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RESEARCH ARTICLE

WASH ACCESS AND STUNTING: A STUDY OF SCHOOL GOING CHILDREN IN EAG STATES OF INDIA

Dhiren Sahoo[1], Archana Kujur[2]

1 *Research Scholar, Department of Geography, Central University of Karnataka, 585367, Karnataka*
2 *Assistant professor, Department of Geography, Central University of Karnataka, 585367, Karnataka*

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Abstract

Introduction: *The literature suggests that children living in the areas with widespread open-defecation, lack of access to safe drinking water and provision of hand hygiene are exposed to a higher level of microbial contamination. These conditions often keep children undernourished, diminishes their cognitive skills leading to intergenerational poverty.* ***Methods:*** *Using the individual and household data from Indian Human Development Survey 2012 (IHDS II), the study used binary logistic model to analyse the impact of household-based water, sanitation and hygiene (WASH) and health outcome of the children in the Empowered Action Group (EAG) states of India.* ***Results:*** *The study suggested that having access to safe water, the chances of being not stunted are 20 per cent lower compared to the children accessing unsafe water. Similarly, children who have a household toilet and practice better hand hygiene, have 20 per cent higher chances of being not stunted against open defecating children and children who do not practice hand-hygiene habits. Other than WASH, the children's demographic traits of being at a higher age, being female over male, indicated a significantly higher odds of being stunted.* ***Conclusion:*** *The empirical findings suggests that WASH has the ability to guide the child related policies with concrete approaches. Since the three components of the WASH are interdisciplinary it is suggested that combined WASH intervention have massive personal*

Introduction

In recent years, economists have turned their attention to indicators such as physical heights (Steckel, 2009), because it has become increasingly clear that poverty is multidimensional and monetary-measured indicators such as minimum income or expenditure that cannot capture all these dimensions appropriately. Although the recent economic growth has been impressive, Indian for decades remains one of the worst performers for both children and adults are in terms of nutrition and height (Deaton & Drèze, 2009).

Several studies indicate that Indian children's widespread presence of small physique compared to international norms cannot be explained credibly by genetic factors (Bhandari, Bahl, Taneja, De Onis, & Bhan, 2002; Coffey, Deaton, Drèze, Spears, & Tarozzi, 2013; Habicht, Yarbrough, Martorell, Malina, & Klein, 1974) as recent research proposed several other likely contributing factors. Studies (Alacevich & Tarozzi, 2017), for example, show that children of Indian descent

born and raised in England are considerably taller than children in India, even though their parents are of similar height.

Some genuine theory that has gained comparatively little recognition in recent economist research into the Indian Stunting puzzle is sanitation (Alacevich & Tarozzi, 2017; Deaton & Drèze, 2009; Spears, Ghosh, & Cumming, 2013). Medical literature records that frequent childhood environmental exposure to faecal germs can be a significant cause of stunting (Humphrey, 2009). In India, sanitation coverage is abysmal, with more than half of households defecating in the open, a much greater proportion than in other parallel-income countries. Spears (Spears, 2013) suggested that sanitation describes the difference in stunting robustly, even after accounting for GDP and other aspects of heterogeneous economic growth. Open defecation variations are enough in order to statistically explain the disparity between Indian children and African children in average height.

Children with poor nutrition often spent all their energy in fighting infections causing permanent loss of height and intelligence. These losses are often cyclical and termed as 'Stunting syndrome' (Prendergast & Humphrey, 2014). Child health has many measurement parameters, but Stunting is most significant to understand the long-term nutritional deprivation among children (WHO, 2012) and is often related to conditions specific to geopolitics, socioeconomics and population, including illness, inadequate food and insufficient access to essential services.

By serving as an obstacle to access to healthy nutrition and spending more time using these services, inadequate WASH will indirectly affect the family. For example, water shortage is shown also to restrict the capacity to grow and water vegetables, thus depriving citizens of the necessary nutrients required to tackle diseases (FAO, 2012). Also, water collection, mainly the responsibility of women and children in developing and underdeveloped countries, serves as an extra burden. These extra time spent also transformed into schooling and nutrition(Grassi, Flavia; Landberg, Josefine; Huyer, 2015; Montgomery & Elimelech, 2007).

