

Unsafe child feces disposal status in Ethiopia: what factors matter? analysis of pooled data from four demographic and health surveys

Biniyam Sahiledengle (✉ biniyam.sahiledengle@gmail.com)

Research article

Keywords: Child feces disposal, Safe management of feces, Stool disposal, Demographic and Health Survey, Pooled data analysis, Water Sanitation and Hygiene (WASH), Ethiopia

Posted Date: May 20th, 2020

DOI: <https://doi.org/10.21203/rs.2.12989/v3>

License: © ⓘ This work is licensed under a Creative Commons Attribution 4.0 International License.

[Read Full License](#)

Version of Record: A version of this preprint was published at BMC Public Health on May 27th, 2020. See the published version at <https://doi.org/10.1186/s12889-020-08945-6>.

Abstract

Background: The only safest way to dispose of a child's feces is to help the child use a toilet or, for very young children, to put or rinse their feces into a toilet; whereas all other disposals are considered unsafe (feces put/rinsed into a drain or ditch, bush or thrown into the garbage, buried or left on the ground, and not disposed of). The study aims to determine the magnitude and factors associated with unsafe child feces disposal in Ethiopia.

Methods: The study is cross-sectional in nature and based on the pooled data from the four rounds of Demographic and Health Surveys (DHS) conducted in Ethiopia (2000-16). Data on child feces disposal practice was collected for all children born during the five years preceding survey. To get detail about the disposal of children's feces, mothers of under-five children were asked, "The last time passed stools, what was done to dispose of the stools?" with respect to the youngest child born. Descriptive statistics were computed to illustrate the given data. Multivariable logistic regression was performed to identify factors associated with unsafe child feces disposal.

Results: The pooled dataset contains data for 40,520 children younger than 5 years, male accounts 20,629 (50.9%). Overall, 77.7% (95%CI: 76.3-79.0) of children feces disposed of unsafely. In the multivariable logistic regression model, those mothers whose child was 13-24 months [AOR: 0.68, 95% CI: (0.60-0.78)] and ≥ 25 months [AOR: 0.66, 95% CI: (0.60-0.72)] were lower odds of unsafe child's feces disposal. Children born into households having two or fewer children were 33% lower [AOR: 0.67, 95% CI: (0.56-0.79)] odds of unsafe child's feces disposal than their counterparts. The odds of disposing of feces unsafely among households having improved toilet facility was 76% lower [AOR: 0.24, 95% CI: (0.19-0.29)] that of households lacking such facilities. Further, being an urban resident, having improved drinking water facility, a high level of maternal and paternal education, paternal occupational status (work in non-agriculture), and maternal age (25-34 and ≥ 35 years) were factors associated with lower odds of unsafe child's feces disposal.

Conclusions: Three in four Ethiopian children feces disposed of unsafely. Household and socio-demographic factors, such as access to improved water and toilet facility, area of a resident (urban), the child's age (older age), and both higher maternal and paternal education levels were significantly associated with lower odds of unsafe child feces disposal.

Background

Proper disposal of child feces in a toilet or latrine connected to a safe sanitation chain, or helping the child to use a toilet is the only safe method, were all other disposal methods (feces put/rinsed into a drain or ditch, bush or thrown into the garbage, buried or left on the ground, and not disposed of) are considered unsafe [1-3]. Unsafe child feces disposal can have a serious impact on children's health, and there is a growing body of literature demonstrating an association between unsafe child feces disposal and increases the risk of diarrheal diseases, environmental enteropathy, and impaired growth [1, 4, 5-13].

Complementing this finding, a review by Gil et al found that unsafe child feces disposal associated with a 23% increase in the risk of diarrheal diseases [7]. Recent studies conducted in Asian and African countries showed that unsafe disposal of children's feces in the community was strongly associated with increased risk of diarrhea and enteric infections in children [5-14]. Beyond the immediate impact of diarrheal disease, unsafe child feces disposal can also have long-lasting implications associated with impaired growth in children [1, 15]; children in households where caregivers reported unsafe child feces disposal had significantly greater odds of being wasted [4]. Most recently a study conducted in rural Bangladesh reported that young children mouthing soil during play in households with visible feces on their compound had an increased risk of stunting [16]. These studies confirm the hypothesis that unsafe child feces disposal has a negative effect on children [1,4, 16].

Despite the evidence to the contrary, the feces of children are less likely to be safely disposed of in a toilet than those of the general population, and poor disposal of children feces is slowing the open defecation free (ODF) progress throughout the globe [1,3,17-23]. According to the United Nations Child Fund (UNICEF) and the World Bank Global Water Practice's (WSP), over 50 percent of households with children under age three reported that the feces of their children were unsafely disposed of [3,24]. Even among households with improved sanitation, unsafe child feces disposal behavior was frequently reported [18, 25, 26]. So far, efforts to combat open defecation (OD) have mainly targeted adults, with only a limited focus on the management of child feces in low-and middle-income countries (LMIC) and how children's feces are being disposed of, in general, has remained a neglected area of research, policy, and program intervention [2,3,6, 15, 27-33]. Still, in many settings, toilets are not designed for or used by children, and young children tend to defecate in environments around the house where susceptible children could be exposed to fecal pathogens [27, 34]. In some cases, parents also discourage children from using a latrine with a squatting slab because they believe that children will dirty the latrine, which possibly endorses open defecation (OD) [13]. Further, there is a widespread wrong perception and cultural beliefs towards child feces management in many communities [2,35]. It is therefore very important to implement educational interventions to enhance the behavior of the children's mothers/caregivers towards child feces disposal practice in many societies since they are responsible for disposing of their children's feces and shaping the child's toilet training [15,30,32,35].

At present, irrefutable evidence implied that sanitation for everyone everywhere has been accelerated throughout the globe [36, 37], as part of the overall drive to achieve the Sustainable Development Goal (SDG) and to end OD. Efforts have been made in Ethiopia for some time now to create the ODF villages through the organized effort of the community by adopting the Community-Led Total Sanitation and Hygiene (CLTSH) approach, and Water, Sanitation, and Hygiene (WASH) initiatives [21,38,39]. In addition to improving the enabling environment for management of children's feces, by including specific child feces related criteria in ODF verification protocols and national sanitation policies [21].

Despite substantive efforts, in past years the problem of open defecation persists in Ethiopia and the magnitude of unsafe child feces disposal remains unclear. Therefore, the purpose of this study is to determine the magnitude and factors associated with unsafe child feces disposal in Ethiopia using

pooled data from four Ethiopian Demographic and Health Survey (EDHS) conducted in the period from 2000 to 2016.

Methods

Study design and data source

The study is cross-sectional in nature and based on data from the population-based Ethiopian Demographic and Health Survey (EDHS). Datasets used in this study were collected from the 1st, 2nd, 3rd, and 4th rounds of EDHS conducted in 2000, 2005, 2011, and 2016 respectively, which are used to carry out the analysis [40-43]. In general, a DHS sample is stratified, clustered, and selected in two stages. At the first stage of sampling, enumeration areas (EA) were selected using systematic sampling with probability proportional to size. In the second stage of sampling, a systematic sample of households per EA was selected in all the regions to provide statistically reliable estimates of key demographic and health variables. A representative sample of 11,645 households from 539 clusters (138 in urban areas and 401 in rural areas) in 2000 EDHS; 14,500 households from 540 clusters (145 urban and 395 rural) in 2005 EDHS; 17,817 households from 624 clusters (187 in urban areas and 437 in rural areas) in 2011 EDHS, and 16,650 households from 645 clusters (202 in urban areas and 443 in rural areas) in 2016 EDHS were selected for the surveys and the response rates were 99, 98, 94, and 98%, respectively. Details of the survey are described elsewhere [40-43]. The present study included all youngest children under age five living with the mother and mothers were asked about the disposal practice of the last passed feces for the youngest child. All respondents who responded to the outcome variable were included in the analysis for this study.

