climate Change: The Lancet Commission report. *Lancet* 2019; **393**: 791–846.

16 Wells C, Sawaya A, Wibaek R, *et al.* The double burden of malnutrition: etiological pathways and consequences for health. *Lancet*.

17 De Cosmi V, Scaglioni S, Agostoni C. Early Taste Experiences and Later Food Choices. *Nutrients* 2017; **9**: 107.

18 Mennella JA. Ontogeny of taste preferences: basic biology and implications for health. *Am J Clin Nutr* 2014; **99**: 704S-711S.

19 Nicklaus S. The Role of Dietary Experience in the Development of Eating Behavior during the First Years of Life. *Ann Nutr Metab* 2017; **70**: 241–5.

20 WHO. Healthy diets. 2015. http://www.who.int/news-room/fact-sheets/detail/healthy-diet.

21 Willett W, Rockström J, Loken B, *et al.* Food in the Anthropocene: the EAT-Lancet Commission on healthy diets from sustainable food systems. *Lancet* 2019; **393**: 447–92.

22 Arimond M, Ruel MT, Consumption F, Division N. Dietary Diversity is associated with Child Nutritional Status : Evidence from. 2003.

23 Afshin A, Sur PJ, Fay KA, *et al.* Health effects of dietary risks in 195 countries, 1990–2017: a systematic analysis for the Global Burden of Disease Study 2017. *Lancet* 2019; **393**: 1958–72.

24 Fraser LK, Clarke GP, Cade JE, Edwards KL. Fast food and obesity: a spatial analysis in a large United Kingdom population of children aged 13-15. *Am J Prev Med* 2012; **42**: e77-85.

25 Taveras EM, Berkey CS, Rifas-Shiman SL, *et al.* Association of consumption of fried food away from home with body mass index and diet quality in older children and adolescents. *Pediatrics* 2005; **116**: e518-24.

26 Niemeier HM, Raynor HA, Lloyd-Richardson EE, Rogers ML, Wing RR. Fast food consumption and breakfast skipping: predictors of weight gain from adolescence to adulthood in a nationally representative sample. *J Adolesc Health* 2006; **39**: 842–9.

27 Malik VS, Pan A, Willett WC, Hu FB. Sugar-sweetened beverages and weight gain in children and adults: a systematic review and meta-analysis. *Am J Clin Nutr* 2013; **98**: 1084–102.

28 Te Morenga L, Mallard S, Mann J. Dietary sugars and body weight: systematic review and meta-analyses of randomised controlled trials and cohort studies. *BMJ* 2012; **346**: e7492.

29 Louzada ML da C, Baraldi LG, Steele EM, *et al.* Consumption of ultra-processed foods and obesity in Brazilian adolescents and adults. *Prev Med (Baltim)* 2015; **81**. DOI:10.1016/j.ypmed.2015.07.018.

30 Lander R, Enkhjargal TS, Batjargal J, *et al.* Poor dietary quality of complementary foods is associated with multiple micronutrient deficiencies during early childhood in

Mongolia. *Public Health Nutr* 2010; **13**: 1304–13.

31 Anderson VP, Cornwall J, Jack S, Gibson RS. Intakes from non-breastmilk foods for stunted toddlers living in poor urban villages of Phnom Penh, Cambodia, are inadequate. *Matern Child Nutr* 2008; **4**: 146–59.

32 Aitsi-Selmi A. Households with a stunted child and obese mother: trends and child feeding practices in a middle-income country, 1992-2008. *Matern Child Health J* 2015; **19**: 1284–91.

33 Pries AM, Rehman AM, Filteau S, Sharma N, Upadhyay A, Ferguson EL. Unhealthy Snack Food and Beverage Consumption Is Associated with Lower Dietary Adequacy and Length-for-Age z-Scores among 12–23-Month-Olds in Kathmandu Valley, Nepal. *J Nutr* 2019; published online July 16. DOI:10.1093/jn/nxz140.

34 Micha R, Karageorgou D, Bakogianni I, *et al.* Effectiveness of school food environment policies on children's dietary behaviors: A systematic review and meta-analysis. *PLoS One* 2018; **13**: e0194555.

35 Popkin BM, Reardon T. Obesity and the food system transformation in Latin America. *Obes Rev* 2018; **19**: 1028–64.

36 Pries AM, Huffman SL, Mengkheang K, *et al.* High use of commercial food products among infants and young children and promotions for these products in Cambodia. *Matern Child Nutr* 2016; **12**: 52–63.

