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ABSTRACT

INTRODUCTION: Household flooring has been associated with diarrhea, but few studies have examined the association between childhood diarrhea and type of household flooring considering the individual and community level characteristics. We aimed to determine if household flooring was associated with childhood diarrhea among children 0 to 23 months of age in Ethiopia.

METHODS: Data from the fourth round of the Ethiopian Demographic and Health Survey (EDHS) conducted in 2016 is used to carry out the analysis. The EDHS was large, cross-sectional by design and nationally representative. In the current analysis, we included children 0 to 23 months of age (n = 4552) with their mother and 636 community clusters. To get information about the occurrence of diarrhea, mothers/caregivers were asked, "Has (NAME) had diarrhea in the last 2 weeks?" The response to this question was recorded as, "yes" or "no." A multilevel binary logistic regression model was fitted to identify factors associated with childhood diarrhea.

RESULTS: The overall prevalence of diarrhea among children 0 to 23 months of age in Ethiopia was 15.5% (95% CI [confidence interval] 14.4-16.5). No association was found between childhood diarrhea and type of household flooring (adjusted odds ratio [AOR] 1.05, 95% CI 0.59-1.88). The adjusted odds also showed that the age of the child, having an acute respiratory infection (ARI), and size of the child at birth were associated with diarrhea.

CONCLUSION: We found no association between childhood diarrhea and the type of household flooring. Further research with strong research design is needed to determine the effect of household flooring on childhood diarrhea.

KEYWORDS: Diarrhea, earth floor, mud, infants, Ethiopia

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Introduction

Diarrhea causes more than half a million childhood mortality across low-income and middle-income countries (LMICs).[1] According to the Global Burden of Disease Study 2017, more than 910 million childhood diarrheal cases were reported each year.[2] Globally, diarrhea remains a leading cause of under-5 mortality-account for 1 in 9 child deaths.[3] In addition to this staggering loss of under-5 life, it can have a detrimental impact on childhood growth and cognitive development.[4,5] It is also estimated that the odds of stunting at 24 months increased by 5% with each diarrheal episode.[6]

Diarrhea is preventable with the application of proper hand hygiene, basic sanitation, and the provision of safe drinking water.[7] Available evidence showed that almost 88% of diarrhea-associated deaths are attributable to unsafe water, inadequate sanitation, and insufficient hygiene.[8] Several studies also explore the effect of single and combined water, sanitation, and hygiene (WASH) intervention in the reduce risk of diarrheal morbidity.[7,9-13] For example, a systematic review on the effects of WASH interventions and acute childhood diarrhea found that various WASH interventions show diarrhea risk reductions between 27% and 53% in children under 5 years old, depending on intervention type.[10] Another updated of meta-analysis also showed that promoting handwashing with soap associated with reduced risk of diarrhea by 30%.[13]

In Ethiopia, diarrheal diseases are major contributors to under-5 morbidity and mortality.[7,14,15] Over the past 2 decades, Ethiopia had shown a decrement in diarrhea prevalence among under-5 children—from 24% in 2000 to 12% in 2016. The overall change (2000-2016) in diarrhea prevalence was 14%.[16,17]

Despite progress in the reduction of childhood diarrhea in Ethiopia, still it is the second leading cause of morbidity and mortality among under-5 children next to pneumonia.[14,17]

Different studies showed that household-level risk factors such as lack of safe water and improved sanitation facility, poor maternal hygiene, household water treatment, methods of complementary feeding, types of water storage equipment, maternal education, and improper waste disposal practices were significant factors for the occurrence of diarrheal illness.[7,9,11,12,14,18,19] In previous works of literature, the effect of improved WASH on childhood diarrhea morbidity was well established. However, in some instances, WASH interventions fail to appear long-term impact,[20] due to reinfection and contamination of the living home as a result of dirt floors. As dirt floors facilitate and increased defilement of finger, fluid, food, and materials that encounter these surfaces and possibly increase the risk of diarrhea among children[21] and an increased risk of parasitic infections.[20,22] A study from Zimbabwe showed that mothers of infants living in households with improved flooring were less likely to report diarrheal illness. Further, the association between flooring and diarrheal illness did not vary by the presence of improved/unimproved water or sanitation.[21] It was also found that dirt and mud floors are a known predictor of diarrhea and parasitic infestations.[21,22] Eliminating a dirt floor from the home results in dramatic reductions in childhood diarrhea and Soil-Transmitted Helminth (STH).[21,23] For instance, replacing a dirt floor with a concrete floor reduces diarrhea by 49%.[24]

The poor in many developing countries, including Ethiopia cannot afford to replace a dirt floor with concrete or improved material and the challenges remain due to cleaning of sand or soil floors are so difficult, the proximity of latrine pits, and unsanitary environmental surrounding. This may be further exacerbated by contamination of the floor by fecal matter brought in on shoes, and especially when animals live in close proximity to humans.[25-27] Earth or sand (48%) and dung (33%), are the 2 most commonly used flooring materials in Ethiopia.[17] Children dwelling in households with mud floors are disproportionately affected by diarrheal diseases.[28]

According to studies conducted in various parts of the country,[14,18,28-31] childhood diarrhea is still a major public health issue in Ethiopia, with a pooled prevalence of 22%.[18] Diarrhea was also relatively common among children aged 6 to 23 months.[28,32] Studies showed that household flooring is an important pathway for the transmission of diarrheal pathogens in Ethiopia.[28,29,32] Besides the lack of a nationwide study that determines the significant influence of household flooring on childhood diarrhea is a significant gap. Therefore, this study was aimed to determine the association between childhood diarrhea and household flooring among children 0 to 23 months of age in Ethiopia.

Methods

Data sources

The data source for this analysis was the 2016 Ethiopia Demographic and Health Survey (EDHS).[17] It is a nationally representative household survey carried out based on a nationally representative sample of households that provide estimates at the national and regional levels. The datasets of EDHS surveys are freely available, and we have accessed it from the online repository of the Demographic and Health Survey (DHS) Program website upon request via a link https://www.dhsprogram.com/data/available-datasets.cfm.

Study design and sampling

The 2016 EDHS was cross-sectional by design. The 2016 EDHS was designed to provide population and health indicators at the national and regional levels. The EDHS used a stratified 2-stage cluster sampling technique.[17] In the current analysis, we included children 0 to 23 months living with their mother (n = 4552 children).

Outcome variable

The primary outcome of interest for this study was presence of diarrhea. The prevalence of childhood diarrhea was measured using the WHO-recommended definition, namely if a child had 3 or more loose stools or watery diarrhea in a day during the 2 weeks preceding the study.[33,34] In the EDHS, mothers were asked if their children under 5 had diarrhea in the past 2 weeks prior to the survey. The response was recorded as "yes" and "no."

Exposure variables

Household floor type was the main exposure variable in this study. The model questions for housing characteristics includes natural (earth/sand, dung), rudimentary floor (wood planks, palm/bamboo), and finished floor (parquet or polished wood, vinyl or asphalt strips/plastic tile, ceramic tiles, cement, carpet). In this analysis rudimentary and finished floor types are considered improved (households without dirt floor), while only natural flooring is considered sub-optimal (households with dirt floor).

