EDITOR'S NOTE

This issue of Abstract Digest presents two breakthrough studies that take a critical look at the association of water, sanitation, and handwashing (WASH) interventions with nutrition and a systematic review on enteric dysfunction and child stunting. Other interesting studies include those related to the design, cost and other program elements pertaining to diets for maternal and child health. Here is a list of all the articles included in this issue:

- Troeger and colleagues (2018) have presented disability-adjusted life-years estimates to drive home the point of substantial morbidity burden and long-term growth faltering effect of diarrheal diseases in children younger than five years.
- Analyzing evidence on the association of water, sanitation, and handwashing (WASH) interventions with nutrition:
  - The two WASH Benefits cluster-randomised controlled trials in Bangladesh (Luby et al. 2018) and Kenya (Null et al. 2018) did not find additional benefits of integrating water, sanitation, and handwashing with nutrition on linear growth. Menon and Frongillo (2018), commenting on the study findings of these two-well-designed cluster-randomised controlled trials, have highlighted the need to interpret the findings emphasizing the context and with an understanding that specific interventions have restricted ability to fully address multiple determinants of child growth.
  - In a multi-country (Ethiopia, India, Peru, and Vietnam) cohort study, children with access to improved sanitation but not improved water were found to be at lower risk of stunting compared to children without access (Dearden et al. 2017).
  - A systematic review conducted by Gera et al. (2018) has suggested that there may be little or no effect of WASH interventions on the anthropometric indices in children from low- and middle-income countries.
- In a multi-country study, spanning 8 low- and middle-income countries across 3 continents, following children from birth to 24 months of age, Scharf et al. (2018) found anthropometric measures, particularly head circumference, related to cognitive development but explaining only a low percent of variance.
- In a systematic review, Harper and colleagues (2018) examined relationship between environmental enteric dysfunction (EED) dysfunction pathways and child stunting and found that evidence exists for the link between inflammation and stunting but that EED is more complex than previously conceptualized.
- Larson and colleagues (2018) found modest associations between length-for-age and motor development, and motor and all mental development outcomes among 12-18-month-old children in Bihar.
- Three studies examined factors associated with infant feeding practices:
  - Chanani and colleagues (2018) have discussed factors influencing exclusive breastfeeding practices in Mumbai's urban informal settlements in the context of a community-based nutrition program for pregnant women.
  - In the first ever systematic review of complementary feeding practices (CFP) in India, Manikam and colleagues (2018) found that appropriate CFPs are not met in India, and knowledge, culture, and parental education are some of the influential factors.

- o Examining patterns of child dietary diversity (DD) in India, using a nationally-representative survey, Gausman and colleagues (2018) found both individual and ecological-level factors to be associated with poor dietary diversity among children and therefore have recommended a population-based approach combined with targeted interventions for at-risk children.
- More and colleagues (2018) evaluated a large-scale community-based management of acute malnutrition program using a quasi-experimental design and found the wasting prevalence to be lower in the intervention areas.
- Garg and colleagues (2018) estimated costs of three feeding regimens (centrally produced ready-to-use therapeutic food, locally produced ready-to-use therapeutic food, and augmented, energy-dense, home-prepared food) for treating uncomplicated severe acute malnutrition and found no significant difference in the cost per child between the different treatments.
- Masters and colleagues (2018) studied 12 nutrition-sensitive programs in Ethiopia, Nigeria and India for costs and dietary impacts of nutrition-sensitive interventions targeting children in resource-limited settings and found that the total costs varied widely among these programs and influenced improvements in different nutrient intakes among children.
- Pearson and colleagues (2018) applied the Optima approach, an epidemiological model for assessing burden of disease, to develop a new tool, 'Optima Nutrition', which can be used to estimate how to target resources to improve nutrition outcomes.
- Kadiyala and colleagues (2018) published the study protocol for a cluster- randomised controlled trial for comparing three variants of a nutrition-sensitive agricultural extension intervention to improve maternal and child nutritional outcomes in rural Odisha, India.

Enjoy reading!

PEER-REVIEWED

Background: Diarrhoea is a leading cause of death and illness globally among children younger than 5 years. Mortality and short-term morbidity cause substantial burden of disease but probably underestimate the true effect of diarrhoea on population health. This underestimation is because diarrhoeal diseases can negatively affect early childhood growth, probably through enteric dysfunction and impaired uptake of macronutrients and micronutrients. We attempt to quantify the long-term sequelae associated with childhood growth impairment due to diarrhoea.
Methods: We used the Global Burden of Diseases, Injuries, and Risk Factors Study framework and leveraged existing estimates of diarrhoea incidence, childhood undernutrition, and infectious disease burden to estimate the effect of diarrhoeal diseases on physical growth, including weight and height, and subsequent disease among children younger than 5 years. The burden of diarrhoea was measured in disability-adjusted life-years (DALYs), a composite metric of mortality and morbidity. We hypothesised that diarrhoea is negatively associated with three common markers of growth: weight-for-age, weight-for-height, and height-for-age Z-scores. On the basis of these undernutrition exposures, we applied a counterfactual approach to quantify the relative risk of infectious disease (subsequent diarrhoea, lower respiratory infection, and measles) and protein energy malnutrition morbidity and mortality per day of diarrhoea and quantified the burden of diarrhoeal disease due to these outcomes caused by undernutrition.
Findings: Diarrhoea episodes are significantly associated with childhood growth faltering. We found that each day of diarrhoea was associated with height-for-age Z-score (-0.0033 [95% CI -0.0024 to -0.0041]; $p=4.43\times10^{-14}$), weight-for-age Z-score (-0.0077 [-0.0058 to -0.0097]; $p=3.19\times10^{-15}$), and weight-for-height Z-score (-0.0096 [-0.0067 to -0.0125]; $p=7.78\times10^{-11}$). After addition of the DALYs due to the long-term sequelae as a consequence of undernutrition, the burden of diarrhoeal diseases increased by 39.0% (95% uncertainty interval [UI] 33.0–46.6) and was responsible for 55 778 000 DALYs (95% UI 49 125400–62396200) among children younger than 5 years in 2016. Among the 15 652300 DALYs (95% UI 12 951300–18806100) associated with undernutrition due to diarrhoeal episodes, more than 84.7% are due to increased risk of infectious disease, whereas the remaining 15.3% of long-term DALYs are due to increased prevalence of protein energy malnutrition. The burden of diarrhoea has decreased substantially since 1990, but progress has been greater in long-term (78.7% reduction [95% UI 69.3–85.5]) than in acute (70.4% reduction [95% UI 61.7–76.5]) DALYs.
Interpretation: Diarrhoea represents an even larger burden of disease than was estimated in the Global Burden of Disease Study. In order to adequately address the burden of its long-term sequelae, a renewed emphasis on controlling the risk of diarrhoea incidence may be required. This renewed effort can help further prevent the potential lifelong cost on child health, growth, and overall potential.