37 Huffman SL, Piwoz EG, Vosti SA, Dewey KG. Babies, soft drinks and snacks: a concern in low- and middle-income countries? *Matern Child Nutr* 2014; **10**: 562–74.

38 Nair Ghaswalla A. Fortified biscuits: Britannia bakes a plan for a healthy business. *The Hindu* 2014; published online Sept. https://www.thehindubusinessline.com/companies/Fortified-biscuits-Britannia-bakes-a-plan-for-a-healthy-business/article20868419.ece.

39 Reeve E, Thow AM, Bell C, *et al.* Implementation lessons for school food policies and marketing restrictions in the Philippines: a qualitative policy analysis. *Global Health* 2018; **14**: 8.

40 Verrill L, Wood D, Cates S, Lando A, Zhang Y. Vitamin-Fortified Snack Food May Lead Consumers to Make Poor Dietary Decisions. *J Acad Nutr Diet* 2017; **117**: 376–85.

41 Jaime PC, Prado RR do, Malta DC. Family influence on the consumption of sugary drinks by children under two years old. *Rev Saude Publica* 2017; **51**: 13s.

42 Kavle JA, Mehanna S, Saleh G, *et al.* Exploring why junk foods are 'essential' foods and how culturally tailored recommendations improved feeding in Egyptian children. *Matern Child Nutr* 2015; **11**: 346–70.

43 Brown K, Henretty N, Chary A, *et al.* Mixed-methods study identifies key strategies for improving infant and young child feeding practices in a highly stunted rural indigenous population in Guatemala. *Matern Child Nutr* 2016; **12**: 262–77.

44 Pries AM, Huffman SL, Champeny M, *et al.* Consumption of commercially produced snack foods and sugar-sweetened beverages during the complementary feeding

period in four African and Asian urban contexts. *Matern Child Nutr* 2017; **13**: e12412.

45 Pries AM, Huffman SL, Mengkheang K, *et al.* High use of commercial food products among infants and young children and promotions for these products in Cambodia. *Matern Child Nutr* 2016; **12**: 52–63.

46 Webb P, Block S. Support for agriculture during economic transformation: impacts on poverty and undernutrition. *Proc Natl Acad Sci U S A* 2012; **109**: 12309–14.

47 Headey D, Hoddinott J, Park S. Drivers of nutritional change in four South Asian countries: a dynamic observational analysis. *Matern Child Nutr* 2016; **12**: 210–8.

48 Ruel MT, Alderman H. Nutrition-sensitive interventions and programmes: how can they help to accelerate progress in improving maternal and child nutrition? *Lancet* 2013; **382**: 536–51.

49 Alderman H, Headey DD. How Important is Parental Education for Child Nutrition? *World Dev* 2017; **94**: 448–64.

50 Kerber KJ, de Graft-Johnson JE, Bhutta ZA, Okong P, Starrs A, Lawn JE. Continuum of care for maternal, newborn, and child health: from slogan to service delivery. *Lancet* 2007; **370**: 1358–69.

51 Bhutta ZA, Das JK, Rizvi A, *et al.* Evidence-based interventions for improvement of maternal and child nutrition: what can be done and at what cost? *Lancet* 2013; **382**: 452–77.

52 The World Health Organization. Assessing and managing children at primary health-care facilities to prevent overweight and obesity in the context of the double burden of malnutrition UPDATES FOR THE INTEGRATED MANAGEMENT OF CHILDHOOD ILLNESS (IMCI). Geneva, Switzerland: World Health Organization, 2017.

53 World Health Organization. Essential Nutrition Actions. Improving Maternal, Newborn, Infant and Young Child Health and Nutrition. Geneva, 2013 https://apps.who.int/iris/bitstream/handle/10665/84409/9789241505550_eng.pdf;jsessionid=6833CE74736696858BE86AF57608B607?sequence=1.

54 Victora CG, Bahl R, Barros AJD, *et al.* Breastfeeding in the 21st century: epidemiology, mechanisms, and lifelong effect. *Lancet* 2016; **387**: 475–90.

55 Horta BL, Loret de Mola C, Victora CG. Long-term consequences of breastfeeding on cholesterol, obesity, systolic blood pressure and type 2 diabetes: a systematic review and meta-analysis. *Acta Paediatr* 2015; **104**: 30–7.

56 Yan J, Liu L, Zhu Y, Huang G, Wang PP. The association between breastfeeding and childhood obesity: a meta-analysis. *BMC Public Health* 2014; **14**: 1267.