The children's health and wellbeing are given utmost priority in framing the historical Sustainable Development Goal (SDG). As the return on expenditure is promising, economies around the world are spending their capital on child development and ignoring these facts keeping millions of children stunted and not to reach their optimum capacity. Poor human capital brings multidimensional poverty and keeping nations backwards in Asia and Africa.

The fact that children in India and its neighbouring countries of South Asia are stunted on average compared to people in Africa, given the fact that the latter is doing worse in indices of economic and child growth is termed as 'Asian Enigma' (Ramalingaswami, Jonsson, & Rohde, 1996).

This study aimed to understand the effects of hygiene and sanitation conditions on health outcomes in the Empowered Action Group (EAG) states of India. These states include Uttarakhand, Utter Pradesh, Rajasthan, Madhya Pradesh, Bihar, and Jharkhand, Chhattisgarh and Odisha. As per the census 2011, most of these states were poorest in sanitation coverage; way below the national average of 46.9 per cent. Further, these states tend to have low Human Development Indices (HDI) like health and education both in terms of prevalence and absolute numbers. For example, of the total population of the state Bihar, 48.2 per cent people were stunted and 22.5 per cent people were with no schooling (Indian Institute for Population Sciences (IIPS) and ICF, 2017). They also have high rates of over-reporting, and due to their large population size, their situation represents a tremendous challenge for India as a whole. Therefore, it becomes necessary to understand the factors which determine absenteeism and health in these states.

Data and Methods

The study uses the individual and household level data of the Indian Human Development Survey 2012 (IHDS II) for the analysis (Desai & Vanneman, 2018). The India Human Development Survey (IHDS) is a nationally representative, a multi-topic panel survey of 41,554 households in 1503 villages and 971 urban neighbourhoods across India. The first round of interviews was completed in 2004-5. The second round of IHDS reinterviewed most of these households in 2011-12 (N=42,152) IHDS has been jointly organised by researchers from the University of Maryland and the National Council of Applied Economic Research (NCAER), New Delhi.

Dependent variable

Stunting, as the two standardised anthropometric measurements provided by the World Health Organization/National Center for Health Statistics (WHO/NCHS), are taken to analyse a child's health status in the study. Stunting is calculated using height-for-age z-scores, can be expressed as follows:

$$z-\text{score} = \frac{\text{measured value} - \text{average value of the reference population}}{\text{the standard deviation of the reference population}}$$

The Z score was computed using WHO AnthroPlus software for the global application of the WHO Reference 2007 for 5-19 years to monitor the growth of school-age children and adolescents. Based on each individual child's height-for-age z-scores, the stunting status can be defined by one of the following integer values: 0 (Stunted; if z-score is $-2\geq$ & ≥ -6) or 1 (Not stunted; if z-score is $-2<$ & ≤ 6).

Independent variable

Three main explanatory dichotomous WASH variables used for the study were constructed from available data related water, toilet, and hand washing from the first round of

the survey. Access to safe water was given code one if the household is using safely managed water from reliable sources (WHO, 2018) that is located on-premise throughout the year or zero otherwise. Access to the toilet was coded one if the household has accessibility to either private or public toilet else zero if the household practices open defecation. Children are performing better hygiene in the form of hand washing with soap after defecation was coded one and otherwise coded zero.

Control variables are secondary variables that can influence the outcome of the study, along with the primary predictor variable. Control variables are held constant to minimise their influence while evaluating the relative relationship between the dependent and independent variables. The control factors themselves are not of primary importance to the study. Based on the review of the literature, the following control variables are considered for the study they are broadly classified into child-related factors, school-related factors and household-related factors. The attribute of the child includes 1) Age in absolute numbers and 2) Gender. The household attribute of the child consists of 1) Religion, 2) Caste, 3) Poverty status 4) Household size, 5) Sources of household incomes, 6) Highest adult education, 7) Residence type, 8) Type of cooking practice, 9) Roof type, 10) Household electrification status and 11) Observation regarding stagnant water around the household.

