Balancing Discovery and Delivery

The role of nutrition research in achieving sustainable development

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Key messages

- We are at a pivotal point in time with reference to global nutrition priorities.
- We have sufficient knowledge of maternal, fetal/newborn and child nutrition to prioritize the scaling up of evidence-based interventions.
- There is, however, a continued need for enhanced understanding of knowledge gaps and investment in research.
- There is also the need for continued development of data systems and metrics for tracking progress, especially for emerging areas of focus.
- The Sustainable Development Goals (SDGs) offer an important opportunity to build on progress to date, and to reconsider existing elements of our approach to improving nutrition, health and human capital worldwide.

Though nutrition has increasingly moved into the global policy spotlight as a stand-alone issue, with national governments and civil society alike taking up the call to invest in nutrition programming, the world is currently not on track to meet nutrition targets set out by the World Health Assembly.[1]

With continued focus and efforts to both invest in proven interventions and enhance data systems, progress can be accelerated. The existing body of evidence points towards key interventions that can have a marked impact on reducing malnutrition-related morbidity and mortality in mothers and children; however, clear gaps remain in the evidence base, a selection of which are highlighted here.

With the launch of the Sustainable Development Goals (SDGs) comes a challenge to rethink our approach to taking action on nutrition issues – a push to think more concretely about the crucial importance of the social determinants of health, as well as the complex political, social and ecological systems that influence an individual's nutritional status. Within the SDGs, which frame our collective development agenda in an aspirational and holistic manner, it will be important to maintain a clear focus on nutrition, so as not to lose momentum towards a world where everyone is able to meet their growth and development potential, supported by a strong nutritional foundation.

> "Within the SDGs it will be important to maintain a clear focus on nutrition"

Much progress has been made towards building the case for investment in nutrition. In 2008, the first Lancet Series on Maternal and Child Undernutrition highlighted the importance of nutrition during pregnancy and the first 24 months in a child's life as a critical window for growth and development over the life-course.[2] Since 2008, the global nutrition agenda has gained increasing momentum with national governments, civil society, and the private sector establishing policies and targeting funds towards evidence-based nutrition interventions to reduce stunting, wasting and micronutrient deficiencies in children, and likewise to enhance the nutritional status of women of childbearing age. Much of the momentum for the nutrition movement

can be attributed to initiatives such as the Scaling Up Nutrition (SUN) Movement: these initiatives galvanize efforts towards actualizing targets through engaging and supporting national governments and civil society to integrate nutrition policy and programming into their existing structures.[3]

Despite the advocacy and acceptance of global initiatives in this direction, progress remains slow. Rates of undernutrition remain unacceptably high, as elucidated in the updated analysis of the Lancet Series on Maternal and Child Nutrition in 2013[2] and the most recent Global Nutrition Report.[1] Globally, 165 million children are still stunted, resulting in truncated cognitive and physical development, ultimately limiting productivity over the lifespan. Progress made towards reducing undernutrition has not yet been able to break the cycle of poverty in most countries where the burdens of stunting, wasting and micronutrient deficiencies are highest. Yet, if the 10 evidence-based nutrition interventions put forth in the Lancet Series were scaled up to 90% coverage, an estimated 900,000 lives could be saved in high nutrition-burden countries, the prevalence of stunting could be reduced by 20%, and that of severe wasting by 60%.[4]

> "Rates of undernutrition remain unacceptably high"

Exclusive breastfeeding is one of the recommended evidence-based interventions where rates have remained woefully low.[4] Recent data from long-term follow-up of a population-based cohort in Pelotas indicates that duration of breastfeeding is associated with higher intelligence quotient (IQ) scores: participants who were breastfed for 12 or more months scored higher on IQ exams (3.76-point difference, 95% CI 2.20–5.33) compared to participants breastfed for less than one month. This analysis also demonstrates that IQ is responsible for 72% of the effect of breastfeeding practices on income later in life using mediation analysis techniques.[2] Yet evidence alone is not enough to successfully promote behavior change. Household practices and individual attitudes are significant determinants of exclusive breastfeeding; these in turn are intrinsically linked to the broader social, economic and cultural context. To successfully increase exclusive breastfeeding rates means establishing an enabling context where it is a viable and valued choice for mothers.

The importance of maternal nutritional status during preconception and pregnancy

Emerging evidence highlights the importance of maternal nutritional status during the preconception period and during pregnancy for long-term health of the child. Inadequate nutrition in the periconception period is linked to small-for-gestational-age (SGA) births, and SGA has been shown to increase mortality risks for infants, to increase risks of stunting at 24 months, and has also been linked to the development of certain non-communicable diseases in adulthood. Black et al[2] estimate that 20% of stunting in children (height-for-age z-score <-2) originates in the fetal period, as shown by being born SGA. Again, the determinants of maternal nutritional status are a complex array of individual, household and community factors.

