

EDITOR'S NOTE

In this issue of Abstract Digest, we present to you a collection of articles on various outcomes, determinants and interventions related to maternal and child nutrition, from around the world, with relevance to India. In addition, this issue features articles on multiple micronutrient supplementation in pregnancy from a special issue of *the Annals of the New York Academy of Sciences* and a systematic scoping review of food environment research in low-and middle -income countries. Here are some of the highlights:

- Through a systematic analysis, [Liu and colleagues](#) (2019) estimated national and subnational all-cause and cause-specific mortality among children younger than 5 years annually in 2000–15 in India to understand progress made and to consider implications for achieving the Sustainable Development Goal (SDG) child survival targets.
 - In a comment to this study, [Awasthi and colleagues](#) (2019) analysed if regional differences in under-5 mortality in India reflect the burden of *Streptococcus pneumoniae* and *Haemophilus influenzae* type b disease.
- [Blencowe and colleagues](#) (2019) report national-level estimates of low birthweight (LBW) for 148 countries in 2015 using population-based national or nationally representative datasets and examined trends (200-16), and found that there was some progress in reducing LBW. However, to meet the global nutrition target, progress has to be accelerated and should involve both improved measurement and programme investments to address the causes of LBW throughout the lifecycle.
- Analysing the stunting trajectories of children from post-infancy to adolescence, in Ethiopia, India, Peru, and Vietnam, [Gausman and colleagues](#) (2019) showed catch-up growth and recurrent stunting occur throughout childhood and there may be opportunities later into childhood and adolescence to improve child growth.
- [Richard and colleagues](#) (2019) used data from the MAL-ED cohort study to identify factors in the first 2 years of life that are associated with height-for-age, weight-for-age, and body mass index z-scores at 5 years of age and concluded that environmental enteric dysfunction (EED) markers, bacterial density, and iron markers are associated with growth at 5 y of age.
- Using the 2014 State of Food Security and Nutrition in Bangladesh report as an example, [Tumilowicz and colleagues](#) (2019) demonstrate that determining the true prevalence of undernutrition, overweight, and obesity among adolescents is complicated by racial/ethnic variation across populations in timing of the adolescent growth spurt, growth potential, and body build. The authors encourage researchers to critically examine interpretation of HAZ and BMIZ indicators and distributions by age when using the 2007 WHO Growth Reference.
- Through cross-sectional assessment, in high-burden pockets of four Indian states, [Kumar and colleagues](#) (2019) showed that mid-upper arm circumference (MUAC) is a strong predictor of maternal body mass index (BMI) among non-pregnant women with children <5 years. Hence, in a resource-constrained setting where measuring BMI may not be feasible, the MUAC cut-offs could reliably be used to screen wasting and severe wasting in non-pregnant women for providing appropriate care.
- Using data from the fourth National Family Health Survey 2016, [Swaminathan and colleagues](#) (2019) developed and applied two geographic information systems

methodologies to provide estimates of four child malnutrition indicators (stunting, underweight, wasting, and anemia) for the 543 parliamentary constituencies in India.

- Discussing this article, [Goli \(2019\)](#) questioned the reliability of methodologies used. In their response, [Blossom and colleagues \(2019\)](#) reiterated the reliability and usability of the methodologies proposed by Swaminathan et al., emphasizing that these can provide broad assessments at the parliamentary constituency level.
- Using data from India's fourth round of National Family Health Survey, [Nguyen and colleagues \(2019\)](#) concluded that children born to adolescent mothers are at a higher risk of being undernourished.
 - In a commentary on this article, [Bhan \(2019\)](#) talked about identifying interventions policies to end child and early marriage in India and adding robust measures of gender empowerment to adolescent health programmes.
- [Ogbo and colleagues \(2019\)](#) used a sample from the 2015–16 India National Family Health Survey to estimate the exclusive breastfeeding (EBF) prevalence and other breastfeeding patterns by region and investigate the association between the study factors (child, maternal, household, health service and community factors) and EBF by regional areas.
- In a [special issue](#) on multiple micronutrient supplementation in pregnancy:
 - [Black and colleagues \(2019\)](#) investigated the benefits of supplementation with multiple micronutrients in pregnancy.
 - [Bourassa and colleagues \(2019\)](#) reviewed evidence regarding the use of antenatal multiple micronutrient supplementation in low- and middle-income countries.
 - [Gernand \(2019\)](#) examined the risk of excess micronutrient intake in pregnancy from antenatal supplements.
- Using data from two national surveys, [Swaminathan and colleagues \(2019\)](#) demonstrated that relation between iron intake and the odds of anemia was weak. Hence providing fortified iron alone may not result in substantial anemia reduction among women of reproductive age in India.
- [Nguyen and colleagues \(2019\)](#) examined the multi-factorial determinants (personal, family, community, and health services) associated with maternal nutrition practices in Uttar Pradesh, India.
- Using data from the Global Burden of Diseases, Injuries, and Risk Factors Study (GBD) 2017, the [GBD 2017 Diet Collaborators \(2019\)](#), evaluated 15 dietary risks for their effects on mortality and disability from cancers, cardiovascular diseases, and diabetes.
 - In a comment to this study, [Forouhi and Unwin \(2019\)](#) raised questions about optimal diet, suboptimal diet, and significant dietary components.
- In a systematic scoping review, [Turner and colleagues \(2019\)](#) did a food environment research in low- and middle-income countries (LMICs) and concluded that food availability was associated with dietary outcomes at the community and school scales across multiple LMICs, although associations varied by vendor type. However, evidence regarding associations between the food environment and nutrition and health outcomes was inconclusive.
- [Minocha and colleagues \(2019\)](#) demonstrated that promoting appropriate levels of production and consumption of high-quality foods rich in protein is critical in India's attempts to enhance diet quality and resolve levels of undernutrition.

Enjoy reading!