Statistical Analysis

Quantitative and qualitative analysis was carried out to fulfill the objectives of the study. Both bivariate and multivariate analyses were done. Bivariate Chi-square and t-test were carried out to check the associations between the dependent and independent variables. The variables in the data were checked for outliers and potential multi-collinearity before carrying out multivariate analysis. For regression analysis, variables that were found to be significantly associated (with $p < 0.10$) were retained. All of the analysis was performed on STATA 14.

Logistic Regression Model

The study uses binary logistic models to map out the interaction between the binary outcome variable is binary and its predictors. The logistic model is structured as follows:

$$\mathbf{Log(pi/1\text{-}pi) = \beta 0 + \beta WASHi + \beta Controlsi + \varepsilon i}$$

Where p is individual children i's probability of being in any of the outcome groups, $\beta 0$ is regression constant, βWASH_i is the vector of three independent WASH indicators, $\beta \text{Controls}_i$ is the vector of independent confounding factors, and ε_i is the error. The coefficient of the regression model is expressed in terms of the Odds Ratio (OR). The interpretation of the odds ratio is that, for a one-unit (or going from 0 to 1) increase in an independent or predictor component (for example, going from open defecation to having a toilet), the odds of being in any outcome group(for example, not stunted vs stunted) increases by the factor of estimated coefficient, holding all other variables in the model constant.

Results

Stunting, or deficient height-for-age, is a symptom of persistent undernutrition that indicates a long-term inability to obtain proper nutrition. Chronic and recurring diseases can also cause stunting. The variance in stunting may be attributed to different variables that may range across several socio-economic variables. Therefore, this section first tries to investigate the variation is stunting and further attempts to understand its relationship with WASH variables. WASH variables are taken as proxy factors for a variety of factors that can affect child health and thereby have an impact on their nutritional status. Children with access to poor WASH can be affected by diseases caused by faecal exposure, gut infections reducing nutritional absorption capacity, and anaemia which may be due to health issues like the presence of hookworm. Therefore, the WASH access of a child is taken as a proxy for less susceptibility to illness on which easily interventions can be carried out at household level by government policies as compared to identification of the disease pathogens which required more complicated policy approach. Further binary logistic regression is carried out to find statistically significant variables to predict the probability of stunting.

The percentage of children who are stunted is shown in Figure 1. Among school-going children aged 8-11, about 28.07 per cent of children are stunted. The percentage of children in the study population may appear low, but since this study does not include children who do not attend school and may belong to lower strata with the least access to resources, the actual number may be far higher. NFHS-4 data shows that the percentage of children under-age five who are stunted varies between 34-48 per cent in these EAG states. Further, if we look at the percentage distribution of children who are stunted there appears to be much variation which can be seen according to the background characteristic.

WASH and Stunting among children

The study hypothesized that children's access to improved WASH could help them to reach the corresponding height and weight of their age and gender.

The result in Figure 2 demonstrations the distribution of children's stunting status by individuals' access to WASH. Overall, the prevalence of stunting is seen to be lower in children with access to clean water, toilet and soap to wash hand. Stunting is lowest for children who have toilet access, followed by handwashing and water. Of all the children who have a toilet at home, just 20 per cent of them are stunted. Similarity 23 per cent of children and 26 per cent of children

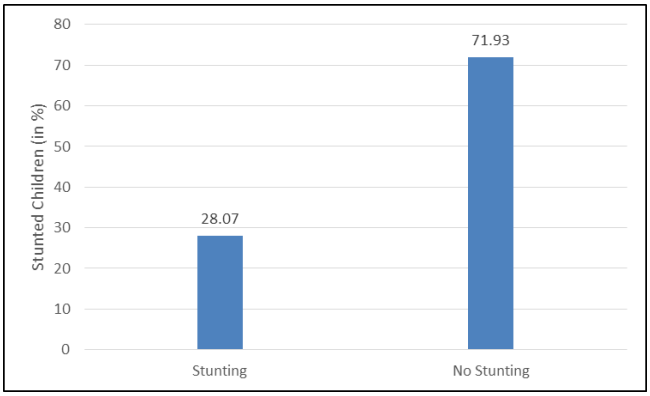

Fig. 1. Percentage of Children Stunted (Source: Author's Computation Using IHDS II Data)