57 World Cancer Research Fund, American Institute for Cancer Research. Diet, nutrition, physical activity and breast cancer. 2017 http://www.aicr.org/continuous-update-project/reports/breast-cancer-report-2017.pdf.

58 Bhutta ZA, Das JK, Rizvi A, *et al.* Evidence-based interventions for improvement of maternal and child nutrition: What can be done and at what cost? *Lancet* 2013; **382**: 452–77.

59 Menon P, Nguyen PH, Saha KK, *et al.* Impacts on Breastfeeding Practices of At-Scale Strategies That Combine Intensive Interpersonal Counseling, Mass Media, and Community Mobilization: Results of Cluster-Randomized Program Evaluations in Bangladesh and Viet Nam. *PLOS Med* 2016; **13**: e1002159.

60 WHO/PAHO. Guiding Principles for Complementary Feeding of the Breastfed Child. Washington, DC, Pan American Health Organization. 2003.

61 Nguyen PH, Kim SS, Nguyen TT, *et al.* Exposure to mass media and interpersonal counseling has additive effects on exclusive breastfeeding and its psychosocial determinants among Vietnamese mothers. *Matern Child Nutr* 2016; **12**: 713–25.

62 Menon P, Nguyen PH, Saha KK, *et al.* Combining Intensive Counseling by Frontline Workers with a Nationwide Mass Media Campaign Has Large Differential Impacts on Complementary Feeding Practices but Not on Child Growth: Results of a Cluster-Randomized Program Evaluation in Bangladesh. *J Nutr* 2016; **146**: 2075–84.

63 Panjwani A, Heidkamp R. Complementary Feeding Interventions Have a Small but Significant Impact on Linear and Ponderal Growth of Children in Low- and Middle-Income Countries: A Systematic Review and Meta-Analysis. *J Nutr* 2017; : jn243857.

64 WHO. Global action plan for the prevention and control of noncommunicable diseases 2013-2020. Geneva, Switzerland: World Health Organization (WHO), 2013.

65 King MH, King S, Felicity, Martodipoero S, World Health Organization. Primary child care : a manual for health workers / Maurice King, Felicity King, Soebagyo Martodipoero. Oxford : Oxford University Press, 1979.

66 Mangasaryan N, Arabi M, Schultink W. Revisiting the concept of growth monitoring and promotion and its possible role in community-based nutrition programs. *Food Nutr Bull* 2011; **32**: 42–53.

67 Roberfroid D, Kolsteren P, Hoerée T, Maire B. Do growth monitoring and promotion programs answer the performance criteria of a screening program? A critical analysis based on a systematic review. *Trop Med Int Health* 2005; **10**: 1121–33.

68 Ashworth A, Shrimpton R, Jamil K. Growth monitoring and promotion: review of evidence of impact. *Matern Child Nutr* 2008; **4 Suppl 1**: 86–117.

69 Eichler K, Wieser S, Rüthemann I, Brügger U. Effects of micronutrient fortified milk and cereal food for infants and children: a systematic review. *BMC Public Health* 2012; **12**: 506.

70 Ramakrishnan U, Nguyen P, Martorell R. Effects of micronutrients on growth of children under 5 y of age: meta-analyses of single and multiple nutrient interventions. *Am J Clin Nutr* 2009; **89**: 191–203.

71 Bhutta Z a, Ahmed T, Black RE, *et al.* What works? Interventions for maternal and child undernutrition and survival. *Lancet* 2008; **371**: 417–40.

72 Haider BA, Bhutta ZA. Multiple-micronutrient supplementation for women during pregnancy. In: Bhutta ZA, ed. Cochrane Database of Systematic Reviews. Chichester, UK: John Wiley & Sons, Ltd, 2015. DOI:10.1002/14651858.CD004905.pub4.

73 Martorell R. Improved nutrition in the first 1000 days and adult human capital and health. *Am J Hum Biol* 2017; **29**: e22952.

74 Ford ND, Behrman JR, Hoddinott JF, *et al.* Exposure to improved nutrition from conception to age two years and adult cardiometabolic disease risk. *Lancet Glob Heal* 2018; **in press**.

75 WHO. Guideline: Updates on the management of severe acute malnutrition in infants and children. Geneva, Switzerland: World Health Organization (WHO), 2013 http://apps.who.int/iris/bitstream/handle/10665/95584/9789241506328_eng.pdf;jsessionid=3BD8B9F0B0D799A3B516D20AE273829F?sequence=1.

