

POLICY BRIEF

THE IMPACT OF  
**POOR SANITATION  
ON NUTRITION**

# BACKGROUND PAPER:

## The Impact of Poor Sanitation on Nutrition

With 165 million children suffering from chronic undernutrition (being stunted) and 52 million suffering from acute malnutrition (being wasted) (UNICEF et al., 2012), more concerted and cross-sectoral action is needed. Improving water, sanitation and hygiene (WASH) in the context of nutrition programming offers one important opportunity to do this. A recent systematic review of 14 studies on WASH interventions in ten low and middle income countries, for example, found suggestive evidence that WASH interventions positively affect height-for-age scores in children under five years of age (Dangour et al., 2013). This paper summarises the evidence for the impact of poor sanitation on nutritional outcomes and highlights the potential offered by greater integration of WASH within nutrition policy and programmes.



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### What is undernutrition?

Undernutrition accounts for 21 per cent of the global disease burden among children (Black et al., 2008), and manifests as stunting (low height-for-age scores), wasting (low weight-for-height scores), and underweight (low weight-for-age scores). There are both direct and indirect causes of undernutrition in children; inadequate dietary intake and infectious diseases, such as diarrhoeal diseases, comprise the former, whilst a multitude of factors including household food insecurity, inadequate care and feeding practices, unhealthy household environments (i.e. those with poor WASH facilities) and inadequate health services comprise the latter (UNICEF, 2013).

Undernutrition is a critical concern amongst children up to the age of 24 months (1,000 days from conception), as damage suffered during this period has been found to lead to long-term impairment, particularly regarding adult stature, and is associated with lower human capital and productivity (Victora et al., 2008, Clasen et al., 2010, Hoddinott et al., 2013a, Hoddinott et al., 2013b). Additionally, damage that occurs during this period may be irreversible (Martorell et al., 1994), hence the first 1,000 days spanning conception to age 24 months has been dubbed the 'critical window' for prevention/action (Dewey and Adu-Afarwuah, 2008).



## The sanitation-nutrition nexus

The sanitation-nutrition nexus refers to the multiple connections between sanitation practices and nutritional outcomes. There are three identified direct pathways through which poor sanitation (and associated open defecation) may adversely affect nutritional outcomes in children: diarrhoeal diseases (Briend, 1990), environmental enteropathy (Humphrey, 2009) and nematode infections (Pruss-Ustun and Corvalan, 2006). Indeed, the World Health Organization estimates that as much as 50 per cent of childhood under nutrition is associated with poor WASH (Pruss-Ustun et al., 2008).

### Diarrhoeal diseases

Diarrhoeal diseases, subsequent malnutrition and their consequences may cause 2.4 million deaths per year (Pruss-Ustun et al., 2008). The relationship between diarrhoeal diseases and malnutrition is, however, complex (Brown et al., 2013). In low income settings, poor sanitation, the absence of a safe means of excreta disposal, often results in individuals' households and environments becoming contaminated with pathogen-ridden human faeces (Curtis et al., 2000) which, when passed through the faecal-oral transmission route, cause diarrhoeal diseases (Clasen et al., 2010, Briend, 1990). Repeated infection with diarrhoeal diseases contributes to chronic malnutrition by inhibiting intestinal absorption of nutrients and is strongly correlated with stunting (Petri et al., 2008, Spears, 2013). Undernutrition in turn increases susceptibility to infectious diseases, such as diarrhoea, thus perpetuating somewhat of a vicious circle (Mara et al., 2010).

### Environmental enteropathy

Recently, it has been hypothesised that tropical or environmental enteropathy (EE), a subclinical condition of the small intestines resulting from the ingestion of faecal bacteria, and which increases gut

permeability and malabsorption of nutrients, may be a primary causal pathway from poor sanitation to stunting (Humphrey, 2009). Though there have been few studies in this area, an observational study conducted in The Gambia found that 39 per cent of weight and 43 per cent of length and height growth failure was associated with an indicator of subclinical intestinal permeability (the ratio of urinary lactulose to mannitol), rather than dietary inadequacy or diarrhoea (Lunn et al., 1991). EE may explain the fact that sanitation appears to have a greater association with improvements in growth than with reductions in diarrhoea (Esrey, 1996, Brown et al., 2013), and biological plausibility for this causal pathway is high (Humphrey, 2009). Results from ongoing studies in Bangladesh, Kenya and Zimbabwe will shed light on this relationship (DFID, 2013) and provide more definitive evidence that will help WASH and nutrition policy and programmes.

### Nematode infections

The third direct pathway between poor sanitation and bad nutritional outcomes concerns soil-transmitted helminth (STH) infections, such as Hookworm, *Ascaris Lumbricoides* and *Trichuris Trichiura*. These infections result in the malabsorption of nutrients and growth retardation or failure (O'Lorcain and Holland, 2000). The majority of worm-related infections are transmitted via contact with or consumption of soil contaminated with human faeces containing worm eggs (DFID, 2013, Geissler et al., 1998). Improved sanitation, by reducing the presence of faeces in individuals' environments, can assist in curbing transmission of STH infections. Indeed, a recent systematic review found that access to sanitation was associated with decreased likelihood of infection with any STH, and specifically with *Ascaris Lumbricoides* and *Trichuris Trichiura* (Strunz et al., 2014), findings which are consistent with an earlier systematic review that found that availability and use of latrines reduced the risk of STH infection by roughly 50 per cent (Ziegelbauer et al., 2012).