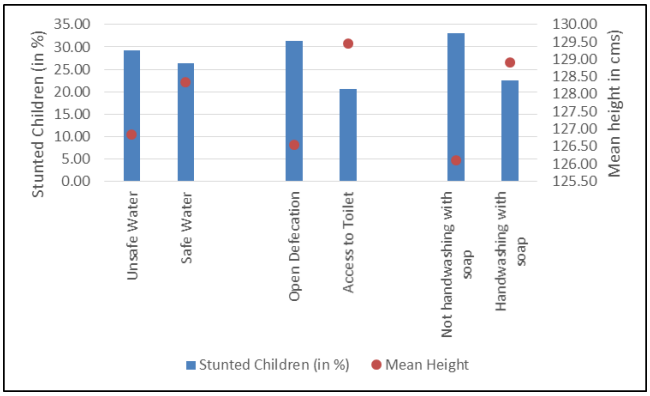

Fig. 2. Percentage of Children Stunting and Mean Height by WASH Access (Source: Author's Computation Using IHDS II Data)

who practise hand-hygiene and had access to clean water respectively were found to be stunted. Similar results are seen based on the mean height reached by children; children with improved WASH were found to have a higher anthropometric height than those who do not have access to these facilities.

Binary Logistic Model to predict the factors affecting the chances non-occurrence of stunting among children

The binary logistic model is used to predict the variables which will negatively affect the occurrence of stunting. The primary aim of this analysis is to see whether the WASH variables significantly influence the occurrences of stunting or not. Other control variables, such as the child characteristics and household characteristics, are also included in this model. For the ease of understanding the results from the model are split into two tables. The first column contains all the independent variables, the second column consists of estimated coefficients or odds ratio, and the third column shows a confidence interval at 95% level of significance.

Table 1. Binary Logistic Regression to Predict No Stunting Among Children According to Their Wash and Child-related Factors

Independent Variables	Dependent variable: No Stunting	
	Odds Ratio (OR)	95% CI
WASH-related Factors		
Drinking Water Access		
Unsafe Water (Ref.)		
Safe Water	0.796***	[0.694-0.913]
Toilet		
Open Defecation (Ref.)		
Access to Toilet	1.196**	[1.014-1.411]
Handwashing Practice After Defecation		
Not handwashing with soap (Ref.)		
Handwashing with soap	1.209***	[1.058-1.382]
Child-related Factors		
Age	0.887***	[0.840-0.937]
Gender		
Male (Ref.)		
Female	0.678***	[0.603-0.763]
Pseudo R-squared	0.045	
chi2	321.3	
Observations	6091	

Stunting=0, No stunting=1, Exponentiated coefficients; 95% confidence intervals in brackets. * p<0.10, ** p<0.05, *** p<0.01, Source: Computed by Author using IHDS II Data

WASH and Child-related factors

Results in Table 1 show that all three WASH variables in the study have significant effects on the child's stunting level. The odds ratio of children with access to safe water is .79 (CI 95%: 0.694-0.913) over children who use unsafe water. In general, for children having access to safe water, the chances of being not stunted are 20 per cent lower compared to the children accessing unsafe water. Similarly, the odds of being not stunted while having access to a household toilet against practicing open defecation is 1.19 (CI 95%: 1.014-1.411), and odds ratio for always handwashing with soap after defecation over not handwashing is 1.2 (CI 95%: 1.058-1.382). Alternatively, it can be articulated as, the children who have a household toilet and practice better hand hygiene, have 20 per cent higher chances of being not stunted against open defecating children and children who do not practice hand-hygiene habits. Other than WASH, the children's demographic traits of being at a higher age, being female over male, indicated a significantly higher odds of being stunted.