PEER-REVIEWED

National, regional, and state-level all-cause and cause-specific under-5 mortality in India in 2000–15: a systematic analysis with implications for the Sustainable Development Goals

Liu, L., Y. Chu, S. Oza, D. Hogan, J. Perin, D.G. Bassani, U. Ram, S.A. Fadel, A. Pandey, N. Dhingra, D. Sahu, P. Kumar, R. Cibulskis, B. Wahl, A. Shet, C. Mathers, J. Lawn, P. Jha, R. Kumar, R.E. Black, and S. Cousens. 2019. “National, regional, and state-level all-cause and cause-specific under-5 mortality in India in 2000–15: a systematic analysis with implications for the Sustainable Development Goals.” *The Lancet Global Health* 7(6): e721-e734.

[https://doi.org/10.1016/S2214-109X\(19\)30080-4](https://doi.org/10.1016/S2214-109X(19)30080-4)

Background: India had the largest number of under-5 deaths of all countries in 2015, with substantial subnational disparities. We estimated national and subnational all-cause and cause-specific mortality among children younger than 5 years annually in 2000–15 in India to understand progress made and to consider implications for achieving the Sustainable Development Goal (SDG) child survival targets. **Methods:** We used a multicausal model to estimate cause-specific mortality proportions in neonates and children aged 1–59 months at the state level, with causes of death grouped into pneumonia, diarrhoea, meningitis, injury, measles, congenital abnormalities, preterm birth complications, intrapartum-related events, and other causes. AIDS and malaria were estimated separately. The model was based on verbal autopsy studies representing more than 100 000 neonatal deaths globally and 16 962 deaths among children aged 1–59 months at the subnational level in India. By applying these proportions to all-cause deaths by state, we estimated cause-specific numbers of deaths and mortality rates at the state, regional, and national levels. **Findings:** In 2015, there were 25·121 million livebirths in India and 1·201 million under-5 deaths (under-5 mortality rate 47·81 per 1000 livebirths). 0·696 million (57·9%) of these deaths occurred in neonates. There were disparities in child mortality across states (from 9·7 deaths [Goa] to 73·1 deaths [Assam] per 1000 livebirths) and regions (from 29·7 deaths [the south] to 63·8 deaths [the northeast] per 1000 livebirths). Overall, the leading causes of under-5 deaths were preterm birth complications (0·330 million [95% uncertainty range 0·279–0·367]; 27·5% of under-5 deaths), pneumonia (0·191 million [0·168–0·219]; 15·9%), and intrapartum-related events (0·139 million [0·116–0·165]; 11·6%), with cause-of-death distributions varying across states and regions. In states with very high under-5 mortality, infectious-disease-related causes (pneumonia and diarrhoea) were among the three leading causes, whereas the three leading causes were all non-communicable in states with very low mortality. Most states had a slower decline in neonatal mortality than in mortality among children aged 1–59 months. Ten major states must accelerate progress to achieve the SDG under-5 mortality target, while 17 are not on track to meet the neonatal mortality target. **Interpretation:** Efforts to reduce vaccine-preventable deaths and to reduce geographical disparities should continue to maintain progress achieved in 2000–15. Enhanced policies and programmes are needed to accelerate mortality reduction in high-burden states and among neonates to achieve the SDG child survival targets in India by 2030.

Comment

Do regional differences in under-5 mortality in India reflect the burden of *Streptococcus pneumoniae* and *Haemophilus influenzae* type b disease?

Awasthi, S., and A. Awasthi. 2019. “Do regional differences in under-5 mortality in India reflect the burden of *Streptococcus pneumoniae* and *Haemophilus influenzae* type b disease?” *The Lancet Global Health* 7(6): e682-e683.

[https://doi.org/10.1016/S2214-109X\(19\)30160-3](https://doi.org/10.1016/S2214-109X(19)30160-3)

In 2015, India had the largest number of global deaths in children younger than 5 years. In their systematic analysis in *The Lancet Global Health*, Li Liu and colleagues estimate all-cause

and cause-specific deaths in 2000–15 for children younger than 5 years in India. To calculate mortality in children younger than 5 years, infant mortality rates, and neonatal mortality rates, the authors extrapolated 1991, 2001, and 2011 census data to estimate the crude birth rate for 2015. All-cause mortality was calculated from the sample registration system (SRS) for 20 large states in India. From these data the authors imputed under-5 mortality and infant mortality rates for the remaining 15 states and union territories. Assignment of cause of death beyond the neonatal period was based on verbal autopsies done in the SRS. For neonatal deaths, causes were assigned according to verbal autopsies done in high-mortality countries.

National, regional, and worldwide estimates of low birthweight in 2015, with trends from 2000: a systematic analysis

Blencowe, H., J. Krusevec, M. de Onis, R.E. Black, X. An, G.A. Stevens, E. Borghi, C. Hayashi, D. Estevez, L. Cegolon, S. Shiekh, V.P. Hardy, J.E. Lawn, and S. Cousens. 2019. "National, regional, and worldwide estimates of low birthweight in 2015, with trends from 2000: a systematic analysis." *The Lancet Global Health*.

[https://doi.org/10.1016/S2214-109X\(18\)30565-5](https://doi.org/10.1016/S2214-109X(18)30565-5)

Background: Low birthweight (LBW) of less than 2500 g is an important marker of maternal and fetal health, predicting mortality, stunting, and adult-onset chronic conditions. Global nutrition targets set at the World Health Assembly in 2012 include an ambitious 30% reduction in LBW prevalence between 2012 and 2025. Estimates to track progress towards this target are lacking; with this analysis, we aim to assist in setting a baseline against which to assess progress towards the achievement of the World Health Assembly targets. **Methods:** We sought to identify all available LBW input data for livebirths for the years 2000–16. We considered population-based national or nationally representative datasets for inclusion if they contained information on birthweight or LBW prevalence for livebirths. A new method for survey adjustment was developed and used. For 57 countries with higher quality time-series data, we smoothed country-reported trends in birthweight data by use of B-spline regression. For all other countries, we estimated LBW prevalence and trends by use of a restricted maximum likelihood approach with country-level random effects. Uncertainty ranges were obtained through bootstrapping. Results were summed at the regional and worldwide level. **Findings:** We collated 1447 country-years of birthweight data (281 million births) for 148 countries of 195 UN member states (47 countries had no data meeting inclusion criteria). The estimated worldwide LBW prevalence in 2015 was 14.6% (uncertainty range [UR] 12.4–17.1) compared with 17.5% (14.1–21.3) in 2000 (average annual reduction rate [AARR] 1.23%). In 2015, an estimated 20.5 million (UR 17.4–24.0 million) livebirths were LBW, 91% from low-and middle-income countries, mainly southern Asia (48%) and sub-Saharan Africa (24%). **Interpretation:** Although these estimates suggest some progress in reducing LBW between 2000 and 2015, achieving the 2.74% AARR required between 2012 and 2025 to meet the global nutrition target will require more than doubling progress, involving both improved measurement and programme investments to address the causes of LBW throughout the lifecycle.