Study variables

Outcome variable

The outcome variable for this study was unsafe child feces disposal practices. The outcome variable was constructed based on the recent WHO definition, response categories such as 'child used toilet or latrine' and 'put/rinsed into toilet or latrine' were combined and coded as "safe disposal of child feces (coded as '0')". And the others were coded as "unsafe disposal of child stool (coded as '1')". Unsafe disposal of child feces was defined as the disposal of feces in any site other than a latrine, such as "put/rinsed into drain/ditch" "thrown into the garbage, "buried, "left in the open,' and 'other' [1].

Explanatory variables

The explanatory variables include; sex of children (male, female), age of the child (0-12 months, 13-24 months, ≥ 25 months), mother's age (< 24, 24-34, ≥ 34 years), mother educational level (no education, primary, secondary, higher), mother's working status (not working, working), partner educational level (no education, primary, secondary, higher), partner occupational status (working in agriculture, work in non-agriculture, not working), household size (<5, ≥ 5), number of children 5 and under ($\leq 2, \geq 3$), main floor

material (cement, earth), sex of household head (male, female), place of residence (urban, rural), mother's exposure to media (yes, no), toilet facility (improved, unimproved), sources of drinking water (improve, unimproved) and presence of diarrhea in the last two weeks (yes, no) [9,12,24,28, 29].

The variable on media exposure includes exposure to the radio and television. The mothers who were not exposed to radio/television were coded as "no" and those who have frequent exposure were coded as "yes". Also, the toilet facility and source of drinking water were categorized into 'improved' and 'unimproved' following the WHO/UNICEF definition [44].

Operational definitions

Unsafe child feces disposal: refers to disposing of child feces in open areas or not disposing of them at all; those left in the open, thrown into the garbage, put/washed/rinsed into open drains, buried, or any other methods are considered unsafe disposal [1-3].

Safe child feces disposal: safe disposal refers to a child use a toilet or latrine or, for very young children, to put or rinse their feces into a toilet or latrine [1,3].

Statistical analysis

Data from the four waves of EDHS (2000-2016) is used to carry out the analysis. First, data were examined how outcome and explanatory variables were defined in each survey and, if necessary, create new "variables" that are as identical as possible over the survey years. Next, the four datasets (*ETKR41FL*, *ETKR51FL*, *ETKR61FL*, and *ETKR70FL*) were merged into a single data and analyzed using a complex sample analysis, taking into accounts for the strata, clusters, and weight variable. A complex sample analysis is a two-step process in SPSS, (1) create a complex sample "*plan file*" after computing a weight variable (*V005*) and (2), run analyses using the plan file through the complex sample package to account for sample design. DHS strongly recommends that weights be included in any statistical analysis that conducts with DHS data and complex sample command must be considered for analyses of significance testing or a confidence interval (CI) [45]. A detailed explanation of the weighting procedure can be found in the EDHS methodology report [40-43].

Descriptive summaries (weighted frequency and percentage) were used to explain the number of study participants in the analysis. A complex sample binary logistic regression model was employed and presented the crude odds ratio (COR) with 95% CIs to identify the relationship between the outcome variable and explanatory variables. Those variables with a p-value of < 0.25 were then entered into a multivariable logistic regression to control the effect of confounder's and to estimate the independent factors of unsafe child feces disposal [46]. Finally, significant variables were identified based on the adjusted odds ratio (AOR) with 95% CIs and p-value < 0.05. The multicollinearity effect was assessed with a cut of off point of variation inflation factor (VIF) of greater than ten. Finally, to check the correctness of the final formulated model, the Hosmer–Lemeshow test for the overall goodness of fit was used [47]. All statistical analysis was carried out using SPSS version 20.0 (IBM Corp., Armonk, NY, USA).

Data quality assurance

In all rounds of EDHS, the data collection tools were pretested and data collectors were passes through extensive training. The training consisted of in-class training, biomarker training, and field practice days. Following the field practice, a debriefing session was held with the pretest field staff, and modifications to the questionnaires were made based on lessons drawn from the exercise [40-43]. In this specific paper, I have greatly worked on data quality assurance by cleaning data before performing analysis.

Ethical consideration

The DHS surveys are anonymous surveys that do not allow any potential identification of any single household or individual in the data file. Informed consent was obtained at the beginning of each interview by the EDHS surveyors. The data used in this analysis were obtained via online registration to measure the DHS program. Data for DHS are publicly available and can be requested from <https://dhsprogram.com/data/>

Results

Socio-demographic characteristics

Table 1 presents the background characteristics of the children across the entire pooled dataset. In this study, 40,520 children under age five living with the mother were included. Of these, 20,629 (50.9%) of the children were male, a great majority of children (90.0%) were from the rural area, and almost one out of five children had diarrhea in the past two weeks before the survey. The mean (standard deviation) age of the child was 28.5 (\pm 17.6) months.

Unsafe child feces disposal

This study revealed that 77.7% (95%CI: 76.3-79.0) of the children feces in Ethiopia were disposed of unsafely (**Table 2**). The proportion of unsafe child feces disposal has decreased from 91.8% (95%CI: 90.0-93.3) in the year 2000, to 81.9% (95%CI: 79.4-84.2) in 2005, 67.4% (95%CI: 64.5-70.2) in 2011, and 64.3% (95%CI: 60.4-68.0) in 2016 (**Additional files 1**). Despite the decline of unsafe child feces disposal over the last 16 years; it is not statistically significant as the confidence intervals overlapped each other (**Additional files 1 and Figure 1**).

Child feces disposal for urban-rural households

Figure 2 presents information about child feces disposal in Ethiopia for urban-rural households. Evidence from the pooled data showed, over three fourth of the rural households (81.2%) had unsafe child feces disposal while that is true only for (45.8%) of the urban households. A closer look into the urban-rural households showed that there are wide disparities in unsafe child feces disposal between urban and rural households in all waves of EDHS. The highest level of unsafe child feces disposal was reported among those children from a rural area in the year 2000 (96.2%) and the lowest level was recorded in the year

2011 among urban dwellers (40.3%). The surveys have shown that a slow decrement in unsafe feces disposal in urban-rural households in the past 16 years; from 96.2% to 67% in rural households and from 52.5% to 40.4% in urban households between the year 2000 and 2016 (**Figure 3**).

Result of bivariate and multivariable analysis

The results of bivariate logistic regression analysis are presented in **Table 3**. The results indicate that child's characteristics (age and sex of the child), mother's characteristics (age and maternal education), paternal characteristics (educational status and occupational status), household characteristics (number of children 5 and under, sex of household head, residence place, and main floor material), media exposure (listening to the radio and watching TV), and WASH-related variables (latrine type and sources of drinking water) were associated with unsafe child feces disposal.

