WORKING PAPER NO. 42

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# Household pit latrines and child health in rural Ethiopia

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Young Lives
An International Study of Childhood Poverty

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# Abstract

In response to pressure to reach the Millennium Development Goal of improved sanitation access, the Ethiopian government has developed an ambitious plan to achieve 100 per cent access to pit latrines by 2012. The plans to achieve this target rely upon the assumption that universal access to pit latrines will lead to improved health outcomes. Using the Young Lives pro-poor longitudinal data of Ethiopian children, this research uses propensity score matching to test this assumption. Children who experienced a change from no toilet to a household pit latrine between rounds of data collection were compared to those who continue to use a forest/field. The findings show that there is no significant difference between groups in terms of health outcomes and that a pit latrine does not necessarily signal improved methods of waste disposal. Individual and group interviews conducted by Young Lives suggest that poor infrastructure and care for pit latrines deter children from using such facilities and promote a preference for the use of other methods of waste disposal. Policy makers should note that simply increasing access to pit latrines will not necessarily promote better health outcomes, especially when 'improved' sanitation appears to be less clean than other available options.

**Keywords:** propensity score matching, child health, sanitation, Ethiopia

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# 1. Introduction

The Young Lives project is a longitudinal study following 12,000 children in four different countries: Ethiopia, India (Andhra Pradesh), Peru and Vietnam. The study began in 2000 and will continue to track these children and their caregivers until 2015. Households from 20 sentinel sites in Ethiopia spanning the five main regions have been selected using purposive and random sampling approaches with a pro-poor bias (Sanchez et al. 2008). Young Lives researches concepts and experiences of poverty on three levels: the community, the household and the child. Through the use of extensive questionnaires, data is gathered on areas such as education, economics, health, food security, social capital and caregiver attitudes and perspectives, among others.[1] The quantitative research is supplemented by qualitative research with approximately 50 children in each country, 25 from each cohort (see below). The purpose of Young Lives is twofold: to improve understanding of the causes and consequences of poverty and to inform the development and implementation of future policies and practices that will reduce childhood poverty (Boyden 2008).

Using the anthropometric data from the Young Lives study as well as information regarding social and economic status, household environment, mother's education and other relevant variables, child health will be analysed in the context of changing methods of waste disposal through their potential effects on z-scores of height-for-age (stunting) and weight-for-age (underweight).

# 2. Review of the literature

UNICEF reported in 2005 that 13 per cent of Ethiopians had access to 'improved' sanitation (UNICEF 2005).[2] Ethiopia's Head of Environmental Health has reported that the current percentage of households with access to sanitation is 28.6 per cent but that 30-80 per cent of the available pit latrines may be non-functional (Gebreselassie 2007). Though the Millennium Development Goal (MDG) target for sanitation in Ethiopia is to reach 52 per cent of all households, the Ethiopian government has ambitious plans to achieve 100 per cent coverage in hygiene and sanitation by 2012, with their new National Hygiene and Sanitation Strategy and Protocol (Gebreselassie 2007). The Protocol is based on three pillars: promoting healthy behaviour (advocacy, social mobilisation, and social marketing); having an enabling social and political environment (political support, public financing and coordination); and access to the necessary products and technology (infrastructure and hygiene products) (Gebreselassie 2007). With the training of 30,000 health extension workers (9,900 already trained) and constructing and equipping health posts (Gebreselassie 2007), the government is trying to address a need that is highlighted by the United Nations Development Programme (UNDP) as a critical development concern (UNDP 2006).

It is estimated that 4 per cent of all deaths and 5.7 per cent of the global burden of disease is caused by poor water, sanitation and hygiene (Pruss et al. 2002). Roughly 1.5 million children under the age of five die from poor sanitation and water each year (UNICEF 2006).

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1 See http://www.younglives.org.uk/research-methodology-data.

2 'Improved sanitation' refers to facilities that flush into a piped sewer system, septic tank, pit latrine, a ventilated latrine, pit latrine with slab or a composting toilet (UNICEF 2005).

Within Ethiopia, it is estimated that more than 250,000 die each year from poor sanitation, hygiene and water (Gebreselassie 2007), compared to the estimated 500,000 children who die each year in Ethiopia due to preventable diseases and malnutrition (UNICEF 2005). Although institutions such as the World Bank and UNICEF have dedicated considerable resources to improving sanitation around the world,[3] 51 countries, including Ethiopia, are at risk of not meeting their sanitation target within the Millennium Development Goal number 7 (target 10) for environmental sustainability (UNICEF 2008). It is estimated that approximately 2.4 billion people will remain without adequate sanitation facilities by 2015 (UNICEF 2007).