## How does poor sanitation affect nutrition outcomes in children up to age 24 months?

### Stunting

Research shows that inadequate dietary intake alone does not explain the global burden of stunting, and dietary interventions have not been able to normalise growth (Dewey and Adu-Afarwuah, 2008). A recent multiple-country study, for example, found that diarrhoeal diseases, caused by poor sanitation, accounted for 25 per cent of stunting in children up to 24 months (Checkley et al., 2008). Meanwhile, an observational study in rural Bangladesh found that environmental contamination, linked to open defecation, caused linear growth faltering through EE; and children living in clean household environments had 0.54 standard deviation higher height-for-age scores (22 per cent lower stunting) than their counterparts living in dirty environments (Lin et al., 2013).

Evidence has shown that sanitation can prevent and reduce stunting; in an analysis of cross-sectional data from eight low and middle income countries (LMICs), improvements in sanitation were found to be associated with increases in length-for-age and height-for-age scores (Esrey, 1996). Similar results were found in a longitudinal study in Peru where inadequate disposal of sewage, and poor water sources and storage accounted for a 1 cm height deficit in children aged 24 months when compared to their counterparts living with better sanitation and water conditions (Checkley et al., 2004). The same study, however, found that diarrhoea only explained 16 per cent of stunting, whilst access to sanitation and water services accounted for 40 per cent. More recently, a recent systematic review found a borderline statistically significant effect of WASH interventions on height-for-age scores (Dangour et al., 2013), though it should be noted that this result was not based on analysis of sanitation interventions alone.

### Wasting

Though diarrhoeal diseases could be a predictor of the effects of poor sanitation on weight-for-height scores, there is limited and inconclusive evidence that poor sanitation is associated with wasting. Whilst



improvements in sanitation were associated with higher weight-for-height scores in the aforementioned eight country cross-sectional study, this was only the case in the absence of improvements in water supplies (Esrey, 1996). Furthermore, the aforementioned systematic review found no evidence of an effect of WASH interventions on weight-for-height scores, though it should be reiterated that this result was not based on analysis of sanitation interventions alone. More research is thus required to establish what if any are the effects of sanitation on wasting.

### Underweight

There is also very limited evidence that improved sanitation conditions are associated with better weight-for-age scores. The same eight country cross-sectional study found that sanitation was associated with higher weight-for-age scores in children living in both rural and urban areas, and

that incremental improvements in sanitation resulted in additional weight gain amongst these children (Esrey, 1996). Interestingly, the health benefits of improved sanitation were more pronounced than those for improved water. Increments in weight-for-age scores were also found in an earlier study in Lesotho investigating the effect of latrines on infant growth, though these were non-significant and greater positive effect on weight-for-age scores was found when both water and sanitation facilities were improved simultaneously (Esrey et al., 1992). Furthermore, the aforementioned systematic review found no evidence of an effect of WASH interventions on weight-for-age scores, though again this result was not based on analysis of sanitation interventions alone. Further research is therefore required to fully establish the effects of sanitation on underweight.



## A spotlight on India

### The situation in India

Despite India being one of the world's largest economies, the latest figures from the Indian National Family Health Survey estimate that 48 per cent of India's children under the age of five are stunted, 43 per cent are underweight, and 20 per cent are

wasted (IIPS, 2007). The term 'Asian Enigma' has been coined to describe this situation, namely that children in Asia are, on an average, shorter than their generally poorer counterparts in Africa (Ramalingaswami et al., 1996). Thus, when viewed alongside global estimates suggesting that 48 percent of India's population practices open defecation (WHO & UNICEF 2014), it is evident that the links between sanitation practices and nutritional outcomes in India merit further investigation.

### What do we know?

Although there is a dearth of literature concerning the impact of poor sanitation on weight-for-height and weight-for-age scores in India, research based on analysis of 140 demographic and health surveys has found that much of the excess stunting in India can be accounted for by open defecation and that the number of people practicing open defecation per square kilometer linearly explains 65 per cent of international variation in child height (Spears, 2013). In a country characterised by high population density such as India, this evidently has implications for policy and practice, particularly in urban settings, and once again illustrates the negative externalities of open defecation.

There is also suggestive evidence that improving sanitation can decrease stunting. Analysis of India's national Total Sanitation Campaign<sup>1</sup> (TSC), for example, found that on an average, the TSC increased height-for-age z-scores by approximately 0.2 standard deviation (Spears, 2012). These results were echoed by the findings of a randomised control trial (RCT) of community sanitation in Maharashtra which indicated a 0.3 to 0.4 standard deviation increase in children's height-for-age z-scores following the intervention (Hammer and Spears, 2013)<sup>2</sup>. In light of the spillover effect of open defecation, these findings would appear to support community, rather than individual oriented, sanitation interventions, though further research is required in this regard.