Covariates: All potential confounders

Diarrhea was considered as the main outcome in this study and household floor type was considered to be an important exposure variable. The factors selected were then categorized as individual and community level characteristics, which were sub-grouped into child related, parental related, and household related factors. The minimal sufficient adjustment sets in this study were then guided by using a direct acyclic graph (DAG; Figure 1). We also used existing literature to create a conceptual framework that explains the path of a study and visualizes the relationship between variables (Figure 2).

Individual-level characteristics

Child related factors. Child's sex (male, female), child's age (in months) (0-5, 6-11, 12-17, 18-23), number of under-five children (<2, 2, ⩾3), currently breastfeeding (yes, no), initiation of

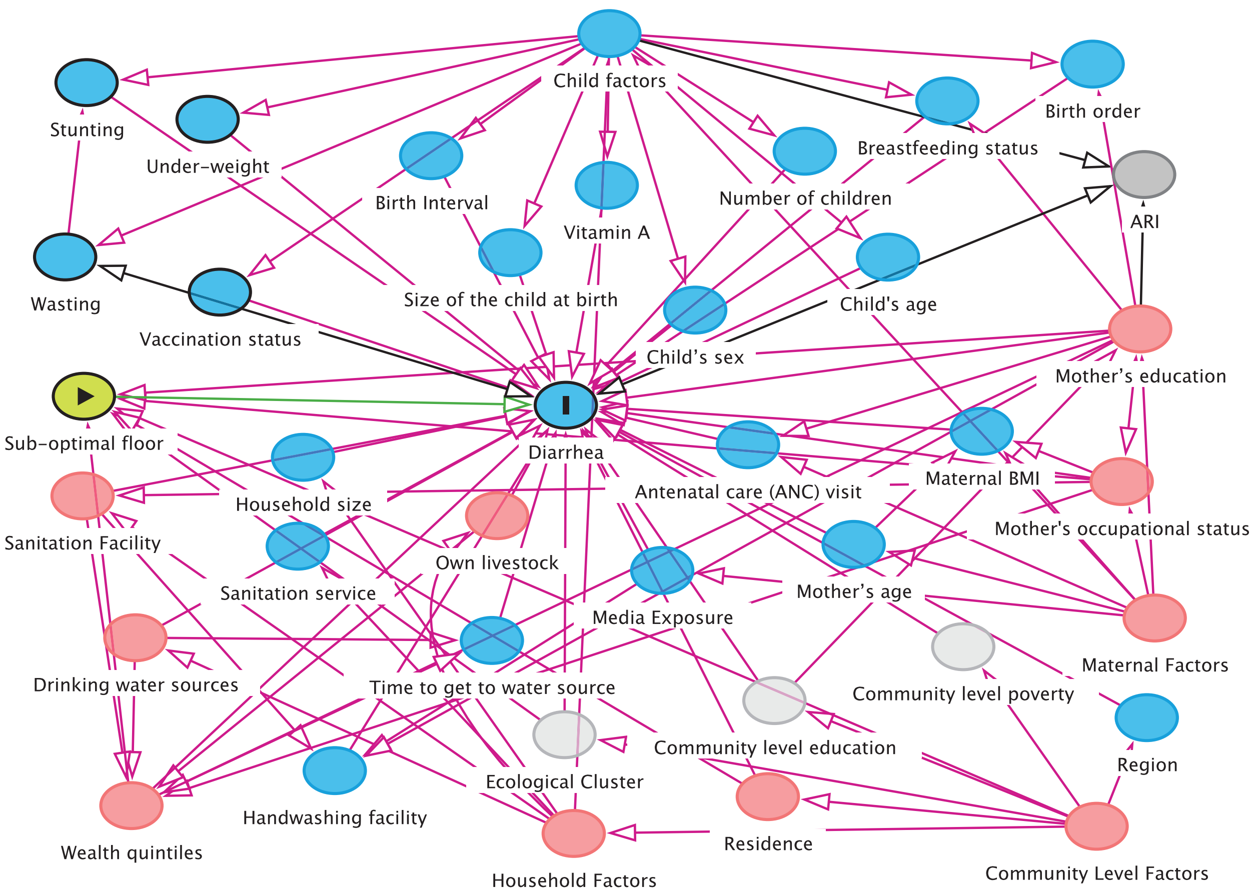

Figure 1. Directed acyclic graph (DAG) to select study confounders.

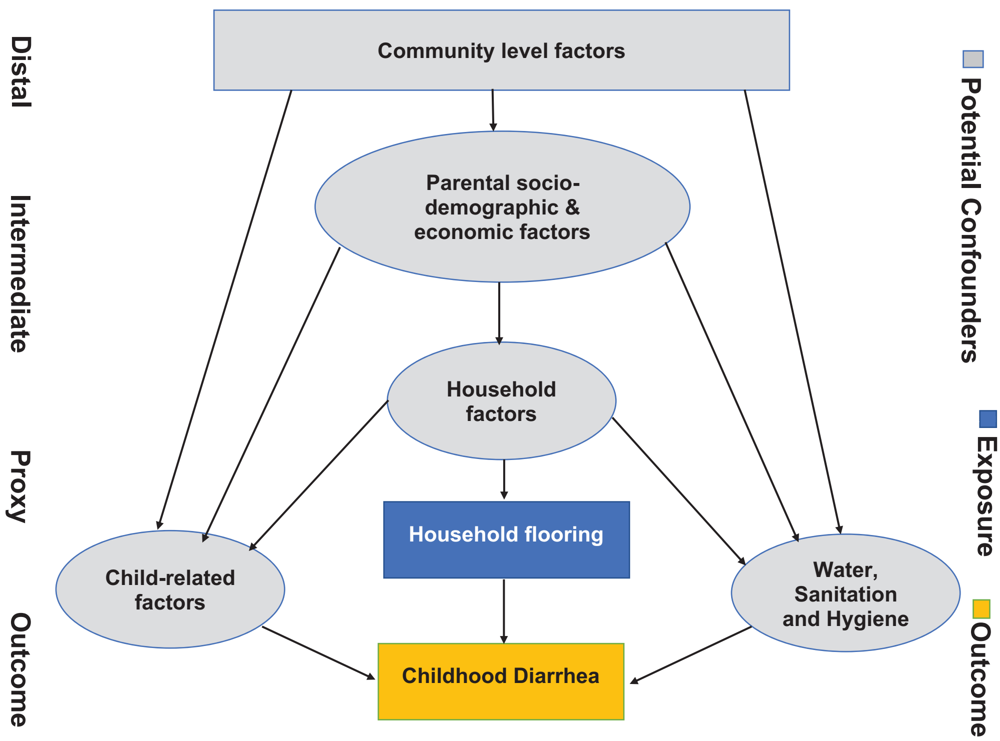

Figure 2. A conceptual framework that illustrates the path of a study and visualizes the relationship between variables.

breastfeeding (within 1, more than 1 hour), when does a child put on breastfeeding? (immediately, not immediately), duration of breastfeeding (up to 12, >12 months), birth order (first born, 2-4, 5, or higher), fever in the last 2-week (yes, no), acute respiratory infection (ARI) (yes, no), stunted (yes, no), wasted (yes, no), under-weight (yes, no), received basic vaccination (yes, no), fully immunized (yes, no), size of the child at birth (large, average, small), received vitamin A in last 6 months (yes, no), and birth interval (short [<33 months], none short [⩾33 months]),

Paternal related factors. mother's age (<18, 18-24, 25-34, 35-49 years), mother's education level (no education, primary, and above), respondent currently working (yes, no), mother's employment status (not working, non-agriculture, agriculture), antenatal clinic visits (ANC) (none, 1-3, 4+), maternal BMI (kg/m^2) (<18.5, 18.5-24.9, 25+), media exposure (yes, no), paternal education (no education, primary, and above), partner employment status (not working, non-agriculture, agriculture), household size (1-4, ⩾5), wealth quintiles (poor, middle, rich), and own livestock (yes, no).

