

Association between Household Environmental Risk and Co-occurring Fever, Cough, and Diarrhea among Under-Five Children in Somalia: Evidence from the 2020 Somali Health and Demographic Survey

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Research Article

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Abstract

Background

Household environmental conditions are important determinants of childhood health, particularly in low-resource settings where inadequate water, sanitation, and hygiene increase the risk of infectious diseases. In Somalia, fever, cough, and diarrhea remain among the leading causes of morbidity among children under five years of age. However, evidence on the association between household environmental risk and the co-occurrence of these illnesses is limited. This study assessed the association between household environmental risk and co-occurring fever, cough, and diarrhea among under-five children in Somalia.

Methods

A secondary analysis was conducted using data from the 2020 Somali Health and Demographic Survey (SHDS). A total of 15,967 under-five children were included. A household environmental risk index was constructed using household environmental indicators, including drinking water source, sanitation facilities, time to obtain water, and electricity access. The outcome was co-occurring childhood illness, defined as the presence of two or more of the following symptoms within the two weeks preceding the survey: fever, cough, and diarrhea. Survey-weighted descriptive statistics summarized participant characteristics, and multivariable survey-weighted logistic regression was used to identify factors associated with co-occurring illness. Adjusted odds ratios (AORs) with 95% confidence intervals (CIs) were reported.

Results

Overall, 723 (4.5%) children experienced co-occurring fever, cough, and diarrhea during the two weeks preceding the survey. Approximately 60.8% of households were classified as having high household environmental risk. After adjustment for potential confounders, children living in households with high environmental risk had significantly higher odds of co-occurring illness than those in lower-risk households (AOR = 1.53, 95% CI: 1.09–2.15; $p = 0.013$). Older child age, rural residence, higher household wealth, and residence in Togdheer and Middle Shabelle were also independently associated with the outcome.

Conclusions

High household environmental risk is associated with increased odds of co-occurring fever, cough, and diarrhea among under-five children in Somalia. Strengthening interventions that improve household environmental conditions, including access to safe drinking water, improved sanitation, and basic

household infrastructure, may reduce the burden of multiple childhood illnesses. These findings support integrated environmental health strategies as part of child survival programs in Somalia.

Introduction

Despite substantial progress in child survival over recent decades, infectious diseases remain a major cause of morbidity and mortality among children under five years of age, particularly in low- and middle-income countries [1]. Fever, diarrheal diseases, and acute respiratory infections are among the leading causes of childhood illness and continue to account for a considerable proportion of preventable deaths and healthcare utilization [2]. Children living in sub-Saharan Africa experience a disproportionately high burden of these illnesses because of persistent socioeconomic inequalities, inadequate access to quality healthcare, malnutrition, and unfavorable environmental conditions [3]. Moreover, fever, cough, and diarrhea frequently occur simultaneously rather than independently, increasing disease severity, prolonging recovery, and elevating the risk of hospitalization and mortality [4]. Consequently, identifying the factors associated with the co-occurrence of these illnesses is essential for informing evidence-based interventions aimed at improving child survival and accelerating progress toward the Sustainable Development Goals [5].

Household environmental risk encompasses a range of modifiable conditions within the home environment that influence children's exposure to infectious pathogens, including unsafe drinking water, unimproved sanitation facilities, limited access to water, poor housing conditions, inadequate hygiene, and household air pollution [6]. These environmental exposures facilitate the transmission of enteric and respiratory pathogens through contaminated water and food, inadequate waste disposal, poor ventilation, and increased contact with infectious agents [7]. Young children are particularly susceptible because of their immature immune systems, frequent hand-to-mouth behaviors, and prolonged exposure to the household environment during early childhood [8]. Evidence from systematic reviews and epidemiological studies has consistently demonstrated that improvements in drinking water, sanitation, hygiene, and household environmental conditions substantially reduce the incidence of diarrheal diseases and respiratory infections among children under five years of age [6]. Consequently, reducing household environmental risk has become a central component of integrated child health and environmental health strategies in low- and middle-income countries [9].