Poor sanitation increases the risk of faecal-oral transmission and is a major risk factor in exposing children to pathogens and infectious diseases (Silva 2005). These pathogens and diseases can cause severe diarrhoea that claims up to 2.2 million lives per year worldwide (Rheingans et al. 2006); even where there are no symptoms, related diseases can prevent the absorption of nutrients necessary for growth and development (Checkley et al. 2004). In a study conducted by Checkley et al. (2004) in Peru, children 24 months of age with the worst sanitation, water source and water storage had 54 per cent more episodes of diarrhoea then those children with optimal conditions. Though data on experiences of illness (diarrhoea) have been collected from the Young Lives sample, it will not be considered in this analysis due to the different methods of questioning employed between Round 1 and Round 2. Also, measuring the incidence of diarrhoea accurately would require data collected more frequently than at the four-year intervals of the Young Lives project. Finally, anthropometric measures provide a more sensitive assessment of the effects of poor sanitation in the short-term and long-term by focusing on nutritional outcomes: height-for-age and weight-for-age. Low height-for-age is associated with poor environmental conditions as well as current experiences, whereas weight-for-age is correlated with cumulative health and nutritional problems (Bhasin et al. 2007). This study attempts to quantify the direct link between sanitation and nutritional health measures while not distinguishing between symptomatic (diarrhoea) and asymptomatic children.

While progress towards the MDG 2015 target for access to adequate water is better than sanitation in Sub-Saharan Africa, neither are on track to reach their target. In Sub-Saharan Africa, water will miss the target by a generation and sanitation will miss the target by more than two generations (UNDP 2006). Meanwhile, the health benefits expected from improved water sources are in danger of being dampened by the lack of similar improvement in sanitation. A study using the Demographic Health Survey (DHS) data from eight different countries showed that child health improves with better water and sanitation services, both in terms of diarrhoeal incidence and anthropometric measures (Esrey 1996).[4] The study also highlights that without accompanied improvements in sanitation, the full health benefits of adequate water resources are diminished (Esrey 1996). Esrey et al. (1986), in their analysis of epidemiological studies that focused on child health and sanitation and water, stress that excrement disposal plays an important role in child health and cannot be underestimated when comparing it to the benefits of clean water, especially in the instances of high rates of diarrhoea.

3 The World Bank as dedicated more than $5.5 billion (US) to improving sanitation over the past 25 years (Iyer et al 2006). UNICEF has a department on waste, environment and sanitation (www.unicef.org/wes).

4 The eight countries used in Esrey’s (1996) study were Burundi, Ghana, Togo, Uganda, Morocco, Sri Lanka, Bolivia and Guatemala.

A multifaceted approach is needed to address health issues associated with poor sanitation and water. Improving access to sanitation and ensuring adequate programmes are in place that address cleanliness practices are central to responding to the health needs of children living in poverty. An example of an existing programme in Ethiopia is the National WASH Coalition, which works with government offices both locally and internationally (WHO, USAID, UNICEF), civil society organisations, the private sector, faith-based organisations and individuals, to contribute to reducing the risk of morbidity and mortality associated with poor sanitation and hygiene. The Coalition's annual areas of focus include: proper hand washing, waste disposal and water quality (Water Supply and Sanitation Collaborative Council).

# 3. Methods

## 3.1 Young Lives data

The first round of quantitative data gathering began in 2001 with caregivers of 2,000 children aged 12 months (8 to 17 months) classified as the 'younger cohort' and a reference population of 1000 children who were 7.5 to 8.5 years, known as the 'older cohort', in each country. The second round of data gathering took place in 2006 when the children in each cohort were 5 to 6 years old and 11 to 12 years old, respectively. Qualitative research was conducted in 2007 with the second round scheduled for late 2008 or early 2009.[5]

This study will analyse the impact of changing methods of waste disposal in households on the health of children in the younger cohort, as measured by z-scores height-for-age (stunting) and weight-for-age (underweight), using both rounds of data from the household survey conducted in 2000/2001 and 2006. The children were between 6 and 18 months in the first round and 5 to 6 years of age during the second round. Children's perspectives of sanitation and cleanliness from the qualitative research will also be included in the study. Although the Young Lives data should not be used as a representative country sample, it can be used to analyse causal relationships from which generalisations can be made (Sanchez et al. 2008).[6]

The Young Lives data of Ethiopian children from the younger cohort, 2,000 in Round 1 and 1,913 in Round 2, were analysed using STATA version 10.[7] The data used for this analysis includes the anthropometric measures of the child's height and weight. Information on wealth status, mother's education, breastfeeding, and other potentially confounding variables were also included in the analysis.[8] The primary weakness of measuring wealth using the wealth index from Round 1 is its infrastructure bias, which is not as applicable to rural communities. Although a more robust method of calculating wealth status is available from the Round 2 data, the status of wealth in Round 1 allows us to understand the context in which the initial changes occurred with the development of sanitation infrastructure.