Household related factors. Drinking water sources (improved, unimproved), sanitation facility (improved, unimproved), sanitation service (basic sanitation service, limited sanitation service, poor sanitation service), time to get to water source (on premises, ⩽30, 31-60, ⩾61 min), and presence of water at handwashing facility (yes, no).

Community level characteristics

Place of residence (urban, rural), community level education (low, high), community level poverty (low, high), region (Oromia, Amhara, Tigray, SNNP, pastoralist, Gambella and Benshangul Gumuz and city administration), ecological cluster (low altitude, moderate altitude, high altitude). Community-level education and poverty were created and included as a community-level factors.

Community-level education was defined as the proportion of mother's who attended primary and secondary or above education within the cluster. This proportion was divided into 2 with reference to the national median value categorized as low for proportion below median value and high for proportion above median value within the cluster. Similarly, community poverty level was an aggregate wealth index categorized as high or low, which is the proportion of women in the poorest and poorer quintile derived from data on wealth index which is categorized as low and high poverty community based on the median value.

Toilet facility and source of drinking water were categorized into "improved" and "unimproved" based on the WHO/UNICEF JMP for water supply and sanitation definition.[35] Facilities that would be considered improved sanitation facility if any of the following types: flush/pour flush toilets to piped sewer systems, septic tanks, and pit latrines; ventilated improved pit (VIP) latrines; pit latrines with slabs; and composting toilets. Other facilities including households with no facility or use bush/field were considered unimproved. Improved sources of drinking water: include piped water, public taps, standpipes, tube wells, boreholes, protected dug wells and springs, rainwater, and bottled water. Other sources of drinking water such as unprotected dug well, unprotected spring, tanker truck/cart with small tank and surface water was considered as unimproved source.

Data analysis

Data analysis was carried out using STATA version 14 (Stata Corp, College Station, Texas, United States) statistical software. We used the "svy" command to weight the survey data as per the recommendation of the EDHS. Sample weights were applied in order to compensate for the unequal probability of selection between the strata that were geographically defined, as well as for non-responses. A detailed explanation of the weighting procedure can be found in the EDHS methodology report.[17]

The EDHS data are hierarchical (children were nested in clusters). Children from the same cluster will be more similar to each other than children from different clusters. For this reason, we used a multilevel model which account the hierarchical nature of the EDHS data.[41] The random effects were measured by the intra-class correlation coefficient (ICC), median odds ratio (MOR), and proportional change in variance (PCV). The ICC was calculated to evaluate whether the variation in presences of childhood diarrhea is primarily within or between communities.[36]

Four multivariable models were fitted to estimate both fixed effects of the individual and community-level factors and random effect of between-cluster variation. Null model (*model 0*): This model was run without any independent variables, to test the random effect of between-cluster variation on childhood diarrhea. Individual level factors (*model 1*): The second model examined effects of individual level characteristics on childhood diarrhea among children living in households with sub-optimal flooring. Community-level factor model (*model 2*): This model contained only characteristics of cluster. This model allows us to examine whether the community level variables explain between cluster variations on childhood diarrhea. Combined model (*model 3*): Important characteristics of individual and community level variables were simultaneously fitted to 1 model to reveal the net fixed and random effects.

The multicollinearity effect was assessed with a cut of off point of variance inflation factor (VIF) of greater than 10.[37] Finally, significant variables were identified based on the adjusted odds ratio (AOR) with 95% CIs (confidence intervals) and *P*-value <.05. Model fits were assessed using log-likelihood (LL), deviance, and Akaike Information Criterion

(AIC).[38-40] Log-likelihood (LL), AIC, and deviance were used to estimate the goodness of fit of the adjusted final model in comparison to the preceding models (individual and community level model adjustments). The LL, AIC, and deviance value for each subsequent model was compared and the model with the highest value of LL and lowest value of deviance and AIC was considered to be the best fit model.[38,40,41] Adjusted ORs (AOR) with a 95% CI were used to declare statistical significance.

Ethics approval

DHS Programme granted permission to download and use the data for this study after being registered and submitting a request with briefly stated objectives of the study. The Institution Review Board approved procedures for DHS public-use data sets that do not in any way allow respondents, households, or sample communities to be identified. There are no names of individuals or household addresses in the data files. The detail of the ethical issues has been published in the 2016 EDHS final report, which can be accessed at: http://www.dhsprogram.com/publications.

Results

Characteristics of study participants and childhood diarrhea prevalence

Tables 1 to 4 lists the individual and community-level characteristics of the children included in this analysis. Of the 4552 children included in the analysis, half (n = 2164, 47.5%) were male. The mean (±standard deviation) age of included children was 10.87 months (±6.71). The majority 72.2% of the children were currently breastfed. Regarding nutritional status of children, 28.2%, 13.7%, and 18.6% of children were stunted, wasted, and under-weight. Over 60.6% of mothers of the children had no formal education, almost one-fifth of them were agricultural employees, and 44.9% were in the poor wealth quintile. The majority of study participants, (n = 3988, 87.6%) were rural dwellers, 54.2% of the respondents use unimproved drinking water sources, and 89.2% use unimproved sanitation facilities. Of the respondents, 34.7% had only media exposure (read newspapers, listened to the radio, or watched television) and low BMI (<18.5 kg/m^2) was observed in fifth of the study participants. The overall prevalence of childhood diarrhea among children 0 to 23 months of age in Ethiopia was 15.5% (95% CI 14.4-16.5). Among children who experience diarrheal illness majority of children, 85.8% live in households with dirt floor.

Bivariable and multivariable multilevel logistic regression analysis results on childhood diarrhea and households flooring in Ethiopia

On bivariable multilevel logistic regression analysis both individual-level (such as child's age, child breastfeeding status, having acute respiratory infection [ARI], being stunted, being under-weight, received basic vaccination, type of household sanitation facility, and presence of water at handwashing facility) and community-level (community level poverty and region) factors were identified factors that significantly associated with childhood diarrhea. On the other hand, in the bivariable multilevel logistic regression analysis type household floor does not show significant association with childhood diarrhea (unadjusted OR 1.17, 95% CI 0.91-1.49) (Table 5).

Table 6 displayed the adjusted estimates of selected factors on childhood diarrhea among children 0 to 23 months of age in Ethiopia. In multivariable multilevel logistic regression *model 3* (model adjusted for both individual-level and community level factors), we found no statistically association between childhood diarrhea and type of household flooring (AOR 1.05, 95% CI 0.59-1.88); however, age of the child, child having acute respiratory infection (ARI), size of the child at birth, and region were found to be associated with childhood diarrhea.