Previous studies conducted in low- and middle-income countries have consistently reported significant associations between poor household environmental conditions and childhood infectious diseases. Inadequate access to improved drinking water, unimproved sanitation facilities, poor hygiene practices, household crowding, and exposure to household air pollution have all been associated with increased risks of diarrheal diseases, acute respiratory infections, and febrile illnesses among children under five years of age [10]. Although these studies provide important evidence on the influence of household environmental factors on child health, the majority have examined fever, cough, or diarrhea as separate outcomes rather than considering their co-occurrence [11]. Because these illnesses often share common environmental determinants and frequently occur simultaneously, evaluating them as a

combined outcome may provide a more comprehensive understanding of the cumulative effects of household environmental exposures on child health [12]. Nevertheless, nationally representative evidence examining the relationship between household environmental risks and co-occurring childhood illnesses remains limited, particularly in sub-Saharan Africa [13].

Somalia continues to experience one of the highest burdens of childhood morbidity in sub-Saharan Africa, driven by prolonged conflict, recurrent droughts, population displacement, widespread poverty, and limited access to essential water, sanitation, and healthcare services [14]. These challenges have contributed to persistently high rates of infectious diseases among children under five years of age, particularly diarrhea, respiratory infections, and febrile illnesses [14]. Although several studies have examined the prevalence and determinants of individual childhood illnesses in low- and middle-income countries, nationally representative evidence on the relationship between cumulative household environmental risk and the co-occurrence of fever, cough, and diarrhea among under-five children in Somalia remains scarce [12]. The availability of nationally representative data from the 2020 Somali Health and Demographic Survey (SHDS) provides an important opportunity to investigate this relationship and generate evidence to inform environmental health interventions and child survival policies in Somalia [15].

Given the limited nationally representative evidence on the relationship between household environmental risk and co-occurring childhood illnesses in Somalia, this study aimed to examine the association between household environmental risk and the co-occurrence of fever, cough, and diarrhea among children under five years of age using data from the 2020 Somali Health and Demographic Survey (SHDS). Specifically, the study assessed the prevalence of co-occurring childhood illnesses, developed a household environmental risk index, and evaluated its association with co-occurring fever, cough, and diarrhea after adjusting for child, maternal, household, and community-level characteristics. The findings are expected to contribute to the evidence base for environmental health and child survival in Somalia and inform policies and interventions aimed at reducing the burden of preventable childhood illnesses [6].

Methods

Study Design and Data Source

This study was a secondary analysis of data from the 2020 Somali Health and Demographic Survey (SHDS), a nationally representative cross-sectional household survey conducted to provide comprehensive information on population health, nutrition, and demographic indicators in Somalia. The SHDS employed a stratified two-stage cluster sampling design to obtain representative estimates at the national and regional levels. Information on household characteristics, maternal and child health, environmental conditions, and socioeconomic status was collected using standardized questionnaires administered to eligible respondents. The survey was implemented by the Directorate of National Statistics in collaboration with national and international partners using standardized survey procedures

to ensure data quality and comparability. The children's recode (KR) dataset was used for the present analysis because it contains detailed information on children under five years of age, their health status, and household characteristics.

Study Population and Sampling

The source population comprised all children aged 0–59 months who were included in the 2020 Somali Health and Demographic Survey (SHDS). The present study utilized data from the Children's Recode (KR) dataset, which contains information on births to interviewed women aged 15–49 years during the five years preceding the survey. Children were eligible for inclusion if complete information was available on the study outcome (co-occurring fever, cough, and diarrhea), household environmental characteristics, and selected covariates. Children with missing or incomplete data on the outcome variable or key explanatory variables were excluded from the analysis. A total of 15,967 under-five children met the eligibility criteria and were included in the final analysis.

Study Variables

Outcome Variable

The outcome variable was co-occurring childhood illness, defined as the occurrence of two or more of the following symptoms during the two weeks preceding the survey: fever, cough, and diarrhea. In the SHDS, mothers were asked whether their child had experienced diarrhea, fever, or cough within the two weeks before the interview. A composite binary outcome variable was created by summing the three illness indicators. Children who experienced two or more illnesses were classified as having co-occurring childhood illness (coded as 1), whereas those with none or only one illness were classified as not having co-occurring childhood illness (coded as 0).

