World Development 107 (2018) 22–39

Contents lists available at ScienceDirect

World Development

journal homepage: www.elsevier.com/locate/worlddev

Sanitation and child health in India

Britta Augsburg [a,*], Paul Andrés Rodríguez-Lesmes [b]

[a] The Institute for Fiscal Studies, EDePo, 7 Ridgmount Street, London WC1E7AE, United Kingdom
[b] Facultad de Economía, Universidad del Rosario, Casa Pedro Fermín, Calle 12 C # 4-59, Bogotá, Colombia

ARTICLE INFO

Article history:
Accepted 4 February 2018

JEL Classification:
I12
O12
O18

Keywords:
Sanitation
Stunting
Children
India

ABSTRACT

Our study contributes to the understanding of key drivers of stunted growth, a factor widely recognized as major impediment to human capital development. Specifically, we examine the effects of sanitation coverage and usage on child height for age in a semi-urban setting in Northern India. Although sanitation – broadly defined as hygienic means of promoting health through prevention of human contact with the hazards of wastes, particularly human waste – has long been acknowledged as an indispensable element of disease prevention and primary health care programmes, a large number of recent impact evaluation studies on sanitation interventions in low income countries fail to find any health improvements. We address endogeneity of sanitation coverage through an instrumental variable approach, exploiting variation in raw material construction prices. Doing so, we find that sanitation coverage plays a significant and positive role in height growth during the first years of life and that this causal relationship holds particularly for girls. Our findings suggest that a policy that aims to increase sanitation coverage in a context such as the one studied here, is not only effective in reducing child stunting but also implicitly targets girls.

1. Introduction

The failure to reach linear growth potential early in life has been widely recognized as a major impediment to human capital development. There is increasing evidence that growth failure is correlated, likely in a causal way, with lower educational and labour market attainments as well as higher risks of health impediments such as diabetes, heart diseases and strokes (Grantham-McGregor, Cheung, Glewwe, Richter, & Strupp, 2007; Hoddinott, Maluccio, Behrman, Flores, & Martorell, 2008; Behrman et al., 2009; Maluccio et al., 2009; Victora, de Onis, Hallal, Bloessner, & Shrimpton, 2010; Adair et al., 2013; Hoddinott et al., 2013; Spears and Lamba, 2016). Rates of stunting, the general term for a child being short for its age, have been reducing over recent years, but 159 million children around the world are still estimated to be affected, more than half of these living in Asia (de Onis et al., 2015).

While a growing body of literature is contributing to our understanding of the consequences of stunting, knowledge is still limited with respect to the key drivers of low height-for-age. It is generally understood that inadequate diet and diseases are important immediate causes of stunting (Black et al., 2008; Bozzoli, Deaton, & Quintana-Domeque, 2009; Smith and Haddad, 2015); however, dealing with the endogeneity of these inputs remains a challenge in the literature (Deaton, 2007) and, with that, in informed policy decision-making. Understanding these key drivers of stunting and identifying interventions that tackle them therefore remain important points on the development agenda.

In this study, we focus on the role of diseases, by analysing the impact of an improved disease environment – specifically, an increase in the use of sanitation technology – on the growth trajectory of children under the age of 5 years. We address the endogeneity of the disease environment using prices of raw materials for the construction of toilets (cement, pipes, tiles and tin sheds) as instruments for sanitation coverage. Diseases have been linked to stunting[1] (Checkley et al., 2008) but have also shown direct associations with short-term (Nokes et al., 1992, 1998; Walker et al., 2011) and long-term effects on human capital (Bozzoli et al., 2009; Almond and Currie, 2011). Understanding the potential of improving

* Corresponding author.
E-mail addresses: britta_a@ifs.org.uk (B. Augsburg), paul.rodriguez@urosario.edu.co (P.A. Rodríguez-Lesmes).

[1] WHO describes stunted growth (low height-for-age) as 'a process of failure to reach linear growth potential as a result of suboptimal health and/or nutritional conditions'.

https://doi.org/10.1016/j.worlddev.2018.02.005
0305-750X/

the disease environment that children live in is hence of direct policy relevance.

The World Health Organization (WHO) identifies diarrhoea as the disease of primary concern: it is said to be the leading cause of child mortality and morbidity in the world, killing an estimated 760,000 children every year (WHO, 2013). Most of these diarrhoea cases are believed to be due to contamination of the environment. Eighty-eight per cent are seen to be linked to unsafe water, inadequate sanitation or insufficient hygiene, as estimated in a 2008 report by WHO (Pruess-Uestuen, Bos, Gore, & Bartram, 2008). More recent thinking associates lack of sanitation additionally with a gut disorder called environmental enteropathy, which in turn has been linked to impaired growth (Lunn, Northrop-Clewes, & Downes, 1991; Campbell, Elia, & Lunn, 2003; Lin et al., 2013). In fact, environmental enteropathy is now seen by many as a much larger contributor to stunting than diarrhoea (Mbuya and Humphrey, 2016). An important focus of global stunting reduction efforts has therefore been effective and affordable interventions that aim to improve the disease environment by tackling access to safe drinking water, adequate sanitation and hygiene behaviour (Mbuya and Humphrey, 2016; Cumming and Cairncross, 2016). Moreover, potential gains from access to sanitation facilities might expand to non-health-related activities such as time-use of households (Dickinson, Patil, Pattanayak, Poulos, & Yang, 2015).

