Determinants of open defecation among rural women in Ghana: Analysis of 2003, 2008 and 2014 Demographic and Health Surveys

Eugene Appiah-Effah[1,2], Kingsley Boakye[3], Tarif Salihu[4], Godwin Armstrong Duku[1,2] * Justice Ofosu-Darko Fenteng[5], George Boateng[5], Francis Appiah[3,4,5]

[1]Regional Water and Environmental Sanitation Centre, Kumasi, Ghana
[2]Department of Civil Engineering, Kwame Nkrumah University of Science and Technology, Kumasi, Ghana
[3]School of Public Health, Kwame Nkrumah University of Science and Technology, Kumasi, Ghana
[4]Department of Population and Health, University of Cape Coast, Cape Coast, Ghana
[5]Department of Social Science, Berekum College of Education, Berekum, Ghana

*Corresponding Author: Godwin Armstrong Duku, Regional Water and Environmental Sanitation Centre, Kumasi, Ghana; Email: godwinarmstrong@gmail.com; Orcid: https://orcid.org/0000-0002-3454-2313; Tel: +233 245127868

Abstract: The study investigated determinants of open defecation among rural women in Ghana. The study extracted data from the female's file of the 2003, 2008 and 2014 Ghana Demographic and Health Survey (GDHS). A total of 4,284 pooled sample size of rural women aged 15-49 with complete information about the variables analyzed in the study. The outcome variable was "open defecation" (i.e., defecating in an open space rather than a toilet facility) whilst fourteen (14) key explanatory variables were used. Two regression models were built, and output reported in odds ratio. Descriptively, 42 in every 100 women aged 15-49 practised open defecation (n=1811, 95'CI=49-52). Open defecation significantly correlated with educational attainment, wealth status, religion, access to mass media, partner's education, and zone of residence. The likelihood to practice open defecation reduced among those with formal education [aOR=0.69, CI=0.56-0.85], those whose partners had formal education [aOR=0.64, CI=0.52-0.80], women in the rich wealth quintile [aOR=0.12, CI=0.07-0.20], the traditionalist [aOR=0.33, CI=0.19-0.57], and those who had access to mass media [aOR=0.70, CI=0.57-0.85]. Residents in the Savannah zone were over 21-fold higher to defecate openly [aOR=21.06, CI=15.97-27.77]. The prevalence of open defecation is disproportionately pro-poor indicating that impoverished rural women are more likely to perform it.

Keywords: Open defecation; rural women; Ghana; Environmental Health; Demographic and Health Survey

1. Introduction

Open defecation continues to remain a major global sanitation and health challenge contributing to an estimated 1.6 million deaths per year [1].

 doi:10.20944/preprints202212.0199.v1

Open defecation, by definition, is the practice of defecating in an open environment (bushes, fields, ditches, beaches, water bodies, canals and other open spaces) rather than a toilet facility [2]. Globally, 1.7 billion people lack access to improved sanitation, out of which 494 million openly defecate into the environment [3]. It is estimated that about 842,000 people in low and middle-income countries die annually from diarrhoeal related diseases due to poor sanitation and hygiene, where children under five bear the greatest burden [4,5]. This is because the unsafe management of human excreta from open defecation and poor personal hygiene are closely linked to diarrhoea and parasitic infection, including soil-transmitted helminth [6].

All the Sustainable Development Goal (SDG) regions have experienced a decline in open defecation [3], except sub-Saharan Africa, where population growth has slowed progress [7]. Yet, sanitation continues to be the 'poor relation' compared with drinking water quality when it comes to investment priorities [8]. In many African countries, people lack access to sanitation facilities that can provide most basic of services. In Nigeria, for example, over 130 million people, or two-thirds of the population, lack access to basic sanitation facilities, whilst in South Africa, over 18 million people experience the same problem [9,10]. In Ghana, nearly half (47%) of the population rely on shared sanitation facilities including public toilet and close to 18% practice open defecation [3]. Ghana ranks second in Africa after Sudan for open defecation [11] and had the fourth lowest sanitation coverage in 2010 [12]. The poor sanitation situation in Ghana has largely been attributed to high poverty rate, and high cost of toilet technologies (Duku et al., 2020; Obeng et al., 2015). Consequently, many poor households who cannot afford improved sanitation solutions resort to unimproved options or practice open defecation [13,14]. Open defecation is linked to excreta-related health risks [15] which also contain disease-causing microbes such as viruses, bacteria, protozoan cysts, and helminths. Exposure to these microorganisms, result in diseases such as diarrhoea, typhoid, cholera, and viral infections[16]. In Ghana, sanitation-related diseases are believed to be the third most prevalent disease recorded by health centres across the country. Diarrhoeal disease which is largely caused by exposure to faecal contamination is believed to be the cause of about 6,600 deaths each year, more than half (50%) of whom are children below the age of five (5) [17].

The economic impact from poor sanitation including open defecation on health and mortality are compounded by the negative impact on the environment and ultimately, on economic growth. The total global cost of inadequate sanitation is estimated at USD 260 billion per year [1]. The Government of Ghana loses 420 million cedis due to poor sanitation and open defection cost the country USD 79 million annually [18,19]. Despite the economic and health consequences of open defecation, the Government of Ghana continue to allocate less than one (1) percent of national budgetary to the sanitation sector [14,20,21]. It has been reported that only 0.1% of budgetary allocations is spent on rural sanitation [22], meanwhile open defecation is disproportionately practiced in rural areas. Available statistics show that, open defecation in rural areas is 14% point higher than the national value of 18% [3]. According to Appiah-Effah et al., (2019), 90% open defecators dwell in rural areas and belong to the lowest wealth quintile. While 32% of the rural Ghanaian population still practice open defecation,

 doi:10.20944/preprints202212.0199.v1

Ghana is drifting from achieving universal access to sanitation by 2030, the objective set by SDG 6.2 [23]. Hence, efforts to eliminate open defecation must target the rural poor [3].