Main Exposure Variable

The main exposure variable was the Household Environmental Risk Index (HERI), which was developed to capture the cumulative environmental risk within the household. The index was constructed using selected household environmental indicators obtained from the SHDS, including source of drinking water, type of sanitation facility, time required to obtain drinking water, and household electricity access. Each indicator was classified into low- or high-risk categories according to internationally recognized definitions for improved and unimproved environmental conditions. The individual indicators were combined to generate an overall environmental risk score, which was subsequently categorized into low household environmental risk and high household environmental risk for analysis.

Covariates

Potential confounding variables were selected based on previous literature and data availability in the SHDS. These included child characteristics (sex, age in months, and birth order), maternal characteristics (maternal age and educational level), household characteristics (wealth index), and community-level characteristics (place of residence and region). These variables were included in the multivariable analysis because they have been consistently associated with childhood infectious diseases and may confound the relationship between household environmental risk and co-occurring childhood illness.

Construction of the Household Environmental Risk Variable

A composite household environmental risk variable was constructed using four household environmental indicators obtained from the 2020 Somali Health and Demographic Survey (SHDS): source of drinking water, type of sanitation facility, time required to obtain drinking water, and household electricity access. Each indicator was dichotomized into low-risk (0) and high-risk (1) categories. Improved drinking water sources, improved sanitation facilities, water collection time of less than 30 minutes, and access to electricity were classified as low-risk conditions (coded as 0), whereas unimproved drinking water sources, unimproved sanitation facilities, water collection time of 30 minutes or more, and lack of household electricity were classified as high-risk conditions (coded as 1). The four binary indicators were summed to generate an environmental risk score ranging from 0 to 4, with higher scores indicating greater household environmental risk. The composite score was subsequently categorized into two groups: low household environmental risk (scores 0–1) and high household environmental risk (scores 2–4). This categorized variable was used as the primary exposure variable in all regression analyses.

Statistical Analysis

Data were analyzed using Stata version 16.0 (StataCorp LLC, College Station, TX, USA). The complex survey design of the Somali Health and Demographic Survey (SHDS) was accounted for by incorporating sampling weights, primary sampling units, and survey strata during analysis.

Descriptive analyses were conducted to summarize the characteristics of the study population. Categorical variables were presented as weighted frequencies and percentages. The distribution of household environmental risk categories and the prevalence of co-occurring fever, cough, and diarrhea among under-five children were estimated.

Bivariable survey-weighted logistic regression analyses were performed to examine the association between household environmental risk and co-occurring childhood illness. Variables with a p-value < 0.20 in bivariable analyses, together with variables considered epidemiologically relevant based on previous evidence, were included in the multivariable survey-weighted logistic regression model.

The final multivariable model assessed the independent association between household environmental risk and co-occurring fever, cough, and diarrhea. Results were presented as adjusted odds ratios (AORs) with 95% confidence intervals (CIs). Statistical significance was determined using a two-sided p-value < 0.05.

Ethical Considerations

The study used secondary data from the 2020 Somali Health and Demographic Survey (SHDS). The original survey was conducted in accordance with ethical principles for human subjects' research, including obtaining informed consent from all eligible participants before data collection. Ethical approval for the SHDS was obtained from the relevant national and institutional ethics committees before survey implementation. The dataset used in this study was obtained through an authorized data access procedure and contained no personally identifiable information. Therefore, the present analysis involved anonymized secondary data and posed minimal risk to participants.

Results

Characteristics of the study population

A total of **15,967** under-five children were included in the analysis. Slightly more than half of the children were male (**52.1%**), while females accounted for **47.9%**. The largest age group was **24–35 months (21.5%)**, followed by **36–47 months (21.2%)** and **48–59 months (20.7%)**. Most children (**82.8%**) were of birth order **1–2**, whereas only **0.8%** were fifth-born or higher.

The majority of mothers had **no formal education (82.9%)**, while **12.7%** had primary education, **3.3%** had secondary education, and only **1.2%** had higher education. Approximately **40.8%** of households resided in rural areas, **33.3%** were nomadic, and **25.9%** were urban residents. Household wealth was relatively evenly distributed across the five wealth quintiles. (**Table 1**).