76 Lenters LM, Wazny K, Webb P, Ahmed T, Bhutta ZA. Treatment of severe and moderate acute malnutrition in low- and middle-income settings: a systematic review, meta-analysis and Delphi process. *BMC Public Health* 2013; **13**: S23.

77 Sridhar SB, Darbinian J, Ehrlich SF, *et al.* Maternal gestational weight gain and offspring risk for childhood overweight or obesity. *Am J Obstet Gynecol* 2014; **211**: 259.e1-259.e8.

78 Lucas K, James P, Choh AC, *et al.* The positive association of infant weight gain with adulthood body mass index has strengthened over time in the Fels Longitudinal Study. *Pediatr Obes* 2018; published online Feb 28. DOI:10.1111/ijpo.12271.

79 Adair LS, Fall CH, Osmond C, *et al.* Associations of linear growth and relative weight gain during early life with adult health and human capital in countries of low and middle income: findings from five birth cohort studies. *Lancet* 2013; **6736**: 109–18.

80 Bazzano A, Potts K, Bazzano L, Mason J. The Life Course Implications of Ready to Use Therapeutic Food for Children in Low-Income Countries. *Int J Environ Res Public Health* 2017; **14**: 403.

81 Luque V, Escribano J, Closa-Monasterolo R, *et al.* Unhealthy Dietary Patterns Established in Infancy Track to Mid-Childhood: The EU Childhood Obesity Project. *J Nutr* 2018; **148**: 752–9.

82 Levy S. Progress against Poverty: Sustaining Mexico's Progresa-Oportunidades Program. Washington, DC: Brookings Institution Press, 2006 http://www.jstor.org/stable/10.7864/j.ctt6wpfjp.

83 Parker SW, Todd PE. Conditional Cash Transfers: The Case of Progresa/Oportunidades. *J Econ Lit* 2017; **55**: 866–915.

84 Leroy JL, Gadsden P, Rodríguez-Ramírez S, de Cossío TG. Cash and In-Kind Transfers in Poor Rural Communities in Mexico Increase Household Fruit, Vegetable, and Micronutrient Consumption but Also Lead to Excess Energy Consumption1–3. *J Nutr* 2010; **140**: 612–7.

85 Abdalla M, Al-Shawarby S. The Tamween Food Subsidy System in Egypt: Evolution and Recent Implementation Reforms. In: Alderman H, Gentilini U, Yemtsov R, eds. The 1.5 Billion People Question: Food, Vouchers, or Cash Transfers? Washington: World Bank, 2016: 107–47.

86 Oliveira V, Tiehen L, Prell M, Smallwood D. Evolution and implementation of the

Supplemental Nutrition Assistance Program in the United States. In: Alderman H, Gentilini U, Yemtsov R, eds. The 1.5 billion people question: Food, vouchers, or cash transfers? Washington, DC: World Bank, 2018: 209–63.

87 Saldiva SRDM, Silva LFF, Saldiva PHN. Avaliação antropométrica e consumo alimentar em crianças menores de cinco anos residentes em um município da região do semiárido nordestino com cobertura parcial do programa bolsa família. *Rev Nutr* 2010; **23**: 221–9.

88 Forde I, Chandola T, Garcia S, Marmot MG, Attanasio O. The impact of cash transfers to poor women in Colombia on BMI and obesity: prospective cohort study. *Int J Obes* 2012; **36**: 1209–14.

89 Carrillo-Larco RM, Miranda JJ, Bernabé-Ortiz A. Impact of Food Assistance Programs on Obesity in Mothers and Children: A Prospective Cohort Study in Peru. *Am J Public Health* 2016; **106**: 1301–7.

90 Chaparro MP, Bernabe-Ortiz A, Harrison GG. Association between food assistance program participation and overweight. *Rev Saude Publica* 2014; **48**: 889–98.

91 Neufeld LM, Garcia-Guerra A, Leroy J, Flores López ML, Fernández Gaxiola AC, Rivera-Donmarco JA. Impacto del programa Oportunidades en nutrición y alimentación en zonas urbanas de México. Cuernavaca, Mexico: National Institute of Public Health, 2005.

92 Fernald LCH, Gertler PJ, Neufeld LM. Role of cash in conditional cash transfer programmes for child health, growth, and development: an analysis of Mexico's Oportunidades. *Lancet* 2008; **371**: 828–37.