Stunting trajectories from post-infancy to adolescence in Ethiopia, India, Peru, and Vietnam

Gausman, J., R. Kim, and S.V. Subramanian. 2019. "Stunting trajectories from post-infancy to adolescence in Ethiopia, India, Peru, and Vietnam." *Maternal & Child Nutrition*: e12835.

<https://doi.org/10.1111/mcn.12835>.

Many interventions focus on preventing stunting in the first 1,000 days of life. We take a broader perspective on childhood growth to assess the proportions of children who suffer persistent

stunting, recover, and falter and become newly stunted between birth and adolescence. We use longitudinal data collected on 7,128 children in Ethiopia, India, Peru, and Vietnam. Data were collected in five survey waves between the ages of 1 to 15 years. We use descriptive and graphical approaches to compare the trajectories of children first stunted by age 1, first stunted by age 5, and those remained not stunted until age 5. On average, 29.6% of children were first stunted by age 1, 12.9% of children were first stunted by the age 5, and 68.7% of children were not stunted at either age 1 or age 5. A larger percentage of children stunted by age 1 remained stunted at age 15 (40.7%) compared with those who were first stunted by age 5 (32.3%); 33.7% of children first stunted by age 1 and 31.1% of children first stunted by age 5 go on to recover, but then falter during later childhood. 13.1% of children who were not stunted at age 1 or age 5 become newly stunted between the ages of 8 and 15. Our results show that children both become stunted and recover from stunting into adolescence. More attention should be paid to interventions to support healthy growth throughout childhood.

Enteric dysfunction and other factors associated with attained size at 5 years: MAL-ED birth cohort study findings

Richard, S.A., B.J.J. McCormick, L.E. Murray-Kolb, G.O. Lee, J.C. Seidman, M. Mahfuz, T. Ahmed, R.L. Guerrant, W.A. Petri, E.T. Rogawski, E. Houpt, G. Kang, E. Mduma, M.N. Kosek, A.A.M. Lima, S.K. Shrestha, R.K. Chandyo, Z. Bhutta, P. Bessong, L.E. Caulfield, and MAL-ED Network Investigators. 2019. "Enteric dysfunction and other factors associated with attained size at 5 years: MAL-ED birth cohort study findings." *The American Journal of Clinical Nutrition* nqz004. <https://doi.org/10.1093/ajcn/nqz004>

Background: Poor growth in early childhood has been associated with increased risk of mortality and morbidity, as well as long-term deficits in cognitive development and economic productivity.

Objectives: Data from the MAL-ED cohort study were used to identify factors in the first 2 y of life that are associated with height-for-age, weight-for-age, and body mass index z-scores (HAZ, WAZ, BMIZ) at 5 y of age. **Methods:** A total of 1017 children were followed from near birth until 5 y of age at sites in Bangladesh, Brazil, India, Nepal, Peru, South Africa, and Tanzania. Data were collected on their growth, environmental enteric dysfunction (EED), micronutrient status, enteric pathogen burden, illness prevalence, dietary intake, and various other socio-economic and environmental factors. **Results:** EED biomarkers were related to size at 5 y. Mean lactulose:mannitol z-scores during the first 2 y of life were negatively associated with all of the growth measures (HAZ: -0.11 [95% CI: -0.19, -0.03]; WAZ: -0.16 [95% CI: -0.26, -0.06]; BMIZ: -0.11 [95% CI: -0.23, 0.0]). Myeloperoxidase was negatively associated with weight (WAZ: -0.52 [95% CI: -0.78, -0.26] and BMIZ: -0.56 [95% CI: -0.86, -0.26]); whereas α -1-antitrypsin had a negative association with HAZ (-0.28 [95% CI: -0.52, -0.04]). Transferrin receptor was positively related to HAZ (0.18 [95% CI: 0.06, 0.30]) and WAZ (0.21 [95% CI: 0.07, 0.35]). Hemoglobin was positively related to HAZ (0.06 [95% CI: 0.00, 0.12]), and ferritin was negatively related to HAZ (-0.08 [95% CI: -0.12, -0.04]). Bacterial density in stool was negatively associated with HAZ (-0.04 [95% CI: -0.08, 0.00]), but illness symptoms did not have any effect on size at 5 y. **Conclusions:** EED markers, bacterial density, and iron markers are associated with growth at 5 y of age. Interventions to reduce bacterial burden and EED may improve long-term growth in low-income settings.

Challenges in Use of Adolescent Anthropometry for Understanding the Burden of Malnutrition

Tumilowicz, A., T. Beal, L.M. Neufeld, and E.A. Frongillo. 2019. "Challenges in Use of Adolescent Anthropometry for Understanding the Burden of Malnutrition." *Advances in Nutrition*. doi: nmy133. <https://doi.org/10.1093/advances/nmy133>

Improving nutritional status during adolescence is an opportunity to improve the lives of this generation and the next. Estimating the burden of malnutrition at a population level is fundamental to targeting interventions and measuring progress over time, and for adolescents, we usually depend on survey data and the 2007 WHO Growth Reference to do so. There is substantial risk of misguided conclusions regarding adolescent prevalence estimates, however, when underlying methodological limitations of the indicators and reference are not adequately considered. We use national prevalence estimates among girls and young women 10–22 y of age from the 2014 State of Food Security and Nutrition in Bangladesh report as an example to demonstrate that determining the true prevalence of undernutrition, overweight, and obesity is complicated by racial/ethnic variation across populations in timing of the adolescent growth spurt, growth potential, and body build. Further challenging the task are inherent limitations of the body mass index as an indicator of thinness and adiposity, and cutoffs that poorly distinguish a well-nourished population from a malnourished one. We provide recommendations for adolescent nutrition policy and program decision-making, emphasizing the importance of 1) critically interpreting indicators and distributions by age when using the 2007 WHO Growth Reference; 2) examining what is happening before and after adolescence, when interpretation of anthropometry is more straightforward, as well as trends over time; and 3) complementing anthropometry with other information, particularly dietary intake. Finally, we advocate that nutrition researchers prioritize exploration of better methods to predict peak height velocity, for development of standardized indicators to measure dietary quality among adolescents, and for studies that will illuminate causal paths so that we can effectively improve adolescent dietary intake and nutritional status.