In the multivariable logistic regression model, the odds of unsafe child feces disposal were higher [AOR: 1.11, 95%CI: (1.03-1.21)] among households having male children than households having female children. Children aged 13-24 months [AOR: 0.68, 95% CI: (0.60-0.78)] and ≥ 25 months [AOR: 0.66, 95% CI: (0.60-0.72)] were less likely to have their feces disposed unsafely than children age between 0–12 months. Lower odds of unsafe child feces disposal was observed among children born to mothers aged 25-34 years [AOR: 0.74, 95%CI: (0.63-0.87)] and ≥ 35 years [AOR: 0.69, 95%CI: (0.57-0.82)] compared to those children born to mothers aged 15-24 years. The odds of unsafe child feces disposal were 35% [AOR: 0.65, 95%CI: (0.55-0.76)] and 27% lower [AOR: 0.73, 95%CI: (0.55-0.96)] in mothers who had primary and secondary education than mothers who had no education, respectively. Likewise, higher paternal educational level and working in non-agriculture were associated with lower odds of unsafe feces disposal (**Table 4**).

In this study, the odds of unsafe feces disposal was 36% lower [AOR: 0.64, 95%CI (0.49-0.82)] in households residing in urban areas than households residing in rural areas. The odds of unsafe feces disposal were 33% lower [AOR: 0.67, 95% CI: (0.56-0.79)] among households having two or fewer children than their counterparts. In this study, the lack of access to drinking water sources and improved toilet facilities were statistically associated with unsafe disposal of feces. The odds of disposing of feces unsafely among households having improved drinking water and improved toilet facility were 18% [AOR: 0.82, 95% CI: (0.70-0.94)] and 76% lower [AOR: 0.24, 95% CI: (0.19-0.29)] than that of households lacking such facilities, respectively (**Table 4**).

Unsafe disposal of feces was statistically associated with the presence of diarrhea. The odds of unsafe child feces disposal was 25% higher [AOR: 1.25, 95% CI: (1.11-1.42)] in children without diarrhea compared to children who suffer from diarrhea. From the pooled data, the odds of unsafe feces disposal were 66% [AOR: 0.34, 95% CI:(0.27-0.43)], 85% [AOR: 0.15, 95%CI (0.12-0.19)] and 89% lower [AOR: 0.11, 95%CI: (0.09-0.14)] in EDHS 2005, 2011 and 2016, respectively compared to EDHS 2000 (**Table 4**).

Discussion

The study aim of this study is to assess the magnitude and factors associated with unsafe child feces disposal in Ethiopia using the waves of EDHS from 2000 to 2016. The pooled data contained 40,520 children under age five, which were included in the study. Of these, 77.7% of them had an unsafe child's feces disposal. The study revealed that unsafe child's feces disposal is less prevalent among households that had improved water and toilet facility, those in urban areas, those with older children, those with a high level of maternal and paternal education, and those with lower numbers of under-five children.

The high proportion of unsafe child's feces disposal found in this study was in line with studies conducted in India (79.0%) [9], 81.4% in Orissa (India) [48], Bangladesh (84%) [4], Malawi (79%) [49], and in Uganda (75%) [50]. The Multiple Indicator Cluster Survey (MICS) reports also showed that more than 50 percent of households with children under age three in 15 of the 26 locations, particular in Africa, South Asia, and Southeast Asia reported that the feces of their youngest child under age three were not deposited into any kind of improved or unimproved toilet or latrine i.e., they were unsafely disposed of [3]. In this study, a considerable number of children feces disposed of in the open field, which may put children at risk of fecal exposure and diarrheal illness. In support of this, a study in Bangladesh explores the link between unsafe feces disposal in the residential compound and increase the risk of fecal exposure [51]. Bawankule et al (2017) also found that unsafe disposal of children's feces even in the neighborhood was associated with a higher risk of diarrhea in children. A review showed that diarrheal diseases were prevalent in areas where poor hygiene and sanitation is widespread [7].

Although the decline of unsafe child feces disposal over the last 16 years is not statistically significant, there was a modest drop on unsafe feces disposal in Ethiopia from 91.8% in the year 2000 to 64.3% in 2016. This is less than 30% in 16 years or about 2% per year, which is very low and it can signify that the basic problem of unsafe child feces disposal still remains in the country. This finding, therefore, embodies an important message for the ongoing WASH, CLTS, and other sanitation-related projects in Ethiopia. First, interventions that encourage children to use the latrine directly may be potentially beneficial to improve the current practice. Second, enhancing the behavior of the children's mothers/caregivers is essential, since in many cases they are responsible for disposing of their children's feces and shaping the child's toilet training. Third, access to a latrine is a necessary condition to have a positive effect on the reduction of unsafe feces disposal [52,53].

In the multivariable logistic regression analysis, the odds of unsafe child feces disposal were lower in mothers who had primary and secondary education than mothers who had no formal education. These observations are quite as expected because less-educated parents are more likely to be unaware of the health risks associated with unsafe excreta disposal and therefore practice unsafe disposal [54]. This finding is in accordance with other studies done in Kenya [55], and India [56].

Consistent with studies in Bangladesh [57,58], Malawi [59], and Cambodia [29], women with younger children were more likely to report unsafely dispose of their children's feces compared with those with older children. This association can be satisfactorily explained by the fact that a shift in safe disposal is usually seen as they get older [21]. To overcome unsafe feces disposal among young children, Hussain et

al suggested four behaviors that should be promoted in a child potty behavior: 1) acquisition of a potty, 2) potty training, 3) regular emptying of the potty into a latrine, and 4) cleaning and maintenance for continued use [53]. In support of this suggestion, studies from Nigeria [30] and Bangladesh [53] showed that child defecation in potties was strongly associated with safe feces disposal. This study further revealed that child feces disposal was associated with maternal age, media exposure, and toilet/latrine access, which is generally consistent with other studies conducted elsewhere [9, 29, 56, 53, 60]. Again, the place of residence was another factor associated with unsafe child feces disposal. The odds of practicing unsafe child feces disposal were significantly lower among urban residents. This coincides with other similar reports [3, 55]. Somewhat surprisingly, the association between unsafe child feces disposal and reported diarrhea is not detected in the present study. However, several studies done in low-income settings, such as Nepal [5], Indonesia [6], Thailand [8], India [9], Burkina Faso [13], and Nigeria [61] reported the association between unsafe feces disposal and childhood diarrhea.

Limitations of the study

This study has several limitations. First, the study suffers from the disadvantages of a cross-sectional study; the temporal relationship between the outcome and explanatory variables could not be established. Second, the study did not record how feces were transported for disposal in study households. This would have added an understanding of the relationship between unsafe child feces disposal and transportation mechanisms. Third, reporting bias is likely to over-report child feces disposal behavior. Fourth, the study may be susceptible to recall bias, as the data dealt with reported practices rather than direct observation of the actual practice. Fifth, the measurement of the prevalence of diarrhea in all EDHS is based on a two weeks recall period, which may introduce a recall and reporting bias in childhood diarrhea prevalence. Sixth, the study didn't use multilevel analysis which is the ideal alternative to address nested data. Therefore, the associations that were found in the multivariable analysis should thus be interpreted cautiously. Finally, despite there were similar trends for many of the countries in the practice of child feces disposal, I would suggest caution against applying the results to countries located in other regions of the world, as cultural differences may affect child stool disposal practices.

Conclusion

Three in four Ethiopian children feces disposed of unsafely. Unsafe child's feces disposal is less prevalent among households that had improved water and toilet facility, those residing in urban areas, those with older children, those with a high level of maternal and paternal education, and those with a lower number of under-five children. The finding highlighted, there is a need for more attention to be paid to curb the significant burden of unsafe child feces disposal in Ethiopia. It is also essential to explore opportunities to integrate child feces management into existing sanitation and hygiene efforts. Moreover, child feces management interventions must consider sanitation coverage as well as behavioral changes, such as efforts to change the behavior of mothers that encourage cleaning children after defecation, potty training at an early age, and using proper methods to transport children feces to a sanitation facility.