The importance of nutritional status among adolescents

Adolescent health is another emerging area of focus, requiring a systems-based approach. Adolescence and young adulthood represent key points in the lifespan where preventive and early clinical interventions can promote health gains in later life. It is well recognized that much of the at-risk behaviors that affect adult health and outcomes begin in adolescence. Additionally, health and nutritional status in the preconception period have important impacts on pregnancy outcomes and on the subsequent growth and development of children. For example, low maternal BMI puts infants at risk of being SGA.[2] Micronutrient status has similarly important impacts on the developing fetus. For example, low maternal vitamin D status is associated with a higher risk of perinatal morbidity and mortality due to an increased risk of severe pre-eclampsia.[5]

A focus on nutritional status in adolescents is an imperative, given that 19% of young women in developing countries, and more in some contexts, will have given birth before they turn 18 (equivalent to 20,000 young women giving birth every day).[6] While adolescence has long been recognized as an important intervention point, development of health information systems focused on tracking adolescent health lags behind information systems for early childhood and adulthood. This is slowly shifting, as adolescence rises on the global action agenda.[6] School-based interventions represent one approach to making progress; however, much work remains to be done to find optimal delivery platforms and to develop targeted programming.

The Double Burden and the need for an integrated approach

There is also rapidly expanding evidence and momentum on the strategies needed to address the growing obesity epidemic. The prevalence of combined overweight and obesity rose by 27.5% for adults and 47.1% for children worldwide from 1980 to 2013.[7] The prevalence of obesity is highest in high-income countries, yet 76% of affected children actually reside in low- and middle income countries (LMICs).[2] Obesity in childhood increases the child's risk of cardiovascular disease and diabetes (and their associated comorbidities) and increases risk of gastro-intestinal complications and psychological effects.[7] Furthermore, LMICs are increasingly experiencing the Double Burden of disease: concurrent challenges of undernutrition and overnutrition. There is

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a clear window of opportunity to intervene and to curtail the rising rates of overweight and obesity, along with the associated chronic diseases; however, an integrated strategy is needed, as is a more robust evidence base for effective interventions to prevent overweight and obesity.

"An integrated strategy is needed to tackle overweight and obesity"

Given the recognition of the need for strategies that match the complexity of nutrition issues, the most recent Lancet Maternal and Child Nutrition Series put forth an enhanced conceptual framework for nutrition interventions, including both nutrition-sensitive and nutrition-specific interventions, as well as contextual factors that determine nutrition outcomes.[4] Nutrition-sensitive approaches include interventions or programs addressing underlying determinants of fetal and child nutrition and development. For example, approaches to address poverty and food insecurity; maternal empowerment and education, household and community resources for care-giving; access to family planning, health services and a hygienic environment. Maternal depression, low parental schooling, and precarious social safety nets have also all been recognized as key determinants of children's nutritional status, and efforts are under way to scale up implementation and integration of nutrition-sensitive interventions to impact health and nutrition of women and children. There is a critical need to link these interventions with nutrition-specific interventions and to clearly demonstrate impact on nutritional outcomes (reduced stunting, wasting and micronutrient deficiencies).

There is also increasing information around understanding the biology and effects of malnutrition, both undernutrition and overweight/obesity, in relation to functional outcomes and potential mechanisms. The effects of nutritional vulnerability around critical periods of brain development and fetal growth are increasingly coming to light through epigenetic studies. For example, DNA methylation on specific chromosome regions (metastable epialleles) occurs in the early embryonic phases and appears to be susceptible to characteristics of the maternal environment, including maternal nutritional status.[8]

Advances in technology

Our deepening understanding of the importance of the preconception environment on metastable epialleles and DNA methylation has been possible due to rapidly advancing technology. Improvements in biochemical tests and laboratory methods are needed to continue enhancing our understanding of the biological processes behind malnutrition. New biomarkers are needed to more easily and accurately capture nutritional status. Greater collaboration is also needed between public health and basic science researchers: amid growing recognition of the roles the microbiome plays in modulating host health, there is a need to be able to accurately detect, classify and understand the function of the constituents of the microbiome, and their complex interactions with each other and the host. The emerging link between the development of acute malnutrition and disturbed gut microbiome is a key example of how collaborative research can enhance our understanding of disease processes with the view towards improving treatment options.[9] Furthermore, developmental outcomes, not just survival outcomes, are increasingly being recognized as key indicators of effective interventions. Within this, developmental plasticity (changes in neurons and synapses seen as a result of developmental processes) is a priority research area, looking at the long-term effects of the early-life environment and prompting a more careful consideration of what the benchmarks ought to be for "effective interventions".[10]

Measuring nutritional outcomes

An important issue lies in our ability to measure nutritional outcomes and to track progress in real time. Credible, timely and easily digestible nutrition data is essential for policy-makers and program implementers to make informed decisions and track progress towards targets (see **Table 1** for current status of data on intervention coverage from the 2014 Global Nutrition Report). Further work to identify new biomarkers would assist with more easily and accurately characterizing malnutrition.