Relationship between mid-upper arm circumference and BMI for identifying maternal wasting and severe wasting: a cross-sectional assessment

Kumar, P., R. Sinha, N. Patil, and V. Kumar. 2019. "Relationship between mid-upper arm circumference and BMI for identifying maternal wasting and severe wasting: A cross-sectional assessment." *Public Health Nutrition*. doi:10.1017/S1368980019000727.
<https://doi.org/10.1017/S1368980019000727>

Objective: To assess the strength of correlation and agreement between mid-upper arm circumference (MUAC) and BMI, and determine suitable MUAC cut-offs, to detect wasting and severe wasting among non-pregnant adult women in India. **Design:** Cross-sectional studies were conducted in five high-burden pockets of four Indian states. **Setting:** Prevalence of malnutrition among women and children is very high in these pockets and the government plans to implement community-based pilot projects to address malnutrition in these areas. **Participants:** Anthropometric measurements were carried out on 1716 women with children <5 years of age. However, analyses were conducted on 1538 non-pregnant adult women. **Results:** The results showed a strong correlation between MUAC and BMI in the nonpregnant women, with correlation coefficient of 0.860 (95% CI 0.831, 0.883; $P < 0.001$). Cohen's κ of 0.812 and 0.884 also showed good agreement between MUAC and BMI in identifying maternal wasting and severe wasting, respectively. The univariate regression model between MUAC and BMI explained 0.734 or 73% of the variation in BMI. The MUAC cut-offs for wasting (BMI < 18.5 kg/m²) and severe wasting (BMI < 16.0 kg/m²) were calculated as 232 and 214.5 mm, respectively. **Conclusions:** MUAC is a strong predictor of maternal BMI among non-pregnant women with children <5 years in high-burden pockets of four Indian states. In a resource-constrained setting where BMI may not be feasible, the MUAC cut-offs could reliably be used to screen wasting and severe wasting in non-pregnant women for providing appropriate care.

Burden of Child Malnutrition in India: A View from Parliamentary Constituencies

Swaminathan, A., R. Kim, Y. Xu, J.C. Blossom, W. Joe, R. Venkataramanan, A. Kumar, and S.V. Subramanian. 2019. "Burden of Child Malnutrition in India: A View from Parliamentary Constituencies." *Economic & Political Weekly* 54(2).

<https://epw.in/journal/2019/2/special-articles/burden-child-malnutrition-india.html>

In India, monitoring and surveillance of health and well-being indicators have been focused primarily on the state and district levels. Analysing population data at the level of parliamentary constituencies has the potential to bring political accountability to the data-driven policy discourse that is currently based on district-level estimates. Using data from the fourth National Family Health Survey 2016, two geographic information systems methodologies have been developed and applied to provide estimates of four child malnutrition indicators (stunting, underweight, wasting, and anemia) for the 543 parliamentary constituencies in India. The results indicate that several constituencies experience a multiple burden of child malnutrition that must be addressed concurrently and as a priority.

Discussion

Unreliable Estimates of Child Malnutrition

Goli, S. 2019. "Unreliable Estimates of Child Malnutrition." *Economic & Political Weekly* 54(6): 64–67.

https://www.researchgate.net/publication/330982107_Unreliable_Estimates_of_Child_Malnutrition

A response to Akshay Swaminathan et al.'s article "Burden of Child Malnutrition in India: A View from Parliamentary Constituencies" (EPW, 12 January 2019). Their methodologies and claims are put to question. In a large country such as India, efforts to generate evidence on developmental parameters at the micro level will strengthen efforts to design evidence-based policy and help in initiating remedial measures. The district is an administrative and planning unit in India, and data on development indicators at the district level are needed to assess the current situation and track progress. Some recent surveys, including the fourth round of the National Family Health Survey (NFHS-4), have proposed designs that allow computation of estimates of some indicators at the district level. Reports and fact sheets of the NFHS-4 also publish estimates of key indicators for districts.

Robust Parliamentary Constituency Estimates Geographic Data Science Approaches

Blossom, J.C., A. Swaminathan, W. Joe, R. Kim, and S.V. Subramanian. 2019. "Robust Parliamentary Constituency Estimates Geographic Data Science Approaches." *Economic & Political Weekly* 54(19).

<https://www.epw.in/journal/2019/19/discussion/robust-parliamentary-constituency-estimates.html>

This article is a response to Srinivas Goli's article "Unreliable Estimates of Child Malnutrition" (EPW, 9 February 2019) that had questioned the reliability of methodologies of Akshay Swaminathan et al.'s article "Burden of Child Malnutrition in India: A View from Parliamentary Constituencies" (EPW, 12 January 2019). The reliability and usability of the methodologies proposed by Swaminathan et al have been reiterated, emphasising that these can provide broad assessments at the parliamentary constituency level.