Variable	Category	n	%
Sex	Male	8322	52.12
	Female	7645	47.88
Age	0–5 months	1636	10.25
	6–11	1330	8.33
	12–23	2866	17.95
	24–35	3438	21.53
	36–47	3385	21.20
	48–59	3312	20.74
	≥ 60	2705	16.94
Birth order	1–2	13223	82.81
	3–4	2617	16.39
	≥ 5	127	0.80
Maternal education	No education	13244	82.95
	Primary	2020	12.65
	Secondary	519	3.25
	Higher	184	1.15
Wealth	Poorest	3372	21.12
	Poorer	3496	21.90
	Middle	3199	20.04
	Richer	3195	20.01
	Richest	2705	16.94
Residence	Urban	4135	25.90
	Rural	6519	40.83
	Nomadic	5313	33.27

Household environmental risk characteristics

More than half of households (**55.1%**) used an improved drinking water source, while **44.9%** relied on unimproved sources. Approximately **59.2%** of households had unimproved sanitation facilities, whereas **40.9%** had improved toilet facilities. Among households with available information on water collection time, **42.3%** required **30 minutes or longer** to obtain drinking water. Only **28.7%** of households had electricity, leaving **71.3%** without electricity.

The household environmental risk score ranged from **0 to 4**, with the largest proportion of households scoring **3 (26.3%)**. Overall, **60.8%** of households were classified as having **high environmental risk**, while **39.2%** were categorized as having **low environmental risk (Table 2)**.

Indicator	Category	n	%
Water source	No risk	8552	55.12
	Risk	6963	44.88
Toilet	No risk	6338	40.85
	Risk	9177	59.15
Water collection time	No risk	4827	57.75
	Risk	3532	42.25
Electricity	Has electricity	4580	28.68
	No electricity	11387	71.32
Environmental risk	Low	6263	39.22
	High	9704	60.78

Prevalence of co-occurring childhood illnesses

Overall, **723 children (4.5%)** experienced **two or more illnesses** (fever, cough, and/or diarrhea) during the two weeks preceding the survey, whereas **95.5%** experienced either one or none of these illnesses (Table 3).

Outcome	n	%
0–1 illness	15244	95.47
≥ 2 illnesses	723	4.53

Factors associated with co-occurring childhood illnesses

In the multivariable survey-weighted logistic regression analysis, household environmental risk was significantly associated with co-occurring childhood illnesses among under-five children. Children living in households classified as having high environmental risk had 53% higher odds of experiencing co-occurring fever, cough, and diarrhea compared with children from households with low environmental risk (AOR = 1.53; 95% CI: 1.09–2.15; p = 0.013).

Child age was significantly associated with co-occurring childhood illnesses. Compared with children aged 0–5 months, children aged 24–35 months (AOR = 1.68; 95% CI: 1.15–2.45; p = 0.007), 36–47 months (AOR = 1.51; 95% CI: 1.05–2.17; p = 0.027), and 48–59 months (AOR = 1.99; 95% CI: 1.30–3.05; p

= 0.002) had significantly higher odds of experiencing co-occurring illnesses. The association among children aged 12–23 months was borderline significant (AOR = 1.49; 95% CI: 1.00–2.23; $p = 0.051$).

Household wealth was significantly associated with the outcome. Compared with children from the poorest households, children from middle (AOR = 1.74; 95% CI: 1.22–2.48; $p = 0.002$), richer (AOR = 1.45; 95% CI: 1.03–2.04; $p = 0.032$), and richest (AOR = 1.70; 95% CI: 1.15–2.51; $p = 0.008$) households had higher odds of co-occurring childhood illnesses.

Place of residence was also significantly associated with childhood illness. Children living in rural areas had higher odds of co-occurring illnesses compared with those living in urban areas (AOR = 1.56; 95% CI: 1.03–2.35; $p = 0.035$), while nomadic residence was not associated with the outcome (AOR = 1.00; 95% CI: 0.73–1.38; $p = 0.991$).

Regional differences were observed. Compared with children from Awdal region, children from Togdheer (AOR = 2.03; 95% CI: 1.21–3.43; $p = 0.008$) and Middle Shabelle (AOR = 2.79; 95% CI: 1.26–6.19; $p = 0.012$) had significantly higher odds of co-occurring illnesses.

Child sex, birth order, and maternal education were not significantly associated with co-occurring childhood illnesses after adjustment.