The result of the full model revealed that the odds of diarrhea among children aged 6 to 11 months (AOR 4.39, 95% CI 2.21-8.74), 12 to 17 months (AOR 4.50, 95% CI 2.18-13.90), and 18 to 23 months (AOR 5.48, 95% CI 1.95-15.48) were higher compared with children aged 0 to 5 months. The adjusted odds of developing diarrhea was 5.64 folds higher among children having acute respiratory infection (ARI) (AOR 5.64, 95% CI 2.83-11.25) compared with their counterparts. The odds of having diarrhea among children with average size at birth were lower (AOR 0.52, 95% CI 0.33-0.82) compared with children with smaller size at birth. Additionally, compared with children live in city administration children live in other regions like Amhara region (AOR 3.45, 95% CI 1.43-8.29), Tigray region (AOR 2.55, 95% CI 1.14-5.69), South Nation Nationality and People (SNNP) region (AOR 2.44, 95% CI 1.07-5.53), and Gambela and Benishangul-Gumuz regions (AOR 3.21, 95% CI 1.43-7.21) were higher odds of developing diarrhea.

Measures of variation (random-effects) and model fit statistics

Measure of variation (random intercept models) and model fit statistics of diarrhea among 0 to 23 months of age in Ethiopia is shown in Table 7. The ICC in the empty model was 9.86%, indicating that 9.86% of the total variability for diarrhea was due to differences between clusters (Enumeration's areas), with the remaining unexplained 90.14% which is attributed to individual differences. Additionally, the ICC in the final model (10.4%) suggested that residual community influences were persistent even after adjusting for the individual- and community-level factors. This implies that there are other unmeasured community factors. In this study, the models were compared with deviance, and model III (a model with both individual and community level factor) was selected, had the lowest deviance (839.75) (Table 7).

Table 1. Individual level-child related characteristics of study participants by household flooring and diarrheal prevalence, Ethiopian DHS.

VARIABLES	CATEGORY	OVERALL N (%)[a] (N = 4552)	HOUSEHOLD WITH DIRT FLOOR, N (%)	DIARRHEA	
				YES, N (%)	NO, N (%)
Child-related factors					
Child's sex					
	Male	2164 (47.5)	1751 (47.4)	354 (50.3)	1810 (47.1)
	Female	2387 (52.5)	1945 (52.6)	350 (49.7)	2037 (52.9)
Child's age (mo) (n = 4248)					
	0-5	1184 (27.7)	1039 (28.3)	89 (13.0)	1095 (30.7)
	6-11	1067 (25.1)	890 (24.2)	241 (35.1)	826 (23.2)
	12-17	1121 (26.4)	968 (26.4)	199 (29.1)	922 (25.9)
	18-23	874 (20.6)	774 (21.1)	156 (22.7)	719 (20.2)
Number of under-5 children					
	<2	1815 (39.9)	1278 (34.6)	324 (46.0)	1491 (38.7)
	2	1967 (43.2)	1746 (47.2)	284 (40.3)	1683 (43.7)
	⩾3	769 (16.19)	671 (18.2)	96 (13.7)	673 (17.5)
Ever breastfeeding					
	Yes	4456 (97.9)	4185 (98.1)	695 (98.7)	3760 (97.8)
	No	94 (2.1)	84 (1.9)	9 (1.3)	85 (2.2)
Currently breastfeeding (n = 4247)					
	Yes	3066 (72.2)	2617 (71.3)	481 (70.2)	2585 (72.6)
	No	1181 (27.8)	1054 (28.7)	204 (29.8)	977 (27.4)
Initiation of breastfeeding (n = 4248)					
	Within 1 h	3066 (72.2)	2617 (71.3)	481 (70.2)	2585 (72.6)
	More than 1 h	1181 (27.8)	1054 (28.7)	204 (29.8)	977 (27.4)
When does a child put on breastfeeding (n = 4193)					
	Immediately	3039 (72.5)	2522 (71.8)	468 (69.2)	2571 (73.1)
	Not immediately	1154 (27.5)	991 (28.2)	209 (30.8)	946 (26.9)
Duration of breastfeeding (n = 4456)					
	Up to 12 mo	2360 (52.9)	1999 (55.2)	360 (51.8)	2000 (53.2)
	>12 mo	2095 (47.1)	1624 (44.8)	335 (48.2)	1760 (46.8)
Birth order					
	First born	964 (21.2)	1510 (16.9)	158 (22.5)	805 (20.9)
	2-4	1919 (42.1)	3834 (42.8)	303 (43.1)	1615 (41.9)
	5 or higher	1669 (36.7)	3604 (40.3)	241 (34.3)	1427 (37.2)
Fever in the last 2-wk (n = 4528)					
	Yes	774 (17.1)	746 (17.5)	331 (47.2)	443 (11.6)
	No	3754 (82.9)	3520 (82.5)	369 (52.8)	3384 (88.4)

(Continued)

Table 1. (Continued)

VARIABLES	CATEGORY	OVERALL N (%)[a] (N = 4552)	HOUSEHOLD WITH DIRT FLOOR, N (%)	DIARRHEA	
				YES, N (%)	NO, N (%)
Acute respiratory infection (ARI)					
	Yes	333 (7.3)	324 (7.6)	145 (20.6)	188 (4.9)
	No	4219 (92.7)	3944 (92.4)	558 (79.4)	3660 (95.1)
Stunted (n = 4003)					
	Yes	1128 (28.2)	1041 (29.9)	220 (34.3)	907 (27.0)
	No	2875 (71.8)	2437 (70.1)	422 (65.7)	2453 (73.0)
Wasted (n = 3986)					
	Yes	544 (13.7)	1041 (29.9)	87 (13.3)	458 (13.7)
	No	3442 (86.3)	2437 (70.1)	563 (86.7)	2878 (86.3)
Under-weight (n = 4094)					
	Yes	759 (18.6)	708 (19.9)	185 (27.7)	574 (16.8)
	No	3334 (81.4)	2856 (80.1)	483 (72.3)	2851 (83.2)
Received basic vaccination (n = 4326)					
	Yes	1010 (23.4)	985 (23.6)	227 (32.5)	784 (21.6)
	No	3316 (76.6)	3183 (76.4)	470 (67.5)	2845 (78.4)
Received Rota virus vaccine (n = 4309)					
	Yes	2451 (56.9)	1998 (55.5)	496 (71.3)	1955 (54.1)
	No	1857 (43.1)	1601 (44.5)	199 (28.7)	1658 (45.9)
Fully immunized (n = 4158)					
	Yes	866 (20.8)	674 (19.1)	201 (29.4)	665 (19.2)
	No	3291 (79.2)	2861 (80.9)	483 (70.6)	2808 (80.8)
Size of the child at birth					
	Large	1381 (30.6)	1067 (29.2)	222 (31.6)	1158 (30.5)
	Average	1851 (41.1)	1501 (41.0)	241 (34.3)	1610 (42.3)
	Small	1274 (28.3)	1089 (29.8)	239 (34.1)	1034 (27.2)
Vitamin A in last 6 mo (n = 4449)					
	Yes	1586 (35.7)	1270 (35.2)	286 (41.5)	1300 (34.6)
	No	2862 (64.3)	2335 (64.8)	402 (58.5)	2460 (65.4)
Birth interval					
	Short (<33 mo)	3399 (74.7)	2734 (73.9)	542 (76.9)	2857 (74.2)
	None short (⩾33 mo)	1153 (25.3)	962 (26.1)	162 (23.1)	990 (25.8)

[a]Weighted frequency and percentage.