93 Leroy JL, Gadsden P, González de Cossío T, Gertler P. Cash and in-Kind Transfers Lead to Excess Weight Gain in a Population of Women with a High Prevalence of Overweight in Rural Mexico1–3. *J Nutr* 2013; **143**: 378–83.

94 Leroy JL, Olney DK, Ruel MT. PROCOMIDA, a Food-Assisted Maternal and Child Health and Nutrition Program, Contributes to Postpartum Weight Retention in Guatemala: A Cluster-Randomized Controlled Intervention Trial. *J Nutr* 2019; published online Aug 2. DOI:10.1093/jn/nxz175.

95 Ecker O, Al-Riffai P, Breisinger C, El-Batrawy R. Nutrition and economic development: Exploring Egypt's exceptionalism and the role of food subsidies. Washington DC, 2016 DOI:10.2499/9780896292383.

96 Bonvecchio A, González W, editors. Estrategia Integral de Atención a la Nutrición (EsIAN) para población beneficiaria de PROSPERA Programa de Inclusión Social. Manual para la Unidad de Salud. Mexico.

97 Global Panel on Agriculture and Food Systems for Nutrition. Healthy Meals in Schools : Policy Innovations Linking Agriculture, Food Systems and Nutrition. Policy Brief 3. 2015.

98 State of School Feeding Worldwide 2013. 2013.

99 Drake L, Meena F, Aurina E, *et al.* School Feeding Programs in Middle Childhood and Adolescence. In: Bundy D, de Silva N, Horton SE, Jamison D, Patton G, eds. Disease

Control Priorities (third edition): Volume 8, Child and Adolescent Health and Development. Washington, D.C.: World Bank, 2017: 79–98.

100 Kristjansson EA, Gelli A, Welch V, *et al.* Costs, and cost-outcome of school feeding programmes and feeding programmes for young children. Evidence and recommendations. *Int J Educ Dev* 2016; **48**: 79–83.

101 UNSCN. School as a system to improve nutrition. A new statement for school-based food and nutrition interventions. Discussion Paper. Geneva, Switzerland: United Nations Standing Committee on Nutrition, 2017.

102 Wijesinha-Bettoni R, Orito A, Löwik M, Mclean C, Muehlhoff E. Increasing fruit and vegetable consumption among schoolchildren: efforts in middle-income countries. *Food Nutr Bull* 2013; **34**: 75–94.

103 Aliyar R, Gelli A, Hamdani SH. A Review of Nutritional Guidelines and Menu Compositions for School Feeding Programs in 12 Countries. *Front Public Heal* 2015; **3**: 148.

104 Bonvecchio-Arenas A, Theodore FL, Hernández-Cordero S, *et al.* La escuela como alternativa en la prevención de la obesidad: la experiencia en el sistema escolar mexicano. *Rev Española Nutr Comunitaria* 2010; **16**: 13–6.

105 Morshed AB, Becker H V, Delnatus JR, Wolff PB, Iannotti LL. Early nutrition transition in Haiti: linking food purchasing and availability to overweight status in school-aged children. *Public Health Nutr* 2016; **19**: 3378–85.

106 Pehlke EL, Letona P, Hurley K, Gittelsohn J. Guatemalan school food environment: impact on schoolchildren's risk of both undernutrition and overweight/obesity. *Health Promot Int* 2016; **31**: 542–50.

107 Rathi N, Riddell L, Worsley A. Food environment and policies in private schools in Kolkata, India: Table 1: *Health Promot Int* 2016; : daw053.

108 Rathi N, Riddell L, Worsley A. What influences urban Indian secondary school students' food consumption? – A qualitative study. *Appetite* 2016; **105**: 790–7.

109 Azeredo CM, de Rezende LFM, Canella DS, *et al.* Food environments in schools and in the immediate vicinity are associated with unhealthy food consumption among Brazilian adolescents. *Prev Med (Baltim)* 2016; **88**: 73–9.

110 Yazdi Feyzabadi V, Keshavarz Mohammadi N, Omidvar N, Karimi-Shahanjarini A, Nedjat S, Rashidian A. Factors Associated With Unhealthy Snacks Consumption Among Adolescents in Iran's Schools. *Int J Heal policy Manag* 2017; **6**: 519–28.

111 Faber M, Laurie S, Maduna M, Magudulela T, Muehlhoff E. Is the school food environment conducive to healthy eating in poorly resourced South African schools? *Public Health Nutr* 2014; **17**: 1214–23.