Effects of water quality, sanitation, handwashing, and nutritional interventions on diarrhoea and child growth in rural Bangladesh: a cluster randomised controlled trial

Luby, S.P., M. Rahman, B.F. Arnold, L. Unicomb, S. Ashraf, P.J. Winch, C.P. Stewart, F. Begum, F. Hussain, J. Benjamin-Chung, E. Leontsini, A.M. Naser, S.M. Parvez, A.E. Hubbard, A. Lin, F.A. Nizame, K. Jannat, A. Ercumen, P.K. Ram, K.K. Das, J. Abedin, T.F. Clasen, K.G. Dewey, L.C. Fernald, C. Null, T. Ahmed, and J.M. Colford Jr. 2018. *The Lancet Global Health* 6(3): e302-e315.
http://www.thelancet.com/journals/langlo/article/PIIS2214-109X(17)30490-4/fulltext

Background: Diarrhoea and growth faltering in early childhood are associated with subsequent adverse outcomes. We aimed to assess whether water quality, sanitation, and handwashing interventions alone or combined with nutrition interventions reduced diarrhoea or growth faltering.
Methods: The WASH Benefits Bangladesh cluster-randomised trial enrolled pregnant women from villages in rural Bangladesh and evaluated outcomes at 1-year and 2-years' follow-up. Pregnant women in geographically adjacent clusters were block-randomised to one of seven clusters: chlorinated drinking water (water); upgraded sanitation (sanitation); promotion of handwashing with soap (handwashing); combined water, sanitation, and handwashing; counselling on appropriate child nutrition plus lipid-based nutrient supplements (nutrition); combined water, sanitation, handwashing, and nutrition; and control (data collection only). Primary outcomes were caregiver-reported diarrhoea in the past 7 days among children who were in utero or younger than 3 years at enrolment and length-for-age Z score among children born to enrolled pregnant women. Masking was not possible for data collection, but analyses were masked. Analysis was by intention to treat.
Findings: Between May 31, 2012, and July 7, 2013, 5551 pregnant women in 720 clusters were randomly allocated to one of seven groups. 1382 women were assigned to the control group; 698 to water; 696 to sanitation; 688 to handwashing; 702 to water, sanitation, and handwashing; 699 to nutrition; and 686 to water, sanitation, handwashing, and nutrition. 331 (6%) women were lost to follow-up. Data on diarrhoea at year 1 or year 2 (combined) were available for 14 425 children (7331 in year 1, 7094 in year 2) and data on length-for-age Z score in year 2 were available for 4584 children (92% of living children were measured at year 2). All interventions had high adherence. Compared with a prevalence of 5·7% (200 of 3517 child weeks) in the control group, 7-day diarrhoea prevalence was lower among index children and children under 3 years at enrolment who received sanitation (61 [3·5%] of 1760; prevalence ratio 0·61, 95% CI 0·46–0·81), handwashing (62 [3·5%] of 1795; 0·60, 0·45–0·80), combined water, sanitation, and handwashing (74 [3·9%] of 1902; 0·69, 0·53–0·90), nutrition (62 [3·5%] of 1766; 0·64, 0·49–0·85), and combined water, sanitation, handwashing, and nutrition (66 [3·5%] of 1861; 0·62, 0·47–0·81); diarrhoea prevalence was not significantly lower in children receiving water treatment (90 [4·9%] of 1824; 0·89, 0·70–1·13). Compared with control (mean length-for-age Z score −1·79), children were taller by year 2 in the nutrition group (mean difference 0·25 [95% CI 0·15–0·36]) and in the combined water, sanitation, handwashing, and nutrition group (0·13 [0·02–0·24]). The individual water, sanitation, and handwashing groups, and combined water, sanitation, and handwashing group had no effect on linear growth.
Interpretation: Nutrient supplementation and counselling modestly improved linear growth, but there was no benefit to the integration of water, sanitation, and handwashing with nutrition. Adherence was high in all groups and diarrhoea prevalence was reduced in all intervention groups except water treatment. Combined water, sanitation, and handwashing interventions provided no additive benefit over single interventions.

