The Effects of Free Drinking Water Treatment on Child Survival in Kenya

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Sector(s): Health

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Fieldwork: Evidence Action

Location: Kenya

Sample: 4,437 children, 2,046 women, 132 villages

Target group: Children under five

Outcome of interest: Mortality Water quality

Intervention type: Subsidies Water, sanitation, and hygiene

AEA RCT registration number: AEARCTR-0005969

Partner organization(s): Evidence Action, Stichting Dioraphte, National Institutes of Health (NIH), Sint Antonius Stichting Project (SAS-P)

Diarrhea is a leading cause of death in children under the age of 5, but adding small amounts of chlorine into water can treat water and prevent a large number of these deaths. Researchers conducted a randomized evaluation in Kenya to test the impact of free point-of-collection, community-wide dispensers on child mortality. Community-wide provision of dilute chlorine solution through dispensers reduced child deaths. It was also highly cost-effective in terms of disability-adjusted life years averted per dollar spent.

Policy issue

Globally, diarrhea is the third leading cause of child mortality among children under the age of five. [1], More than 80 percent of these deaths are attributable to contaminated drinking water. [2] Water treatment may be critical: chlorination has been shown to be not only safe and inexpensive, but also effective in inactivating most pathogens that cause diarrhea.

However, take-up of chlorine to treat water remains low in many low- and middle-income countries. One approach to increasing take-up may be to increase free provision of chlorine solution through community-wide dispensers. Additionally, the long term effects of treating water on child mortality are still widely understudied. Can free community-wide provision of chlorinated water dispensers reduce child mortality?

Context of the evaluation

In Kenya, the mortality rate for children under the age of five years was estimated at 44 deaths per 1000 live births in 2014 With diarrhea a leading cause of death, contaminated water sources in villages and very few houses having access to piped water may be a major contributor.

The evaluation took place in two counties in western Kenya, Bungoma and Kakamega, where according to the 2014's survey by UNICEF's Multiple Indicator Cluster Survey the rates of child mortality were estimated to be 24 and 61 deaths per 1000 live births, respectively. In these counties, eight and 27 of those deaths happened within the first months of a child life, and 10 and 21 deaths happened within 2-12 months of a child's life. Contaminated water may be a cause of infant death, as about 32 percent of mothers in Bungoma and 20 percent in Kakamega reported giving their newborns liquids other than breast milk within the first 3 days of life, thereby increasing their children's exposure to potentially contaminated water.

Details of the intervention

To understand the impact of chlorine treatment on child mortality, researchers leveraged existing chlorine dispensers that had been randomly rolled out for a separate intervention in collaboration with the NGO Evidence Action in Western Kenya. Villages participating in the evaluation were rural, relied on communal water sources, and had unimproved water and sanitation facilities.

The study took place in 18 groups of villages that had participated in the previous study, with nine groups receiving dispensers and nine groups serving as the comparison group. Villages receiving the intervention had dispensers that provided dilute chlorine solution to treat drinking water. Local promoters were elected by the community to educate community members on how chlorine and the dispenser worked, and why it was important to disinfect the water. These promoters also help with the maintenance and refilling of the dispensers.

Researchers leveraged data from previous interventions. Evidence Action had continued to monitor and fill community water dispenser with dilute chlorine even after the completion of the initial study. Meanwhile, data on mortality, diarrhea, and other self-reported outcomes came from another study from the same region that had enrolled women aged between 18 and 35 to receive water treatment and tracked child health outcomes. In this study, researchers also tracked use of chlorine to treat drinking water through surprise visits to households and testing the water.

Results and policy lessons

Providing free dispensers for chlorine to treat water reduced under-five mortality. Children living in villages with dilute chlorine solution dispensers were 63 percent less likely to die relative to the comparison group. Similarly, under-2 mortality fell by 67 percent and postnatal mortality decreased by 65 percent.

Chlorine take-up: Four years after the original study was completed, researchers found sustained levels of chlorine in water among households in program villages when compared to comparison groups. Sixty-five percent of mothers in villages with dispensers self-reported usually chlorinating their water, and 71 percent reported chlorinating their water in the past 30 days. Researchers also conducted surprise visits to households to check for chlorine in drinking water. They found that 24 percent of households in villages with dispensers had evidence of chlorination, compared with 15 percent of households in comparison villages. Thirty-one percent reported obtaining chlorine from water dispensers at the water source, compared to 11 percent in the comparison groups.

Health impacts: Chlorinating water solutions reduced child mortality in both under-2 and under-5 age groups by 67 percent and 63 percent respectively. This reduction was largely driven by a 65 percent reduction in mortality among children in their first year of life (aged 2 months to 12 months). This may have been due to reduced diarrhea, although other adopted health behaviors could also have contributed to the reduction in mortality.

Cost-effectiveness analysis: Community-wide provisions of dilute chlorine solution through chlorine dispensers were cost-effective, at US$ 25 per disability-adjusted life year for a child under the age of five. Installing and maintaining chlorine dispensers at scale costs about US$ 9 per child under 5 per year. Providing chlorine solution through dispensers was twenty times more cost-effective than the WHO-recommended threshold for highly-cost effective programs.

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1. World Health Organization. 2024. “Diarrhoeal Disease.” Fact sheet, March 7, 2024. World Health Organization. https://www.who.int/news-room/fact-sheets/detail/diarrhoeal-disease.

2. Mebrahtom, Samuel, Alemayehu Worku, and Daniel J. Gage. 2022. “The Risk of Water, Sanitation and Hygiene on Diarrhea Related Infant Mortality in Eastern Ethiopia: A Population Based Nested Case Control Study.” BMC Public Health 22 (1): 343. https://doi.org/10.1186/s12889-022-12735-7.