Abbreviations

AOR: Adjusted odds ratio; CI: Confidence interval; CLTS: Community-Led Total Sanitation; COR: Crude odds ratio; DHS: Health and demographic surveys; EDHS: Ethiopian Health and demographic surveys; ODF: Open defecation free; OD: Open defecation; SDGs: Sustainable Development Goals; SPSS: Statistical Package for Social Sciences; VIF: Variance inflation factor; WHO: World Health Organization

Declarations

Ethics approval and consent to participate

Ethical clearance for this survey was obtained from the Ethiopia Health and Nutrition Research Institute Review Board, the National Research Ethics Review Committee at the Ministry of Science and Technology, and the Institutional Review Board of ICF International and the Centers for Disease Control and Prevention. Informed verbal consent was obtained from all mothers/caretakers of the selected children on behalf of their children. The data were obtained via online registration to measure the DHS program and downloaded after the purpose of the analysis was communicated and approved.

Consent for publication

Not Applicable

Availability of supporting data

The dataset was demanded and retrieved from the DHS website <https://dhsprogram.com> after formal online registration and submission of the project title and detail project description.

Competing interests

The author declares that he has no competing interests.

Funding

No organization funded this research.

Authors' Contribution

BS conceptualizes, performed the analysis, wrote and approved the final manuscript.

Acknowledgments

Not applicable

References

1. World Health Organization (WHO): Guidelines on sanitation and health. 2018, Licence: CC BY-NC-SA 3.0 IGO. Geneva.
2. Bain R, Luyendijk R: Are burial or disposal with garbage safe forms of child faeces disposal? An expert consultation. *Waterlines*. 2015; 34(3):241-254.
3. Rand EC, Loughnan L, Maule L, Reese H: Management of child feces: current disposal practices. *Water and Sanitation Program: Research Brief (June)*. 2015:8.
4. George CM, Oldja L, Biswas S, Perin J, Sack RB, Ahmed S, Shahnaiz M, Haque R, Parvin T, Azmi IJ: Unsafe child feces disposal is associated with environmental enteropathy and impaired growth. *The Journal of pediatrics*. 2016; 176:43-49.
5. Lamichhane P, Sharma A, Mahal A: Does safe disposal of child faeces matter? An assessment of access to improved sanitation and child faeces disposal behaviour and diarrhoea in rural Nepal. *International health*. 2018; 10(4):277-284.
6. Cronin A, Sebayang S, Torlesse H, Nandy R: Association of safe disposal of child feces and reported diarrhea in Indonesia: need for stronger focus on a neglected risk. *International journal of environmental research and public health*. 2016; 13(3):310.
7. Gil A, Lanata C, Kleinau E, Penny M: Children's feces disposal practices in developing countries and interventions to prevent diarrheal diseases: A literature review. *Environmental Health Project*. 2004.
8. Wilunda C, Panza A: Factors associated with diarrhea among children less than 5 years old in Thailand: a secondary analysis of Thailand multiple indicator cluster survey 2006. *Journal of Health Research*. 2009, 23(Suppl.):17-22.
9. Bawankule R, Singh A, Kumar K, Pedgaonkar S: Disposal of children's stools and its association with childhood diarrhea in India. *BMC public health*. 2017; 17(1):12.
10. Traore E, Cousens S, Curtis V, Mertens T, Tall F, Traore A, Kanki B, Diallo I, Rochereau A, Chiron J: Child defecation behaviour, stool disposal practices, and childhood diarrhoea in Burkina Faso: results from a case-control study. *Journal of Epidemiology & Community Health*. 1994; 48(3):270-275.
11. Mihrete TS, Alemie GA, Teferra AS: Determinants of childhood diarrhea among under-five children in Benishangul Gumuz regional state, north West Ethiopia. *BMC pediatrics*. 2014; 14(1):102.
12. Baltazar JC, Solon FS: Disposal of faeces of children under two years old and diarrhoea incidence: a case-control study. *International journal of epidemiology*. 1989; 18(Supplement_2):S16-S19.
13. Curtis V, Schmidt W, Luby S, Florez R, Touré O, Biran A: Hygiene: new hopes, new horizons. *The Lancet infectious diseases*. 2011; 11(4):312-321.
14. Roy E, Hasan KZ, Haque R, Haque AF, Siddique A, Sack RB: Patterns and risk factors for helminthiasis in rural children aged under 2 in Bangladesh. *South African Journal of Child Health*. 2011; 5(3):78-84.
15. Bauza V, Guest JS: The effect of young children's faeces disposal practices on child growth: evidence from 34 countries. *Tropical Medicine & International Health*. 2017; 22(10):1233-1248.

16. George CM, Oldja L, Biswas S, Perin J, Lee GO, Kosek M, et al. Geophagy is associated with environmental enteropathy and stunting in children in rural bangladesh. *Am J Trop Med Hyg* 2015;92:1117-24.
17. Bain R, Luyendijk R: Are burial or disposal with garbage safe forms of child faeces disposal? An expert consultation. *Waterlines*. 2015; 34(3):241-254.
18. Rand EC, Loughnan L, Maule L, Reese H: Management of child feces: current disposal practices. *Water and Sanitation Program: Research Brief (June)*. 2015:8.
19. Walker CLF, Perin J, Aryee MJ, Boschi-Pinto C, Black RE: Diarrhea incidence in low-and middle-income countries in 1990 and 2010: a systematic review. *BMC public health*. 2012; 12(1):220.
20. Majorin F, Torondel B, Routray P, Rout M, Clasen T: Identifying potential sources of exposure along the child feces management pathway: a cross-sectional study among urban slums in Odisha, India. *The American journal of tropical medicine and hygiene*. 2017; 97(3):861-869.
21. United Nations Children's Fund: Child feces disposal in Ethiopia. 2014. Available from: <https://www.wsp.org/sites/wsp.org/files/publications/WSP-Ethiopia-CFD-Profile.pdf> (Accessed April 6, 2020)
22. WHO/UNICEF Joint Water Supply Sanitation Monitoring Programme: Progress on drinking water and sanitation: 2014 Update: World Health Organization. 2014.
23. Pasteur K: Keeping track: CLTS monitoring, certification and verification. 2017.
24. Markovitz AR, Goldstick JE, Levy K, Cevallos W, Mukherjee B, Trostle JA, Eisenberg JN: Where science meets policy: comparing longitudinal and cross-sectional designs to address diarrhoeal disease burden in the developing world. *International journal of epidemiology*. 2012; 41(2):504-513.
25. Sahiledengle B: Prevalence and associated factors of safe and improved infant and young children stool disposal in Ethiopia: evidence from demographic and health survey. *BMC public health*. 2019; 19(1):970.
26. Majorin F, Nagel CL, Torondel B, Routray P, Rout M, Clasen TF: Determinants of disposal of child faeces in latrines in urban slums of Odisha, India: a cross-sectional study. *Transactions of The Royal Society of Tropical Medicine and Hygiene*. 2019; 113(5):263-272.
27. Lanata CF, Huttly SR, Yeager BA: Diarrhea: whose feces matter? Reflections from studies in a Peruvian shanty town. *The Pediatric infectious disease journal*. 1998; 17(1):7-9
28. Azage M, Haile D: Factors associated with safe child feces disposal practices in Ethiopia: evidence from demographic and health survey. *Archives of Public Health*. 2015; 73(1):40.
29. Miller-Petrie MK, Voigt L, McLennan L, Cairncross S, Jenkins MW: Infant and young child feces management and enabling products for their hygienic collection, transport, and disposal in Cambodia. *The American journal of tropical medicine and hygiene*. 2016; 94(2):456-465.
30. Jinadu M, Adegbenro C, Esmail A, Ojo A, Oyeleye B: Health promotion intervention for hygienic disposal of children's faeces in a rural area of Nigeria. *Health education journal*. 2007; 66(3):222-228.