5 Please see Crivella et al.'s forthcoming publication for more information on qualitative research.

6 For more information on the comparability of young lives data with the Demographic and Health Survey 2000 and the Welfare and Monitoring Survey 2000 read (Sanchez et al 2008).

7 Attrition of children in Ethiopian sample is largely due to death and migration.

8 Wealth index was calculated adding household quality, consumer durables and services. Housing quality was calculated as scaled values (0 to 1) of rooms per person, wall, roof and floor durability divided by 4; consumer durables were calculated as scaled values (0 to 1) of radio, fridge, bicycle, TV, motorbike/scooter, motor car/truck, mobile phone, landline phone, modern bed, table or chair and sofa divided by 11; services were calculated as scaled values (0 to 1) of electricity, water, sanitation and cooking fuel divided by 4.

The height-for-age and weight-for-age z-scores were calculated using the WHO reference population and ANTHRO programme (WHO 2004) for both rounds, when the children were, on average, 12 months old and then again when they were 5 to 6 years old. Flagged z-scores, based on the WHO criteria, were excluded from the study, decreasing the total sample size to 1,880. Flagged z-scores for weight-for-age and height-for-age were < - 5.0 and > 5.0 and < - 5.0 and > 3.0, respectively (O'Donnell et al. 2008).

Children were categorised into two groups for this study – the treatment group, which consisted of 390 children who went from having no toilet in Round 1 to having a household pit latrine in Round 2. The control group was composed of 590 children who did not have toilets of any form in Round 1 and Round 2. However, due to the small numbers of urban children in the treatment and control group (n=125) and the diverse experiences urban children have in terms of resources and community density compared to their rural peers, the study focuses only on rural children, dropping the number of children in the control and treatment group to 496 and 357, respectively (Table 1). The covariates from Round 1 used in this study include gender, mother's education, length of breastfeeding, water sources, wealth index, weight-for-age z-scores, household size and ethnicity. The treatment effects were analysed with propensity score matching using the psmatch2 procedure (Leuven and Sianesi 2003), utilising kernel matching and nearest neighbour matching.[9]

A limitation of this analysis is the lack of information regarding the exact time at which households and communities had access to pit latrines within the last four years. If households acquired pit latrines very recently before the second round of questionnaires, the results may be biased towards a lack of change in child health outcomes. However, while height-for-age and weight-for-age are chronic measures of health, they will exhibit changes in less than a year. Despite the limitations of this approach, the results will still be highly relevant with the assumption that most of the households that acquired pit latrines will have done so far enough prior to the second round of data collection to show changes (or their lack) in child health.

**Table 1:** *Breakdown of toilet use between Round 1 and Round 2 (Rural)*

| **Type of toilet** | | **Round 1** | | | | |
|---|---|---|---|---|---|---|
| | | **Flush toilet** | **Pit latrine (household)** | **Pit latrine (communal)** | **None** | **Other** |
| Round 2 | Flush toilet/septic tank | 0 | 0 | 0 | 2 | 0 |
| | None: Forest/field/open place | 1 | 57 | 27 | **496*** | 1 |
| | Neighbour's toilet | 0 | 82 | 2 | 12 | 4 |
| | Pit latrine (communal) | 0 | 2 | 2 | 35 | 1 |
| | Pit latrine (household) | 20 | 97 | 14 | **347**** | 53 |
| | Relative's toilet | 0 | 3 | 0 | 1 | 0 |
| | Simple latrine on pond | 0 | 16 | 1 | 54 | 3 |

Note: *Control Group **Treatment Group. Sample size = 1203

Qualitative research with children and caregivers was conducted in 2007 through individual and group interviews, using methods such as body mapping and community mapping (Tafere et al. 2008). A subsample of children from the younger and older cohorts were interviewed

9 Leuven, E., and B. Sianesi (2003) 'PSMATCH2: Stata Module to Perform Full Mahalanobis and Propensity Score Matching, Common Support Graphing and Covariate Imbalance Testing' software.

from five out of the twenty sentinel sites, one from each of the five main regions, including two urban and three rural communities. For the purposes of this study, data from the older children's interviews – 34 in total – were coded and categorised based on perspectives of cleanliness and toilet use, using ATLAS.ti (version 4.2, 1999), a qualitative data management software. Though the qualitative research did not focus specifically on experiences of sanitation, strong views of pit latrine use and cleanliness were brought forward by the children and subsequently investigated by the interviewers. The children also provide practical assessments and reasoning behind using the field versus unclean pit latrines.