Table 7 (*Model 3*) revealed that the PCV for individual and community level factors model adjustment was 70.69%; indicating that almost 71% of the variance in the odds of diarrheal morbidity among children 0 to 23 months of age was explained by individual and community-levels factors found in the model. Moreover, the MOR indicated that diarrhea was attributed to community-level factors. The MOR for childhood diarrhea was 2.01 in the empty model (null model); this showed that

Table 2. Individual level-parental factors of study participants by household flooring and diarrheal prevalence, Ethiopian DHS.

VARIABLES	CATEGORY	OVERALL N (%)[a] (N=4552)	HOUSEHOLD WITH DIRT FLOOR, N (%)	DIARRHEA YES, N (%)	NO, N (%)
Parental factors					
Mother's age (y)					
<18		94 (2.1)	79 (2.2)	4 (0.5)	90 (2.3)
18-24		1237 (27.2)	1018 (27.6)	199 (28.3)	1038 (26.9)
25-34		2322 (51.0)	1838 (49.7)	375 (53.3)	1946 (50.6)
35-49		898 (19.7)	759 (20.5)	125 (17.8)	773 (20.1)
Mother's education level					
No education		2758 (60.6)	2416 (65.4)	402 (57.1)	2356 (61.2)
Primary and above		1794 (39.4)	1280 (34.6)	302 (42.9)	1492 (38.8)
Respondent currently working					
Yes		1104 (24.3)	835 (22.6)	191 (27.2)	913 (23.7)
No		3448 (75.7)	2860 (77.4)	513 (72.8)	2935 (76.3)
Respondent's employment status					
Not working		2714 (59.6)	2207 (59.7)	399 (56.7)	2315 (60.2)
Non agriculture		933 (20.5)	649 (17.6)	168 (23.9)	764 (19.9)
Agriculture		905 (19.9)	839 (22.7)	136 (19.4)	768 (19.9)
Antenatal care visits (ANC) (n=4259)					
None		1493 (35.0)	1348 (37.8)	205 (30.0)	1287 (36.0)
1-3		1341 (31.5)	1159 (32.5)	235 (34.5)	1105 (30.9)
4+		1425 (33.5)	1060 (29.7)	243 (35.5)	1182 (33.1)
Place of delivery					
Home		2866 (62.0)	2488 (67.3)	430 (61.1)	2436 (63.3)
Healthcare facility		1686 (37.0)	1207 (32.7)	273 (38.9)	1412 (36.7)
Maternal BMI (kg/m^2) (n=4361)					
<18.5		895 (20.5)	775 (21.5)	139 (20.6)	755 (20.5)
18.5-24.9		3177 (72.9)	2699 (74.9)	494 (72.8)	2683 (72.9)
25+		287 (6.6)	129 (3.6)	45 (6.6)	242 (6.6)
Media exposure[b]					
Yes		1.581 (34.7)	1037 (28.1)	264 (37.6)	1316 (34.2)
No		2971 (65.3)	2659 (71.9)	439 (62.4)	2532 (65.8)
Paternal education (n=4319)					
No education		2345 (54.3)	1767 (50.5)	388 (58.7)	1957 (53.5)
Primary and above		1974 (45.7)	1735 (49.5)	273 (41.3)	1701 (46.5)
Partner occupation (n=4319)					
Not working		320 (7.4)	274 (7.8)	54 (8.1)	266 (7.3)
Agricultural employee		2821 (65.3)	2509 (71.6)	404 (60.8)	2418 (66.2)
Non-agricultural employee		1.177 (27.3)	722 (20.6)	207 (31.1)	970 (26.5)
Sex of the household head					
Male		3917 (86.0)	3229 (87.4)	620 (88.0)	3297 (85.7)
Female		636 (14.0)	466 (12.6)	84 (12.0)	551 (14.3)

[a]total number study participants.

Table 3. Individual level-household factors of study participants by household flooring and diarrheal prevalence, Ethiopian DHS.

VARIABLES	CATEGORY	OVERALL N (%)[a] (N = 4552)	HOUSEHOLD WITH DIRT FLOOR, N (%)	DIARRHEA	
				YES, N (%)	NO, N (%)
Household factors					
Household size					
	1-4	1382 (30.4)	992 (26.8)	224 (31.8)	1158 (30.1)
	⩾5	3170 (69.6)	2704 (73.2)	480 (68.2)	2690 (69.9)
Wealth quintiles (n = 4538)					
	Poor	2039 (44.9)	1917 (51.9)	278 (39.7)	1762 (45.9)
	Middle	948 (20.9)	868 (23.5)	153 (21.8)	795 (20.7)
	Rich	1550 (34.2)	911 (24.6)	268 (38.4)	1282 (33.4)
Own livestock					
	Yes	3559 (83.6)	3329 (90.1)	576 (84.4)	2984 (83.4)
	No	699 (16.4)	367 (9.9)	106 (15.6)	593 (16.6)
Drinking water sources[b] (n = 4423)					
	Improved	2027 (45.8)	1462 (40.4)	317 (47.0)	1709 (45.6)
	Unimproved	2396 (54.2)	2162 (59.6)	358 (53.0)	2038 (54.4)
Sanitation facility[c] (n = 4423)					
	Improved	476 (10.7)	432 (10.3)	59 (8.7)	416 (11.1)
	Unimproved	3947 (89.2)	3755 (89.7)	617 (91.3)	3330 (88.9)
Sanitation service[d] (n = 2801)					
	Basic sanitation service	244 (8.7)	127 (5.9)	26 (5.8)	218 (9.3)
	Limited sanitation service	232 (8.3)	65 (3.0)	33 (7.4)	199 (8.4)
	Poor sanitation service	2325 (83.0)	1956 (91.1)	389 (86.8)	1935 (82.3)
Time to get to water source (n = 4412)					
	On premises	538 (12.2)	198 (5.5)	88 (13.1)	450 (12.0)
	<30 min	2425 (54.9)	2153 (59.5)	360 (53.3)	2065 (55.3)
	30-60 min	863 (19.6)	741 (20.5)	125 (18.6)	738 (19.7)
	⩾60	584 (13.3)	525 (14.5)	101 (15.0)	483 (12.9)
Presence of water at handwashing facility (n = 2267)					
	Yes	1603 (70.7)	1371 (74.4)	264 (71.8)	1339 (70.5)
	No	663 (29.3)	470 (25.6)	104 (28.2)	559 (29.5)
Household floor (n = 4259)					
	Households with dirt floor	3687 (86.6)	—	585 (85.8)	3102 (86.7)
	Households without dirt floor	572 (13.4)	—	97 (14.2)	475 (13.3)

[a]Weighted frequency and percentage.
[b]Facilities that would be considered improved if any of the following types: flush/pour flush toilets to piped sewer systems, septic tanks, and pit latrines; ventilated improved pit (VIP) latrines; pit latrines with slabs; and composting toilets. Other facilities including households with no facility or use bush/field were considered unimproved. Include piped water, public taps, standpipes, tube wells, boreholes, protected dug wells and springs, rainwater, and bottled water.
[c]Improved sources of drinking water: Include piped water, public taps, standpipes, tube wells, boreholes, protected dug wells and springs, and rainwater. Because the quality of bottled water is unknown, households that use bottled water for drinking are classified as using an improved source only if the water they use for cooking and hand washing comes from an improved source.
[d]Improved sanitation facility that is not shared with other households was considered as having basic sanitation service whereas households with an improved sanitation facility that is shared with other households was considered as having limited sanitation service.