31. Jinadu MK, Esmail OA, Adegbenro CA: Disposal of children's faeces and implications for the control of childhood diarrhoea. *The journal of the Royal Society for the Promotion of Health*. 2004; 124(6):276-279.
32. Morita T, Godfrey S, George CM: Systematic review of evidence on the effectiveness of safe child faeces disposal interventions. *Tropical Medicine & International Health*. 2016; 21(11):1403-1419.
33. Mertens T, Jaffar S, Fernando M, Cousens S, Feachem R: Excreta disposal behaviour and latrine ownership in relation to the risk of childhood diarrhoea in Sri Lanka. *International journal of epidemiology* 1992, 21(6):1157-1164.
34. Brown J, Cairncross S, Ensink JH: Water, sanitation, hygiene and enteric infections in children. *Archives of disease in childhood*. 2013; 98(8):629-634.
35. Chebet JJ, Kilungo A, Alaofè H, Malebo H, Katani S, Nichter M. Local Perceptions, Cultural Beliefs, Practices and Changing Perspectives of Handling Infant Feces: A Case Study in a Rural Geita District, North-Western Tanzania. *International Journal of Environmental Research and Public Health*. 2020;17(9):3084.
36. World Health Organization and UNICEF: Progress on drinking water, sanitation and hygiene: 2017 update and SDG baselines. 2017.
37. UN Vows to Eliminate Open Defecation by 2025. Available from: <https://ourworld.unu.edu/en/un-vows-to-eliminate-open-defecation-by-2025> (Accessed May 4, 2020)
38. Federal Democratic Republic of Ethiopia Ministry of Health: National Hygiene and Sanitation Strategy to Enable 100% Adoption of Improved Hygiene and Sanitation. . Ethiopia: Federal Democratic Republic of Ethiopia Ministry of Health.; 2005.
39. Ministry of Health Ethiopia: Community Led Sanitation and Hygiene (LTSH) verification and certification protocol. Addis Ababa, Ethiopia: Federal Democratic Republic of Ethiopia Ministry of Health.
40. Central Statistical Authority [Ethiopia] and ORC Macro: Ethiopia Demographic and Health Survey 2000. Addis Ababa, Ethiopia and Calverton, Maryland, USA: Central Statistical Authority and ORC Macro. 2001.
41. Central Statistical Agency [Ethiopia] and ORC Macro: Ethiopia Demographic and Health Survey 2005. Addis Ababa, Ethiopia and Calverton, Maryland, USA: Central Statistical Agency and ORC Macro. 2006.
42. Central Statistical Agency [Ethiopia] and ICF International: Ethiopia Demographic and Health Survey 2011. . Addis Ababa, Ethiopia and Calverton, Maryland, USA: Central Statistical Agency and ICF International. 2012.
43. CSA I: Central statistical agency (CSA)[Ethiopia] and ICF. Ethiopia demographic and health survey, Addis Ababa, Ethiopia and Calverton, Maryland, USA 2016.
44. World Health Organization and UNICEF: Core questions on drinking water and sanitation for household surveys. 2006.
45. IBM: IBM SPSS Complex Samples 22. Armonk, NY 10504-1785. U.S.A. 2013

46. Vittinghoff E, Glidden DV, Shiboski SC, McCulloch CE: Logistic regression. In *Regression methods in biostatistics*. Boston: Springer. 2012 (pp. 139-202); 2012.
47. Hosmer Jr DW, Lemeshow S. *Sturdivant RX: Applied logistic regression*: John Wiley & Sons. 2013.
48. Majorin F, Freeman MC, Barnard S, Routray P, Boisson S, Clasen T: Child feces disposal practices in rural Orissa: a cross sectional study. *PloS one*. 2014; 9(2):e89551
49. United Nations Children's Fund: Child feces disposal in Malawi. 2014. Available from: <https://www.wsp.org/sites/wsp.org/files/publications/WSP-Malawi-CFD-Profile.pdf> (Accessed May 10, 2020)
50. United Nations Children's Fund: Child feces disposal in Uganda. 2014. Available from: <http://www.wsp.org/sites/wsp.org/files/publications/WSP-Uganda-CFD-Profile.pdf> (Accessed May 10, 2020)
51. Kwong LH, Ercumen A, Pickering AJ, Unicomb L, Davis J, Luby SP: Hand-and Object- Mouthing of Rural Bangladeshi Children 3–18 Months Old. *International Journal of Environmental Research and Public Health*. 2016; 13(6):E563.
52. Phaswana-Mafuya N, Shukla N: Factors that could motivate people to adopt safe hygienic practices in the Eastern Cape Province, South Africa. *African health sciences*. 2005; 5(1):21-28.
53. Hussain F, Luby SP, Unicomb L, Leontsini E, Naushin T, Buckland AJ, Winch PJ. Assessment of the acceptability and feasibility of child potties for safe child feces disposal in rural Bangladesh. *The American journal of tropical medicine and hygiene*. 2017; 97(2):469-476.
54. Dreibelbis R, Winch PJ, Leontsini E, Hulland KR, Ram PK, Unicomb L, et al. The integrated behavioural model for water, sanitation, and hygiene: a systematic review of behavioural models and a framework for designing and evaluating behaviour change interventions in infrastructure-restricted settings. *BMC public health*. 2013; 13(1):1015.
55. United Nations Children's Fund: Child feces disposal in Kenya. 2014. Available from: <http://wsporg/sites/wsporg/files/publications/WSP-Kenya-CFD-Profilepdf> (Accessed May 10, 2020)
56. Preeti P, Sahoo SK, Biswas D, Dasgupta A: Unsafe disposal of child faeces: a community-based study in a rural block in West Bengal, India. *Journal of Preventive Medicine and Public Health*. 2016; 49(5):323.
57. Islam M, Ercumen A, Ashraf S, Rahman M, Shoab AK, Luby SP, Unicomb L: Unsafe disposal of feces of children < 3 years among households with latrine access in rural Bangladesh: association with household characteristics, fly presence and child diarrhea. *PloS one*. 2018; 13(4):e0195218
58. Sultana R, Mondal UK, Rimi NA, Unicomb L, Winch PJ, Nahar N, al. e: An improved tool for household faeces management in rural Bangladeshi communities. *Trop Med Int Health*. 2013; 18(7):854–860.
59. Nkoka, O. Correlates of appropriate disposal of children's stools in Malawi: a multilevel analysis. *BMC Public Health*. 20; 604 (2020).
60. Freeman MC, Majorin F, Boisson S, Routray P, Torondel B, Clasen T: The impact of a rural sanitation programme on safe disposal of child faeces: a cluster randomised trial in Odisha, India. *Transactions of The Royal Society of Tropical Medicine and Hygiene*. 2016; 110(7):386-392.

61. Aluko O, Afolabi O, Olaoye E, Adebayo A, Oyetola S, Abegunde O: The management of the faeces passed by under five children: an exploratory, crosssectional research in an urban community in Southwest Nigeria. BMC Public Health. 2017; 17:178.