# 4. Results

## 4.1 General description

The height-for-age (stunting) and weight-for-age (underweight) z-scores between Rounds 1 and 2 show an improvement in the children's malnutrition status, though the levels are still considered high by the WHO standards (O'Donnell et al. 2008). The percentage of children classified as being underweight (height-for-age z-scores under -2 SD) dropped from 36.6 per cent in Round 1 to 27.3 per cent in Round 2 (Table 2). A similar trend occurred with stunting (height-for-age z-scores below -2 SD), with 44.8 per cent in Round 1 to 33.9 per cent in Round 2. This descriptive overview of the z-scores illustrates a general trend of improvement among the younger cohort, despite the still relatively high levels of children's malnutrition (O'Donnell et al. 2008) (Figure 1ab and 2ab).

**Table 2:** *Round 1 and Round 2 z-scores*

| | | **Round 1** | | | **Round 2** | | |
|---|---|---|---|---|---|---|---|
| | | **Number of children** | **Percentage** | **Mean (SD)** | **Number of children** | **Percentage** | **Mean (SD)** |
| z-wfa | < -2 SD | 440 | 36.6 | -1.58 (1.46) | 329 | 27.3 | -1.44 (0.93) |
| | < -3 SD | 191 | 15.8 | | 55 | 4.5 | |
| z-hfa | < -2 SD | 539 | 44.8 | -1.63 (1.91) | 408 | 33.9 | -1.54 (1.10) |
| | < -3 SD | 275 | 22.9 | | 112 | 9.3 | |

Note: sample size = 1203

**Figure 1:** *Height-for-age z-score distribution*

**a) Round 1** **b) Round 2**

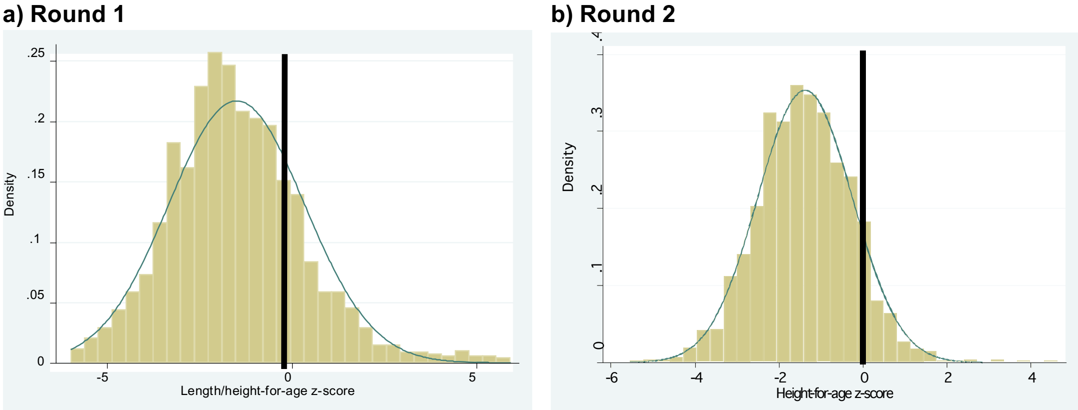
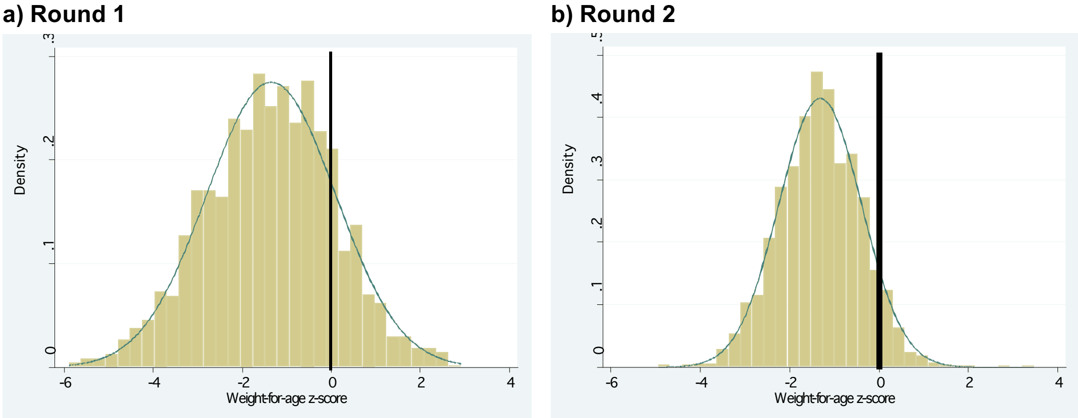


**Figure 2:** *Weight-for-age z-score distribution*




The subsample (n=848) that is analysed using propensity score matching has a much lower SD scores of weight-for-age and height-for-age compared to the whole sample (Table 3). The treatment group has z-scores for weight-for-age and height-for-age of -1.39 SD and -1.54 SD, respectively. The control group has an even lower score compared to average, with weight for height and height-for-age scores reaching an average of -1.56 SD and -1.69 SD, respectively. This difference in z-scores among the subsample could be attributed to the criteria for treatment and control groups (no sanitation facilities in Round 1). The impact of not having sanitation facilities at the time of the first round of data gathering may have had lasting impacts on health for the subsample and this can be explored in subsequent rounds of data gathering.