Nutrition is a prime example of an issue that is best addressed through a systems approach – it cannot be adequately conceptualized through a biomedical lens alone, given that food and the associated behaviors are intrinsically linked to culture and social norms. Since nutritional status is affected by a complex range of factors, it can be easily lost in the fray. We have seen nutrition rise into the realm of high politics, in part through building a focused base of biomedical and epidemiological research, as well as through cost-effectiveness analyses and the establishment of focused targets and priority interventions. However, this approach may have promoted an overly medicalized view of nutrition, prompting a disproportionate investment in interventions addressing the proximal determinants of nutrition rather than investments in addressing the social determinants of health and other structural issues that ultimately lead to poor nutritional status.

"Nutrition challenges are best addressed through a systems approach"

TABLE 1: Data on intervention coverage (IFPRI, 2014)

Time period	Intervention	Status of data on coverage
Preconception	Folic acid supplementation/fortification	Data are only available on coverage of iron–folic acid supplementation during pregnancy (not for all women of reproductive age or during periconceptual period, as modeled in Bhutta et al (2013).
Pregnancy	Balanced energy-protein supplementation	No program data exist as far as we know.
	Calcium supplementation	Few programs exist as far as we know.
	Multiple micronutrient supplementation	There are no national programs for multiple micronutrient supplementation in pregnancy.
Breastfeeding	Promotion of breastfeeding (including early initiation)	Data are available on exclusive breastfeeding, early breastfeeding initiation, and continued breastfeeding. Note that these are practices, not program coverage.
Preventive	Complementary feeding for food-secure and -insecure population	Data are available on practices, minimum acceptable diet (MAD), minimum diet diversity (MDD). There are no data on program coverage.
	Vitamin A supplementation for children 6–59 months old	Coverage data exist for many countries.
	Preventive zinc supplementation	There are no preventive zinc supplementation programs globally, and so currently coverage is zero.
Curative	Zinc for treatment of diarrhea	Data are available for 58 countries; for 50 countries the coverage rate is < 5 percent.
	Feeding for children with moderate acute malnutrition	No programs for moderate acute malnutrition exist presently at scale.
	Therapeutic feeding for severe wasting	Geographic data are available but are not very meaningful. Direct coverage data are not national.
All	Universal salt iodization	Coverage data exist for many countries.

The global community has also seen increased emphasis on accountability and measuring impact. The collective eagerness to make progress towards nutrition targets is admirable at its core; yet care must be taken to avoid the focus becoming on the metrics themselves, rather than the human state that the metrics are meant to represent. If we narrowly focus on attaining targets, it becomes easy to rationalize any means of reaching those numbers. Unsustainable interventions may end up being prioritized if they are easiest to measure and show the largest changes in the short run.

The SDGs and the nutritional status of populations worldwide

The launch of the SDGs represents an important push to reconsider our approach to improving the nutritional status of populations worldwide. The SDGs highlight the need for a systems approach to tackling the most pressing issues facing our planet: extreme poverty, climate change, and strained natural resources. The SDGs provoke policy-makers and leaders to think about development in a new light. They represent a shift away from thinking about "lifting up" low-income countries to benchmarks set by high-income countries. Rather, the SDGs challenge all nations to change their approach to economic growth.

> "The SDGs are what a vision ought to be: lofty and ambitious"

The SDGs are what a vision ought to be: lofty and ambitious. They are a challenge to strive for excellence and to grapple with complexity. Yet, within this framing, do we risk losing momentum towards achieving nutrition targets? If the MDGs (Millennium Development Goals) were too narrow and overly reductionist, the SDGs by contrast may be overly open-ended, risking once again losing nutrition in the fray. We cannot assume that optimal nutrition and food security will naturally follow from improved

TABLE 2: Embedding nutrition targets within the SDG targets[1]

Nutrition target	Where nutrition target can be embedded within the SDG targets
Reduce low birth weight (WHA target)	**Target 3.2:** "by 2030 end preventable deaths of newborns and under-5 children"
Reduce anemia in women of reproductive age (WHA target)	
Increase rate of exclusive breastfeeding (WHA target)	
Prevent increase in under-five overweight (WHA target)	**Target 3.4:** "by 2030 reduce by one third premature mortality from NCDs through prevention and treatment"
Increase coverage of nutrition-specific interventions	**Target 3.8:** "achieve universal health coverage"
Increase coverage of nutrition-sensitive interventions	**Target 1.3:** "implement nationally appropriate social protection measures for all and by 2030 achieve substantial coverage of the poor and the vulnerable"
	Target 6.1: "by 2030 achieve universal and equitable access to safe and affordable drinking water for all"
	Target 6.2: "by 2030 achieve access to adequate and equitable sanitation and hygiene for all and end open defecation"
Improve the enabling environment	**Target 5.5:** "ensure women's full and effective participation and equal opportunity for leadership at all levels of decision making in political, economic, and public life"
	Target 10.3: "ensure equal opportunity and reduce inequalities in outcome such as stunting by wealth quintile"

economic development, as evidenced by the emergence of the obesity epidemic in high-income countries. Clearly there is a need for a concerted focus on nutrition and food policy, within the context of a more holistic set of development goals.