This notwithstanding, the determinants of open defecation are unclear, rarely documented and likely differ across contexts. Financial constraints, lack of toilet facilities, poor hygienic conditions, lack of privacy, or unpleasant smell have been reported elsewhere [13,24], whilst in others, practicing open defecation was due to absence of functional toilets [25,26]. Belay et al., (2022) reported age, education, access to media, wealth status, access to drinking water, residence, country income status, and the region as predictors to open defecation. This was a multi-country study; hence, the outcome variable "open defecation" could be influenced by country-specific health and sanitation programs and policies. Additionally, the study did not focus on rural residents even though rural residents may differ from urban in terms of socio-economic characteristics. This presents a challenge to understanding the correlates of open defecation among rural residents in Ghana. We acknowledge that a study has been conducted on open defecation in Ghana [24]. however, findings were not drawn from a nationally representative dataset, coupled with failure to focus on rural residents. Hence, this study extends the previous studies by conducting a nationally representative study on the determinants of open defecation among rural women in Ghana using datasets from 2003, 2008 and 2014 Demographic and Health Surveys. The study's outcome will provide pragmatic recommendations and appropriate open defecation elimination strategies that will help decline open defecation and achieve the sustainable development goal.

2. Methods

2.1. Data source

The study used the female's file of the 2003, 2008 and 2014 Ghana Demographic and Health Survey (GDHS) waves. The study excluded previous surveys before 2003 since most of the key explanatory variables and outcome variables were not captured in those surveys. These surveys are implemented by the Ghana Statistical Service (GSS), the Ghana Health Service (GHS), and the National Public Health Reference Laboratory (NPHRL) of the GHS, whilst ICF International provides technical assistance through the DHS program. The United States Agency for International Development (USAID) funds the surveys with support from the Global Fund through the Ghana AIDS Commission (GAC) and the National Malaria Control Programme (NMCP), the United Nations Children's Fund (UNICEF), the United Nations Development Programme (UNDP), the United Nations Population Fund (UNFPA), the International Labour Organization (ILO), the Danish International Development Agency (DANIDA), and the Government of Ghana. These surveys objectively provide current evidence on various demographic and health-specific topics such as fertility levels and preferences, childhood deaths, contraception and family planning methods, maternal and child health and HIV/AIDS and other sexually transmitted infections information. The eligibility criteria for a woman to be included in the survey were that she should fall within 15-49

 doi:10.20944/preprints202212.0199.v1

years and must be a usual member of the selected households and spend the night before the survey in the selected household [28].

The Ghana Statistical Service (GSS) created a sampling frame that was utilized for its most recent Population and Housing Census, which was the basis for the GDHS in 2003, 2008, and 2014. (PHC). This frame includes an exhaustive list of all census enumeration areas (EAs) established during censuses, together with detailed information on the EA's location, residential status (rural or urban), and estimated residential household count. EAs are chosen in each stratum in two steps using a two-stage sample design. By classifying the sampling frame within each sampling stratum before sample selection, according to administrative units in various levels, and by using a probability proportional to size selection at the first stage of sampling, implicit stratification and proportional allocation are achieved at each of the lower administrative levels. In the initial stage, EAs were chosen independently within each sample stratum with a probability inversely correlated to the size of the EAs.

In each of the chosen EAs, a household listing operation is carried out, and the lists of homes produced and serves as a sampling frame for the second stage of household selection. The next step involves a selection of a single segment with a probability proportional to segment size. Only the chosen part was used for the household listing. The newly constructed household listing was used to pick a specified number of households per cluster with equal probability of systematic selection in the second step of the selection process. Only the chosen houses were visited and interviewed. To avoid bias, no substitutions or changes to the chosen households are permitted during data collection [28]. Overall, the present study relied on a pooled sample size of 4,284 rural women aged 15-49 who had complete information about the variables analyzed.

2.1. Outcome variable

The main outcome variable was "open defecation" operationalized as defecating in an open space such as bushes, fields, ditches, beaches, water bodies, canals and other open spaces) rather than a toilet facility [2]. In the surveys, women were asked about what toilet they used. This was posed as "What kind of toilet facility do members of your household usually use?" and the responses were: (1) flush or pour toilet/flush to a piped sewer system (i.e., flush to a septic tank, flush to pit latrine, flush to somewhere else, flush, don't know where); (2) pit latrine (i.e., ventilated improved pit latrine, pit latrine with slab, pit latrine without a slab, open pit); (3) bucket toilet; (4) hanging toilet/hanging latrine; (5) no facility/bush/field; and (6) other (specify). To specifically calculate those who practised open defecation or otherwise, all women who asserted that they have "no facility/bush/field" was classified as "open defecation" whilst the remaining responses were classified as having "toilet facility"[2]. We then recoded "open defecation" as "1" and "toilet facility" as "0".

2.3. Explanatory variables

The study selected fourteen (14) key explanatory variables and were age, education, wealth status, employment status, marital status, religion, ANC

 doi:10.20944/preprints202212.0199.v1

visits, parity, access to mass media, women's household decision-making autonomy, sex of household head, partner's education, zone of residence, and survey year. These variables were chosen due to their practical importance and relevance to sanitation and hygiene (Belay et al., 2022; Busienei et al., 2019). To make the results reader-friendly, some of these variables were recoded. Education was recoded into "no formal education", and "formal education"; wealth status was recoded into "poor", "middle", and "rich"; employment was status recoded into "none working class", and "working class"; marital status was recoded into "married", "cohabiting", and "others"; religion was recoded as "no religion", "Christian", "Muslim", "traditionalist", and "others"; and ANC visits was recoded into "≤7 visits", and "≥8 visits". Based on the total fertility rate of Ghana, which is 4.2 children per woman (Ghana Statistical Service et al., 2015), parity was recoded as "one birth", "two births", "three births", and "four or more births". Following Appiah et al., (2022) computation of access to mass media from three cardinal variables (i.e., frequency of reading newspapers/magazines; frequency of listening to the radio; and frequency of watching television), we categorized mass media into "yes" and "no". Women's household decision-making autonomy recoded into "not autonomous", and "autonomous"; sex of the household head recoded as "male", and "female"; partner's education recoded as "no formal education", and "formal education"; and zone of residence recoded as "coastal zone", "middle zone", and "savanna zone".