Social, biological, and programmatic factors linking adolescent pregnancy and early childhood undernutrition: a path analysis of India's 2016 National Family and Health Survey

Nguyen, P.H., S. Scott, S. Neupane, L.M. Tran, and P. Menon. 2019. "Social, biological, and programmatic factors linking adolescent pregnancy and early childhood undernutrition: a path analysis of India's 2016 National Family and Health Survey." *The Lancet Child & Adolescent Health*. [https://doi.org/10.1016/S2352-4642\(19\)30110-5](https://doi.org/10.1016/S2352-4642(19)30110-5)

Background: Adolescent pregnancy and child undernutrition are major social and public health concerns. We aimed to examine associations between adolescent pregnancy and child undernutrition in India, where one in five adolescents live, and one in three of the world's stunted children. **Methods:** Data were from India's fourth National Family Health Survey, 2015–16. Primiparous women aged 15–49 years who gave birth between 2010 and 2016 were classified on the basis of age at first birth: 10–19 years (adolescence), 20–24 years (young adulthood), and 25 years or older (adulthood). Primary outcomes were anthropometric measures of offspring undernutrition. Multivariable regression and structural equation models were used to understand the extent to which these measures were linked to adolescent pregnancy and the potential social, biological, and programmatic pathways. **Findings:** Of the 60 096 women in the sample, 14 107 (25%) first gave birth during adolescence. Children born to adolescent mothers had lower Z scores for length or height-for-age (mean difference –0.53 SD), weight-for-age (–0.40 SD), and weight-for-length or height (–0.16 SD) than children born to adult mothers. Compared with adult mothers, adolescent mothers were shorter (–1.21 cm, 95% CI –1.78 to –0.65), more likely to be underweight (18 percentage points, 15–21) and anaemic (8 percentage points, 6–11), less likely to access health services (–4 to –15 percentage points), and had poorer complementary feeding practices (–3 to –9 percentage points). Adolescent mothers also had less education (–3.30 years, 95% CI –3.68 to –2.91), less bargaining power (–7 to –15 percentage points), and lived in poorer households (–0.66 SD, 96% CI –0.82 to –0.50) with poorer sanitation (–28 percentage points, –32 to –24). In the path analysis, these intermediate factors predicted child anthropometry, with the strongest links being mother's education (18%), socioeconomic status (13%), and weight (15%). **Interpretation:** Children born to adolescent mothers are at risk of being undernourished. Adolescent pregnancy is related to child undernutrition through poor maternal nutritional status, lower education, less health service access, poor complementary feeding practices, and poor living conditions. Policies and programmes to delay pregnancy and promote women's rights could help break the intergenerational cycle of undernutrition through many routes.

Commentary

Preventing teenage pregnancy in India to end the cycle of undernutrition

Bhan, N. 2019. "Preventing teenage pregnancy in India to end the cycle of undernutrition." *The Lancet Child & Adolescent Health*.

[https://doi.org/10.1016/S2352-4642\(19\)30111-7](https://doi.org/10.1016/S2352-4642(19)30111-7)

India's large adolescent population of more than 243 million presents both an unprecedented opportunity and challenge. Although these adolescents hold the promise of achieving India's economic potential, a growing body of work shows persisting challenges to adolescent health and development, including nutrition deficits, exclusion from livelihood choice, social engagement and health services, and unequal gender norms inside and outside the home. Adding to this body of work, a new study by Phuong Nguyen and colleagues presents evidence on the health costs of teenage pregnancy in India, which can be lifelong and intergenerational, that affect the lives of a large number of girls.

Regional prevalence and determinants of exclusive breastfeeding in India

Ogbo, F.A., M.V. Dhimi, A.O. Awosemo, B.O. Olusanya, J. Olusanya, U.L. Osuagwu, P.R. Ghimire, A. Page, and K.E. Agho. 2019. "Regional prevalence and determinants of exclusive breastfeeding in India." *International Breastfeeding Journal* 14(20).

<https://doi.org/10.1186/s13006-019-0214-0>

Background: Exclusive breastfeeding (EBF) has important benefits for both the mother and child. In India, no nationwide studies have examined patterns of EBF in the past decade to inform national and subnational breastfeeding programmes. The present study aimed to investigate the regional prevalence and determinants of EBF in India. **Methods:** This study used a total weighted sample of 21,352 from the 2015–2016 India National Family Health Survey. EBF was measured as the proportion of infants 0–5 months of age who received breast milk as the only source of nourishment, based on mother's recall on feeds given to the infant 24 h before the survey. The prevalence of EBF and other breastfeeding patterns were estimated by region, and multivariable logistic regression that adjusted for clustering and sampling weights was used to investigate the association between the study factors (child, maternal, household, health service and community factors) and EBF by regional areas in India. **Results:** This study indicated that wide differences in the prevalence of EBF and other childhood feeding practices exist across regions of India, where Southern India had the highest EBF prevalence (79.2%) and the North-East reported the lowest (68.0%). EBF prevalence decreased with infant age, dropping faster in the South (43.7% at 5 months) compared to the North-East region (54.0% at 5 months). Similarly, substantial variations in key determinants of EBF were evident by region, where higher birth order was the only common factor associated with non-EBF across all regions. Key modifiable determinants of non-EBF included higher maternal education in the South and belonging to rich households in Central India, while those for EBF were higher maternal education in the Central region and frequent antenatal care (≥ 4) visits in Northern India. **Conclusion:** This study demonstrates wide variations in regional prevalence and determinants of EBF in India. Improving EBF participation in India would require multifaceted national and subnational efforts that include dedicated funds and the establishment of appropriate policy and interventions that are consistently monitored and evaluated.

Special Issue

Multiple Micronutrient Supplementation in Pregnancy

Annals of the New York Academy of Sciences 1444(1): 1–51.

<https://nyaspubs.onlinelibrary.wiley.com/toc/17496632/2019/1444/1>

Commentary

Benefits of supplementation with multiple micronutrients in pregnancy

Black, R.E., and K.G. Dewey. 2019. "Benefits of supplementation with multiple micronutrients in pregnancy." *Annals of the New York Academy of Sciences* 1444(1): 3–5.

<https://doi.org/10.1111/nyas.14088>

Good nutrition during pregnancy is important for fetal development and survival and for growth from birth through childhood. Inadequate maternal nutrition can result in infants having low birth weight (LBW, defined as birth weight of <2500 g), which is caused by preterm birth, fetal malnutrition, or both together. It is estimated that in 2015, 14.6% of births globally were LBW totaling 20.5 million births, mainly in South Asia and sub-Saharan Africa. Babies with LBW, both those who are preterm or have fetal malnutrition, assessed as being born small for gestational age (SGA), as well as babies who are SGA and not LBW, have an elevated risk of death in infancy. In addition, these babies have an elevated risk of stunting of linear growth and development in childhood and of adult-onset chronic diseases.