Table 4
Multivariable survey-weighted logistic regression of factors
associated with co-occurring childhood illnesses (N = 15,917)

Variable	AOR	95% CI	P-value
Household environmental risk			
Low environmental risk	Ref.	—	—
High environmental risk	1.53	1.09–2.15	0.013
Child sex			
Male	Ref.	—	—
Female	0.97	0.76–1.24	0.815
Child age (months)			
0–5 months	Ref.	—	—
6–11 months	1.32	0.79–2.21	0.287
12–23 months	1.49	1.00–2.23	0.051
24–35 months	1.68	1.15–2.45	0.007
36–47 months	1.51	1.05–2.17	0.027
48–59 months	1.99	1.30–3.05	0.002
Birth order			
1–2 children	Ref.	—	—
3–4 children	1.19	0.90–1.59	0.218
≥ 5 children	1.40	0.61–3.20	0.430
Maternal education			
No education	Ref.	—	—
Primary	1.27	0.95–1.71	0.104
Secondary	1.24	0.78–1.97	0.354
Higher	0.39	0.13–1.13	0.082
Household wealth quintile			
Poorest	Ref.	—	—
Poorer	0.98	0.66–1.46	0.911
Middle	1.74	1.22–2.48	0.002

Variable	AOR	95% CI	P-value
Household environmental risk			
Richer	1.45	1.03–2.04	0.032
Richest	1.70	1.15–2.51	0.008
Residence			
Urban	Ref.	—	—
Rural	1.56	1.03–2.35	0.035
Nomadic	1.00	0.73–1.38	0.991
Region			
Awdal	Ref.	—	—
Woqooyi Galbeed	1.52	0.70–3.29	0.286
Togdheer	2.03	1.21–3.43	0.008
Sool	0.85	0.49–1.49	0.579
Sanaag	1.39	0.81–2.38	0.230
Bari	1.25	0.75–2.09	0.383
Nugaal	1.78	1.00–3.16	0.050
Mudug	1.05	0.47–2.38	0.901
Galgaduud	1.39	0.77–2.53	0.275
Hiraan	1.27	0.68–2.40	0.455
Middle Shabelle	2.79	1.26–6.19	0.012
Banadir	1.32	0.76–2.27	0.319
Bay	1.31	0.63–2.72	0.475
Bakool	1.16	0.71–1.90	0.550
Gedo	2.10	0.99–4.42	0.052
Lower Juba	2.17	0.84–5.64	0.111

Abbreviations: AOR, adjusted odds ratio; CI, confidence interval.

Discussion

This study examined the association between household environmental risk and co-occurring fever, cough, and diarrhea among under-five children in Somalia using nationally representative data from the 2020 Somali Health and Demographic Survey. The findings demonstrated that children living in households with high environmental risk had significantly higher odds of experiencing co-occurring childhood illnesses compared with children living in households with low environmental risk. After adjusting for child, household, and geographic characteristics, high household environmental risk was associated with 53% increased odds of co-occurring fever, cough, and diarrhea. These findings highlight the importance of household environmental conditions as a potential contributor to the burden of multiple childhood illnesses in Somalia.

The association between household environmental risk and childhood illness is biologically plausible. The environmental risk index used in this study incorporated key household conditions, including drinking water source, sanitation facility type, water collection time, and household electricity access. These factors represent important dimensions of the environment in which children live and may influence exposure to infectious agents. Previous global evidence has demonstrated that unsafe drinking water, inadequate sanitation, and poor hygiene practices are major contributors to childhood infectious diseases, particularly diarrhea, through increased exposure to fecal contamination and enteric pathogens [16]. Although diarrhea is strongly linked to WASH conditions, poor household environments may also increase susceptibility to respiratory infections through inadequate hygiene, crowded living conditions, and exposure to contaminated environments [17].

The present findings are consistent with previous studies from sub-Saharan Africa showing that household environmental conditions are associated with childhood illness. Studies using Ethiopian Demographic and Health Survey data have reported significant associations between household WASH-related factors and childhood diarrhea, emphasizing the continuing importance of safe water and sanitation access in reducing preventable childhood morbidity [18]. Similar evidence from Nigeria, Kenya, Uganda, and Tanzania has shown that children living in households with inadequate water and sanitation conditions experience higher risks of diarrhea and other infectious diseases compared with children living in households with better environmental conditions [19].