Table 4. Community level characteristics of study participants by household flooring and diarrheal prevalence, Ethiopian DHS.

VARIABLES	CATEGORY	OVERALL N (%)[a] (N=4552)	HOUSEHOLD WITH DIRT FLOOR, N (%)	DIARRHEA YES, N (%)	NO, N (%)
Community level variables					
Place of residence					
Urban		565 (12.4)	165 (4.5)	79 (11.2)	486 (12.6)
Rural		3988 (87.6)	3531 (95.5)	625 (88.8)	3362 (87.4)
Community level education					
Low		1418 (31.1)	886 (24.0)	233 (33.1)	1185 (30.8)
High		3135 (68.9)	2810 (76.0)	471 (66.9)	2664 (69.2)
Community level poverty					
Low		1986 (43.6)	1388 (37.5)	346 (49.1)	1640 (42.6)
High		2566 (56.4)	2309 (62.5)	358 (50.9)	2208 (57.4)
Region					
Oromia		2032 (44.6)	1714 (46.4)	251 (35.6)	1781 (46.3)
Amhara		824 (18.1)	712 (19.3)	167 (23.8)	656 (17.1)
Tigray		319 (7.0)	268 (7.3)	63 (8.9)	256 (6.7)
SNNP		920 (20.2)	753 (20.4)	174 (24.7)	746 (19.4)
Pastoralist[b]		248 (5.4)	180 (4.9)	25 (3.7)	222 (5.8)
City administration		150 (3.3)	17 (0.5)	14 (2.1)	135 (3.5)
Gambella and B/Gumuz		59 (1.3)	50 (1.4)	8 (1.1)	51 (1.3)
Ecological cluster					
Low altitude		2560 (56.5)	2192 (59.3)	407 (58.2)	2153 (56.2)
Moderate altitude		1841 (40.6)	1395 (37.8)	271 (38.8)	1570 (41.0)
High altitude		129 (2.8)	108 (2.9)	21 (3.0)	108 (2.8)

[a]Weighted frequency and percentage.
[b]Afar and Somalia regions.

there was variation between communities (clustering) since MOR was 2.01 times higher than the reference (MOR = 1). The unexplained community variation in diarrheal morbidity becomes (MOR = 2.05) when all factors were added to the empty model (null model). This indicates that when all factors are included, the effect of clustering is still statistically significant in the full model.

Discussion

This study aimed to determine if household flooring was associated with childhood diarrhea among children 0 to 23 months of age in Ethiopia. No association was found between childhood diarrhea and type of household flooring. The study also showed that odds of diarrhea was higher among children aged 6 to 11, 12 to 17, and 18 to 23 months compared with younger siblings 0 to 5 months of age. Children having acute respiratory infection (ARI), size of the child at birth and place of residence were identified factors associated with childhood diarrhea.

There was no association observed between the type of flooring and the occurrence of childhood diarrhea (AOR 1.05, 95% CI 0.59-1.88). This has been a recurring finding throughout our analysis. A lack of sufficient power or sample size is one possible explanation. This is due to the EDHS's cross-sectional nature in answering our research objective. Second, the association was ruled out since the study did not capture seasonal variations in childhood diarrhea. Because earthen or other rudimentary household flooring is difficult to clean, it can become wet and chilly, increasing the risk of diarrhea, especially during rainy seasons. Third, as with all observational studies, our analyses are potentially susceptible

Table 5. Multilevel bivariate logistic regression analysis of the prevalence of diarrhea among children aged 0 to 23 months of age in Ethiopia.

VARIABLES	UNADJUSTED OR (95% CI)	*P*-VALUE
Child-related factors		
Child's sex (Ref.: Female)		
Male	1.14 (0.95-1.36)	.148
Child's age (Ref.: 0-5 mo)		
6-11	**2.76 (2.08-3.66)***	<.001
12-17	**2.74 (2.07-3.62)***	<.001
18-23	**2.49 (1.85-3.35)***	<.001
Number of under-5 children (Ref.: <2)		
2	1.07 (0.88-1.30)	.482
⩾3	0.65 (0.65-1.10)	.222
Currently breastfeeding (Ref.: No)		
Yes	**1.76 (1.35-2.29)***	<.001
Initiation of breastfeeding (Ref.: Within 1 h)		
More than 1 h	1.18 (0.97-1.43)	.088
When does a child put on breastfeeding (Ref.: Immediately)		
Not immediately	**1.34 (1.10-1.62)***	.003
Duration of breastfeeding (Ref.: >12 mo)		
Up to 12 mo	0.85 (0.72-1.02)	.087
Birth order (Ref.: First born)		
2-4	1.06 (0.84-1.33)	.617
5 or higher	0.99 (0.77-1.26)	.930
Acute respiratory infection (ARI) (Ref.: Yes)		
No	**0.20 (0.15-0.28)***	<.001
Stunted (Ref.: No)		
Yes	**1.33 (1.08-1.64)***	.006
Wasted (Ref.: No)		
Yes	1.02 (0.79-1.32)	.857
Under-weight (Ref.: No)		
Yes	**1.43 (1.14-1.78)***	.001
Received basic vaccination (Ref.: Yes)		
No	**0.69 (0.56-0.84)***	<.001
Fully immunized (Ref.: Yes)		
No	**0.72 (0.58-0.88)***	.002
Size of the child at birth (Ref.: Large)		
Average	0.83 (0.66-1.03)	.098
Small	1.19 (0.95-1.51)	.118

(Continued)

Table 5. (Continued)

VARIABLES	UNADJUSTED OR (95% CI)	*P*-VALUE
Vitamin A in last 6 mo (Ref.: Yes)		
No	**0.67 (0.56-0.80)***	<.001
Birth interval (Ref.: Short < 33 mo)		
None short (⩾33 mo)	0.89 (0.72-1.09)	.275
Parental factors		
Mother's age (Ref.: <18 y)		
18-24	1.64 (0.72-3.74)	.238
25-34	1.63 (0.72-3.69)	.241
35-49	1.49 (0.65-3.45)	.342
Mother's education level (Ref.: Primary and above)		
No education	0.85 (0.71-1.03)	.102
Respondent currently working (Ref.: Yes)		
No	**0.78 (0.64-0.96)***	.019
Respondent's employment status (Ref.: Not working)		
Non agriculture	**1.45 (1.17-1.81)***	.001
Agriculture	0.39 (0.86-1.42)	.397
Maternal BMI (kg/m²) (Ref.: <18.5)		
18.5-24.9	1.01 (0.82-1.25)	.878
25+	0.76 (0.53-1.11)	.157
Media exposure (Ref.: Yes)		
No	0.89 (0.73-1.07)	.225
Paternal education (Ref.: Primary and above)		
No education	**1.24 (1.03-1.50)***	.024
Partner occupation (Ref.: Not working)		
Agricultural employee	0.99 (0.72-1.38)	.990
Non-agricultural employee	1.11 (0.79-1.54)	.545
Sex of the household head (Ref.: Male)		
Female	0.85 (0.68-1.06)	.152
Household factors		
Household size (Ref.: 1-4)		
⩾5	1.10 (0.91-1.33)	.321
Wealth quintiles (Ref.: Rich)		
Poor	0.91 (0.73-1.12)	.362
Middle	1.28 (0.78-1.68)	.071
Own livestock (Ref.: Yes)		
No	0.99 (0.79-1.23)	.956