Reviews

Review of the evidence regarding the use of antenatal multiple micronutrient supplementation in low- and middle-income countries

Bourassa, M.W., S.J.M. Osendarp, S. Adu-Afarwuah, S. Ahmed, C. Ajello, G. Bergeron, R. Black, P. Christian, S. Cousens, S. de Pee, K.G. Dewey, S.E. Arifeen, R. Engle-Stone, A. Fleet, A.D. Gernand, J. Hodinott, R. Klemm, K. Kraemer, R. Kupka, E. McLean, S.E. Moore, L.M. Neufeld, L. Persson, K.M. Rasmussen, A.H. Shankar, E. Smith, C.R. Sudfeld, E. Udomkesmalee, and S.A. Vosti. 2019. "Review of the evidence regarding the use of antenatal multiple micronutrient supplementation in low- and middle-income countries." *Annals of the New York Academy of Sciences* 1444(1): 6–21.
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Inadequate micronutrient intakes are relatively common in low- and middle-income countries (LMICs), especially among pregnant women, who have increased micronutrient requirements. This can lead to an increase in adverse pregnancy and birth outcomes. This review presents the conclusions of a task force that set out to assess the prevalence of inadequate micronutrient intakes and adverse birth outcomes in LMICs; the data from trials comparing multiple micronutrient supplements (MMS) that contain iron and folic acid (IFA) with IFA supplements alone; the risks of reaching the upper intake levels with MMS; and the cost-effectiveness of MMS compared with IFA. Recent meta-analyses demonstrate that MMS can reduce the risks of preterm birth, low birth weight, and small for gestational age in comparison with IFA alone. An individual-participant data meta-analysis also revealed even greater benefits for anemic and underweight women and female infants. Importantly, there was no increased risk of harm for the pregnant women or their infants with MMS. These data suggest that countries with inadequate micronutrient intakes should consider supplementing pregnant women with MMS as a cost-effective method to reduce the risk of adverse birth outcomes.

The upper level: examining the risk of excess micronutrient intake in pregnancy from antenatal supplements

Gernand, A.D. 2019. "The upper level: examining the risk of excess micronutrient intake in pregnancy from antenatal supplements." *Annals of the New York Academy of Sciences* 1444(1): 22-34.
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Micronutrient deficiencies are prevalent and co-occurring among pregnant women in low- and middle-income countries (LMIC). To prevent and treat deficiencies, antenatal vitamin and mineral supplements are the most common interventions during gestation. With most micronutrients, there can be health risks when intake regularly exceeds a high amount, and an upper threshold value set by the United States and Canada, the World Health Organization, and other groups is commonly called an upper intake level (UL). This review summarizes what is known about risks in pregnancy when ULs are exceeded and assesses the potential risk of exceeding the UL if a pregnant woman is taking a multiple micronutrient supplement. Overall, there is limited information on pregnancy-specific risks from excess intake. When assuming high dietary intake plus the amount in a standard multiple micronutrient supplement (with 30 mg of iron), only niacin and iron would be expected to slightly exceed the UL. Known risks for this level intake for each nutrient are transient and mild.

Dietary Iron Intake and Anemia Are Weakly Associated, Limiting Effective Iron Fortification Strategies in India

Swaminathan, S., S. Ghosh, J.S. Varghese, H.S. Sachdev, A.V. Kurpad, and T. Thomas. 2019. "Dietary Iron Intake and Anemia Are Weakly Associated, Limiting Effective Iron Fortification Strategies in India." *The Journal of Nutrition* 149(5): 831–839.

<https://doi.org/10.1093/jn/nxz009>

Background: Anemia prevalence in India remains high despite preventive iron supplementation programs. Consequently, concurrent national policies of iron fortification of staple foods have been initiated. **Objectives:** This study evaluated the relation between dietary iron intake and anemia (hemoglobin <12 g/dL) in women of reproductive age (WRA; 15–49 y) with respect to iron fortification in India. **Methods:** Data from 2 national surveys were used. Data on hemoglobin in WRA were sourced from the National Family Health Survey-4, whereas dietary intakes were sourced from the National Sample Survey. Adjusted odds for anemia with increasing iron intake were estimated, along with the effect of modulating nutrients such as vitamins B-12 and C, from statistically matched household data from the 2 surveys. The risks of inadequate (less than the Estimated Average Requirement for WRA) and excess (more than the tolerable upper limit for WRA) intakes of iron were estimated by the probability approach. **Results:** The relation between iron intake and the odds of anemia was weak (OR: 0.992; 95% CI: 0.991, 0.994); increasing iron intake by 10 mg/d reduced the odds of anemia by 8%. Phytate and vitamin B-12 and C intakes modified this relation by reducing the odds by 1.5% when vitamin B-12 and C intakes were set at 2 µg/d and 40 mg/d, respectively. The additional intake of 10 mg/d of fortified iron reduced the risk of dietary iron inadequacy from 24–94% to 9–39% across states, with no risk of excess iron intake. Approximately doubling this additional iron intake reduced the risk of inadequacy to 2–12%, but the risk of excess intake reached 22%. **Conclusions:** Providing fortified iron alone may not result in substantial anemia reduction among WRA in India and could have variable benefits and risks across states. Geographically nuanced dietary strategies that include limited fortification and the intake of other beneficial nutrients should be carefully considered.

Maternal nutrition practices in Uttar Pradesh, India: role of key influential demand and supply factors

Nguyen, P.H., S. Kachwaha, R. Avula, M. Young, L.M. Tran, S. Ghosh, R. Agrawal, J. Escobar-Alegria, S. Patil, and P. Menon. 2019. "Maternal nutrition practices in Uttar Pradesh, India: role of key influential demand and supply factors." *Maternal & Child Nutrition*.