Tables

Table 1: The characteristics of the respondents in the DHS pooled data 2000-2016, Ethiopia (n=40,520)

Characteristic	Categories	Weighted frequency	Percent
Child's characteristics			
Sex of the child	Male	20,629	50.9
	Female	19,890	49.1
Age of the child	0-12 months	10,040	24.8
	13-24 months	8,093	20.0
	≥25 months	22,386	55.2
Diarrhea in the past two weeks (n=38,037)	Yes	6,616	17.4
	No	31,421	82.6
Mother's characteristics			
Age of mother	15-24	10,216	25.2
	25-34	20,388	50.3
	>=35	9,916	24.5
Marital status	Married	37,281	92.0
	Divorced/separated	1,651	4.1
	Widowed	576	1.4
	Living with a partner	823	2.0
	Single	188	0.5
Mother's working status (n=40,404)	Not working	21,250	52.6
	Working	19,155	47.4
Mother's education	No education	30,365	74.9
	Primary	8,258	20.4
	Secondary	1,527	3.8
	Higher	369	0.9
Paternal characteristics			
Partner educational level (n=39,822)	No education	22,254	55.9
	Primary	13,485	33.9
	Secondary	3,193	8.0
	Higher	890	2.2
Partner occupational status (n=40,006)	Working in agriculture	32,539	81.3
	Work in non-agriculture	6,794	17.0
	Not working	673	1.7
Household characteristics			
Household size	Less than 5	9,841	24.3
	5 or more	30,679	75.7
Number of children 5 and under	2 or less	33,572	82.9
	3 and above	6,948	17.1
Sex of household head	Male	35,364	87.3
	Female	5,156	12.7
Place of residence	Urban	4,032	10.0
	Rural	36,488	90.0
Main floor material (n=39,595)	Cement	2,705	6.8
	Earth	36,890	93.2
Media exposure			
Listening radio (n=40,508)	Yes	14,094	34.8
	No	26,414	65.2
Watching TV (n=40,476)	Yes	6,369	84.3
	No	34,107	15.7
Water and sanitation facility			
Sources of drinking water (n=39,685)	Improved	17,519	44.1
	Unimproved	22,165	55.9
Latrine type (n=39,698)	Improved	4,475	11.3
	Unimproved	35,223	88.7
Survey year	2000	11,550	28.5
	2005	10,692	26.4
	2011	11,413	28.2
	2016	6,864	16.9

Table 2: Weighted child feces disposal practice in Ethiopia, pooled data from DHS 2000-2016 (n=40,520)

Child stool disposal practice	Weighted Frequency	Weighted percent with 95 % (CI)
Always use toilet/latrine	831	2.1 (1.8-2.4)
Throw in toilet/latrine	8,217	20.3 (19.0-21.6)
Throw outside the dwelling	5,158	12.7 (11.6-14.0)
Throw outside the yard	7,598	18.8 (17.6-20.0)
Bury in the yard	2,088	5.2 (4.5-5.9)
Rinse away	4,397	10.9 (10.0-11.8)
Use disposable diapers	402	1.0 (0.8-1.3)
Use washable diapers	1,993	4.9 (4.2-5.7)
Not disposed of	7,000	17.3 (15.9-18.7)
Other	2,837	7.0 (6.3-7.8)
Overall pooled child stool disposal practice		
Unsafe §	31,471	77.7 (76.3-79.0)
Safe	9,048	22.3 (21.0-23.7)

§Unsafe disposal of child stool was defined as disposal of stool in any site other than a sanitary latrine

Table 3: Bivariate logistic regression result on factors associated with unsafe child feces disposal in Ethiopian DHS 2000-2016, (n=40,520)

Characteristic	Categories	Child stool disposal		COR(95%CI)	P-value
		Unsafe (n=31,471)	Safe (n=9,048)		
Child's characteristics					
Sex of the child	Male	16,202	4,427	1.12(1.04-1.18)*	0.00
	Female	15,269	4,621	1	
Age of the child	0-12 months	8,035	2,005	1	
	13-24 months	6,064	2,029	0.75(0.67-0.83)*	0.00
	≥25 months	17,372	5,014	0.86(0.80-0.93)*	
Diarrhea in the past two weeks (n=38,038)	Yes	5,220	1,396	1	
	No	24,194	7,228	0.89(0.79-1.00)	0.06
Mother's characteristics					
Age of mother	15-24	8,197	2,019	1	
	25-34	15,509	4,879	0.78(0.69-0.88)*	0.00
	≥35	7,765	2,151	0.89(0.78-1.02)	
Mother's working status (n=40,403)	Not working	16,371	4,878	1	
	Working	15,018	4,136	1.08(0.96-1.21)	0.18
Mother's education	No education	25,181	5,184	1	
	Primary	5,403	2,855	0.39(0.34-0.44)*	0.00
	Secondary	779	748	0.21(0.17-0.26)*	
	Higher	108	261	0.09(0.06-0.12)*	
Paternal characteristics					
Partner educational level (n=39,825)	No education	18,834	3,421	1	
	Primary	9,828	3,657	0.49(0.43-0.55)*	0.00
	Secondary	1,923	1,271	0.28(0.23-0.33)*	
	Higher	347	544	0.12(0.09-0.15)*	
Partner occupational status (n=40,006)	Working in agriculture	26,817	5,721	1	
	Work in non-agriculture	3,839	2,955	0.28(0.24-0.32)*	0.00
	Not working	444	229	0.41(0.29-0.59)*	
Household characteristics					
Household size	Less than 5	7,552	2,289	0.93(0.85-1.03)	0.15
	5 or more	23,919	6,759	1	
Number of children 5 and under	2 or fewer	25,857	7,715	0.79(0.69-0.92)*	0.00
	3 and above	5,614	1,333	1	
Sex of household head	Male	27,636	7,728	1	
	Female	3,835	1,321	0.81(0.71-0.92)*	0.00
Place of residence	Urban	1,847	2,185	0.19(0.16-0.24)*	0.00
	Rural	29,625	6,863	1	
Main floor material (n=39,595)	Cement	1,117	1,588	0.17(0.14-0.21)*	0.00
	Earthen floors	29,615	7,275	1	

Media exposure					
Listening radio (n=40,508)	Yes	9,798	4,296	0.50(0.45-0.56)*	0.00
	No	21,663	4,751	1	
Watching TV (n=40,476)	Yes	3,595	2,774	0.29(0.25-0.34)*	0.00
	No	27,834	6,274	1	
Water and sanitation facility					
Sources of drinking water (n=39,685)	Improved	12,582	4,937	0.56(0.48-0.64)*	0.00
	Unimproved	18,195	3,971	1	
Latrine type (n=39,698)	Improved	2,093	2,382	0.20(0.17-0.23)*	0.00
	Unimproved	28,696	6,527	1	
Survey year	2000	10,602	948	1	
	2005	8,762	1,931	0.41(0.31-0.53)*	0.00
	2011	7,697	3,716	0.19(0.14-0.24)*	
	2016	4,411	2,453	0.16(0.12-0.21)*	

Crude odds ratio (COR); *significantly associated p-value < 0.05(crude)

Table 4: Multivariable logistic regression result on factors associated with unsafe child feces disposal in Ethiopia DHS, 2000-2016 (n=40,520)