Effects of water quality, sanitation, handwashing, and nutritional interventions on diarrhoea and child growth in rural Kenya: a cluster-randomised controlled trial

Null, C., C.P. Stewart, A.J. Pickering, H.N. Dentz, B.F. Arnold, C.D. Arnold, J. Benjamin-Chung, T. Clasen, K.G. Dewey, L.C.H. Fernald, A.E. Hubbard, P. Kariger, A. Lin, S.P. Luby, A. Mertens, S.M. Njenga, G. Nyambane, P.K. Ram, and J.M. Colford Jr. 2018. *The Lancet Global Health* 6(3): e316-e329.
http://www.thelancet.com/journals/langlo/article/PIIS2214-109X(18)30005-6/fulltext

Background: Poor nutrition and exposure to faecal contamination are associated with diarrhoea and growth faltering, both of which have long-term consequences for child health. We aimed to assess whether water, sanitation, handwashing, and nutrition interventions reduced diarrhoea or growth faltering.

Methods: The WASH Benefits cluster-randomised trial enrolled pregnant women from villages in rural Kenya and evaluated outcomes at 1 year and 2 years of follow-up. Geographically-adjacent clusters were block-randomised to active control (household visits to measure mid-upper-arm circumference), passive control (data collection only), or compound-level interventions including household visits to promote target behaviours: drinking chlorinated water (water); safe sanitation consisting of disposing faeces in an improved latrine (sanitation); handwashing with soap (handwashing); combined water, sanitation, and handwashing; counselling on appropriate maternal, infant, and young child feeding plus small-quantity lipid-based nutrient supplements from 6–24 months (nutrition); and combined water, sanitation, handwashing, and nutrition. Primary outcomes were caregiver-reported diarrhoea in the past 7 days and length-for-age Z score at year 2 in index children born to the enrolled pregnant women. Masking was not possible for data collection, but analyses were masked. Analysis was by intention to treat.

Findings: Between Nov 27, 2012, and May 21, 2014, 8246 women in 702 clusters were enrolled and randomly assigned an intervention or control group. 1919 women were assigned to the active control group; 938 to passive control; 904 to water; 892 to sanitation; 917 to handwashing; 912 to combined water, sanitation, and handwashing; 843 to nutrition; and 921 to combined water, sanitation, handwashing, and nutrition. Data on diarrhoea at year 1 or year 2 were available for 6494 children and data on length-for-age Z score in year 2 were available for 6583 children (86% of living children were measured at year 2). Adherence indicators for sanitation, handwashing, and nutrition were more than 70% at year 1, handwashing fell to less than 25% at year 2, and for water was less than 45% at year 1 and less than 25% at year 2; combined groups were comparable to single groups. None of the interventions reduced diarrhoea prevalence compared with the active control. Compared with active control (length-for-age Z score −1·54) children in nutrition and combined water, sanitation, handwashing, and nutrition were taller by year 2 (mean difference 0·13 [95% CI 0·01–0·25] in the nutrition group; 0·16 [0·05–0·27] in the combined water, sanitation, handwashing, and nutrition group). The individual water, sanitation, and handwashing groups, and combined water, sanitation, and handwashing group had no effect on linear growth.

Interpretation: Behaviour change messaging combined with technologically simple interventions such as water treatment, household sanitation upgrades from unimproved to improved latrines, and handwashing stations did not reduce childhood diarrhoea or improve growth, even when adherence was at least as high as has been achieved by other programmes. Counselling and supplementation in the nutrition group and combined water, sanitation, handwashing, and nutrition interventions led to small growth benefits, but there was no advantage to integrating water, sanitation, and handwashing with nutrition. The interventions might have been more efficacious with higher adherence or in an environment with lower baseline sanitation coverage, especially in this context of high diarrhoea prevalence.

Can integrated interventions create the conditions that support caregiving for better child growth?
Menon, P., and E.A. Frongillo. 2018. *The Lancet Global Health* 6(3): e236-e237.
http://www.thelancet.com/journals/langlo/article/PIIS2214-109X(18)30028-7/fulltext

Children born to healthy mothers who live in homes with piped water and improved sanitation, are fed adequate diets, and have appropriate health care have better growth outcomes. Yet intervention trials to test the effects of integrated delivery of specific interventions that address elements of these determinants—such as the Articles by Stephen Luby and colleagues and Clair Null and colleagues reported in this issue of The Lancet Global Health—have come up short.

Children with access to improved sanitation but not improved water are at lower risk of stunting compared to children without access: a cohort study in Ethiopia, India, Peru, and Vietnam
Dearden, K.A., W. Schott, B.T. Crookston, D.L. Humphries, M.E. Penny, J.R. Behrman, and The Young Lives Determinants and Consequences of Child Growth Project Team. 2017. *BMC Public Health* 17(110). doi: 10.1186/s12889-017-4033-1.
http://repositorio.grade.org.pe/bitstream/handle/GRADE/475/s12889-017-4033-1.pdf?sequence=1&isAllowed=y

Background: This study's purpose was to understand associations between water, sanitation, and child growth.
Methods: We estimated stunting (height-for-age Z score <-2 SD) and thinness (BMI-Z <-2 SD) risk ratios using data from 7,715 Ethiopian, Indian, Peruvian, and Vietnamese children from the Young Lives study.
Results: In unadjusted models, household access to improved water and toilets was often associated with reduced stunting risk. After adjusting for child, household, parent, and community variables, access to improved water was usually not associated with stunting nor thinness except in Ethiopia where access to improved water was associated with reduced stunting and thinness at 1y and 5y. In contrast, in both unadjusted and adjusted models, stunting at 1y was less common among children with good toilet access than among those without access and this difference persisted when children were 5y and 8y. For example, in adjusted estimates, Vietnamese 5y olds with access to improved toilets had relative stunting risk at 8y 0.62-0.68 that of 5y olds with no access to improved toilets. Water and toilets were rarely associated with thinness.
Conclusions: Results from our study indicate that access to improved sanitation is more frequently associated with reduced stunting risk than access to improved water. However, additional studies are needed before drawing definitive conclusions about the impact of toilets relative to water. This study is the first to our knowledge to demonstrate the robust and persistent importance of access to improved toilets in infancy, not only during the first year but continuing into childhood. Additional longitudinal investigations are needed to determine concurrent and long-term associations of WASH with stunting and thinness.