<https://doi.org/10.1111/mcn.12839>

Despite strong policy and program commitment, essential maternal nutrition services are not reaching enough women in many countries. This paper examined multi-factorial determinants (personal, family, community, and health services) associated with maternal nutrition practices in Uttar Pradesh, India. Data were from a household survey of pregnant (n=667) and recently delivered women (n=1,835). Multivariable regression analyses were conducted to examine the determinants of four outcomes: consumption of diverse diets, consumption of iron folic acid (IFA) and calcium tablets, and weight monitoring during pregnancy. Population attributable risk analysis was used to estimate how much the outcomes can be improved under optimal program implementation. During pregnancy, women consumed 28 IFA and 8 calcium tablets, 18% consumed diverse diet and 17% were weighed ≥3 times. Nutrition knowledge was associated with consumption of diverse diet (OR=2.2 times), IFA (2.3 times), calcium (11.7 times) and weight monitoring (1.3 times). Beliefs and self-efficacy were associated with IFA (OR=2.0) and calcium consumption (OR=4.6). Family support and adequate health services were also associated with better nutrition practices. Under optimal program implementation, we estimate 51% women would have adequate diet diversity, an average

consumption of 98 IFA and 106 calcium tablets, and women would be weighed 4.9 times during pregnancy. Strengthening existing program operations and increasing demand for services has the potential to result in large improvements in maternal nutrition practices from current baseline levels, but may not be sufficient to meet WHO-recommended levels without creating an enabling environment including improvements in education and income levels to support behavior change.

Health effects of dietary risks in 195 countries, 1990–2017: a systematic analysis for the Global Burden of Disease Study 2017

GBD 2017 Diet Collaborators. 2019. "Health effects of dietary risks in 195 countries, 1990–2017: a systematic analysis for the Global Burden of Disease Study 2017." *The Lancet* 393(10184): 1958-1972.

[https://doi.org/10.1016/S0140-6736\(19\)30041-8](https://doi.org/10.1016/S0140-6736(19)30041-8)

Background: Suboptimal diet is an important preventable risk factor for non-communicable diseases (NCDs); however, its impact on the burden of NCDs has not been systematically evaluated. This study aimed to evaluate the consumption of major foods and nutrients across 195 countries and to quantify the impact of their suboptimal intake on NCD mortality and morbidity. **Methods:** By use of a comparative risk assessment approach, we estimated the proportion of disease-specific burden attributable to each dietary risk factor (also referred to as population attributable fraction) among adults aged 25 years or older. The main inputs to this analysis included the intake of each dietary factor, the effect size of the dietary factor on disease endpoint, and the level of intake associated with the lowest risk of mortality. Then, by use of disease-specific population attributable fractions, mortality, and disability-adjusted life-years (DALYs), we calculated the number of deaths and DALYs attributable to diet for each disease outcome. **Findings:** In 2017, 11 million (95% uncertainty interval [UI] 10–12) deaths and 255 million (234–274) DALYs were attributable to dietary risk factors. High intake of sodium (3 million [1–5] deaths and 70 million [34–118] DALYs), low intake of whole grains (3 million [2–4] deaths and 82 million [59–109] DALYs), and low intake of fruits (2 million [1–4] deaths and 65 million [41–92] DALYs) were the leading dietary risk factors for deaths and DALYs globally and in many countries. Dietary data were from mixed sources and were not available for all countries, increasing the statistical uncertainty of our estimates. **Interpretation:** This study provides a comprehensive picture of the potential impact of suboptimal diet on NCD mortality and morbidity, highlighting the need for improving diet across nations. Our findings will inform implementation of evidence-based dietary interventions and provide a platform for evaluation of their impact on human health annually.

Comment

Global diet and health: old questions, fresh evidence, and new horizons

Forouhi, N.G., and N. Unwin. 2019. "Global diet and health: old questions, fresh evidence, and new horizons." *The Lancet* 393(10184): 1916-1918.

[https://doi.org/10.1016/S0140-6736\(19\)30500-8](https://doi.org/10.1016/S0140-6736(19)30500-8)

Few, if any, would contest that diet and nutrition have a crucial and substantial impact on human health. But the devil is in the details. Common questions include: is there such a thing as an optimal diet? What is suboptimal? Which dietary components matter most? And given the necessity to take action on climate change and planetary health, what should the world eat? The Global Burden of Diseases, Injuries, and Risk Factors Study (GBD) contributes towards answering these questions by estimating the burden of mortality and disability attributable to specific dietary risks, within a comparative risk assessment framework that currently considers 84 behavioural, environmental, occupational, and metabolic risks across 195 countries and territories. The latest in the series is the current report in *The Lancet* by

the GBD 2017 Diet Collaborators, using data from GBD 2017. 15 dietary risks were evaluated for their effects on mortality and disability from cancers, cardiovascular diseases, and diabetes.

Food Environment Research in Low- and Middle-Income Countries: A Systematic Scoping Review

Turner, C., S. Kalamatianou, A. Drewnowski, B. Kulkarni, S. Kinra, and S. Kadiyala. 2019. "Food Environment Research in Low- and Middle-Income Countries: A Systematic Scoping Review." *Advances in Nutrition*. doi: nmz031.

<https://doi.org/10.1093/advances/nmz031>

Food environment research is increasingly gaining prominence in low- and middle-income countries (LMICs). However, in the absence of a systematic review of the literature, little is known about the emerging body of evidence from these settings. This systematic scoping review aims to address this gap. A systematic search of 6 databases was conducted in December 2017 and retrieved 920 records. In total, 70 peer-reviewed articles met the eligibility criteria and were included. Collectively, articles spanned 22 LMICs, including upper-middle-income countries (n = 49, 70%) and lower-middle-income countries (n = 18, 26%). No articles included low-income countries. Articles featured quantitative (n = 45, 64%), qualitative (n = 17, 24%), and mixed-method designs (n = 11, 8%). Studies analyzed the food environment at national, community, school, and household scales. Twenty-three articles (55%) assessed associations between food environment exposures and outcomes of interest, including diets (n = 14), nutrition status (n = 13), and health (n = 1). Food availability was associated with dietary outcomes at the community and school scales across multiple LMICs, although associations varied by vendor type. Evidence regarding associations between the food environment and nutrition and health outcomes was inconclusive. The paucity of evidence from high-quality studies is a severe limitation, highlighting the critical need for improved study designs and standardized methods and metrics. Future food environment research must address low-income and lower middle-income countries, and include the full spectrum of dietary, nutrition, and health outcomes. Improving the quality of food environment research will be critical to the design of feasible, appropriate, and effective interventions to improve public health nutrition in LMICs.