**Table 3:** *Treatment vs. control – average z-scores (Round 2)*

| | z- weight-for-age | z- height-for-age |
|---|---|---|
| Treatment (n=347) | -1.42 (0.96) | -1.69 (1.08) |
| Control (n = 496) | -1.58 (0.90) | -1.54 (1.13) |
| Whole sample (n=1202) | -1.44 (0.92) | -1.34 (1.08) |

Note: Standard deviations are in parenthesis.

For the purposes of this study, the treatment effects were measured and the children were matched using the following variables: length of breastfeeding, household size, mother’s education, gender, source of drinking, weight-for-age z-scores and ethnicity. The treatment and control groups were matched based on these variables and tested using the nearest neighbourhood and kernel matching; health outcomes were measured using z-scores for weight-for-age Round 2 and height-for-age Round 2.

The propensity score matching (PSM) method was selected in order to reduce bias when analysing casual relationships using observational data (Rosenbaum et al. 1983). PSM generates predicted probabilities of two groups (control and treatment) by balancing the distribution of observed covariates (such as wealth status, household size, etc.) (Jalan et al. 2003).[10] Table 4 provides the summary statistics of conditioning variables used in propensity score matching. Three specifications were used to check robustness of test (see notes for details on Table 4). The probit estimates of the three specifications can be found on Table 5.

10 For more details on propensity score matching see: Caliendo and Kopeinig (2005) ‘Some Practical Guidance for the Implementation of Propensity Score Matching’, IZA DP No. 1588.

**Table 4:** *Summary statistics for conditioning variables from matched and unmatched samples*

| | **Raw Sample** | | | **Matched Sample** | | |
|---|---|---|---|---|---|---|
| | **Treatment (1)** | **Control (2)** | **t-test (p-value) testing for the equality of means between (1) and (2)** | **Treatment (4)** | **Control (5)** | **t-test (p-value) testing for the equality of means between (4) and (5)** |
| **Weight-for-age z-score (sd)** | -1.41(0.05) | -1.58(0.04) | -2.50 (0.01)** | -1.38 | -1.35 | -0.16 (0.89) |
| **Height-for-age z-score (sd)** | -1.56 (0.06) | -1.68 (0.05) | -1.73(0.04)** | -1.58 | -1.41 | -1.05 (0.29) |
| ***Specification 1*** | | | | | | |
| **Gender (male)** | 0.47 | 0.46 | 0.24(0.811) | 0.46 | 0.45 | 0.40(0.69) |
| **Mother's Education** | 0.54 | 0.78 | -6.95(0.00)** | 0.55 | 0.53 | 0.48(0.63) |
| **Father's Education** | 0.70 | 0.51 | 5.20(0.000)** | 0.69 | 0.67 | 0.60(0.55) |
| **Tigerian** | 0.055 | 0.34 | -9.95(0.00)** | 0.05 | 0.045 | 0.55(0.58) |
| **Oromo** | 0.17 | 0.18 | -0.18(0.855) | 0.17 | 0.13 | 1.58(0.114) |
| **Amhara** | 0.19 | 0.24 | -0.16(0.10)* | 0.19 | 0.19 | -0.10(0.919) |
| **Household size (log)** | 1.73 | 1.66 | 2.51(0.01)** | 1.72 | 1.69 | 1.00(0.32) |
| **Breastfed for 12 months** | 0.97 | 0.99 | -2.38(0.02)** | 0.97 | 0.98 | -1.21(0.23) |
| **Age of child (months)** | 11.95 | 12.25 | -1.16(0.25) | 11.94 | 11.73 | 0.75(0.45) |
| **Unprotected water source** | 0.66 | 0.73 | -2.00(0.05)** | 0.66 | 0.71 | -1.21(0.224) |
| **z-score Weight-for-age** | -1.49 | -1.88 | 3.77(0.00)** | -1.50 | -1.50 | -0.06(.96) |
| **Wealth Index (log)** | -3.42 | -3.29 | -1.59(0.11) | -3.43 | -3.5 | 1.24(0.22) |
| ***Specification 2*** | | | | | | |
| **Gender (female)** | 0.53 | 0.54 | -0.32(0.752) | 0.53 | 0.50 | -0.24(0.81) |
| **Gender of HH head** | 0.95 | 0.88 | 3.22(0.001)** | 0.95 | 0.96 | -0.59(0.56) |
| **Household size** | 3.11 | 2.881 | 2.38(0.02)** | 3.11 | 3.22 | -1.06(0.292) |
| **Wood** | 0.76 | 0.48 | 7.84(0.00)** | 0.76 | 0.75 | 0.09(0.926) |
| ***Specification 3*** | | | | | | |
| **Electricity** | 0.95 | 0.98 | -1.92(0.06)* | 28.5 | 28.3 | -0.20(0.84) |
| **Measles Vaccination** | 0.49 | 0.57 | -2.32(0.02)** | 0.95 | 0.96 | -0.49 (0.63) |