Impact of Water, Sanitation and Hygiene Interventions on Growth, Non-diarrheal Morbidity and Mortality in Children Residing in Low- and Middle-income Countries: A Systematic Review
Gera, T., D. Shah, and H.S. Sachdev. 2018. *Indian Pediatrics*. doi: S097475591600119.
https://www.ncbi.nlm.nih.gov/pubmed/29428924

Objective: To evaluate the impact of water, sanitation and hygiene (WASH) interventions in children (age <18 y) on growth, non-diarrheal morbidity and mortality in children.

Design: Systematic review of randomized controlled trials, non-randomized controlled trials and controlled before-after studies.

Setting: Low- and middle-income countries.

Participants: 41 trials with WASH intervention, incorporating data on 113055 children.

Intervention: Hygiene promotion and education (15 trials); water intervention (10 trials), sanitation improvement (7 trials), all three components of WASH (4 trials), combined water and sanitation (1 trial) and sanitation and hygiene (1 trial).

Outcome measures: (i) Anthropometry: weight, height, weight-for-height, mid-arm circumference; (ii) Prevalence of malnutrition; (iii) Non-diarrheal morbidity; and (iv) mortality.

Results: There was no effect of hygiene intervention on most anthropometric parameters (low to very low quality evidence). Hygiene intervention reduced the risk of developing Acute respiratory infections by 24% (RR 0.76; 95% CI 0.59, 0.98; moderate quality evidence), cough by 10% (RR 0.90; 95% CI 0.83, 0.97; moderate quality evidence), laboratory-confirmed influenza by 50% (RR 0.5; 95% CI 0.41, 0.62; very low quality evidence), fever by 13% (RR 0.87; 95% CI 0.74, 1.02; moderate quality evidence), and conjunctivitis by 51% (RR 0.49; 95% CI 0.45, 0.55; low quality evidence). There was low quality evidence to suggest no impact of intervention on mortality (RR 0.65; 95% CI 0.25, 1.7). Improvement in water supply and quality was associated with slightly higher weight-for-age Z-score (MD 0.03; 95% CI 0, 0.06; low quality evidence), but no significant impact on other anthropometric parameters or infectious morbidity (low to very low quality evidence). There was very low quality evidence to suggest reduction in mortality (RR 0.45; 95% CI 0.25, 0.81). Improvement in sanitation had a variable effect on the anthropometry and infectious morbidity. Combined water, sanitation and hygiene intervention improved height-for-age z scores (MD 0.22; 95% CI 0.12, 0.32) and decreased the risk of stunting by 13% (RR 0.87; 95% CI 0.81, 0.94) (very low quality of evidence). There was no evidence of significant effect of combined WASH interventions on non-diarrheal morbidity (fever, respiratory infections, intestinal helminth infection and school absenteeism) were not altered by intervention (low to very low quality of evidence). Any WASH intervention (considered together) resulted in lower risk of underweight (RR 0.81; 95% CI 0.69, 0.96), stunting (RR 0.77; 95% CI 0.68, 0.86) and wasting (RR 0.12, 0.85) (low to very low quality of evidence).

Conclusion: Available evidence suggests that there may be little or no effect of WASH interventions on the anthropometric indices in children from low- and middle-income countries. There is low to very low quality of evidence to suggest decrease in prevalence of wasting, stunting and underweight. WASH interventions (especially hygiene intervention) were associated with lower risk of non-diarrheal morbidity (very low to moderate quality evidence). There was very low quality evidence to suggest some decrease to no change in mortality. These potential health benefits lend support to the ongoing efforts for provision of safe and adequate water supply, sanitation and hygiene.

Early childhood growth and cognitive outcomes: Findings from the MAL-ED study

Although many studies around the world hope to measure or improve developmental progress in children to promote community flourishing and productivity, growth is sometimes used as a surrogate because cognitive skills are more difficult to measure. Our objective was to assess how

childhood measures of anthropometry correlate with measures of child development in low-income settings with high prevalence of poor nutrition and enteric disease, to inform studies considering growth outcomes in the absence of direct child developmental skill assessment. Children from the MAL-ED study were followed from birth to 24 months of age in field sites in 8 low- and middle-income countries across 3 continents. Monthly weight, length, and head circumference measurements were performed. At 24 months, the Bayley Scales of Infant and Toddler Development was administered. We correlated cognitive measures at 24 months with anthropometric measurements from birth to 2 years comparing 3 constructs: absolute attained monthly measures, summative difference in measures from the mean growth curve, and rate of change in measures. Growth faltering at multiple time periods is related to Bayley cognitive outcomes at 24 months. Birthweight, overall growth by 18–24 months, and rate of growth in the 6- to 18-month period were most associated with 24-month developmental scores. In this study, head circumference measurements, compared with length, was more closely linked to cognitive scores at 24 months. Notably, all studies between growth and cognitive outcomes exhibited low r2 values (0.001–0.049). Anthropometric measures, particularly head circumference, were related to cognitive development, although explaining a low percent of variance. When feasible, direct measures of child development may be more useful.

