STUDY SUMMARY

WASH Benefits: The Effects of Water Quality, Sanitation, Handwashing, and Nutrition Interventions on Child Health, Growth, and Development in Rural Kenya

Poor nutrition and exposure to fecal contamination are associated with diarrhea and growth faltering, and both have long-term consequences for child health and development. In Kenya, researchers partnered with IPA to conduct a large-scale randomized evaluation of the impacts of water, sanitation, handwashing, and nutrition interventions delivered alone and in combination. The study found that behavioral messaging and simple technological interventions––including chlorination for treating household drinking water, improved pit latrines and tools for disposing of child and animal feces, and handwashing stations with soapy water––was insufficient to reduce diarrhea or improve child growth in the water, sanitation, and handwashing arms of the evaluation. The nutrition intervention, comprised of counselling and supplementation, modestly improved children's growth. None of the interventions improved measures of child development measured two years after intervention delivery began. The findings call into question the ability of large-scale water, sanitation, and handwashing interventions to reduce diarrhea or improve children's growth or development in similar contexts.

Policy Issue

Diarrheal diseases are a leading cause of death for children in the developing world, killing nearly half a million children under the age of five each year.[1] Even when diarrheal episodes are not fatal, illness early in life can have long-term effects on child growth and development.[2] [3] Many cases of diarrhea can be prevented with good water quality, proper sanitation, and handwashing with soap. However, conclusive evidence on the relative health benefits of water, sanitation, and hygiene (WASH) interventions is lacking, though WASH programs are common in rural areas of many low-income countries.

Along with its sister trial in Bangladesh, this was the first randomized evaluation to test whether individual or combined water, sanitation, or handwashing interventions reduce diarrhea and/or improve child growth. This was also the first rigorous evaluation of upgrading from unimproved to improved latrines in sub-Saharan Africa.

RESEARCHERS
Clair Null, Amy Pickering, Christine Stewart, Audrie Lin, Sammy Njenga, Jack Colford, Ben Arnold, Kathryn Dewey, Lia Fernald, Patricia Kariger

COUNTRY
Kenya

PARTNER
Kenya Medical Research Institute (KEMRI)

PROGRAM AREA
Health

Evaluation Context

TOPICS
Early Childhood Development, Maternal & Child Health, Nutrition, WASH

TIMELINE
2013-2016

The study took place among pregnant women and their newborn children in rural areas of Bungoma, Vihiga and Kakamega counties in western Kenya. Diarrhea prevalence is fairly high in these areas; very few households have piped water or improved sanitation facilities and handwashing is inconvenient and uses precious water hauled by women and children from communal sources. Twenty-seven percent of children under three in comparison compounds suffered from diarrhea the previous week. Among the comparison group, 94 percent of drinking water samples were contaminated with *E. coli*, only 17 percent of households had an improved latrine and only 1 percent of households had a potty to facilitate safe disposal of children's feces (diapers are not commonly used), and only 5 percent of respondents had soap and water at a designated handwashing station.

Details of the Intervention

Researchers evaluated the individual and combined effects of various WASH and nutrition interventions on the health, growth and development of children in their first two years of life. The large-scale randomized evaluation took place among 8,246 women and their newborns in rural areas of western Kenya.

Researchers randomly assigned 702 clusters (1-2 villages each) to one of eight groups:

1. *Water quality:* Chlorine dispensers were installed at communal water sources, and each household received 1 liter of bottled chlorine every six months. Local promoters encouraged treating and safely storing drinking water, emphasizing how this could improve the health of children in the household.
2. *Sanitation:* Households received free child potties, "sani-scoops" to remove feces, and a new or upgraded pit latrine. Local promoters encouraged using latrines for defecation, removal of human and animal waste from the household area, and safe disposal of children's feces.
3. *Handwashing:* Households received "dual tippy tap" stations for handwashing, with independent pedals attached to 5-liter jerry cans of clean water and jugs of soapy water. Local promoters encouraged handwashing with soap after contact with feces and before handling food, and replenished soap in the handwashing stations every 6 months.
4. *Water Quality, Sanitation, and Handwashing:* Households received all three WASH interventions.
5. *Nutrition:* Local promoters encouraged dietary diversity during pregnancy and lactation, early initiation of breastfeeding (within the first 24 hours of birth), exclusive breastfeeding for the first six months, appropriate and diverse complementary feeding starting at six months, and continued breastfeeding until age 2. From 6-24 months, enrolled children and their siblings in the same age range received a supply of small quantity lipid-based nutrient supplements (LNS), which are fortified products that contain vitamins, minerals, and fats, and are designed specifically for preventative use.
6. *Nutrition + Water, Sanitation, and Handwashing:* Households received the three WASH interventions plus the nutrition intervention.