While interventions that address *simultaneously* water and sanitation environment have been shown to positively affect child health (Merchant et al., 2003; WHO, 2008; Pruess-Uestuen et al., 2008; Checkley et al., 2008; Duflo, Greenstone, Guiteras, & Clasen, 2015), their relative effectiveness, and the role of improved household sanitation in particular, have proven harder to pin down.[2] While a number of studies have been able to rigorously show positive impacts of improved household sanitation (see, for example, Spears (2012), Kumar and Vollmer (2013), Pickering et al. (2015) and Dickinson et al. (2015)), many other recent randomized controlled trials (RCTs) showed no health impacts (Pattanayak et al., 2007; Clasen et al., 2014; Patil et al., 2014).[3]

Our study similarly considers the impact of sanitation on child health. However, instead of focusing on individual household sanitation ownership, we concentrate on sanitation *coverage*, in the sense of the percentage of people using a toilet in a community. The main motivation lies in the understanding that individual household sanitation is unlikely to live up to its promise of improving health statuses when (i) it is not used and (ii) neighbours are still contaminating the environment, i.e. that externalities are at play.[4] The percentage of households in a community that use a toilet is hence hypothesized to be a key driver when trying to understand the potential of sanitation in improving child health.

A number of researchers have turned their attention to linking sanitation *coverage* to child health. Most relevant in the context of our study are Spears (2012) and Hammer and Spears (2013). Exploiting the staggered introduction of India's Total Sanitation Campaign to conduct a difference-in-differences analysis, and the eligibility rules for a village sanitation prize to conduct a regression discontinuity analysis, Spears (2012) shows that infant mortality decreased by 4 per 1,000 and children's height increased by 0.2 standard deviations at the mean programme intensity.[5] Hammer and Spears (2013), concentrating on a special experimental effort in the same area of India, find through an RCT that the programme was associated with a 0.3–0.4 standard deviation increase in children's height-for-age z-scores. Dickinson et al. (2015) consider the effect of a randomized controlled trial of a community-led campaign in Orissa (India). They find that this village- rather than individual-level intervention aimed at ending open defecation increases child height-for-age by 0.37–0.52 standard deviations and weight-for-age by 0.26–0.31 standard deviations. The role of community adoption is relevant not only due to health externalities, but also because adoption has been shown to be more effective if interventions are designed at such a level (Guiteras, Levinsohn, & Mobarak, 2015; Duflo et al., 2015).

We contribute to this active and growing literature in three ways. For one, we explore the impact of sanitation coverage on child health in a (semi-)urban context by considering Indian households residing in slums and peripheral villages. Slum populations are an important group in this context since a distinctive characteristic of their environment is very crowded conditions, implying more important sanitation externality links, while at the same time experiencing on average worse access to sanitation (Buttenheim, 2008; Hathi, Haque, Pant, Coffey, & Spears, 2017). The National Sample Survey Office (NSSO, 2010) estimates that 81% of slum-dwellers in India had inadequate access to sanitation in 2008–09, which compares with national urban sanitation coverage rates of 26% in 2011. A sequence of ongoing work by the Research Institute for Compassionate Economics (r.i.c.e.) suggests that the population *density* in which children grow up is what matters most for sanitation exposure and hence impacts on health (see, for example, Coffey (2014), Hathi et al. (2014), Spears (2014) and Vyas et al. (2014)). A second reason why the slum population is particularly relevant is its fast growth. UN-Habitat (2010) estimates that 40% of the world's urban expansion is taking place in slums. At the same time, cities are struggling to keep pace with necessary infrastructure investment, leading to a phenomenon referred to as 'urbanization of poverty' – partly driven by the externalities of inadequate sanitation.

The second contribution of our study is that it identifies the marginal effect of sanitation coverage on children's growth by exploiting village-level variation in sanitation investment prices, which – as an economic model that we present highlights – determines the marginal cost of this investment and hence induces exogenous variation in the sanitation environment. We find that a 10 percentage point increase in sanitation coverage translates into an approximately 0.7 centimetre increase in height at age 4.

Finally, our third contribution is our consideration of differential effects by gender of the child. Our findings suggest that girls benefit more from an improved sanitation environment than boys, an association that has also been shown in the context of rural Ecuador (Fuller, Villamor, Cevallos, Trostle, & Eisenberg, 2016). This finding implies that sanitation investments can be used as a strategy to implicitly target girls. Such strategies can be of particular importance in a country such as India, where research has shown that boys receive higher parental investment (Barcellos, Carvalho, & Lleras-Muney, 2014).

The rest of the paper proceeds as follows. We start with an exposition of the data and study context in Section 2, followed by a discussion in Section 3 of the methodology we apply. Our

[2] Bennett (2012) in fact suggests that clean water and sanitation are substitutes in the context of the Philippines, clean water having large unintended consequences on sanitation uptake.

[3] Hypothesized reasons for this are manifold and mostly link to technological, financial and behavioural challenges.

[4] This is another possible reason why recent RCTs have failed to demonstrate health impacts of improved sanitation, namely that the coverage increase achieved was not significant enough.

[5] Other work in progress includes Geruso and Spears (2014), who use the fraction of Muslims in a village as an instrument. Gertler et al. (2015) also use an instrument in estimating the impact of open defecation rates on child health (measured by child height). Andrés, Briceño, Chase, and Echenique (2017) use a simple cross-sectional approach, not attempting to account for endogeneity in their variables of interest.