SAFANSI
The South Asia Food and Nutrition Security Initiative

EARLY CHILDHOOD DIARRHEA IN RURAL BANGLADESH

Bangladesh has made great strides in health and sanitation since the early 1990s, notably in health outcomes among children five years old and younger. The under-five child mortality rate in Bangladesh has decreased by 71 percent during this period, and the proportion of children affected by diarrheal illness declined by half between 1994 and 2014, from 12 to 6 percent. The proportion of the population with access to improved sanitary facilities increased from 34 to 61 percent between 1990 and 2015. Yet as of 2013, Bangladesh remained one of the fifteen countries with the highest mortality rates attributable to diarrhea and pneumonia according to UNICEF. And diarrheal illness in particular continues to wield a negative impact on childhood nutrition and development outcomes in Bangladesh. Given these facts a key question remains – what are the potential explanations for the persistence of diarrheal burden given the increased sanitation coverage?

Fecal-oral pathogens, which are generally believed to be the primary culprits in the transmission of diarrheal illnesses, travel through contact with hands, food, flies, water, and soil. These *pathways* can all be largely disrupted through sanitation and hygiene interventions, but in ways that are not fully understood. The transmission of the pathogens is complex, and the pathways they follow are not only environmentally mediated, but heavily influenced by human behavior.

Improving our understanding of the relative importance of these different pathways and the source fecal contamination, whether it is human or animal, is necessary to inform decisions about which interventions will be the most effective in reducing the transmission of enteric pathogens and minimizing exposure to children in rural Bangladesh. The purpose of this study was to characterize environmental routes of child exposure to fecal contamination in rural Bangladesh, through collection and testing of household and environmental samples, and observations of child and caregiver behaviors.

The study was nested within a larger randomized controlled trial with funding from the World Bank's South Asia Food and Nutrition Security Initiative (SAFANSI), measuring the benefits of water quality, sanitation, hand washing, and nutritional interventions to improve child health and development.[1] The study involved comparison of outcomes in three study arms. The first arm was a *sanitation only intervention*, which consisted of households receiving dual pit latrines and other hardware for the safe handling of child feces, in addition to behavior change interventions to encourage their use. The second arm was a *water, hygiene, and sanitation intervention* (WHS) where households received the same hardware and behavior change messaging, as well as chlorine tablets for

In Tangail, one of the villages in the pilot, a couple stands next to an improved toilet, which was a product of the intervention under the sanitation arm of the study. (Zahid/World Bank)

[1] WASH Benefits Study http://www.washbenefits.net/

water treatment, a lidded narrow-mouth vessel for safe water storage, and handwashing stations and soapy water at their latrine and food preparation areas. The third arm was a *control* where households received no interventions. In all, 1,843 households were included in this study.

Findings

The study found that E. coli and fecal coliform contamination levels were similar across intervention arms for all sample types (hands, food, flies, water, and soil) both in terms of percentage of positive samples and level of contamination with the exception of stored water in the WSH intervention arm. Source water from tubewells were less contaminated than household stored water, yet approximately one-quarter of tubewells were contaminated with E. coli and half were contaminated with fecal coliform across all arms. This highlights that while Bangladesh has made great strides in providing basic access to water supply, these efforts have not necessarily translated into safe drinking water.

The situation becomes worse when assessing fecal contamination of stored water in vessels within the household, where only about 21 percent of all samples across treatment arms were considered safe to drink. These results suggest that contamination is occurring during transport from the source to home, or occurring within the household. The samples that were classified as safe to drink were largely driven by the WSH intervention arm that provided chlorine tablets for purification, and a storage vessel that minimized contact with water.

The transmission route though soil and childrens' hand was particularly salient. Soil from courtyard areas where small children are likely to play and mouth objects is an important pathway that deserves greater attention. Soil collected from the child's outdoor play area in the compound courtyard exhibited two important characteristics. The first is that 98 percent of samples tested positive for E. coli, and 82 percent for fecal coliform. The second is that the levels of contamination were extraordinarily high; a typical soil sample had about 120,000 E. coli and 240,000 fecal coliform per dry gram of soil. Results from the soil samples are important because structured observations noted a high incidence of young children mouthing their hands and other objects which had just come in direct contact with soil and with animals, and 18 percent of small children were observed putting soil directly into their mouths. More than one-third (40%) of children were found to have at least some E. coli contamination on their hands, and hand contamination was found to be higher in children older than 6 months as compared to those under six months of age.

Beyond testing for the presence and levels of E. coli and fecal coliform, this study also used molecular analysis to identify whether the source of contamination was either of human or animal (cattle/goats/poultry) origin. The molecular testing was done for three pathways: stored water, children's hands, and courtyard soil, and was only carried out in the sanitation and control arms. Results showed that the ruminant marker (cattle/goats) was the most prevalent in all three types of samples (22 percent of stored water, 54 percent of child hand rinse, 63 percent of soil samples). Poultry markers followed with 23 percent being detected in soil samples, 1 percent of stored water, and 2 percent of child hand rinses. The human marker was not