112 Office of Assistant Director-General (Agriculture Department). School Feeding and Possibilities of Direct Purchasing from Family Farming: Case Studies from Eight Countries. Santiago, 2015.

113 Godin KM, Chacón V, Barnoya J, Leatherdale ST. The school environment and sugar-

sweetened beverage consumption among Guatemalan adolescents. *Public Health Nutr* 2017; **20**: 2980–7.

114 de Villiers A, Steyn NP, Draper CE, *et al.* "HealthKick": Formative assessment of the health environment in low-resource primary schools in the Western Cape Province of South Africa. *BMC Public Health* 2012; **12**: 794.

115 Corvalán C, Uauy R, Flores R, Kleinbaum D, Martorell R. Reductions in the Energy Content of Meals Served in the Chilean National Nursery School Council Program Did Not Consistently Decrease Obesity among Beneficiaries. *J Nutr* 2008; **138**: 2237–43.

116 Salazar G, Vasquez F, Concha F, *et al.* Pilot nutrition and physical activity intervention for preschool children attending daycare centres (JUNJI); primary and secondary outcomes. *Nutr Hosp* 2014; **29**: 1004–12.

117 Ruel MT, Quisumbing AR, Balagamwala M. Nutrition-sensitive agriculture: What have we learned so far? *Glob Food Sec* 2018; published online Feb. DOI:10.1016/j.gfs.2018.01.002.

118 Berezowitz CK, Bontrager Yoder AB, Schoeller DA. School Gardens Enhance Academic Performance and Dietary Outcomes in Children. *J Sch Health* 2015; **85**: 508–18.

119 Utter J, Denny S, Dyson B. School gardens and adolescent nutrition and BMI: Results from a national, multilevel study. *Prev Med (Baltim)* 2016; **83**: 1–4.

120 Davis JN, Spaniol MR, Somerset S. Sustenance and sustainability: maximizing the impact of school gardens on health outcomes. *Public Health Nutr* 2015; **18**: 2358–67.

121 Warren E, Hawkesworth S, Knai C. Investigating the association between urban agriculture and food security, dietary diversity, and nutritional status: A systematic literature review. *Food Policy* 2015; **53**: 54–66.

122 Pullar J, Allen L, Townsend N, *et al.* The impact of poverty reduction and development interventions on non-communicable diseases and their behavioural risk factors in low and lower-middle income countries: A systematic review. *PLoS One* 2018; **13**: e0193378.

123 World Bank. Learning from World Bank history: Agriculture and food-based approaches for addressing malnutrition. Agriculture and environmental services Discussion Paper Series 10. Washington, DC, 2014 http://documents.worldbank.org/curated/en/497241468168227810/pdf/887400NWP0Box30ning0from0WB0History.pdf.

124 Anand SS, Hawkes C, de Souza RJ, *et al.* Food Consumption and its Impact on Cardiovascular Disease: Importance of Solutions Focused on the Globalized Food System: A Report From the Workshop Convened by the World Heart Federation. *J Am Coll Cardiol* 2015; **66**: 1590–614.

125 Global Panel on Agriculture and Food Systems for Nutrition. Food systems and diets: Facing the challenges of the 21st century. London, UK: Global Panel on Agriculture and Food Systems for Nutrition, 2016.

126 Qaim M. Globalisation of agrifood systems and sustainable nutrition. *Proc Nutr Soc* 2017; **76**: 12–21.

127 Pingali PL. Green Revolution: Impacts, limits, and the path ahead. *Proc Natl Acad Sci* 2012; **109**: 12302–8.

128 Pries AM, Filteau S, Ferguson EL. Snack food and beverage consumption and young child nutrition in low- and middle-income countries: A systematic review. *Matern Child Nutr* 2019; **15**: e12729.

129 Shekar M, Kakietek J, Dayton Eberwein J, Walters D. An Investment Framework for Nutrition: Reaching the Global Targets for Stunting, Anemia, Breastfeeding, and Wasting. The World Bank, 2017 DOI:10.1596/978-1-4648-1010-7.

130 Scaling Up Nutrition. Planning and costing for the acceleration of actions for nutrition: experiences of countries in the Movement for Scaling Up Nutrition. Geneva, Switzerland, 2014 http://scalingupnutrition.org/wp-content/uploads/2014/05/Final-Synthesis-Report.pdf.

131 Nugent R, Levin C, Hale J, Hutchinson B. Economic impacts of the double burden of malnutrition. *Lancet*.