7. *Active comparison group:* Households did not receive any intervention. However, village-level promoters visited households to record the circumference of the child's arm (MUAC), a measurement that was also conducted for children in the other groups.
8. *Passive comparison group:* No intervention or household visits.

Across all arms other than the passive comparison group, promoters were intended to visit monthly for the duration of the trial, but endline survey data suggest that the frequency of visits slowed to every other month during the second year of the trial.

Researchers used data from surveys conducted one and two years after the interventions began to evaluate the impact of the interventions on physical, cognitive, and socio-emotional growth and development. Outcomes of interest included diarrhea prevalence and physical growth (length for age, weight for age, and head circumference), as well as motor skills, verbal skills, and socio-emotional development. The evaluation also measured environmental contamination, parasitic infections, and indicators of compromised immune systems and gut function.

Results and Policy Lessons

Adherence: Adherence to the sanitation and nutrition interventions was more than 70 percent and 90 percent for both years of the study, respectively. Adherence to the handwashing intervention also started out strong at over 75 percent in the first year, but then fell sharply to less than 25 percent in the second year. Adherence to water quality intervention was around 40 percent in the first year and around 20 percent in the second year.

Promoters visited around 75 percent of their households within the past month during the first year, but that fell by the second year, with 30-40 percent of households reporting a visit in the past month.

Compared to what many governments and NGOs achieve at scale, these adherence rates were comparable or higher.[4]

Diarrhea prevalence: None of the interventions (improved water quality, safe sanitation, handwashing, nutrition, or combinations of the interventions) had any impact on caregiver-reported diarrhea prevalence in the first or second years of life. Diarrhea rates were high throughout the year, without a strong seasonal pattern.

Parasitic infections: There is some evidence that the water intervention (chlorination) interrupted transmission of pathogens. After two years of intervention exposure, prevalence of one intestinal worm infection (Ascaris) was 18% lower as a result of the water treatment, and the prevalence was 22% lower in the combined water, sanitation, and handwashing intervention arms. Trichuris and hookworm were rarely detected, resulting in imprecise effect estimates. No intervention reduced the parasitic infection Giardia.

Growth: The WASH interventions that did not include nutrition had no effect on children's growth. Children in groups that received the nutrition component (groups 5-6) experienced small increases in growth. For example, children in the nutrition group were 0.13 standard deviations taller than the control group, while children in the nutrition plus WASH group were 0.16 standard deviations taller

than the control group. The difference between these impacts is not statistically significant, meaning combining nutrition with WASH was not more effective than nutrition alone.

It is possible the WASH interventions would have a larger impact if adherence were higher, but the results are relevant to programs with similar adherence in this context.

In addition, the findings suggest that nutritional interventions that include counselling and supplements (LNS) can modestly reduce growth faltering, but fall short of eliminating it, even when adherence to supplements is high.

Development: After one year of intervention, relative to the active control group, children in the combined WASH and nutrition arm (group 6) were more likely to be able to stand with assistance and walk with assistance, and children in the handwashing arm (group 3) were more likely to be able to stand alone. However, one year later, there were no differences between any of the intervention arms and the active control arm on any of our measures of child development (including communication, gross motor, and personal social skills assessed by the Expanded Ages and Stages Questionnaire).

Overall, the WASH interventions (groups 1-4) did not reduce childhood diarrhea or improve growth, even during the first year of the trial when adherence was quite high. The nutrition intervention led to small increases in child growth, consistent with previous studies. Contrary to expectations, there was no additional benefit to combining nutrition with a WASH program.

Why so little impact?

Researchers theorize one reason the WASH interventions tested here were not very effective in reducing children's exposure to pathogens is due to the presence of animal feces in the household environment. Even when drinking water was cleaner, children under two still had high levels of fecal bacteria on their hands and toys. Further research is needed on the impacts of other innovative approaches to reduce child exposure to fecal contamination, such as automatically chlorinating water coming from communal water sources and sealing dirt floors.

Sources

[1] Wang, Haidong, Mohsen Naghavi, Christine Allen, Ryan M. Barber, Zulfiqar A. Bhutta, Austin Carter, Daniel C. Casey et al. "Global, regional, and national life expectancy, all-cause mortality, and cause-specific mortality for 249 causes of death, 1980–2015: a systematic analysis for the Global Burden of Disease Study 2015." *The lancet* 388, no. 10053 (2016): 1459-1544.

[2] Crimmins EM, Finch CE, 2006. Infection, inflammation, height, and longevity. Proc Natl Acad Sci USA 103: 498–503.

[3] Prendergast, Andrew J., and Jean H. Humphrey. "The stunting syndrome in developing countries." *Paediatrics and international child health* 34, no. 4 (2014): 250-265.

[4] Adherence was compared to five large-scale WASH programs on three continents. For details, see

p. 22 (Table S8) in the appendix of Null et. al. 2018.