Note: For the binary variables, the values in columns 1, 2, 4 and 5 are proportions. For continuous variables, the mean value is shown. ** Significant to the 5% level or higher *Significant to the 10% level or higher.

Specification 2: father's education, Tigerian, Oromo, Amhara, sex of household head, household size (loghhsize*loghhsize), breastfed for 12 months, z-weight-for-age, wealth index (log), wood. Specification 3: gender (1 = female), Tigerian, Oromo, Amhara, breastfed for 12 months (1 = yes), unprotected water source (well, spring, pond, river), z weight-for-age, wood, measles vaccination, electricity (1= no). Specification 1 was selected for the analysis of weight-for-age z-scores and height-for-age z-scores. The 'matched sample' is after imposing common support, defined as the maximum of mins, and the minimum of maxs.

**Table 5:** *Probit estimates for balancing score*

| | Specification 1 | Specification 2 | Specification 3 |
|---|---|---|---|
| **Gender** | -0.06 (-0.57) | -- | - 0.04 (0.38) |
| **Mother's Education** | -.361 (-3.04)** | -- | -- |
| **Father's Education** | 0.08 (0.67) | 0.166(1.50) | -- |
| **Tigerian** | -1.91(-10.13)** | -2.017(-8.62)** | -2.05(-8.89)** |
| **Oromo** | -.73(-4.97)** | -0.609(-4.34)** | -0.69(-4.86)** |
| **Amhara** | -.84 (-5.89)** | -0.69(-3.96)** | -1.07(-5.98)** |
| **Household Size (log)** | 0.44(3.08)** | 0.122(2.92)** | -- |
| **Breastfed for 12 months** | -1.02(-2.39)** | -0.88(-2.11)** | -0.829(1.95)* |
| **Age of child (months)** | -0.00 (-0.03) | -- | -- |
| **Unprotected water source** | -0.55 (-4.51)** | -- | -0.63(-5.21)** |
| **z-score weight-for-age** | .11(2.96)** | 0.135(3.77)** | -- |
| **Wealth Index (log)** | 0.15(2.68)** | 0.053(3.85)** | -- |
| **Gender of HH head** | -- | 0.44 (2.21)** | -- |
| **Wood** | -- | -0.16(-0.94) | -0.145(-0.84) |
| **Measles vaccination** | -- | -- | 0.05(0.48) |
| **Electricity** | -- | -- | -0.32(-1.17) |
| **_cons** | 1.98 (3.41)** | 1.44(2.67)** | 2.40(4.42)** |

Note: z-statistics are in parenthesis. ** Significant to the 5% level or higher.

**Table 6:** *The Average Treatment Effects (ATT) of treatment on child health using PSM*

| | Specification 1 | | Specification 2 | | Specification 3 | |
|---|---|---|---|---|---|---|
| | **Weight-for-age z-score** | **Height-for-age z-score** | **Weight-for-age z-score** | **Height-for-age z-score** | **Weight-for-age z-score** | **Height-for-age z-score** |
| **Nearest neighbour** | -0.18 (0.12) | -1.19 (0.17) | 0.09(0.10) | 0.37(0.15) | 0.33(0.12) | 1.34(0.12) |
| **Kernel matching** | 0.63(0.08) | 0.44(0.10) | 1.19(0.07) | 1.30(0.10) | 1.47(0.082) | 1.52(0.11) |
| **Balancing property satisfied** | Yes | Yes | Yes | Yes | Yes | Yes |
| **Common support imposed** | Yes | Yes | Yes | Yes | Yes | Yes |
| **% treated observations outside region of common support** | 1.2 | 1.2 | 0.3 | 0.3 | 0.6 | 0.6 |
| ***Observations*** | | | | | | |
| **Treated** | 308 | 308 | 312 | 312 | 307 | 307 |
| **Control** | 440 | 440 | 439 | 439 | 434 | 434 |

Note: Standard Error in Parenthesis.