Table 2. Binary Logistic Regression to Predict No Stunting Among Children According to Their Household Characteristic

Predictors	No Stunting	
	Odds Ratio (OR)	95% CI
Household-related Factors		
Religion		
Hindu (Ref.)		
Non-Hindu	0.832**	[0.700-0.989]
Caste		
General (Ref.)		
OBC	0.944	[0.794-1.121]
SC/ST	0.830*	[0.683-1.009]
Poverty Status		
Non-poor (Ref.)		
Poor	0.874**	[0.766-0.997]
Household Size		
<=5 (Ref.)		
>5	0.832***	[0.731-0.947]
Source of Income		
Agriculture (Ref.)		
Labour	0.801***	[0.692-0.928]
Others	1.055	[0.893-1.248]
Highest adult Education		
Illiterate (Ref.)		
<=5	0.894	[0.753-1.062]
>5	1.119	[0.964-1.300]
Residence Type		
Rural (Ref.)		
Urban	1.263**	[1.055-1.512]
Clean Cooking Practices		
Unclean cooking (Ref.)		
Clean cooking	1.418***	[1.228-1.639]
Roof Type		
Kutcha (Ref.)		
Pucca	1.195**	[1.036-1.379]
Household Electricity		
No (Ref.)		
Yes	1.271***	[1.108-1.458]
Observations: Stagnant Water		
Stagnant Water (Ref.)		
No Stagnant Water	1.162*	[0.999-1.350]
Pseudo R-squared	0.045	
chi2	321.3	
Observations	6091	

Stunting=0, No stunting=1, Exponentiated coefficients; 95% confidence intervals in brackets. * p<0.10, ** p<0.05, *** p<0.01, Source: Computed by Author using IHDS II Data

Household-related factors

The result from Table 2 shows that among the household-related variables shows that children with belonging to the following background characteristic are less likely to be non-stunted: belonging to the non-Hindu religion, belonging to the SC/ST caste over the General caste, belonging to the poor family, having a large family size of more than five members and a family source of income from labour over agriculture.

Additionally, children who belong to the following households are more likely to be non-stunted, such as living in an urban area over a rural area, maintaining clean cooking habits over unclean habits, living under a pucca roof compared to a kutcha roof, providing household electricity and a hygienic household environment as compared to other children.

Conclusion

The study uses the Indian Human Development Survey's longitudinal and panel characteristics to understand the impact of WASH behaviours such as Safe drinking water, toile access and hand-wash with soap health outcome of the children. The results from this chapter show that the prevalence of stunting, is considerably high among the school going children and there is a wide disparity across different socio-economic strata. The percentage of children who are stunted is as high as 28.07 per cent, which shows wide variation across different groups. The percentage of children are stunted in ten years of age group, and almost nine per cent female children are stunted as compared to male children. As per the background factors, a higher percentage of children who are stunted and who are thin and severely thin belong the following categories; Hindu religion, SC/ST caste, household size of more than five, where the household source of income is labour, Household where adults are not educated, living in rural areas, living in households were unclean fuel is used for cooking, living in households with kutcha roof, living in households with no electricity and around whose house water stagnation is observed.

The stunting results with good WASH access indicates significant positive results. The percentage distribution graph of WASH and stunting shows that a lower percentage of children who have access to WASH is stunted as compared to children who do not have access to proper WASH facility. The binary logistic regression result shows similar result where children who have access to toilet and who washing hand with soap have statistically significant lower odds of being stunted. The results from the chapter show that there is a positive association of good WASH access on the health of the children. Recognising the connection between WASH and nutrition has the ability to guide policies, initiatives, and concrete approaches. Policymakers have recently realised the value of WASH as a key mediating factor in the reduction of widespread malnutrition among children. Since

the mediating pathway between WASH and nutrition is involved, it is suggested that combined WASH intervention works best against individual components. A broad spectrum of well-documented and generally accepted health and non-health benefits are provided by increased access to clean and sustainable WASH. Significant adoption of WASH, along with dietary interventions, is beneficial not only to a person but also to the community as a whole.

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