Characteristic	Categories	Child stool disposal		AOR(95%CI)
		Unsafe (n=31,471)	Safe (n=9,048)	
Child's characteristics				
Sex of the child	Male	16,202	4,427	1.11(1.03-1.21)**
	Female	15,269	4,621	1
Age of the child	0-12 months	8,035	2,005	1
	13-24 months	6,064	2,029	0.68(0.60-0.78)**
	≥25 months	17,372	5,014	0.66(0.60-0.72)**
Diarrhea in past two weeks (n=38,038)	Yes	5,220	1,396	1
	No	24,194	7,228	1.25(1.11-1.42)**
Mother's characteristics				
Age of mother	15-24	8,197	2,019	1
	25-34	15,509	4,879	0.74(0.63-0.87)**
	>=35	7,765	2,151	0.69(0.57-0.82)**
Mother's working status (n=40,403)	Not working	16,371	4,878	1
	Working	15,018	4,136	1.04(0.92-1.17)
Mother's education	No education	25,181	5,184	1
	Primary	5,403	2,855	0.65(0.55-0.76)**
	Secondary	779	748	0.73(0.55-0.96)**
	Higher	108	261	0.87(0.50-1.53)
Paternal characteristics				
Partner educational level (n=39,825)	No education	18,834	3,421	1
	Primary	9,828	3,657	0.74(0.64-0.85)**
	Secondary	1,923	1,271	0.56(0.46-0.69)**
	Higher	347	544	0.72(0.50-1.04)
Partner occupational status (n=40,006)	Working in agriculture	26,817	5,721	1
	Work in non-agriculture	3,839	2,955	0.74(0.62-0.90)**
	Not working	444	229	0.94(0.61-1.42)
Household characteristics				
Household size	Less than 5	7,552	2,289	1.09(0.96-1.25)
	5 or more	23,919	6,759	1
Number of children 5 and under	2 or fewer	25,857	7,715	0.67(0.56-0.79)**
	3 and above	5,614	1,333	1
Sex of household head	Male	27,636	7,728	1
	Female	3,835	1,321	1.00(0.86-1.17)
Place of residence	Urban	1,847	2,185	0.64(0.49-0.82)**
	Rural	29,625	6,863	1
Main floor material (n=39,595)	Cement	1,117	1,588	0.71(0.54-0.92)**
	Earthen floors	29,615	7,275	1
Media exposure				
Listening radio (n=40,508)	Yes	9,798	4,296	0.88(0.76-1.01)
	No	21,663	4,751	1
Watching TV (n=40,476)	Yes	3,595	2,774	0.96(0.72-1.03)
	No	27,834	6,274	1
Water and sanitation facility				

Sources of drinking water (n=39,685)	Improved	12,582	4,937	0.82(0.70-0.94)**
	Unimproved	18,195	3,971	1
Latrine type (n=39,698)	Improved	2,093	2,382	0.24(0.19-0.29)**
	Unimproved	28,696	6,527	1
Survey year	2000	10,602	948	1
	2005	8,762	1,931	0.34(0.27-0.43)**
	2011	7,697	3,716	0.15(0.12-0.19)**
	2016	4,411	2,453	0.11(0.09-0.14)**

AOR = adjusted odds ratio; ** significantly associated p-value < 0.05(Adjusted)

Additional File

Additional file 1: Unsafe child feces disposal characteristics of the households in DHS 2000, 2005, 2011, and 2016, Ethiopia

Figures

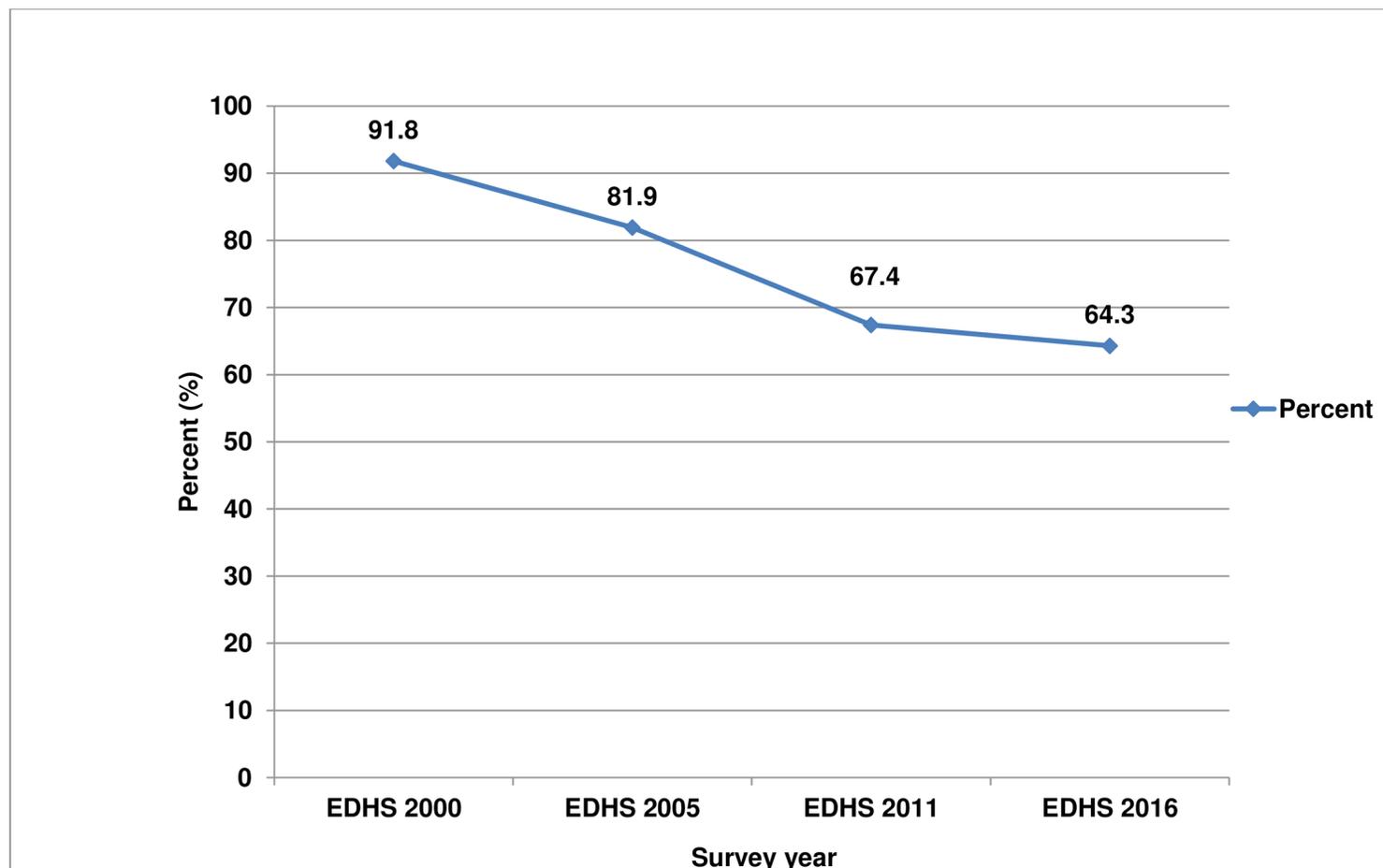


Figure 1

Unsafe child feces disposal in Ethiopia, DHS 2000-2016 (n=40,520)