Specification 2: father's education, Tigerian, Oromo, Amhara, sex of household head, household size (loghhsize*loghhsize), breastfed for 12 months, z-weight-for-age, wealth index (log), wood. Specification 3: gender (1 = female), Tigerian, Oromo, Amhara, breastfed for 12 months (1 = yes), unprotected water source (well, spring, pond, river), z weight-for-age, wood, measles, electricity (1= no). Balancing property is satisfied for all specifications with difference in means of matched observables not significantly different from 0 at least at the 10% level. Kernel matching set as default using epanechnikov and nearest neighbour set as 1. Common support is defied as the maximum of the mins, and the minimum of the max. The standard errors for the average treatment on the treated effect are computed using bootstrap with 50 replications. Resultant z-scores are reported in parenthesis with *significant at the 10% level and ** significant at the 5% level.

Due to the method of matching, the sample size was reduced to 308 for the treatment group and 440 for the control group (specification 1). Through the use of propensity score matching, the treatment effects between the control and treatment group on the health of children (height-for-age and weight-for-age) were found to be insignificant when using both nearest neighbour matching and kernel matching (Table 6).[11]

Two additional specifications were selected as a robustness check (specification 2 and 3), the results of which confirm that there is no significant difference in health outcomes between children in the treatment and control groups.

## 4.2 Insights from qualitative research

While the quantitative findings outlined above may appear counter-intuitive, data from Young Lives interview research with the older cohort may help to explain why pit latrine accessibility does not significantly improve health outcomes.[12] Children associate clean toilets with wealth and status in terms of access at school and at home, and where toilets smell or are dirty children choose less 'sanitary' locations for defecation.

Children's perspectives on pit latrines at school provide insight into their understanding of cleanliness and health. Many children describe clean toilets as a symbol of well-being as well as a status symbol of a private school, whereas public schools are distinguished by their dirty toilets. Punishment for being late, as described by Aamina from an urban community, is to clean the toilets: 'If I am late, I would rather go back home than clean a toilet…because I might have been sick with a flu because of the bad smell of the toilet.'

In a group interview Dawit, a boy from the rural community of Aksum, describes the common issue of clean toilets in his school:

> … the other thing is the fact that there is no separate toilet for boys and girls. And the toilet is not clean. Many children don't properly use the toilet, refusing to use the same area where the other children use and use the one corner rather than the hole. Thus the toilet became dirty. Thus many children prefer to use the open field near the school.

During a community mapping exercise with a group of boys his age, Dahnay – a 12 year old boy also from Aksum – expressed his views on why children avoid using pit latrines. These were summarised by the interviewer: '[h]e and other [sic] students fear the toilet. Many of them prefer to use the open field. They fear [they] might be draw [sic] in the hole….' Dahnay reiterated his dislike of unclean pit latrines during an individual interview:

11 Robustness ensured: multiple models tested.

12 Please note that the children's interviews were translated from their original language to English by translators employed by the Ethiopian Young Lives Team.

> DAHNAY: I hate to go to the toilet.
> INTERVIEWER: Why?
> DAHNAY: I hate the smell and the bad smell causes cough.
> INTERVIEWER: Is it the smell which causes the cough?
> DAHNAY: Yes because the students, even the teachers, defecate in and outside the toilet. And when I smell this I would be exposed to cough.
> INTERVIEWER: Don't you use the toilet?
> DAHNAY: No, I do not.
> INTERVIEWER: Then where do you use?
> DAHNAY: I go to the forest and defecate.
> INTERVIEWER: Is it better in the woods?
> DAHNAY: Yes, it is better to use there. Because there are only few people who use that.
> INTERVIEWER: If I came to your school, to start class from Grade 1, what kind of advice would you give me? And what would you say if I ask you where the toilet is?
> DAHNAY: I would tell you not to use the toilet, and to use the woods as toilet.

The perspective of using the field as a more sanitary alternative to a pit latrine, and the general experience of children with unclean toilets, emphasises the difficulty of accurately analysing the impact of existing sanitation structures on child health by challenging the assumption that pit latrines are 'better' than an open field. It also highlights the dichotomy that exists between striving to achieve an international standard that is at risk of becoming a superficial target which does not reflect the reality of life in Ethiopia.[13]

During a group interview with six boys from one of the rural communities, they were asked to draw pictures and describe a boy living a good life and a boy living a bad life. Two of the six boys mentioned poor sanitation conditions as indicators of a child living a bad life. As Dawit describes: 'a child [who] has a bad life is not clean and his body is full of housefly. The toilet is also full of housefly.' Daniachew, a young boy from the same community, describes a child with a bad life: 'the child has untidy cloth[ing], his legs are thin. The toilet [they own] is full of housefly.' When describing a child with a good life, Demissie explains: 'The toilet is far from the main house so as to make the family members safe from being infected with communicable disease, transmitted by a housefly.' Demissie's knowledge of disease transmission suggests that educational projects addressing hygiene and sanitation have reached his community.