(Continued)

Table 5. (Continued)

VARIABLES	UNADJUSTED OR (95% CI)	*P*-VALUE
Sources of drinking water (Ref.: Improved)		
Unimproved	0.99 (0.82-1.20)	.957
Type of household's sanitation facility (Ref.: Improved)		
Unimproved	**1.29 (1.01-1.65)***	.048
Sanitation service (Ref.: Basic sanitation service)		
Limited sanitation service	1.17 (0.74-1.86)	.491
Poor sanitation service	**1.56 (1.06-2.31)***	.023
Time to get to water source (Ref.: On premises)		
<30 min	1.07 (0.82-1.39)	.603
30-60 min	0.98 (0.71-1.34)	.903
⩾60 min	1.18 (0.86-1.63)	.303
Presence of water at handwashing facility (Ref.: Yes)		
No	**1.34 (1.01-1.78)***	.045
Household floor (Ref.: Households without dirt floor)		
Households with dirt floor	1.17 (0.91-1.49)	.213
Community level variables		
Place of residence (Ref.: Urban)		
Rural	1.26 (0.98-1.63)	.066
Community level education (Ref.: High)		
Low	1.06 (0.87-1.31)	.538
Community level poverty (Ref.: Low)		
High	**0.78 (0.64-0.95)***	.016
Region (Ref.: City administrations)		
Oromia	1.19 (0.82-1.71)	.358
Amhara	**1.90 (1.29-2.79)***	.001
Tigray	**1.80 (1.23-2.63)***	.002
SNNP	**1.84 (1.28-2.65)***	.001
Pastoralist	0.92 (0.65-1.30)	.656
Gambella and B/Gumuz	**1.44 (1.01-2.05)***	.046
Ecological cluster (Ref.: High altitude)		
Low altitude	0.79 (0.34-1.83)	.592
Moderate altitude	0.75 (0.32-1.76)	.517

*$P < .05$.
Significantly associated p-value (Crude).

to unmeasured confounding. For example, this study was unable to capture all sanitation-related experiences that women may have, as well as the level of contamination in their homes and community spaces in which children play, which could influence a child's likelihood of diarrhea. As young children usually put objects and surfaces they come into contact with in their mouths; while this is a normal development in early childhood, it may increase the risk of childhood diarrhea; however, this relationship has not been sufficiently explored in our study.

Table 6. Results of multivariable multilevel logistic regression analysis of factors associated with childhood diarrhea among children age 0 to 23 months in Ethiopia.

VARIABLES	NULL MODEL	MODEL 1	MODEL 2	MODEL 3[a]
		ADJUSTED OR (95% CI)	ADJUSTED OR (95% CI)	ADJUSTED OR (95% CI)
Child-related factors				
Child's age (Ref.: 0-5 mo)				
6-11		4.58 (2.30-9.13)**		**4.39 (2.21-8.74)****
12-17		5.70 (2.23-14.57)**		**4.50 (2.18-13.90)****
18-23		5.55 (1.95-15.84)*		**5.48 (1.95-15.48)***
Currently breastfeeding (Ref.: No)				
Yes		1.04 (0.52-2.06)		0.90 (0.45-1.81)
Initiation of breastfeeding (Ref.: within 1 h)				
More than 1 h		0.65 (0.23-1.84)		0.72 (0.25-2.03)
When does a child put on breastfeeding? (Ref.: not immediately)				
Immediately		0.60 (0.22-1.62)		0.67 (0.25-1.81)
Duration of breastfeeding (Ref.: >12 mo)				
Up to 12 mo		1.59 (0.74-3.44)		1.53 (0.72-3.28)
Acute respiratory infection (ARI) (Ref.: No)				
Yes		5.78 (2.90-11.49)**		**5.64 (2.83-11.25)****
Stunted (Ref.: No)				
Yes		0.96 (0.59-1.56)		0.92 (0.56-1.51)
Under-weight (Ref.: No)				
Yes		1.32 (0.75-2.33)		1.29 (0.93-2.29)
Received basic vaccination (Ref.: Yes)				
No		0.91 (0.37-2.24)		0.93 (0.38-2.28)
Fully immunized (Ref.: Yes)				
No		0.99 (0.41-2.41)		0.97 (0.39-2.38)
Size of the child at birth (Ref.: Small)				
Large		0.67 (0.41-1.10)		0.68 (0.42-1.11)
Average		0.52 (0.33-0.83)*		**0.52 (0.33-0.82)***
Vitamin A in last 6 months (Ref.: Yes)				
No		0.65 (0.44-0.96)*		0.69 (0.46-1.03)
Parental factors				
Mother's education level (Ref.: Primary and above)				
No education		0.87 (0.56-1.36)		0.85 (0.54-1.33)
Respondent currently working (Ref.: Yes)				
No		0.91 (0.47-1.75)		0.87 (0.45-1.67)

(Continued)

Table 6. (Continued)

VARIABLES	NULL MODEL	MODEL 1	MODEL 2	MODEL 3[a]
		ADJUSTED OR (95% CI)	ADJUSTED OR (95% CI)	ADJUSTED OR (95% CI)
Respondent's employment status (Ref.: Not working)				
Non agriculture		1.29 (0.64-2.64)		1.29 (0.63-2.67)
Agriculture		0.90 (0.47-1.72)		0.76 (0.39-1.47)
Paternal education (Ref.: Primary and above)				
No education		1.07 (0.66-1.74)		1.12 (0.68-1.84)
Household factors				
Wealth quintiles (Ref.: Rich)				
Poor		0.65 (0.35-1.19)		0.62 (0.32-1.19)
Middle		0.94 (0.54-1.63)		0.88 (0.51-1.54)
Sanitation service (Ref.: Basic sanitation service)				
Limited sanitation service		0.89 (0.46-1.75)		1.04 (0.53-2.07)
Poor sanitation service		0.91 (0.50-1.65)		0.73 (0.39-1.35)
Presence of water at hand washing facility (Ref.: Yes)				
No		1.46 (0.98-2.17)		1.39 (0.93-2.08)
Household floor (Ref.: Households without dirt floor)				
Households with dirt floor		1.63 (0.97-2.74)		1.05 (0.59-1.88)
Community level variables				
Place of residence (Ref.: Urban)				
Rural			1.42 (1.04-1.93)*	1.50 (0.77-2.95)
Community level poverty (Ref.: Low)				
High			0.67 (0.52-0.85)*	1.02 (0.60-1.72)
Region (Ref.: City administrations)				
Oromia			1.08 (0.72-1.60)	1.90 (0.78-4.61)
Amhara			1.72 (1.14-2.58)*	**3.45 (1.43-8.29)***
Tigray			1.79 (1.21-2.66)*	**2.55 (1.14-5.69)***
SNNP			1.72 (1.17-2.54)*	**2.44 (1.07-5.53)***
Pastoralist			1.01 (0.69-1.46)	1.93 (0.76-4.88)
Gambella and B/Gumuz			1.47 (1.01-2.15)*	**3.21 (1.43-7.21)***

[a]Individual level variables included in the full model (model 3): Child's age, currently breastfeeding, initiation of breastfeeding, when does a child put on breastfeeding, duration of breast feeding, size of the child at birth, having acute respiratory infection (ARI), stunted, under-weight, received basic vaccination, fully immunized, received vitamin A in last 6 months, respondent currently working, mother's employment status, mother's education level, paternal education, presence of water at handwashing facility, place of residence, community level poverty, and region. Type of household's sanitation facility was omitted because of collinearity.
*$P < .05$. **$P < .001$.
Significantly associated p-values (Adjusted).

