



Review

Effects of sanitation on cognitive development and school absence: A systematic review



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ABSTRACT

Objective: We undertook this systematic review to explore the relationship between sanitation and learning outcomes, specifically cognitive development and absence.

Methods: We searched leading databases to identify experimental and observational studies that address the effect of sanitation on our outcomes of interest. We identified 17 studies that met the review's eligibility criteria, four reporting on measures of cognitive development, 12 on school absence (with two studies reporting on school and work absence), and one study that reported on both outcomes. We assessed the risk of bias of individual studies as well as the overall strength of evidence for each outcome. Because of fundamental differences among the studies in terms of sanitation exposure and outcome measurement, pooling results via meta-analysis was deemed inappropriate so a descriptive review is presented.

Results: Studies reported that access to household sanitation was associated with measures of improved cognitive ability in children. However, collectively these studies were rated by GRADE as poor methodological quality with significant potential for confounding and bias, including publication bias. Studies on the association between household, community or school sanitation and school absence yielded mixed results. Some sanitation studies reported lower absence while others reported higher absence. Only the two randomized controlled trials reported no overall effects on absence even when combining sanitation with water supply improvements and hygiene promotion. Study quality as assessed by GRADE was again generally poor.

Conclusion: While studies to date provide some support for positive effects from sanitation on cognitive development, the effects on school absence are uncertain. Differences in effects may be due to differences in study settings, type of sanitation exposure and most notably in outcome definitions. Further research in multiple settings using rigorous study designs and measuring intermediate outcomes such as exposure can help determine the effects of sanitation on these important learning outcomes.

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1. Introduction

Almost one billion people currently lack access to sanitation (UNICEF, 2015). Most live in rural settings in developing countries and practice open defecation. Systematic reviews on the health impacts of sanitation have focused on anthropometric outcomes (Dangour et al., 2013; Freeman et al., submitted) or on infectious disease outcomes, such as diarrhoea, trachoma, soil transmitted helminth infection and schistosomiasis (Clasen et al., 2010; Freeman et al., submitted; Grimes et al., 2014; Stocks et al., 2014; Strunz et al., 2014; Wolf et al., 2014). The World Health Organization (WHO), however, defines health not only as the absence of disease but as a “state of complete physical, mental and social well-being.” Sanitation has the potential to address not only infectious disease but various aspects of well-being, such as reaching one’s full potential through proper cognitive development and the ability to attend school and work.

Researchers have begun to explore the different causal pathways for these learning outcomes. In one pathway, researchers theorize and initial studies show that access to sanitation lowers rates of sanitation-related illnesses and as a result, may lead to better cognitive ability and a healthier state to attend school or work (Khalil et al., 2016; Pinkerton et al., 2016; Watanabe and Petri, 2016) (Fig. 1–A). Even reductions in asymptomatic but repeated enteric infections, known as environmental enteropathy, has been linked to improvements in early childhood development (Kosek, 2017). In another pathway specific to the school setting, access to adequate school sanitation creates a comfortable learning environment which may lower rates of student absence and ultimately lead to better school performance (Pearson and McPhedran, 2008) (Fig. 1–B). Several studies in low and middle-income countries have also explored the connection between adequate school sanitation and attendance rates of postmenarcheal girls who require sanitation facilities to hygienically and comfortably manage their menstruation (Boosey et al., 2014; Caruso et al., 2013; Haver et al., 2013; Long et al., 2013; Pearson and McPhedran, 2008; Phillips-Howard et al., 2016; Sommer, 2010). The purpose of this review is to assess the impact of sanitation, be it access, quality or a specific sanitation intervention at the household, school or community level, on cognitive development and absence from school or work.

The WHO commissioned this systematic review as part of its effort to develop the evidence base for a set of guidelines on sanitation and health. This review is one of three reviews on the impact of sanitation on different health outcomes: sanitation-related infectious diseases and nutritional status (Freeman et al., submitted), wellbeing (Sclar et al., unpublished results), and the current two outcomes of interest – cognitive development and absence from school or work. Since only two eligible studies examined both school and work absence, we describe cognitive development and

absence as ‘learning outcomes’ throughout this review. In addition, although the literature to date often uses the term “absenteeism” to describe this learning outcome, “absenteeism” specifically refers to missing school or work on a regular basis and often without a suitable reason like illness. As such, we use the term “absence” which more generally refers to the act of missing school or work. These reviews on sanitation and aspects of health are part of a series of systematic reviews that also examine the impact of different sanitation interventions on latrine coverage and use (Garn et al., 2016) and the impact of sanitation on transmission pathways (Sclar et al., 2016a).

2. Methods

2.1. Search strategy

We searched the literature to identify relevant studies that address the impact of sanitation on measures of cognitive development and absence (see Supplemental Text S1 for protocol and Supplemental Text S2 for PRISMA Checklist). Our search included studies published in English, Spanish, Portuguese, French, German or Italian with any publication status (published, unpublished, in press, grey literature, etc.) written between 1950 and December 2015. We conducted our search in English and used two separate generic search strings, one for each learning outcome: (1) *cognitive development*: ((Bathroom OR toilet OR “toilet facilities” OR latrine OR sanitation OR sanitary OR “water closet” OR ecosan OR feces OR faeces OR sewage or sewer OR sewerage OR “open defecation”) AND (cognition OR “cognitive disorders” OR “mental development” OR development OR “child development” OR “child development disorders” OR “mental disorders” OR IQ OR “intelligence quotient”)) and (2) *absence*: ((Bathroom OR toilet OR “toilet facilities” OR latrine OR sanitation OR sanitary OR “water closet” OR ecosan OR feces OR faeces OR sewage OR sewer OR sewerage OR “open defecation”) AND (absenteeism OR work OR labour OR labor OR “work absenteeism” OR “employee absenteeism” OR “school absenteeism” OR enrollment OR schools OR attendance) AND (humans)).

We searched the following databases: British Library for Development Studies, Campbell Library, clinicaltrials.gov, Cochrane Library, EMBASE, EBSCO (CINHAL, PsychInfo), LILACS, POPLINE, ProQuest, PubMed, Research for Development, Sanitary Engineering and Environmental Sciences (REPIDISCA), Social Science Research Network (SSRN), Sustainability Science Abstracts (SAS), Web of Science, and 3ie International Initiative for Impact Evaluation. We also searched the following organizations’ conference proceedings and websites: Carter Center, CDC Global WASH, International Water Association, Menstrual Hygiene Management in WASH in Schools Virtual Conference, Stockholm Environment Institute, Stockholm World Water Week Conference, UNC Water and Health Conference,

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