The stronger association observed for the combined environmental risk measure in this study may reflect the cumulative effect of multiple household disadvantages. Previous studies have often examined individual environmental factors separately, such as water source or sanitation facility, whereas children are usually exposed to multiple environmental conditions simultaneously. A household with unsafe water, inadequate sanitation, prolonged water collection time, and limited infrastructure may create a greater risk environment than any single factor alone. Composite environmental risk measures may therefore provide a more realistic representation of children's exposure to unhealthy household environments [20].

Child age was also significantly associated with co-occurring childhood illnesses. Children aged 24–35 months, 36–47 months, and 48–59 months had higher odds of experiencing multiple illnesses

compared with infants aged 0–5 months. This finding may be explained by increased mobility and environmental exposure among older children. As children begin crawling, walking, and exploring their surroundings, they may have increased contact with contaminated soil, unsafe water sources, and unhygienic household environments. Similar age-related patterns have been reported in DHS-based studies from Ethiopia and other African countries, where children in the second and third years of life commonly experience increased exposure to infectious disease risks [21].

Household wealth was also associated with co-occurring childhood illnesses. Interestingly, children from middle, richer, and richest households had higher odds of co-occurring illnesses compared with children from the poorest households. This finding differs from the commonly reported relationship between poverty and childhood illness. One possible explanation is that wealthier households may have greater awareness of childhood symptoms, improved healthcare-seeking behavior, or increased likelihood of reporting illness during surveys. Similar variations in the relationship between socioeconomic status and reported childhood illness have been observed in some population-based studies, where reporting patterns and access to healthcare influence measured disease prevalence [22].

Children living in rural areas had significantly higher odds of co-occurring childhood illnesses compared with children living in urban areas. This finding is consistent with evidence from many low- and middle-income countries, where rural populations often experience greater barriers to safe water, sanitation infrastructure, healthcare access, and health information. In Somalia, rural and nomadic communities frequently face challenges related to geographic isolation, limited infrastructure, and reduced access to essential services, which may increase children's vulnerability to infectious diseases [23].

Regional differences were also observed, with children from Togdheer and Middle Shabelle having higher odds of co-occurring childhood illnesses compared with children from Awdal. These differences may reflect variation in environmental conditions, water availability, sanitation coverage, climate-related factors, livelihood patterns, and access to healthcare services across Somali regions. Previous evidence from DHS analyses across Africa has demonstrated substantial geographic variation in childhood illness patterns, highlighting the importance of locally adapted public health interventions rather than uniform approaches [24].

This study has several strengths. First, it used nationally representative SHDS data, allowing the findings to reflect childhood health conditions across different population groups in Somalia, including urban, rural, and nomadic communities. Second, the analysis incorporated survey weights and accounted for the complex survey design, improving the representativeness of the estimates. Third, the use of a composite household environmental risk variable allowed assessment of the combined contribution of multiple environmental disadvantages rather than evaluating individual household factors independently.

Several limitations should also be considered. Because of the cross-sectional design, temporal relationships between household environmental risk and childhood illness cannot be established. Household environmental characteristics were measured at the time of the survey and may not fully represent previous exposures before illness occurrence. Additionally, fever, cough, and diarrhea were

based on caregiver reports, which may introduce recall or reporting bias. Finally, as a secondary analysis, the study was limited to variables available within the SHDS dataset, and other important factors such as nutritional status, vaccination history, and healthcare access could not be fully assessed.

Overall, this study provides evidence that household environmental risk is independently associated with co-occurring fever, cough, and diarrhea among under-five children in Somalia. Improving household water, sanitation, hygiene, and basic environmental conditions may contribute to reducing the burden of multiple childhood illnesses. Integrated interventions targeting vulnerable rural and high-risk communities should be prioritized to improve child health outcomes in Somalia.

Conclusion

This study found that household environmental risk was independently associated with co-occurring fever, cough, and diarrhea among under-five children in Somalia. Children living in households with high environmental risk had significantly higher odds of experiencing multiple childhood illnesses compared with those living in households with lower environmental risk. The findings highlight the importance of improving household environmental conditions, including access to safe drinking water, adequate sanitation, and improved household infrastructure, as part of strategies to reduce preventable childhood illnesses. Public health interventions should prioritize environmentally vulnerable households, particularly in rural and high-risk regions, through integrated water, sanitation, hygiene, and child health programs.