Table 7. Model comparison to determine factors associated with childhood diarrhea in households with sub-optimal flooring.

INDIVIDUAL- AND COMMUNITY-LEVEL CHARACTERISTICS	NULL MODEL (EMPTY MODE)	MODEL 1	MODEL 2	MODEL 3
Random effect				
Community-level variance (SE)	0.36 (0.08)	0.71 (0.50)	0.50 (0.25)	0.62 (0.38)
ICC (%)	9.86 (6.06-15.6)	13.25 (4.49-33.2)	7.15 (3.79-13.07)	10.4 (2.61-33.65)
MOR	2.01	2.27	1.79	2.05
PCV (%)	Reference	103.66	34.40	70.67
Model fit statistics				
AIC	3584.92	910.26	3558.28	911.75
BIC	3597.67	1049.65	3622.06	1090.96
DIC (−2log-likelihood)	3581.12	854.26	3538.29	839.75

Abbreviations: AIC, Akaike's information criterion; BIC, Bayesian information criteria; DIC, deviance information criterion; ICC, intra-class correlation coefficient; MOR, median odds ratio; SE, standard error.
Null model (empty model) was fitted without determinant variables: model 1 is adjusted for individual-level variables, model 2 is adjusted for community-level variables, and model 3 is the final model adjusted for individual- and community-level variables.

Despite this finding, previous studies conducted in Zimbabwe, Ethiopia, and India[21,28,29,42] showed that household flooring is an important pathway for the transmission of childhood diarrheal illness. For instance, a cross-sectional study conducted by Paul[42] reported that children from households having dirt floor materials were associated with 8% higher likelihood of diarrhea (AOR 1.08, 95% CI 1.03, 1.12) compared to those whose households had non-dirt floor materials. In the same manner, a study conducted in Zimbabwe showed that mothers of infants living in households with improved flooring were less likely to report diarrheal illness in the last 4 weeks (adjusted prevalence difference [PDa] = −4.8%, 95% CI −8.6, −1.0). The association between flooring and diarrheal illness did not vary by the presence of improved/unimproved water or sanitation.[21]

In this study, the odds of diarrhea among children older than 6 months were higher compared with those aged <6 months, which was similar to the results of a study done in Rwanda,[43] Pakistan,[44] and Ethiopia.[34] The possible justifications could be due to the fact that children older than 6 months usually crawling on the ground which increases the probability of getting and contracting filth materials, particularly those live-in households with the mud floor may expose to pathogenic microorganisms easily. In addition, in this age, unhygienic, and contaminated food as a result of sub-optimal flooring may increase the risk of diarrhea. On the other hand, younger infants-age less than 6 months would be protected against diarrheal diseases by different mechanisms such as maternal antibodies obtained through exclusive breastfeeding and they are less exposed to the contaminated floor because these ages are neither crawling nor walking and cannot easily pick dirt or other contaminated objects.

In the current study, the odds of developing diarrhea was 5 times higher among children having acute respiratory infection (ARI) compared with their counterparts. Acute upper respiratory infections (ARIs) usually comes on quickly with symptoms. The symptoms are fever, cough, or difficulty breathing. Some children may be more susceptible to simultaneous infections (ie, comorbidity) or sequential infections because of compromised immune function and malnutrition. Symptoms may also include nausea, vomiting, and diarrhea. Due to the nature of the study design, we are unable to determine which occurred first. However, this finding is concurrent with previously conducted studies.[45-47] Recent evidence suggests that preceding diarrheal disease may be a risk factor for subsequent respiratory illness.[45] For instance, a study by Walker et al[46] reported diarrhea as a direct risk factor for acute lower respiratory tract infections among children under 3 years of age. Moreover, studies have looked for the co-occurrence of diarrhea and respiratory illness and have found that these 2 diseases occur together at a rate that is greater than that expected by chance.[45,46]

Additionally, compared with children living in city administration children living in other regions were higher odds of developing diarrhea. This finding can satisfactorily explain by children living in cities tend to live in households with improved WASH facilities, as a result, the risk of fecal-oral disease transmission may be minimal as compared to those children who live in other regions.

Limitations

Though the study aimed to determine the association between household flooring and childhood diarrhea among children 0 to 23 months of age in Ethiopia it has some limitations. Firstly, the analyses were conducted using EDHS data collected in a cross-sectional survey, which prevents causal inferences. Secondly, because the information on childhood diarrhea was self-reported, there is the possibility of poor recall. The preferable reported prevalence in the last 24 hour, which is most of the time 100% accurate, studies may have overestimated recall error, since the higher diarrhea prevalence closer to the day of the visit may indicate that people remember diarrhea during the past 7 days as having occurred more recently than was actually the case.[48] Recall bias may increase likelihood that those with the outcome will recall and report exposures compared to those without the outcome, these may affect our estimates. Cognitively, reporting of past activities is potentially subject to a range of different recall errors: telescoping (where respondents incorrectly shift activity forward or backward in time, into or out of the recall period), heaping (where respondents incorrectly agglomerate past events into 1 point in time, eg, "about 3 months ago"), and recall decay (where events further in the past are forgotten and under-reported) errors.[49] Our estimates of childhood diarrhea are based on mother's 14-day recall period. Nevertheless, it may be noted that all DHS surveys are cross-sectional and use 2-week recall to determine the prevalence of childhood illnesses. Third, we used children's birth size as a proxy for birth weight because birth weight information was not available for 86% of the children in EDHS. In settings having a dearth of accurate and reliable data on birth weight studies have shown that birth size is a good indicator of birth weight.[50,51] Fourth, the present study may not have adequate sample size to see the effect of household flooring on childhood diarrhea. Hence it can be taken as one of the limitations which requires further research. Therefore, further research should incorporate broader populations and better study designs to determine the true effect of household flooring on childhood diarrheal morbidity. Despite these limitations, we used a multilevel model to account for the clustered nature of EDHS data, which enhances the accuracy of estimates.

Conclusion

We found no association between childhood diarrhea and type of household flooring, but age of the child, having ARI, and size of the child at birth were important factors associated with diarrhea among Ethiopian children aged 0 to 23 months. Strong research is needed to determine the effect of household flooring on childhood diarrhea. Cluster randomized trials (CRTs) may be an effective method for testing interventions to identify children at higher risk based on household living conditions. This could have significant implications for interventional packages and help determine whether more research in this area is required.

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Author Contributions

BS: Conceptualizes, design the study and data curation, performed the analysis, wrote and approved the final manuscript. AK, DA, YT, DW, DZ, and TA: Contribute to the analysis, critically reviewed the manuscript and approved the final manuscript. All authors read and approved the final manuscript before submission.

Availability of Supporting Data

The data we used which is the 2016 Ethiopian Demographic and Health Survey was obtained from the DHS program (www.dhsprogram.com) but the "Dataset Terms of Use" do not permit us to distribute this data as per data access instructions (http://dhsprogram.com/data/Access-Instructions.cfm). To get access to the dataset you must first be a registered user of the website (www.dhsprogram.com) and download the 2016 Ethiopian Demographic and Health Survey.

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