Though this paper focuses on rural children, children in urban communities also have similar perspectives of sanitation and cleanliness. In a group interview employing the method of body mapping to discuss health, a group of female children aged 12 from an urban community associated dirty toilets with coughs and illness, as summarised by the interviewer: 'They also agreed that cough is caused by poor sanitation. For example…if there is an unclean pit latrine it may cause cough.' During another exercise of well-being vs. ill-being, Abeba, a 14-year-old girl from the same community, highlights the importance of proper sanitation, as summarised by the interview: 'To be health[y], sanitation is extremely important.'

The Young Lives qualitative research shows that although more children may have access to pit latrines they may not perceive them as a source of cleaner sanitation practices. In fact, pit latrines are often identified by children as health risks. Although the sanitation infrastructure

13 The Ethiopian Minister of Health highlights the issue of non-functioning and unused pit latrines, stating that up to 80 per cent of existing structures are not functioning, adding pressure to their ambitious plan of providing adequate sanitation for a country of 71 million (Gebreselassie 2007).

in Ethiopia may be improving, without changes in attitudes and behaviour towards maintenance and cleanliness, children will not make use of the new infrastructure. Instead, they will continue to use the forest and open field, which poses significant health risks associated with uncontained faeces.

# 5. Conclusion

This analysis of the younger cohort within the Young Lives sample of Ethiopian children, using propensity score matching, shows that there is no significant difference between children's nutritional status – comparing groups who have had no toilet facilities in the last four years to those who have changed from no facilities to the use of a household pit latrine in the last four years. Though there is a difference of means for the height-for-age and weight-for-age z-scores, when confounding variables such as mother's education, water sources, child's ethnicity and household wealth are controlled for, the difference is not significant.

These findings potentially reinforce the statement made by the Head of the Environmental Health Department during Water Week 2007 - the quality of the pit latrines in Ethiopia are low, with up to 80 per cent non-functioning (Gebreselassie 2007). Thus, the pit latrines may not be a source of quality waste disposal associated with an intermediate level of infrastructure and improved sanitation. The transmission of faecal-oral contaminants is less likely to be reduced with poor quality and un-maintained pit latrines.

Previous studies have suggested a general trend of improved height associated with improved sanitation (Esrey 1996; Checkely et al. 2004). However, as Esrey and Habitcht (1986) summarise, the conflicting results of studies that analyse the impact of sanitation on health are also due to behavioural changes. Though understanding the behaviour of the children as well as their perspectives and the perspectives of their parents about pit latrines was not addressed during the quantitative rounds, the qualitative data provides insight into children's perceptions and use of pit latrines.

The poor quality of pit latrines, their uncleanness and perceptions of them as potential sources of illness are concerns that are reiterated by the Young Lives children during group and individual interviews. Children's aversion to the use of pit latrines for fear of contracting illness and their preference for using a forest or field highlights a major concern for national and international monitors: what is the standard of the infrastructure being put into place to reach international targets? Furthermore, is the focus on developing 'intermediate' sanitation really addressing the needs of children by tackling the serious risks of poor sanitation?

The challenge to countries as they attempt to respond to the international target for environmental stability places communities at risk of developing a poor quality infrastructure that will not, in the end, respond to the central issue of the public health risks related to poor sanitation. When rising to meet the goals set forward by the international community, is quality better than quantity? Is it worth settling for suboptimal solutions in the short-term?

With these findings in mind, it is important for international agencies and national governments to develop methods by which the quality of sanitation infrastructure can be monitored. Such work would rely upon further research into the perspectives of communities and children on the use of pit latrines or more optimal methods of waste disposal, as well as personal hygiene. If the quality of rapidly-built infrastructure cannot be ensured then perhaps a re-evaluation of approaches to sanitation is in order.

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## Young Lives Partners

Young Lives is coordinated by a small team based at the University of Oxford, led by Jo Boyden.

Ethiopian Development Research Institute, Ethiopia

Centre for Economic and Social Sciences, Andhra Pradesh, India

Save the Children – Bal Raksha Bharat, India

Sri Padmavathi Mahila Visvavidyalayam (Women's University), Andhra Pradesh, India

Grupo de Análisis para el Desarollo (Group for the Analysis of Development), Peru

Instituto de Investigación Nutricional (Institute for Nutritional Research), Peru

Centre for Analysis and Forecast, Vietnamese Academy of Social Sciences, Vietnam

General Statistics Office, Vietnam

The Institute of Education, University of London, UK

Child and Youth Studies Group (CREET), The Open University, UK

Department of International Development University of Oxford, UK

Statistical Services Centre, University of Reading, UK

Save the Children UK (staff from the Rights and Economic Justice team in London as well as staff in India, Ethiopia and Vietnam).

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