2.4. Statistical analysis

The statistical analysis proceeded with steps. Firstly, a general computation of women aged 15-49 years who practiced open defecation or otherwise was done, and the results were presented proportionally. Secondly, we performed a trend analysis of open defecation across the survey waves with a group bar graph (see Figure 1). Next, we summarized the surveyed population characteristics using proportions and percentages. A cross-tabulation was done between the practice of open defecation across the key explanatory variables, accompanied by a chi-square test of independence. At a cut-off point of 5%, any key explanatory variable that had no association with the outcome variable was not entered into the multivariable model (Model II).

At a 95% confidence interval, we built two regression models. The Model I was a bivariate calculation between the outcome variable and key explanatory variables. In the Model II, we constructed a multivariate calculation for the key explanatory variables and the outcome variable. The results for the Model I was reported in Odds Ratio, whilst Model II was reported in adjusted Odds Ratio. We interpreted the odds as having a higher likelihood to open defecation when the odds were above 1 and vice versa. To ascertain the model fit, the "goodness of fit" test was applied, and the results indicated that the selected explanatory variables were adequate to explain variations in the outcome variable. Also, the weighting factor in the datasets was applied to offset estimations and sampling biases. Additionally, we checked the tolerance level between our key explanatory variables using the Variance Inflation Factor (VIF). The results showed no evidence of multicollinearity between our key explanatory variables (Mean VIF=1.44, Maximum VIF=2.07, Minimum VIF=1.08).

Preprints (www.preprints.org) | NOT PEER-REVIEWED | Posted: 12 December 2022 doi:10.20944/preprints202212.0199.v1

2.5. Ethical considerations

The present study utilized an existing dataset. Therefore, the authors of this study had no hand in all fieldwork and activities that led to the generation of the datasets used in the study. As such, ethical principles applicable to the study involving human participants did not apply to this study. However, the datasets were requested from the measure DHS platform and downloaded after access to the datasets were granted. However, the measure DHS anonymized the dataset before making it public. The datasets are publicly available at the Measure DHS dataset repository and can be downloaded at www.measuredhs.org.

3. Results

3.1. Descriptive statistics for the Study

Generally, 42 in every 100 women aged 15-49 practised open defecation (n=1811, 95'CI=49-52), with 58% having access to a toilet facility (n=2472, 95'CI=48-51) (data not shown). Figure 1 displays defecating types among rural women in Ghana. It was found that open defecation increased from 50% to 52% between 2003 and 2008 and remained similar (51%) in 2014.

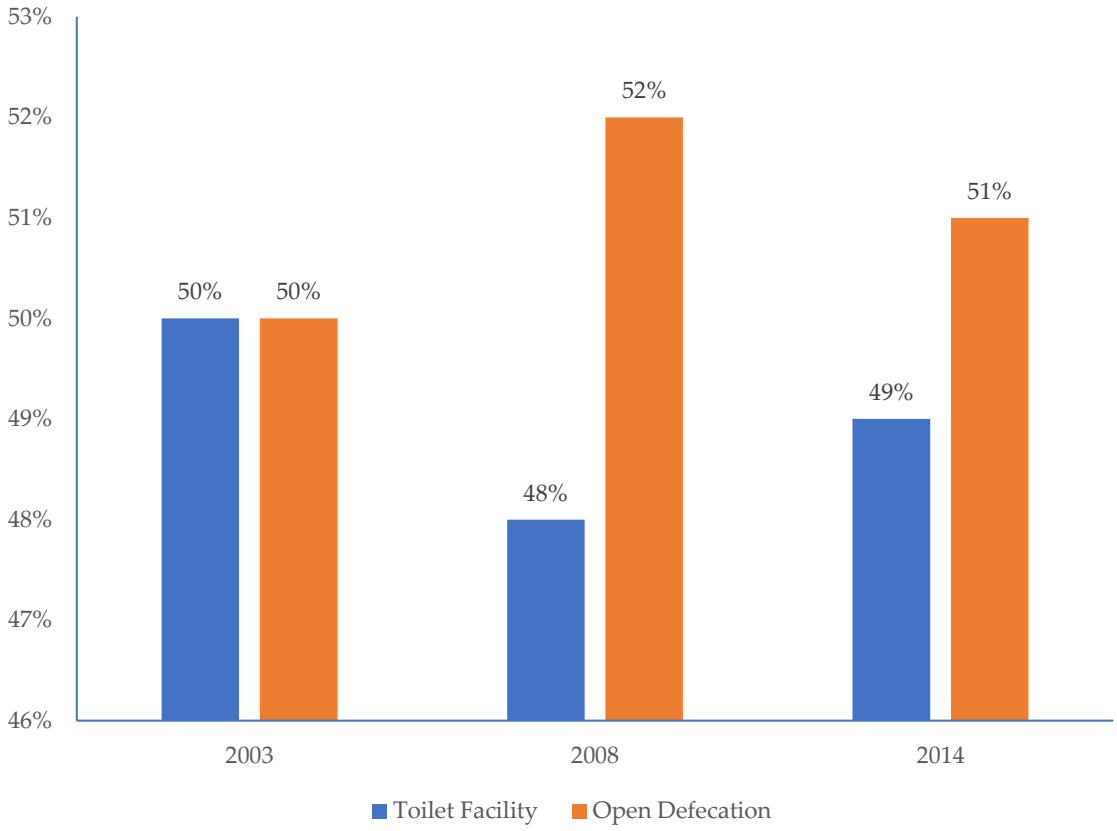

Figure 1: Defecating practices among rural women aged 15-49 in Ghana

Sources: Adapted from 2003, 2008 and 2014 GDHS

Preprints (www.preprints.org) | NOT PEER-REVIEWED | Posted: 12 December 2022 doi:10.20944/preprints202212.0199.v1