Environmental enteric dysfunction pathways and child stunting: A systematic review

Background: Environmental enteric dysfunction (EED) is commonly defined as an acquired subclinical disorder of the small intestine, characterized by villous atrophy and crypt hyperplasia. EED has been proposed to underlie stunted growth among children in developing countries. A collection of biomarkers, organized into distinct domains, has been used to measure different aspects of EED. Here, we examine whether these hypothesized relationships, among EED domains and between each domain and stunting, are supported by data from recent studies.
Methodology: A systematic literature search was conducted using PubMed, MEDLINE, EMBASE, Web of Science, and CINAHL between January 1, 2010 and April 20, 2017. Information on study objective, design, population, location, biomarkers, and results were recorded, as well as qualitative and quantitative definitions of EED. Biomarkers were organized into five EED domains, and the number of studies that support or do not support relationships among domains and between each domain with stunting were summarized.
Results: There was little evidence to support the pathway from intestinal permeability to microbial translocation and from microbial translocation to stunting, but stronger support existed for the link between intestinal inflammation and systemic inflammation and for intestinal inflammation and stunting. There was conflicting evidence for the pathways from intestinal damage to intestinal permeability and intestinal damage to stunting.
Conclusions: These results suggest that certain EED biomarkers may require reconsideration, particularly those most difficult to measure, such as microbial translocation and intestinal permeability. We discuss several issues with currently used biomarkers and recommend further analysis of pathogen-induced changes to the intestinal microbiota as a pathway leading to stunting.

A Path Analysis of Nutrition, Stimulation, and Child Development Among Young Children in Bihar, India

Nutrition plays an important role in the development of a child, particularly in low- and middle-income countries where malnutrition is often widespread. The relation between diet, hemoglobin, nutritional status, motor development, stimulation and mental development was examined in a cross-sectional sample of 1,079 children 12–18 months of age living in rural Bihar, India. Path analysis revealed associations between (a) length-for-age z-scores and motor development, standardized β (β) = .285, p < .001, and (b) motor and all mental development outcomes (language: β = .422; personal-social: β = .490; memory: β = .139; and executive function: β = .072, all p < .001). Additionally, stimulation was significantly associated with language scores and hemoglobin concentration with memory. These findings inform interventions aimed at improving child development in Northern India.

Participation of pregnant women in a community-based nutrition program in Mumbai's informal settlements: Effect on exclusive breastfeeding practices

Background: In urban Maharashtra, India, approximately half of mothers exclusively breastfeed. For children residing in informal settlements of Mumbai, this study examines factors associated with exclusive breastfeeding, and whether exclusive breastfeeding, in a community-based nutrition program to prevent and treat wasting among children under age three, is associated with enrolment during the mother's pregnancy.
Methods: The nutrition program conducted a cross-sectional endline survey (October-December 2015) of caregivers in intervention areas. Factors associated with exclusive breastfeeding for infants under six months of age were explored using multi-level logistic regressions. Additionally, program surveillance data collected during home-based counselling visits documented breastfeeding practices for children under six months of age. Using the surveillance data (January 2014-March 2016), exclusive breastfeeding status was regressed adjusting for child, maternal and socioeconomic characteristics, and whether the child was enrolled in the program in utero or after birth.
Results: The community-based endline survey included 888 mothers of infants. Mothers who received the nutrition program home visits or attended group counselling sessions were more likely to exclusively breastfeed (adjusted odds ratio 1.67, 95% CI 1.16, 2.41). Having a normal weight-for-height z-score (adjusted odds ratio 1.57, 95% CI 1.00, 2.45) was associated positively with exclusive breastfeeding. As expected, being an older infant aged three to five months (adjusted odds ratio 0.34, 95% CI 0.25, 0.48) and receiving a prelacteal feed after birth (adjusted odds ratio 0.57, 95% CI 0.41, 0.80) were associated with lower odds of exclusively breastfeeding. Surveillance data (N = 3420) indicate that infants enrolled in utero have significantly higher odds of being exclusively breastfed (adjusted odds ratio 1.55, 95% CI 1.30, 1.84) than infants enrolled after birth.
Conclusions: Prenatal enrolment in community-based programs working on child nutrition in urban informal settlements of India can improve exclusive breastfeeding practices.

Objective: Suboptimal nutrition among children remains a problem among South Asian (SA) families. Appropriate complementary feeding (CF) practices can greatly reduce this risk. Thus, we undertook a systematic review of studies assessing CF (timing, dietary diversity, meal frequency and influencing factors) in children aged <2 years in India.
Design: Searches between January 2000 and June 2016 in MEDLINE, EMBASE, Global Health, Web of Science, OVID Maternity & Infant Care, CINAHL, Cochrane Library, BanglaJOL, POPLINE and WHO Global Health Library. Eligibility criteria: primary research on CF practices in SA children aged 0–2 years and/or their families. Search terms: 'children', 'feeding' and 'Asians' and derivatives. Two researchers undertook study selection, data extraction and quality appraisal (EPPI-Centre Weight of Evidence).
Results: From 45 712 abstracts screened, sixty-four cross-sectional, seven cohort, one qualitative and one case–control studies were included. Despite adopting the WHO Infant and Young Child Feeding guidelines, suboptimal CF practices were found in all studies. In twenty-nine of fifty-nine studies, CF was introduced between 6 and 9 months, with eight studies finding minimum dietary diversity was achieved in 6–33 %, and ten of seventeen studies noting minimum meal frequency in only 25–50 % of the study populations. Influencing factors included cultural influences, poor knowledge on appropriate CF practices and parental educational status.
Conclusions: This is the first systematic review to evaluate CF practices in SA in India. Campaigns to change health and nutrition behaviour and revision of nationwide child health nutrition programmes are needed to meet the substantial unmet needs of these children.