Declarations

Ethics approval and consent to participate

The study was based on secondary analysis of anonymized data from the 2020 Somali Health and Demographic Survey (SHDS). The original survey obtained ethical approval from the relevant national and institutional ethics committees before data collection, and informed consent was obtained from all participants. The present study used de-identified publicly available data and therefore did not require additional ethical approval.

Consent for publication

Not applicable.

Availability of data and materials

The dataset analyzed in this study was obtained from the Somali Health and Demographic Survey (SHDS) 2020 conducted by the Somali National Bureau of Statistics. The dataset is available through the official SHDS data repository: Somali Health and Demographic Survey 2020 – National Bureau of Statistics Somalia. The data used in this study were anonymized and contained no personally identifiable information. Access to the microdata was obtained through the authorized data access procedure.

Competing interests

The author declares that there are no competing interests.

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Authors' contributions

YOA conceptualized the study, conducted data analysis, interpreted the findings, and drafted the manuscript. The author read and approved the final manuscript.

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References

1. Knappett M, et al. Pediatric post-discharge mortality in resource-poor countries: a systematic review and meta-analysis. *EClinicalMedicine*. Jan. 2024;67. 10.1016/j.eclinm.2023.102380.
2. Fischer Walker CL, et al. Global burden of childhood pneumonia and diarrhoea. *Lancet*. 2013;381(9875):1405. 10.1016/S0140-6736(13)60222-6.
3. Sarfo JO et al. May., Acute lower respiratory infections among children under five in Sub-Saharan Africa: a scoping review of prevalence and risk factors, *BMC Pediatrics* 2023 23:1, vol. 23, no. 1, p. 225-, 2023, 10.1186/S12887-023-04033-X
4. Winskill P, Hogan AB, Thwing J, Mwandigha L, Walker PGT, Lambert B. Health inequities and clustering of fever, acute respiratory infection, diarrhoea and wasting in children under five in low- and middle-income countries: a Demographic and Health Surveys analysis, *BMC Medicine* 2021 19:1, vol. 19, no. 1, p. 144-, Jun. 2021, 10.1186/S12916-021-02018-0
5. Islam MS et al. Nov., Prevalence and Determinants of Diarrhea, Fever, and Coexistence of Diarrhea and Fever in Children Under-Five in Bangladesh, *Children (Basel)*, vol. 10, no. 11, 2023, 10.3390/CHILDREN10111829
6. Wolf J, et al. Effectiveness of interventions to improve drinking water, sanitation, and handwashing with soap on risk of diarrhoeal disease in children in low-income and middle-income settings: a systematic review and meta-analysis. *Lancet*. Jul. 2022;400(10345):48–59. 10.1016/S0140-6736(22)00937-0.
7. Mulatu G, et al. Association of drinking water and environmental sanitation with diarrhea among under-five children: Evidence from Kersa demographic and health surveillance site, eastern Ethiopia. *Front Public Health*. Nov. 2022;10:962108. 10.3389/FPUBH.2022.962108/TEXT.