Table 1 is a descriptive result of the study. It was found that open defecation peaked among women aged 45-49 (61%), those with no formal education (72%), the poor (61%) and the married (56%). Women who had ≤7 of ANC visits (54%), at parity 4 or more (53%), had no access to mass media (62%), were not autonomous in household decision-making process (51%), whose household was headed by a male (55%), whose partner has no formal education (77%) and reside in the Savannah zone (90%) topped the practice of open defecation. With the exception of employment status (X^2=0.073, p-value=0.787) and women's household decision-making autonomy (X^2=2.706, p-value=0.100), the rest of the key explanatory variables were significantly associated with open defecation (Table 1).

Table 1: Descriptive results for the study (weighted N=4284)

Key explanatory variables	Weighted frequency (n)	Weighted percent (%)	Defecating practices		X^2	*p-value*
			Toilet facility (%)	Bush/ Field (%)		
Age (in years)					15.721	0.015
15-19	144	3	49	51		
20-24	751	18	51	49		
25-29	1070	25	46	54		
30-34	909	21	52	48		
35-39	795	19	50	50		
40-44	425	10	50	50		
45-49	190	4	39	61		
Education					784.245	0.000
No formal education	1923	45	28	72		
Formal education	2361	55	71	29		
Wealth status					641.475	0.000
Poor	2962	69	39	61		
Middle	867	20	79	21		
Rich	455	11	94	6		
Employment status					0.073	0.787
None working class	418	10	49	51		
Working class	3866	90	49	51		
Marital status					183.112	0.000
Married	3339	78	44	56		
Cohabiting	819	19	70	30		
Others	128	3	75	25		
Religion					466.528	0.000
No religion	154	4	23	77		
Christian	2701	63	61	39		
Muslim	623	15	43	57		

Preprints (www.preprints.org) | NOT PEER-REVIEWED | Posted: 12 December 2022 doi:10.20944/preprints202212.0199.v1

Traditionalist	616	14	26	74		
Others	190	4	13	87		
ANC visits					85.060	0.000
≤7 visits	3469	81	46	54		
≥8 visits	815	19	64	36		
Parity					11.176	0.011
One birth	647	15	54	46		
Two births	728	17	51	49		
Three births	726	17	49	51		
Four or more births	2183	51	47	53		
Access to Mass Media					406.738	0.000
No	2601	61	38	62		
Yes	1683	39	71	29		
Women's household decision autonomy					2.706	0.100
not autonomous	3538	83	49	51		
Autonomous	746	17	52	48		
Sex of household head					128.005	0.000
Male	3502	82	45	55		
Female	782	18	69	31		
Partner's education					937.133	0.000
No formal education	1578	37	23	77		
Formal education	2706	63	70	30		
Zone of residence					2.100	0.000
Coastal zone	1026	24	82	18		
Middle zone	1879	44	80	20		
Savanna zone	1379	32	10	90		

Source: Computed from 2003, 2008 and 2014 GDHS.

3.2. Inferential results for the Study

Table 2 shows the inferential results of the study. Compared with women who had no formal education, the likelihood to practice open defecation reduced among those with formal education [aOR=0.69, CI=0.56-0.85], just as among those whose partners had formal education compared with those whose partners had no formal education [aOR=0.64, CI=0.52-0.80]. Women in the rich wealth quintile had lesser odds of practicing open defecation than the poor [aOR=0.12, CI=0.07-0.20]. The likelihood to defecate openly was lesser among the traditionalist than those not affiliated with any religion [aOR=0.33, CI=0.19-0.57]. Women who had access to mass media had fewer odds of practicing open defecation than their counterparts without access to mass media [aOR=0.70, CI=0.57-0.85]. Residents in the Savannah zone were over 21-fold higher to defecate openly compared to those in the coastal zone [aOR=21.06, CI=15.97-27.77].

Table 2: Inferential results for the study

	Model I		Model II	
Key explanatory variables	OR	95%CI	aOR	95%CI
Age (in years)				
15-19	Ref	1,1	Ref	1,1

Preprints (www.preprints.org) | NOT PEER-REVIEWED | Posted: 12 December 2022 doi:10.20944/preprints202212.0199.v1