<sup>1</sup>The Total Sanitation Campaign was launched by the Government of India in 1999 to end open defecation in rural areas by 2012. It advocated a bottom-up, community-led and demand-driven approach to securing sustainable sanitation behaviour change (UNICEF, 2009).

<sup>2</sup>It should be noted, however, that in the latter study latrine usage was not directly observed nor the contribution of EE to stunting outcomes assessed.

Given these findings, greater collaboration between the Government of India's Ministry of Women and Child Development, as the body responsible for nutritional outcomes in children under the age of five, and the Ministry of Drinking Water and Sanitation would be valuable. This will be even more salient due to the Government of India's commitment to achieving a 'Clean India' by 2019 and the funding for sanitation related interventions and research this will invariably elicit.

Who are the key actors in integrating good sanitation practice into nutrition and what should these actors do?

Despite its potential importance, WASH has been described as a 'blind spot' of the nutrition sector (Chambers and Medeazza, 2013). The focus of nutrition policy and practice has traditionally been on improving the immediate determinants of undernutrition, namely quality and quantity of food, rather than addressing the underlying determinants of undernutrition, such as poor sanitation (ibid).

The evidence available and summarised herein indicates that the sanitation-nutrition nexus warrants far greater attention by policy-makers, practitioners and researchers in the WASH and nutrition worlds and recognition of the potential value of integrated approaches to tackling the underlying determinants of poor nutritional outcomes.

### Policy-makers

The post-2015 development agenda provides an important opportunity to address the sanitation-nutrition nexus and capitalise on synergies. In particular, there is an opportunity for donors, aid agencies and national governments to:

- Foster cross-sectoral collaboration to break the vicious circle of malnutrition and diarrhoeal diseases by, for example, establishing knowledge sharing platforms.
- Include WASH targets in any global post-2015 nutrition goal, and vice versa, and establish joint indicators to monitor progress in this regards<sup>3</sup>.



- Fund and deliver multi-sectoral nutrition-sensitive interventions alongside nutrition-specific interventions<sup>4</sup>.

### Practitioners

The nutritional significance of sanitation has, thus far, been predominantly overlooked. It is suggested therefore that nutrition practitioners:

- Work with WASH practitioners to tackle the underlying causes of diarrhoea, EE and nematode infections, i.e. poor WASH. Prevention is always better than cure.
- Consult WASH experts on proven, effective methods of securing sanitation behaviour change in LMICs.
- Prioritise improving sanitation for pregnant women and children up to the age of 24 months, thus targeting the critical 1,000 day window.
- Design interventions which include entire communities. Learning from successful

<sup>3</sup>Height-for-age scores may be more suitable indicators for measuring the health effects of improved sanitation than diarrhoea (Checkley et al., 2004).

<sup>4</sup>The SHOUHARDO project in Bangladesh, for example, successfully employed both nutrition-specific and nutrition-sensitive components to secure a 4.5 per cent annual reduction of stunting in children aged 6 to 24 months (Smith et al., 2013).



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Community Led Total Sanitation interventions such as those carried out in Bangladesh (Kar and Pasteur, 2005) and India (WaterAid India, 2008, Pattanayak et al., 2009) will be salient.

- Endeavour to reduce the contamination of children's play and feeding areas by human and animal faeces. The results of pilot interventions in Mali (Toure et al., 2013), Bangladesh (Islam et al., 2013) and Nepal (Om Prasad et al., Forthcoming 2014) will offer valuable insights, and holistic approaches to interrupting the faecal-oral transmission route in babies may be beneficial (Ngure et al., 2014).

### Researchers

Despite the body of evidence exploring the sanitation-nutrition nexus having slowly grown during recent years, there is still a dearth of high quality studies on the effect of sanitation interventions on physical growth in children (Dangour et al., 2013). These large evidence gaps need to be filled if greater commitment and investment are to be made in interventions informed by the sanitation-nutrition nexus. It would be particularly beneficial for such evidence to arise from large-scale randomised effectiveness trials.

Methodologically sound and rigorous research exploring the following should be prioritised by global research agendas:

- The relative contribution of diarrhoeal diseases, EE and nematode infections on child stunting, wasting and underweight.
- The effect of improved sanitation on stunting, wasting and underweight scores.
- The effect of WASH on other nutritional outcomes, such as anaemia.
- Cost-effective, nutrition sensitive sanitation (and holistic WASH) interventions, specifically those targeting the critical 1,000 day window, that are sustainable and can be scaled up and adapted to different contexts.

Finally, although this paper has focused primarily on sanitation, water and hygiene interventions (comprising the other two core elements of the WASH acronym) have also been found to improve nutritional outcomes (Dangour et al., 2013). The synergistic effect of WASH interventions on nutritional outcomes should not, therefore, be overlooked, and merits further investigation.

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