Objective: Dietary diversity (DD) measures dietary variation in children. Factors at the child-, community-, and state-levels may be associated with poor child nutritional outcomes. However, few studies have examined the role of macro-level factors on child DD. This study seeks to 1) describe the distribution of child DD in India, 2) examine the variation in DD attributable to the child-, community and state-levels, and 3) explore the relationship between community socioeconomic context and child DD.
Research Methods and Procedures: Using nationally representative data from children aged 6-23 months in India, multilevel models were used to determine the associations between child DD and individual- and community-level factors.
Results: There was substantial variation in child DD score across demographic and socioeconomic characteristics. In an age and sex-only adjusted regression model, the largest portion of variation in child DD was attributable to the child-level (75%) while the portions of variance attributable to the community-level and state-level were similar to each other (15% and 11%). Including individual-level socioeconomic factors explained 35.6 percent of the total variation attributed to child DD at the community-level and 24.8 percent of the total variation attributed to child DD at the state-level.

Finally, measures of community disadvantage were associated with child DD in when added to the fully-adjusted model.

Conclusions: This study suggests that both individual and contextual factors are associated with child DD. These results suggest that a population-based approach combined with a targeted intervention for at-risk children may be needed to improve child DD in India.

Community-Based Management of Acute Malnutrition to Reduce Wasting in Urban Informal Settlements of Mumbai, India: A Mixed-Methods Evaluation
More, N.S., A. Waingankar, S. Ramani, S. Chanani, V. D'Souza, S. Pantvaidya, A. Fernandez, and A. Jayaraman. 2018. *Global Health: Science and Practice* 6(1):103-127. doi: https://doi.org/10.9745/GHSP-D-17-00182
http://www.ghspjournal.org/content/6/1/103

Background: We evaluated an adaptation of a large-scale community-based management of acute malnutrition program run by an NGO with government partnerships, in informal settlements of Mumbai, India. The program aimed to reduce the prevalence of wasting among children under age 3 and covered a population of approximately 300,000.

Methods: This study used a mixed-methods approach including a quasi-experimental design to compare prevalence estimates of wasting in intervention areas with neighboring informal settlements. Cross-sectional data were collected from March through November 2014 for the baseline and October through December 2015 for the endline. Endline data were analyzed using mixed-effects logistic regression models, adjusting for child, maternal, and household characteristics. In addition, we conducted in-depth interviews with 37 stakeholders (13 staff and 24 mothers) who reported on salient features that contributed to successful implementation of the program.

Results: We interviewed 2,578 caregivers at baseline and 3,455 at endline in intervention areas. In comparison areas, we interviewed 2,082 caregivers at baseline and 2,122 at endline. At endline, the prevalence of wasting decreased by 28% (18% to 13%) in intervention areas and by 5% (16.9% to 16%) in comparison areas. Analysis of the endline data indicated that children in intervention areas were significantly less likely to be malnourished (adjusted odds ratio, 0.81; confidence interval, 0.67 to 0.99). Stakeholders identified 4 main features as contributing to the success of the program: (1) tailoring and reinforcement of information provided to caregivers in informal settings, (2) constant field presence of staff, (3) holistic case management of issues beyond immediate malnourishment, and (4) persistence of field staff in persuading reluctant families. Staff capabilities were enhanced through training, stringent monitoring mechanisms, and support from senior staff in tackling difficult cases.

Conclusion: NGO–government partnerships can revitalize existing community-based programs in urban India. Critical to success are processes that include reinforced knowledge-building of caregivers, a high level of field support and encouragement to the community, and constant monitoring and follow-up of cases by all staff levels.

Costing of three feeding regimens for home-based management of children with uncomplicated severe acute malnutrition from a randomised trial in India
Garg, C.C., S. Mazumder, S. Taneja, M. Shekhar, S. B. Mohan, A. Bose, S.D. Iyengar, R. Bahl, J. Martines, and N. Bhandari. 2018. *BMJ Global Health*. doi: 10.1136/ bmjgh-2017-000702.
http://gh.bmj.com/content/3/2/e000702

Trial design: Three feeding regimens—centrally produced ready-to-use therapeutic food, locally produced ready-to-use therapeutic food, and augmented, energy-dense, home-prepared food— were provided in a community setting for children with severe acute malnutrition (SAM) in the age group of 6–59 months in an individually randomised multicentre trial that enrolled 906 children. Foods, counselling, feeding support and treatment for mild illnesses were provided until recovery or 16 weeks.

Methods: Costs were estimated for 371 children enrolled in Delhi in a semiurban location after active survey and identification, enrolment, diagnosis and treatment for mild illnesses, and finally treatment with one of the three regimens, both under the research and government setting. Direct costs were estimated for human resources using a price times quantity approach, based on their salaries and average time taken for each activity. The cost per week per child for food, medicines and other consumables was estimated based on the total expenditure over the period and children covered. Indirect costs for programme management including training, transport, non-consumables, infrastructure and equipment were estimated per week per child based on total expenditures for research study and making suitable adjustments for estimations under government setting.

Results: No significant difference in costs was found across the three regimens per covered or per treated child. The average cost per treated child in the government setting was estimated at US$56 (<3500 rupees).

Conclusion: Home-based management of SAM with a locally produced ready-to-use therapeutic food is feasible, acceptable, affordable and very cost-effective in terms of the disability-adjusted life years saved and gross national income per capita of the country. The treatment of SAM at home needs serious attention and integration into the existing health system, along with actions to prevent SAM.