20-24	0.92	[0.64-1.31]	0.99	[0.59-1.68]
25-29	1.09	[0.77-1.54]	0.96	[0.56-1.67]
30-34	0.87	[0.61-1.23]	0.68	[0.38-1.22]
35-39	0.94	[0.66-1.34]	0.61	[0.33-1.11]
40-44	0.96	[0.66-1.40]	0.68	[0.35-1.27]
45-49	1.47	[0.96-2.27]	0.84	[0.41-1.70]
Education				
No formal education	Ref	1,1	Ref	1,1
Formal education	0.16***	[0.14-0.18]	0.69***	[0.56-0.85]
Wealth status				
Poor	Ref	1,1	Ref	1,1
Middle	0.17***	[0.14-0.21]	0.57***	[0.44-0.73]
Rich	0.04***	[0.03-0.07]	0.12***	[0.07-0.20]
Marital status				
Married	Ref	1,1	Ref	1,1
Cohabiting	0.34***	[0.29-0.41]	0.93	[0.72-1.19]
Others	0.26***	[0.16-0.40]	0.73	[0.40-1.32]
Religion				
No religion	Ref	1,1	Ref	1,1
Christian	0.19***	[0.13-0.28]	0.40***	[0.25-0.65]
Muslim	0.41***	[0.28-0.60]	0.66	[0.39-1.12]
Traditionalist	0.86	[0.58-1.27]	0.33***	[0.19-0.57]
Others	2.07**	[1.22-3.49]	0.79	[0.39-1.60]
ANC visits				
≤7 visits	Ref	1,1	Ref	1,1
≥8 visits	0.47	[0.40-0.55]	0.95	[0.75-1.21]
Parity				
One birth	Ref	1,1	Ref	1,1
Two births	1.11	[0.90-1.38]	0.97	[0.69-1.36]
Three births	1.22	[0.99-1.52]	1.16	[0.80-1.68]
Four or more births	1.32**	[1.11-1.57]	0.99	[0.67-1.45]
Access to Mass Media				
No	Ref	1,1	Ref	1,1
Yes	0.25***	[0.22-0.29]	0.70***	[0.57-0.85]
Sex of household head				
Male	Ref	1,1	Ref	1,1
Female	0.38***	[0.32-0.45]	0.97	[0.76-1.24]
Partner's education				
No formal education	Ref	1,1	Ref	1,1
Formal education	0.13***	[0.11-0.15]	0.64***	[0.52-0.80]
Zone of residence				
Coastal zone	Ref	1,1	Ref	1,1
Middle zone	1.14	[0.92-1.42]	0.94	[0.74-1.18]
Savannah zone	41.67***	[32.91-52.76]	21.06***	[15.97-27.77]
Survey wave				
2003	Ref	1,1	Ref	1,1
2008	1.11	[0.94-1.30]	1.15	[0.89-1.49]
2014	1.05	[0.92-1.20]	1.05	[0.84-1.31]

 doi:10.20944/preprints202212.0199.v1

Model specification	
Number of observations	4284
Number of covariate patterns	2692
Pearson chi2(2665)	2976.52
Sig. level	0.000

Exponentiated coefficients; 95% confidence intervals in brackets, OR=Odd Ratio, aOR = Adjusted Odds Ratio, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$, 1=Reference category
Source: Computed from 2003, 2008, and 2014 GDHS

4. Discussion

The prevalence and determinants of open defecation (OD) (bush/field) among rural women in Ghana aged 15 to 49 were assessed in this study. In general, the study discovered that open defecation rose from 50% to 52% between 2003 and 2008 and remained stable (51%) in 2014. These results align with earlier studies carried out in Ghana 49.5% [24], and Benin 53.9% (Belay et al., 2022). However, the open defecation rates were greater than those recorded in Kenya 23.5% [32], Senegal 12.4% , Nigeria 24.5% [30] and Indonesia 28.5% [33], but lower than those observed in Niger 72.7% and Chad 70.6%, respectively (Belay, et al., 2022). The variation in open defecation rates could be attributed to the differences in implementation frameworks, socio-economic statuses, and study design approaches [34]. This may also be due to the varying government pledges and participation in various community initiative programmes, which take a better method to reducing OD practice and achieving the preferred sanitation program [2,34]. Notably, the higher OD rates observed in this study could be due to the lack of funds available to rural women to construct sanitation facilities (toilet facilities) [35]. However, having a sanitation facility (toilet facility) at home does not necessarily mean you will utilize it [24]. Another factor contributing to the increase in OD practice may be the rural women's previous habits of being used to the practice [35].

According to the study, OD among rural women aged 15 to 49 in Ghana is significantly influenced by factors like education, wealth position, religion, access to mass media, partners' educational levels, and zone of residence. Education has a big impact on the practice of OD. Rural women with formal education showed less likelihood to practice OD than those without formal education. This is backed by prior studies conducted in Tanzania [36], Nigeria [37], and Ghana [24]. Education decreased the probability of OD, according to research conducted in Ghana [24]. This could be because educated women are generally more aware of the importance of having sanitation facilities and the consequences of OD practice. Additionally, having more knowledge augments the likelihood that households will be able to produce an income, which is the biggest obstacle to building sanitation facilities (Belay et al., 2022; Patwa & Pandit, 2018). The lack of schooling or poor level of education among rural women suggests a limited understanding of fecal-oral routes of disease transmission. Therefore, these women would not view open defecation as improper [38]. This calls for hands-on sanitation and cleanliness interventions to raise rural women's understanding and awareness about cleanliness and hygiene practices.

 doi:10.20944/preprints202212.0199.v1

As opposed to poor women in rural Ghana, women in the rich wealth quintile exhibited reduced odds of practicing OD, according to this study. This conclusion is corroborated by prior research from Mozambique [39], Nigeria [37], India[40], and Ghana [24] that found poorer households have a greater propensity to resort to OD than affluent households. However, wages cannot fully account for greater OD rates [37]. In a study in Ghana to determine the causes of OD, it was shown that respondents had major income problems, with many bemoaning the debt they had accumulated through borrowing money for other items, such as food. They consequently lacked the resources necessary to build sanitation facilities [13,41]. In accordance with findings from additional studies, households of lower socio-economic status are less likely to possess latrines than those of higher socio-economic status [24,42].

Comparable to this, a study that looked at the causes of OD identified a major issue as a lack of funding for maintaining or constructing lasting restroom facilities [34]. This highlights how crucial it is to incorporate household income enhancement sectors when creating sanitation and hygiene promotion programs to remove obstacles to achieving ODF families [38]. According to Belay et al., (2022), most OD activities occur in rural parts of low-income nations like Ghana. There are also financial disparities between the rich and the poor in OD behaviours [43]. Open defecation was a common practice in nations with significant poverty levels, and the wealth gap between the rich and the poor was particularly vast [24,30]. According to a study, the amount of sanitation aid distributed per person in low-income nations like Ghana significantly impacted the decline in OD practice (Belay et al., 2022).