Supply and demand of high quality protein foods in India: Trends and opportunities

Minocha, S., S. Makkara, S. Swaminathan, T. Thomas, P. Webb, and A.V. Kurpada. 2019. "Supply and demand of high quality protein foods in India: Trends and opportunities." *Global Food Security* 23: 139-148.

<https://doi.org/10.1016/j.gfs.2019.05.004>

Indian diets and national subsidy programmes are biased towards cereals, offering only limited quality protein. Promoting appropriate levels of production and consumption of high quality foods rich in protein is critical in India's attempts to enhance diet quality and resolve stubbornly high levels of undernutrition. Using nationally representative datasets, simulations were performed to assess the likely additional requirements of quality protein sources in the context of environmental stressors in India. Results suggest that policymakers need to pay much more attention to the drivers of protein supply via pulses and milk, whose demand is expected to rise sharply. For eggs, fish and meat, demand is not expected to increase significantly, thus efforts are needed to encourage consumer demand growth. Overall, to achieve enhanced dietary quality in coming decades agricultural and other food policies need to shift from a cereals only focus, to stronger investment in pulses, dairy and egg production.

NON-PEER REVIEWED

Recommendations for data collection, analysis and reporting on anthropometric indicators in children under 5 years old

Recommendations for data collection, analysis and reporting on anthropometric indicators in children under 5 years old. Geneva: World Health Organization and the United Nations Children's Fund (UNICEF), 2019. Licence: CC BY-NC-SA 3.0 IGO.

<https://www.who.int/nutrition/publications/anthropometry-data-quality-report/en/>

This document is intended as a reference for the recommended steps in collecting, analyzing and reporting malnutrition estimates based on anthropometric data in nationally representative surveys. Its objective is to set out standardized methods for generating representative malnutrition estimates based on anthropometric data relating to weight, length/height and age in children less than 5 years old (or aged 0–59 months). Some recommendations included in this document are evidence-based while others rely more on practical experience and expert advice. When developing this technical guidance, it became clear that there is a need for further research to provide a wider range of evidence-based recommendations and to determine whether the use of technologically more advanced measuring instruments leads to the collection of more accurate data. The aim of this document is to guide survey implementers on how to improve the quality of anthropometric data for global monitoring. It should allow countries to track their progress towards the Global Nutrition Targets for 2025 and the SDGs for 2030 more effectively.

UPCOMING EVENTS & DEADLINES

13th Asian Congress of Nutrition

Theme: Nutrition and food innovation for sustained well-being

Description: The Food and Nutrition Society of Indonesia (PERGIZI PANGAN Indonesia) and the Federation of Asian Nutrition Societies (FANS) are organising the 13th Asian Congress of Nutrition in the Bali International Convention Center. Its goals are to promote nutrition and food innovation and encourage scientific interchange among food, nutrition and health researchers and professionals in Asia and worldwide. The event will cover topics such as dietetics and clinical nutrition, early life nutrition and holistic nutrition and well-being.

When: August 4-7, 2019

Where: Bali, Indonesia

For more information: <https://acn2019.org/>

30th Annual Meeting on Nutrition & Food Sciences

Theme: Promoting quality of healthy life through Nutrition and Food

Description: This pinnacle will unite the senior level specialists with an ideal mix for multidisciplinary coordinated effort between innovators, researchers, academicians from everywhere throughout the world and discuss the most recent achievements with keynotes and plenary presentations in the field of food and nutritional mainly concentrating on Nutrition, Food Science and Public Health.

When: September 19-20, 2019

Where: Hong Kong

For more information: <https://world.nutritionalconference.com/>

ABOUT POSHAN

Partnerships and Opportunities to Strengthen and Harmonize Actions for Nutrition in India (POSHAN) is a multi-year initiative that aims to build evidence on effective actions for nutrition and support the use of evidence in decision-making. It is supported by the Bill & Melinda Gates Foundation and led by IFPRI in India.

ABOUT ABSTRACT DIGEST

In each issue, the POSHAN Abstract Digest brings you some of the new and noteworthy studies on maternal and child nutrition. It focuses on India-specific studies and also brings to you other relevant global or regional literature with broader implications for maternal and child nutrition. The Abstract Digest is based on literature searches to identify selected studies that we think are most relevant to nutrition issues in India and to Indian programs and policies. We share with you a collection of abstracts from articles published in peer-reviewed journals, as well as selected non-peer-reviewed articles by researchers in reputed academic and/or research institutions and which demonstrated rigor in their research objectives, methodology, and analysis. The abstracts in this document are reproduced in their original form from their source, and without editorial commentary about specific articles.

CONTACT US

Email us at IFPRI-POSHAN@cgiar.org

IFPRI-NEW DELHI

INTERNATIONAL FOOD POLICY RESEARCH INSTITUTE
NASC Complex, CG Block, Dev Prakash Shastri Road, Pusa, New Delhi 110012, India
T +91.11.66166565
F +91.11.66781699
<http://poshan.ifpri.info/>

IFPRI-HEADQUARTERS

INTERNATIONAL FOOD POLICY RESEARCH INSTITUTE
2033 K Street, NW, Washington, DC 20006-1002 USA
T. +1.202.862.5600 F. +1.202.467.4439
Skype: IFPRIhomeoffice
ifpri@cgiar.org
www.ifpri.org

This publication has been prepared by POSHAN with research assistance from Pratima Mathews, IFPRI, and has not been peer reviewed. Any opinions stated herein are those of the author(s) and do not necessarily reflect the policies of the International Food Policy Research Institute. Please contact [Dr. Rasmi Avula](#) for any questions.