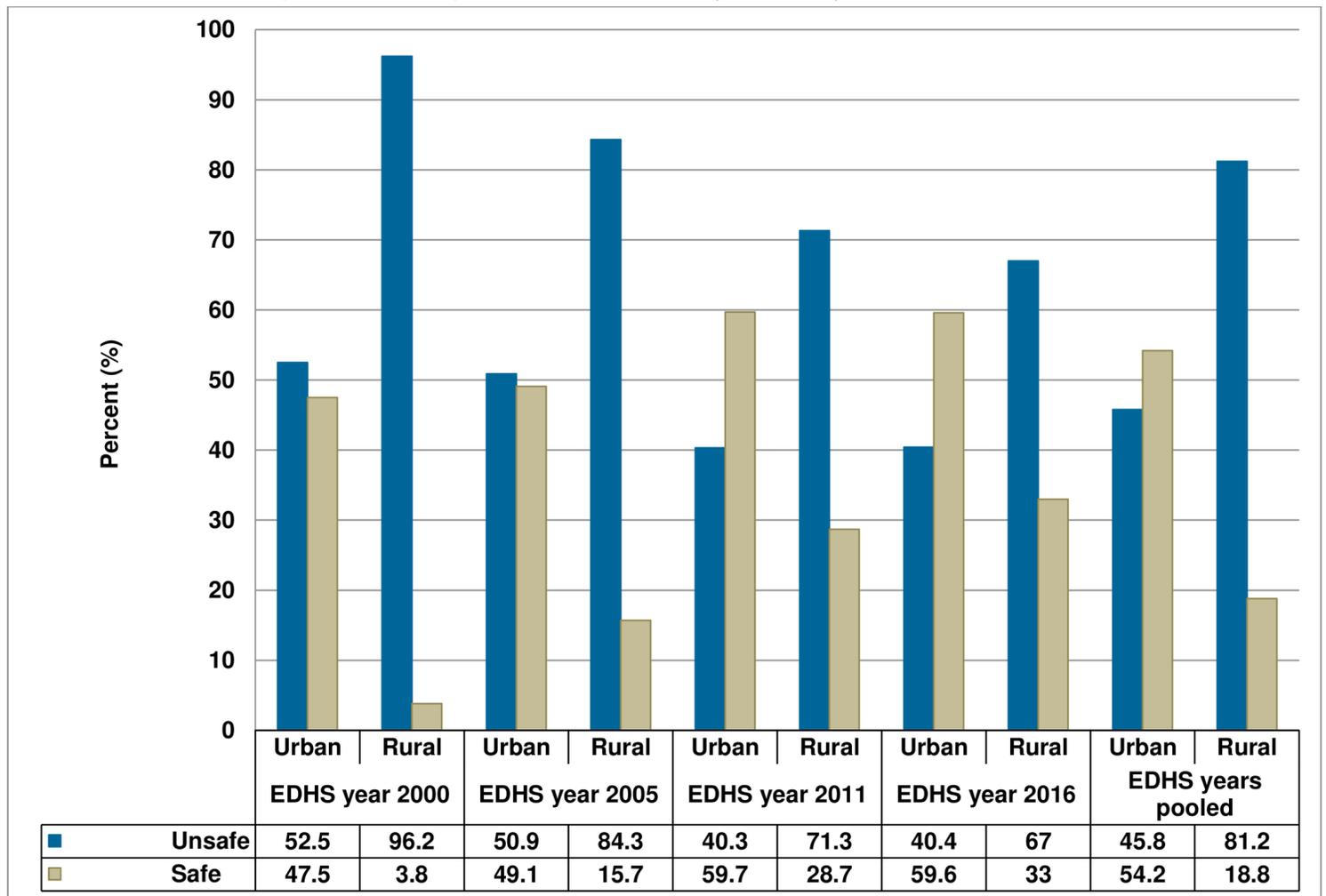


Figure 2

Child feces disposal status among urban and rural households in Ethiopia, DHS 2000-2016 (n=40,520)

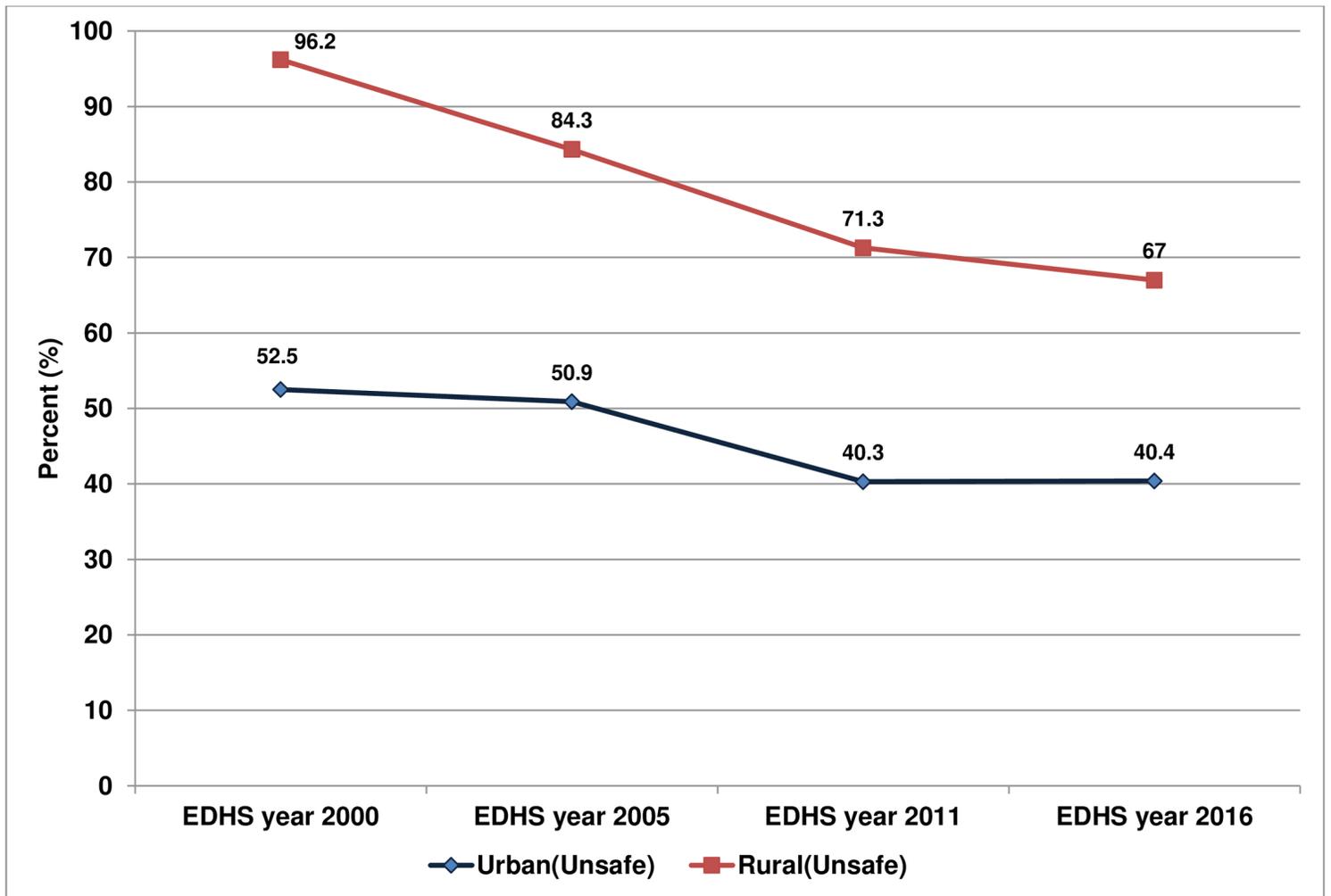


Figure 3

Unsafe feces disposal among urban and rural households in DHS 2000-2016, Ethiopia

Supplementary Files

This is a list of supplementary files associated with this preprint. Click to download.

- [AdditionalFiles1.pdf](#)