In terms of mass media access, this study found that rural women who had access to the media were less likely to practice open defecation than their peers who did not. This outcome demonstrates the value of the mass media in disseminating information about sanitation and hygiene. This result corroborates earlier studies from Nigeria [44] and India [45] that found employing mainstream media, social media, and community-based media was crucial for avoiding OD practice. This might be because exposure to media raises public knowledge of the negative effects of OD and helps people internalize the advantages of using restrooms [37,45]. This result suggests that the Ghanaian government should deploy the media to spread awareness of poor sanitation and hygiene behaviours, such as open defecation. This may raise rural women's knowledge of the harmful health implications of open defecation and the need to stop engaging in this hazardous behaviour [46].

Education is crucial for improving human assets and understanding the significance of environmental cleanliness. Environmental health officials and citizens must share a common understanding for environmental health policies to be implemented, which calls for some education [24,47]. In our analysis, we discovered a strong correlation between partners' educational attainment and their practice of open defecation. Women with educated spouses are less likely to defecate in public than women with uneducated partners (i.e., as the partner's level of education rises, the chance of open defecation among women decreases). This finding was anticipated because educated spouses know the dangers of open defecation and the importance of having a toilet at home. A greater degree of education may increase a

 doi:10.20944/preprints202212.0199.v1

husband and wife's ability to generate money, increasing their capability to build a restroom and even embrace superior technologies [24]. Since husbands in Ghana typically decide whether to embrace latrines, their level of education is crucial [37]. The current study also discovered that traditionalist women were less likely to defecate in public than women who did not practice any religion.

The current study also found that the zone of residence is a key determinant of whether rural women practice open defecation. Compared to rural women living in the coastal zone, OD practice was highest among those living in the savannah zone. Similar to the current study, zonal disparities in OD prevalence have also been found in Tanzania [48], Nigeria [37], Ethiopia, and Ghana [49], all of which have high rates of open defecation. This is because this region has the biggest percentage of pastoralist groups and a relatively low level of commitment to planning for outcomes that prevent open defecation [43]. High rates of drought and conflicts involving water are also probably significant contributors to the area's inadequate sanitation and hygiene coverage [27,30,50]

Additionally, since farming is the main activity in this area, these women resort to open defecation in the gardens, shrubs, and tree plantations because there are no restrooms or facilities for washing their hands close to the farmlands [29]. In a study conducted in Uttarakhand, India, [40] established that the majority of men and women who defecate openly do so because of their work as farmers and other sources of income. It is crucial for sanitation advocates to consider and concentrate on assisting farming women to climb the sanitation ladder [38]

4.1. Policy implications

This study assessed the prevalence and determinants of OD practices. Two consequences for policy are suggested by the use of wealth status in explaining OD behaviours. The foremost is the regime's fiscal strategy and how much it considers the accessibility of better sanitation facilities. The second policy suggestion relates to the function of the general policy for reducing poverty, whose results should include effects on progressive outcomes like better access to sanitation facilities. The rising importance of income in determining whether or not one defecates leads to the conclusion that a tax cut and better supply-side competitiveness are essential components of the optimum fiscal framework for making enhanced sanitation facilities accessible to all. For most sanitation-related goods and services in rural Ghana, there may be an option to exclude these from value-added tax (VAT).

More so, subsidies or the installation of toilets could be some of the strategies for developing better sanitation in rural regions. However, research favours a larger role for supplementary public campaigns that use behavioural change communication (BCC) through the mass media. Studies have recently supported the significance of BCC using the mass media to address inadequate sanitation. Some of the underprivileged homes that NGOs helped install toilets in Nigeria and India did not use them, primarily because they were unaware of how important they were [51,52]. Therefore, it would be possible to use the mass media to inform rural women about the

 doi:10.20944/preprints202212.0199.v1

negative effects of excreting in public on their health and socio-economic status.

The current capital allocation and education improvements must be sustained and may eventually hasten access to better sanitation. These developments include the growth of secondary and higher education and the rising sectoral share of education. Education could also reduce the impact of rurality in elucidating disparities in OD practice [52]. Greater resources are available to urban dwellers in terms of institutions, assets, and education [53]. If the rural-urban difference in OD occurrence is to be minimized, these issues merit an equity-based strategy drive. The better educated the population, the greater the impact of initiatives like those related to BCC will probably be. A higher level of education, for example, would make it easier for the local populace to adopt already-existing, straightforward changes (like those in sanitation) that could save their children's lives [52]. Equally crucial is that decision-makers refrain from prioritizing easier-to-reach regions, which are typically non-poor and non-rural regions, as this can lead to ineffective policymaking [52].

Generally, governments must play a crucial role in promoting sanitation and controlling harmful defecation practices [54,55]. This is demonstrated by initiatives like the Swachh Bharat Mission (SBM) of the Indian government. However, the strategies and tools governments could use to intervene successfully also matter. Even though India's SBM hygiene programme reduced rural open defecation to 45% from 70% in some states, it was a top-down approach in which rural people were frequently forced to build latrines with little attention paid to latrine usage or impending fecal sludge management [56]. Due to the type and degree of force used beneath the SBM, it poses a threat to the sustainability of OD reductions. Additionally, because rural women's concerns regarding latrine pits and pit emptying were not considered, unsafe latrine pit emptying has resulted [56]. Such insights from Indian government programs could help countries like Ghana, which is having trouble planning interventions that will address OD in rural Ghana and sustain results from the intended interventions.

5. Conclusion

The study assessed the prevalence and contributing factors of open defecation among rural women aged 15-49 in Ghana. Open defecation was significantly correlated with factors such as formal educational attainment, wealth status, religion, access to mass media, partner's education, and zone of residence. In rural Ghana, the prevalence of open defecation is disproportionately pro-poor, which indicates that impoverished rural women are more likely to perform it. Ghana's Ministry of Health should develop a basic sanitation and hygiene program with an emphasis on savannah zone residents, women without formal education, rural communities, and nonreligious people. It is important to increase public access to media and education. Public health initiatives should also aim to close the rich-poor divide in OD practice among rural women.