Designing programs to improve diets for maternal and child health: Costs and impacts of nutrition-sensitive programs in Ethiopia, Nigeria, and India
Masters, W.A., K.L. Rosettie, S. Kranz, G. Danaei, P. Webb, D. Mozaffarian, and Global Nutrition and Policy Consortium. 2018. *Health Policy and Planning.* doi: czy013.
https://doi.org/10.1093/heapol/czy013

Improving maternal and child nutrition in resource-poor settings requires effective use of limited resources, but priority-setting is constrained by limited information about program costs and impacts, especially for interventions designed to improve diet quality. This study utilized a mixed methods approach to identify, describe and estimate the potential costs and impacts on child dietary intake of 12 nutrition-sensitive programs in Ethiopia, Nigeria and India. These potential interventions included conditional livestock and cash transfers, media and education, complementary food processing and sales, household production and food pricing programs. Components and costs of each program were identified through a novel participatory process of expert regional consultation followed by validation and calibration from literature searches and comparison with actual budgets. Impacts on child diets were determined by estimating of the magnitude of economic mechanisms for dietary change, comprehensive reviews of evaluations and effectiveness for similar programs, and demographic data on each country. Across the 12 programs, total cost per child reached (net present value, purchasing power parity adjusted) ranged very widely: from 0.58 to 2650 USD/year among five programs in Ethiopia; 2.62 to 1919 USD/year among four programs in Nigeria; and 27 to 586 USD/year among three programs in India. When impacts were assessed, the largest dietary improvements were for iron and zinc intakes from a complementary food production program in

Ethiopia (increases of 17.7 mg iron/child/day and 7.4 mg zinc/child/day), vitamin A intake from a household animal and horticulture production program in Nigeria (335 RAE/child/day), and animal protein intake from a complementary food processing program in Nigeria (20.0 g/child/day). These results add substantial value to the limited literature on the costs and dietary impacts of nutrition-sensitive interventions targeting children in resource-limited settings, informing policy discussions and serving as critical inputs to future cost-effectiveness analyses focusing on disease outcomes.

Optima Nutrition: an allocative efficiency tool to reduce childhood stunting by better targeting of nutrition-related interventions

Pearson, R., M. Killedar, J. Petravic, J.J. Kakietek, N. Scott, K.L. Grantham, R.M. Stuart, D.J. Kedziora, C.C. Kerr, J. Skordis-Worrall, M. Shekhar, and D. P. Wilson. 2018. *BMC Public Health* 18:384. https://doi.org/10.1186/s12889-018-5294-z

Background: Child stunting due to chronic malnutrition is a major problem in low- and middle-income countries due, in part, to inadequate nutrition-related practices and insufficient access to services. Limited budgets for nutritional interventions mean that available resources must be targeted in the most cost-effective manner to have the greatest impact. Quantitative tools can help guide budget allocation decisions. **Methods:** The Optima approach is an established framework to conduct resource allocation optimization analyses. We applied this approach to develop a new tool, 'Optima Nutrition', for conducting allocative efficiency analyses that address childhood stunting. At the core of the Optima approach is an epidemiological model for assessing the burden of disease; we use an adapted version of the Lives Saved Tool (LiST). Six nutritional interventions have been included in the first release of the tool: antenatal micronutrient supplementation, balanced energy-protein supplementation, exclusive breastfeeding promotion, promotion of improved infant and young child feeding (IYCF) practices, public provision of complementary foods, and vitamin A supplementation. To demonstrate the use of this tool, we applied it to evaluate the optimal allocation of resources in 7 districts in Bangladesh, using both publicly available data (such as through DHS) and data from a complementary costing study. **Results:** Optima Nutrition can be used to estimate how to target resources to improve nutrition outcomes. Specifically, for the Bangladesh example, despite only limited nutrition-related funding available (an estimated $0.75 per person in need per year), even without any extra resources, better targeting of investments in nutrition programming could increase the cumulative number of children living without stunting by 1.3 million (an extra 5%) by 2030 compared to the current resource allocation. To minimize stunting, priority interventions should include promotion of improved IYCF practices as well as vitamin A supplementation. Once these programs are adequately funded, the public provision of complementary foods should be funded as the next priority. Programmatic efforts should give greatest emphasis to the regions of Dhaka and Chittagong, which have the greatest number of stunted children. **Conclusions:** A resource optimization tool can provide important guidance for targeting nutrition investments to achieve greater impact.

Upscaling Participatory Action and Videos for Agriculture and Nutrition (UPAVAN) trial comparing three variants of a nutrition-sensitive agricultural extension intervention to improve maternal and child nutritional outcomes in rural Odisha, India: study protocol for a cluster randomised controlled trial

Background: Maternal and child undernutrition have adverse consequences for pregnancy outcomes and child morbidity and mortality, and they are associated with low educational attainment, economic productivity as an adult, and human wellbeing. 'Nutrition-sensitive' agriculture programs could tackle the underlying causes of undernutrition.

Methods/design: This study is a four-arm cluster randomised controlled trial in Odisha, India. Interventions are as follows: (1) an agricultural extension platform of women's groups viewing and discussing videos on nutrition-sensitive agriculture (NSA) practices, and follow-up visits to women at home to encourage the adoption of new practices shown in the videos; (2) women's groups viewing and discussing videos on NSA and nutrition-specific practices, with follow-up visits; and (3) women's groups viewing and discussing videos on NSA and nutrition-specific practices combined with a cycle of Participatory Learning and Action meetings, with follow-up visits. All arms, including the control, receive basic nutrition training from government community frontline workers. Primary outcomes, assessed at baseline and 32 months after the start of the interventions, are (1) percentage of children aged 6–23 months consuming ≥ 4 out of 7 food groups per day and (2) mean body mass index (BMI) (kg/m2) of non-pregnant, non-postpartum (gave birth > 42 days ago) mothers or female primary caregivers of children aged 0–23 months. Secondary outcomes are percentage of mothers consuming ≥ 5 out of 10 food groups per day and percentage of children's weight-for-height z-score < -2 standard deviations (SD). The unit of randomisation is a cluster, defined as one or more villages with a combined minimum population of 800 residents. There are 37 clusters per arm, and outcomes will be assessed in an average of 32 eligible households per cluster. For randomisation, clusters are stratified by distance to nearest town (< 10 km or ≥ 10 km), and low (< 30%), medium (30–70%), or high (> 70%) proportion of Scheduled Tribe or Scheduled Caste (disadvantaged) households. A process evaluation will assess the quality of implementation and mechanisms behind the intervention effects. A cost-consequence analysis will compare incremental costs and outcomes of the interventions.