Of the 17 SDGs, several relate to nutrition-specific and nutrition-sensitive topics, namely:

Goal 1: End poverty in all its forms everywhere
Goal 2: End hunger, achieve food security and improved nutrition and promote sustainable agriculture
Goal 3: Ensure healthy lives and promote well-being for all at all ages
Goal 6: Ensure availability and sustainable management of water and sanitation for all
Goal 10: Reduce inequality within and among countries

Table 2 outlines proposed nutrition targets that could be embedded within the SDG targets. A clear, focused approach to tracking our progress towards nutrition targets will build on the groundswell of work done to date, while drawing upon the strengths of the SDGs in promoting an approach to development that addresses root causes in a manner sensitive to the needs of humans as well as those of the planet.

The importance of implementation research

There is a need for continued research across the spectrum of description, discovery, development and delivery. Given the key importance of delivering evidence-based interventions to populations in need, greater emphasis should be placed on implementation research and innovative strategies for the integration of nutrition into existing and emerging platforms for delivery, including those that to date have largely focused on delivering MNCH and child survival interventions.

The need to tackle nutrition challenges with a systems lens is paramount. Equally paramount is the need for enhanced investment in training nutrition experts, integrating nutrition into the curricula for healthcare providers broadly, and for augmenting nutrition literacy levels within the general public. Dedicated nutrition specialists are in demand, but fundamental change will be seen only when nutrition is understood and valued across every sector.

In summary, we are at a pivotal point in time in relation to global nutrition priorities. We know enough about the relationships of maternal, fetal/newborn and child nutrition, and their association with short- and long-term outcomes, to prioritize evidence-based interventions. Simultaneously, there is a continued need for enhanced understanding of knowledge gaps that can be addressed with a concerted research agenda. There is also a need for continued development of data systems and metrics for accurately tracking progress towards targets. The SDGs offer an important opportunity to build on the progress to date, and to reconsider existing elements of our approach to improving nutrition and health status worldwide.

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References

01. IFPRI. Global Nutrition Report 2014: Actions and Accountability to Accelerate the World's Progress on Nutrition. Washington, DC: IFPRI, 2014. Retrieved from: globalnutritionreport.org/2014/11/13/global-nutrition-report-2014/ on April 25, 2015.

02. Black RE, Victora CG, Walker SP et al. Maternal and Child Undernutrition and Overweight in Low-Income and Middle-Income Countries. Lancet 2013;382(9890):427–51.

03. SUN. 2014 Annual Progress Report. Scaling Up Nutrition Movement. Retrieved from: scalingupnutrition.org/wp-content/uploads/2014/11/SUN_Progress-Report_ENG_20141024_web_pages03.pdf on April 25, 2015.

04. 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(9890):452–77.

05. Pérez-López FR, Pasupuleti V, Mezones-Holguin E et al. Effect of vitamin D supplementation during pregnancy on maternal and neonatal outcomes: a systematic review and meta-analysis of randomized controlled trials. Pediatric Perinatal Epidemiology 2015 Mar 23. pii:S0015–0282(15)00149-1. doi: 10.1016/j.fertnstert.2015.02.019 [Epub ahead of print].

06. United Nations Population Fund. Motherhood in childhood. New York, USA: UNFPA, 2013. Retrieved from: www.unfpa.org/sites/default/files/pub-pdf/EN-SWOP2013-final.pdf on April 25, 2015.

07. World Health Organization. Interim Report of the Commission on Ending Childhood Obesity. Geneva, Switzerland: WHO, 2015. Retrieved from: www.who.int/end-childhood-obesity/commission-ending-childhoodobesity-interim-report.pdf on April 25, 2015.

08. Dominguez-Salas P, Moore SE, Baker MS et al. Maternal nutrition at conception modulates DNA methylation of human metastable epialleles. Nat Commun 2014;5:3746. doi: 10.1038/ncomms4746.

09. Guerrant RL, Oria RB, Moore SR et al. Malnutrition as an Enteric Infectious Disease with Long-Term Effects on Child Development. Nutr Rev 2008;66(9):487–505.

10. Gluckman PD, Hanson MA, Bateson P et al. Towards a new developmental synthesis: adaptive developmental plasticity and human disease. Lancet 2009;373:1654–57.