6. Strengths and limitations

 doi:10.20944/preprints202212.0199.v1

The study's use of a nationally representative dataset to assess the factors influencing open defecation among rural Ghanaian women is one of its strengths. Additionally, using a large sample size is often important in cross-sectional studies, which has improved the validity and generalizability of the study results. Furthermore, the outcomes produced through acceptable methods and scientific study criteria perfectly match those of earlier studies. By outlining sanitation requirements, this study will assist Ghana in more efficiently allocating its sanitation and hygiene resources. However, one limitation of this study may be recall bias, which could result from the possibility that women may give socially acceptable answers and have trouble remembering earlier events. Culture also has an impact on open defecation. When a father-in-law and daughter-in-law share a restroom, it may be considered improper in some cultures, resulting in open defecation. These cultural traits, however, could not be included in the analysis since they were not found in the dataset.

Funding: This research received no external funding

Informed Consent Statement: The present study utilized an existing dataset. Therefore, the authors of this study had no hand in all fieldwork and activities that led to the generation of the datasets used in the study. As such, ethical principles applicable to the study involving human participants did not apply to this study. However, the datasets were requested from the measure DHS platform and downloaded after access to the datasets were granted. However, the measure DHS anonymized the dataset before making it public.

Author Contributions: Conceptualization, FA, EAE, KB, and TS**; m**ethodology, FA; validation, FA, JODF, GB, KB TS, EAE, and GAD; formal analysis, FA; investigation: FA, EAE, KB, and TS; data curation, FA; original draft preparation, FA, JODF, GB, KB, TS, EAE, and GAD; review & editing, FA, JODF, GB, KB, TS, EAE, and GAD; visualization, GAD; supervision, FA; project administration, FA, and EAE.

Conflict of interest: The authors declare no conflict of interest

Data Availability Statement: The datasets are publicly available at the Measure DHS dataset repository and can be downloaded at www.measuredhs.org.

Acknowledgement: We are grateful to Measure DHS for giving us access to the data used in this study.

Appendix

Appendix 1: Multicollinearity results

Variables	VIF	1/VIF
Parity	2.07	0.484069
Age	1.99	0.501278
Partner's education	1.67	0.599058
Education	1.61	0.621948
Zone of residence	1.59	0.630342
Wealth	1.38	0.723595
Access to Mass Media	1.32	0.758350
Religion	1.22	0.818225
Marital status	1.15	0.868205
Sex of household head	1.12	0.892761

Survey wave	1.12		0.893194
ANC visits	1.08		0.929275
Mean VIF		1.44	

References

1. The World Bank The Global Sanitation Crisis Available online: https://www.worldbank.org/en/news/infographic/2020/07/02/the-global-sanitation-crisis (accessed on 19 November 2022).
2. Clasen, T.; Boisson, S.; Routray, P.; Torondel, B.; Bell, M.; Cumming, O.; Ensink, J.; Freeman, M.; Jenkins, M.; Odagiri, M.; et al. Effectiveness of a Rural Sanitation Programme on Diarrhoea, Soil-Transmitted Helminth Infection, and Child Malnutrition in Odisha, India: A Cluster-Randomised Trial. *Lancet Glob Health* **2014**, *2*, e645–e653, doi:10.1016/S2214-109X(14)70307-9.
3. WHO/UNICEF *Progress on Household Drinking Water, Sanitation and Hygiene 2000-2020: Five Years into the SDGs*; World Health Organization (WHO) and the United Nations Children's Fund (UNICEF): Geneva, Switzerland, 2021;
4. WHO/UNICEF *Progress on Drinking Water , Sanitation and Hygiene: 2017 Update and SDG Baselines - Launch Version*; 1st ed.; World Health Organization (WHO) and the United Nations Children's Fund (UNICEF), 2017: Geneva, 2017; ISBN CC BY-NC-SA 3.0 IGO.
5. Saleem, M.; Burdett, T.; Heaslip, V. Health and Social Impacts of Open Defecation on Women: A Systematic Review. *BMC Public Health* **2019**, *19*, 1–12, doi:10.1186/S12889-019-6423-Z/TABLES/3.
6. Abudulai, I.; Abdulai Robert Aziz, T.; Ofori, B.; Atta Adjei, G. The Menace of Open Defecation in Ghanaian Communities: The Case of Gambaga and Nalerigu Communities in North East Region. *International Journal of Environmental Protection and Policy* **2021**, *9*, 16, doi:10.11648/j.ijepp.20210902.11.
7. Abubakari, S.W.; Oppong, F.B.; Wiru, K.; Manu, G.; Apraku, E.A.; Abukari, M.; Zandoh, C.; Asante, K.P. Open Defecation and Attainment of Sustainable Development Goal Six: Evidence from Kintampo Surveillance System, Ghana. *Ghana Med J* **2021**, *55*, 273–277, doi:10.4314/gmj.v55i4.7.
8. Mariwah, S.; Hampshire, K.; Owusu-Antwi, C. Getting a Foot on the Sanitation Ladder: User Satisfaction and Willingness to Pay for Improved Public Toilets in Accra, Ghana. *Journal of Water Sanitation and Hygiene for Development* **2017**, washdev2017007, doi:10.2166/washdev.2017.007.
9. Akpakli, D.E.; Manyeh, A.K.; Akpakli, J.K.; Kukula, V.; Gyapong, M. Determinants of Access to Improved Sanitation Facilities in Rural Districts of Southern Ghana: Evidence from Dodowa Health and Demographic Surveillance Site. *BMC Res Notes* **2018**, *11*, 473, doi:10.1186/s13104-018-3572-6.
10. Obeng, P.A.; Keraita, B.; Oduro-kwarteng, S.; Bregnhøj, H. Usage and Barriers to Use of Latrines in a Ghanaian Peri-Urban Community. *Environ. Process* **2015**, *2*, 261–274, doi:10.1007/s40710-015-0060-z.
11. WHO/UNICEF *Progress on Household Drinking Water, Sanitation and Hygiene 2000-2017: Special Focus on Inequalities*; United Nations Children's Fund (UNICEF) and World Health Organization (WHO): New York, USA., 2019; ISBN 978-92-806-5036-5.
12. WHO/UNICEF Progress on Sanitation and Drinking Water: 2010 Update. *WHO Library* **2010**, 60.
13. Duku, G.A.; Appiah-Effah, E.; Nyarko, K.B.; Dwumfour-Asare, B. Early Live-Prototype Testing of a Low-Cost Latrine Technology for Rural and Peri-urban Communities: The Case of a Modified Pour-Flush Latrine. *Sci Afr* **2020**, *8*, e00338, doi:10.1016/j.sciaf.2020.e00338.
14. Appiah-Effah, E.; Duku, G.A.; Azangbego, N.Y.; Aggrey, R.K.A.; Gyapong-Korsah, B.; Nyarko, K.B. Ghana's Post-MDGs Sanitation Situation: An Overview. *Journal of Water, Sanitation and Hygiene for Development* **2019**, *9*, 397–415, doi:10.2166/washdev.2019.031.