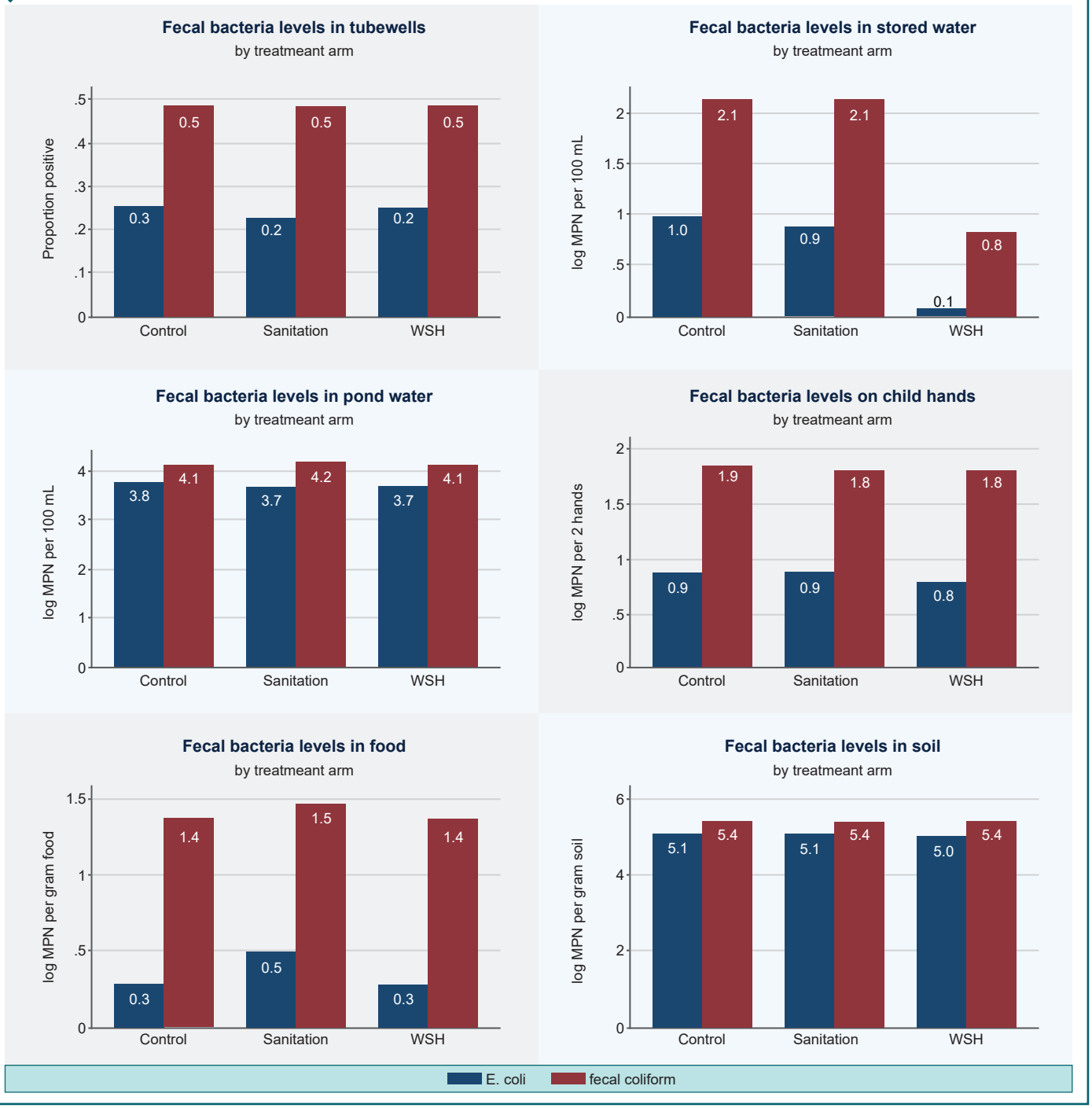
An improved toilet from a village from Tangail. (Zahid/World Bank)

detected in stored water, but was in 9 percent of soil and 2 percent of child hand rinse samples. The ruminant marker was present at a greater frequency in water samples from control compared to sanitation households, but there were no other significant differences in occurrence of the animal or human fecal markers in sanitation versus control households.

Practical Implications

The omnipresence of fecal contamination across multiple pathways highlights that household and personal hygiene behaviors are critical to break fecal-oral transmission routes even when quality infrastructure is available. Looking forward

Fecal Bacterial Levels



hygiene behaviors not only need to encompass the management of human feces, but also that of animal feces which has traditionally been given less attention in the sphere of public health.

The contamination of water supply at the source and point of use poses difficult infrastructure challenges. Proposing technological solutions to address this challenge goes beyond the scope of this study, nevertheless, promotion of household water treatment and storage appears to be a practical and logical solution for the foreseeable future. In areas of Bangladesh where inadequate sanitation does not properly contain human feces, improved infrastructure is necessary but insufficient. Behavior change interventions that promote toilet use, handwashing with soap, safe management of children's feces, and discouraging the use of pond water for cleaning dishes and utensils are important behaviors required for breaking the transmission pathways.

This study elevates the significance of animal waste as a contributor of enteric pathogens to household environments in rural Bangladesh. Reducing fecal loading from animal waste in the household environment requires a more serious dialogue with agricultural specialists on animal rearing and handling of animal waste. Dialogue with these specialists will be valuable in informing environmental health policies and in enabling local authorities to address behaviors that play a role in childhood exposure to fecal pathogens.

An unimproved toilet from a village from Tangail. Sanitation marketing encourages rural households to move from unimproved to improved toilets. (Zahid/World Bank)

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