Discussion: This trial will contribute evidence on the impacts of NSA extension through participatory, low-cost, video-based approaches on maternal and child nutrition and on whether integration with nutrition-specific goals and enhanced participatory approaches can increase these impacts.

NON-PEER REVIEWED

Reducing stunting in children: equity considerations for achieving the global nutrition targets 2025
Reducing stunting in children: equity considerations for achieving
The Global Nutrition Targets 2025. Geneva: World Health Organization; 2018. Licence: CC BY-NC-SA 3.0 IGO.
http://apps.who.int/iris/bitstream/10665/260202/1/9789241513647-eng.pdf

This series on Equity considerations for achieving the Global Nutrition Targets 2025 (3) have two objectives. First, it aims to underscore the relevance of social determinants, health equity, gender and human rights in malnutrition, and the need to further advocate for their inclusion in nutrition

actions at global, regional and national scales. Second, it aims to provide policy-makers and programme and project managers with practical and useful examples of evidence on nutrition interventions that face and address inequalities in nutrition. Throughout the document, boxes are used to present examples on the use of evidence for project design and implementation; multisectoral collaboration; and incorporation of social determinants, health-equity, gender and human-rights approaches in nutrition actions. This series has been designed to disseminate concise information to public health nutrition officers who are not experts in social and health inequalities. The non-exhaustive examples are contextual and therefore are not to be considered for global guidance. Current and updated World Health Organization (WHO) guidelines are available online and they are referenced in this document for this target on reducing stunting in children and in the other documents of the series for the rest of the targets.

Improved governance for nutrition reduces stunting among indigenous Adivasi children in Maharashtra, India
Aguayo, V.M., S. Saunik, V. Krishna, R. Nair, and W. J. Schultink. 2017. *UNSCN News* 42:107-109.
https://www.unscn.org/uploads/web/news/UNSCN-News42-2017.pdf

India is considered a success story in terms of economic growth. However, this economic performance has left behind the country's indigenous peoples, who, although identified by the Constitution as Scheduled Tribes, they prefer the name Adivasi ("original inhabitants"). This article describes the creation of the State Nutrition Mission in 2005 under the chairmanship of the State Chief Minister and comprised of hand-picked professionals who are mandated to coordinate interdepartmental efforts to reduce child undernutrition in the 5 districts of Maharashtra, India with the largest Adivasi population: Amravati, Gadchiroli, Nandurbar, Nasik and Thane. It also highlights the achievements and increased coverage (extended to all the rural and tribal blocks across Maharashtra's 33 districts) of the State Nutrition Mission during the 2005-2015 period. The State Nutrition Mission has been a key policy instrument in accelerating the reduction of child stunting in Maharashtra. Analysis has shown that the decline of child stunting in Maharashtra was broad-based and pro-Adivasi, indicating that the Mission's efforts to improve governance for nutrition led to greater social inclusion and equity. The main lessons learned are drawn from the Mission's focus on scaling up proven interventions and strengthening leadership, coordination, coverage, quality, equity, and accountability for nutrition results.

The sociocultural drivers of food choices: Formative research among pregnant and lactating women in Rajasthan
Monterrosa, E.C. 2017. *Sight and Life* 31(2): 27-35.
https://sightandlife.org/wp-content/uploads/2017/12/SAL_TechnolyandEntrepreneurship_The-Social-Drivers-of-Food-Choices.pdf

Addressing maternal undernutrition is not just about the nutrient profile of the foods women eat; it also requires an understanding of the social norms and beliefs that guide eating practices during pregnancy and lactation. Pregnant and lactating women (PLW) in Rajasthan consume on average 30% less than the Indian Medical Research Council's recommended intakes for calories and for protein in the third trimester of pregnancy or during exclusive breastfeeding. Formative research was conducted to identify how key social influencers shape the decisions of PLW in Rajasthan on what and when to eat and to understand important barriers to healthy eating during pregnancy.

Food taboos tend to be propagated by mothers-in-law (MIL), whereas husbands may be more accessible to dietary advice in respect of their wives, not least because of the cost of medical care in the event that they fall sick. Key insights of the research are that improving food intake is feasible through non- main-meal occasions, that women need permission to eat more during pregnancy and lactation, and that actionable dietary advice needs to be relevant, specific, and desirable.

UPCOMING EVENTS

Institute for Financial Management and Research (IFMR)'s annual course on 'Measurement and Survey Design'

CLEAR/J-PAL South Asia is organising a 3-day introductory course on Measurement and Survey Design. This course uses an array of pedagogical tools including lectures, case studies and experiential exercises to increase participants' understanding of the process of designing and implementing effective survey questionnaires that yield high quality data. The course is specifically intended for researchers, M&E professionals and other individuals looking to build and/or refresh their knowledge of fundamental skills for collecting primary quantitative data.

When: May 28 – 30, 2018

Where: India Habitat Centre, New Delhi, India

For more information: http://www.clearsouthasia.org/activities/measurement-and-survey-design-course-2018/

17th World Congress on Obesity & Nutrition

Call for submitting abstracts is open for the 17th World Congress on Obesity & Nutrition, on the theme of 'Exceeding the Vision towards Obesity and Nutrition.'

When: September 21-22, 2018

Where: Osaka, Japan

For more information: https://obesitycongress.nutritionalconference.com/global-meetings-online-visitors-readers.php