8. Zhu K, et al. Assessing exposure to household air pollution in children under five: A scoping review. *Environ Pollut.* Oct. 2022;311:119917. 10.1016/J.ENVPOL.2022.119917.
9. Daffe ML et al. Dec., Household level of air pollution and its impact on the occurrence of Acute Respiratory Illness among children under five: secondary analysis of Demographic and Health Survey in West Africa, *BMC Public Health* 2022 22:1, vol. 22, no. 1, p. 2327-, 2022, 10.1186/S12889-022-14611-W
10. Azanaw J, Malede A, Yalew HF, Worede EA. Determinants of diarrhoeal diseases among under-five children in Africa (2013–2023): a comprehensive systematic review highlighting geographic variances, socioeconomic influences, and environmental factors, *BMC Public Health* 2024 24:1, vol. 24, no. 1, p. 2399-, Sep. 2024, 10.1186/S12889-024-19962-0
11. Adedokun ST, Yaya S. Factors associated with adverse nutritional status of children in sub-Saharan Africa: Evidence from the Demographic and Health Surveys from 31 countries, *Matern. Child Nutr.*, vol. 17, no. 3, Jul. 2021, 10.1111/MCN.13198
12. Winskill P, Hogan AB, Thwing J, Mwandigha L, Walker PGT, Lambert B. Health inequities and clustering of fever, acute respiratory infection, diarrhoea and wasting in children under five in low- and middle-income countries: a Demographic and Health Surveys analysis, *BMC Medicine* 2021 19:1, vol. 19, no. 1, p. 144-, Jun. 2021, 10.1186/S12916-021-02018-0
13. Islam MS, et al. Prevalence and Determinants of Diarrhea, Fever, and Coexistence of Diarrhea and Fever in Children Under-Five in Bangladesh. *Children.* Nov. 2023;10(11):1829. 10.3390/CHILDREN10111829/S1.
14. Tahlil AA et al. Nov., Burden and sociodemographic determinants of pneumonia and diarrhoea among children younger than 5 years in Somalia: a community-based cross-sectional study, *BMJ Open*, vol. 15, no. 11, p. e098505, 2025, 10.1136/BMJOPEN-2024-098505
15. UNFPA Somalia | The Somali Health and Demographic Survey. 2020. Accessed: Jul. 12, 2026. [Online]. Available: https://somalia.unfpa.org/en/publications/somali-health-and-demographic-survey-2020?utm_source=chatgpt.com
16. Progress on. household drinking water, sanitation and hygiene 2000–2024: special focus on inequalities | JMP. Accessed: Jul. 12, 2026. [Online]. Available: <https://washdata.org/reports/jmp-2025-wash-households>
17. Darvesh N, Das JK, Vaivada T, Gaffey MF, Rasanathan K, Bhutta ZA. Water, sanitation and hygiene interventions for acute childhood diarrhea: a systematic review to provide estimates for the Lives Saved Tool, *BMC Public Health* 2017 17:4, vol. 17, no. 4, p. 776-, Nov. 2017, 10.1186/S12889-017-4746-1
18. Wolf J, et al. Systematic review: Assessing the impact of drinking water and sanitation on diarrhoeal disease in low- and middle-income settings: Systematic review and meta-regression. *Trop Med Int Health.* Aug. 2014;19(8):928–42. : 10.1111/TMI.12331;CTYPE:STRING:JOURNAL.
19. Sahiledengle B, Agho K. Determinants of Childhood Diarrhea in Households with Improved Water, Sanitation, and Hygiene (WASH) in Ethiopia: Evidence from a Repeated Cross-Sectional Study.

- Environ Health Insights. 2021;15. 10.1177/11786302211025180.
20. Soboksa NE. Associations Between Improved Water Supply and Sanitation Usage and Childhood Diarrhea in Ethiopia: An Analysis of the 2016 Demographic and Health Survey. Environ Health Insights. 2021;15. 10.1177/11786302211002552.
 21. Yaya S, Hudani A, Udenigwe O, Shah V, Ekholuenetale M, Bishwajit G. Improving Water, Sanitation and Hygiene Practices, and Housing Quality to Prevent Diarrhea among Under-Five Children in Nigeria. Trop Med Infect Disease 2018. Apr. 2018;3(2). 10.3390/TROPICALMED3020041.
 22. Null C, et al. Effects of water quality, sanitation, handwashing, and nutritional interventions on diarrhoea and child growth in rural Kenya: a cluster-randomised controlled trial. Lancet Glob Health. Mar. 2018;6(3):e316–29. 10.1016/S2214-109X(18)30005-6.
 23. Hirai M, Roess A, Huang C, Graham J. Exploring geographic distributions of high-risk water, sanitation, and hygiene practices and their association with child diarrhea in Uganda. Glob Health Action. Dec. 2016;9(1). 10.3402/GHA.V9.32833.
 24. McClelland PH et al. Improved Water and Waste Management Practices Reduce Diarrhea Risk in Children under Age Five in Rural Tanzania: A Community-Based, Cross-Sectional Analysis, *International Journal of Environmental Research and Public Health* 2022, Vol. 19, Page 4218, vol. 19, no. 7, p. 4218, Apr. 2022. 10.3390/IJERPH19074218