15. Cairncross, S.; Hunt, C.; Boisson, S.; Bostoen, K.; Curtis, V.; Fung, I.C.H.; Schmidt, W.P. Water, Sanitation and Hygiene for the Prevention of Diarrhoea. *Int J Epidemiol* **2010**, *39*, doi:10.1093/ije/dyq035.
16. Prüss-Üstün, A.; Bos, R.; Gore, F.; Bartram, J. Safer Water, Better Health: Costs, Benefits and Sustainability of Interventions to Protect and Promote Health. *World Health Organization* **2008**, 53.
17. Verhoeven, J. *Scaling up Household Water Treatment and Safe Storage in Ghana*; Daalen, T. van, Grift, V. van der, Eds.; 2018;
18. WSP *Ghana Loses GHC420 Million Annually Due to Poor Sanitation March: ECONOMIC IMPACTS OF POOR SANITATION IN AFRICA*; Ghana, 2012;
19. WSP *Economic Impacts for Poor Sanitation in Africa*; 2012;
20. White, Z.; Boot, N. The Evolution of Rural Sanitation Approaches in Ghana. In Proceedings of the 41st WEDC International Conference, Egerton University, Nakuru, Kenya, 2018: Transformation towards sustainable and resilient WASH Services; Nakuru, Kenya, 2018; pp. 1–6.
21. Monney, I.; Antwi-Agyei, P. Beyond the MDG Water Target to Universal Water Coverage in Ghana: The Key Transformative Shifts Required. *Journal of Water Sanitation and Hygiene for Development* **2018**, *8*, 127–141, doi:10.2166/washdev.2018.176.
22. Ntow, S. *Sanitation Status in Ghana and the Role of the CSOs in the Policy Processes*; Twende Mbele: Accra, Ghana, 2019;
23. USAID *The Challenges of Sustaining Open Defection Free (ODF) Communities in Rural Ghana: Research Brief*; 2021;
24. Osumanu, I.K.; Kosoe, E.A.; Ategeeng, F. Determinants of Open Defecation in the Wa Municipality of Ghana: Empirical Findings Highlighting Sociocultural and Economic Dynamics among Households. *J Environ Public Health* **2019**, *2019*, 1–10, doi:10.1155/2019/3075840.
25. Odagiri, M.; Muhammad, Z.; Cronin, A.A.; Gnilo, M.E.; Mardikanto, A.K.; Umam, K.; Asamou, Y.T. Enabling Factors for Sustaining Open Defecation-Free Communities in Rural Indonesia: A Cross-Sectional Study. *Int J Environ Res Public Health* **2017**, *14*, 1–20, doi:10.3390/ijerph14121572.
26. UN-HABITAT Sustainability of Open Defecation Free Campaign in GSF Supported Programme Districts, Nepal. **2017**, 26.
27. Belay, D.G.; Chilot, D.; Asratie, M.H. Spatiotemporal Distribution and Determinants of Open Defecation among Households in Ethiopia: A Mixed Effect and Spatial Analysis. *PLoS One* **2022**, *17*, e0268342, doi:10.1371/journal.pone.0268342.
28. Ghana Statistical Service (GSS); Ghana Health Service (GHS); ICF International *2014 Ghana Demographic and Health Survey Key Findings*; Rockville, Maryland, USA, 2015;
29. Busienei, P.J.; Ogendi, G.M.; Mokua, M.A. Open Defecation Practices in Lodwar, Kenya: A Mixed-Methods Research. *Environ Health Insights* **2019**, *13*, 117863021982837, doi:10.1177/1178630219828370.
30. Belay, D.G.; Asratie, M.H.; Aragaw, F.M.; Tsega, N.T.; Endalew, M.; Gashaw, M. Open Defecation Practice and Its Determinants among Households in Sub-Saharan Africa: Pooled Prevalence and Multilevel Analysis of 33 Sub-Saharan Africa Countries Demographic and Health Survey. *Trop Med Health* **2022**, *50*, 28, doi:10.1186/s41182-022-00416-5.
31. Appiah, F.; Fenteng, J.O.D.; Darteh, A.O.; Dare, F.; Saah, J.A.; Takyi, M.; Ayerakwah, P.A.; Boakye, K.; Ameyaw, E.K. Association between Mass Media Exposure and Endorsement of HIV-Infected Female Teachers' Teaching: Insight from 2014 Ghana Demographic and Health Survey. *BMC Womens Health* **2022**, *22*, 121, doi:10.1186/s12905-022-01705-1.
32. Njuguna, J.; Muruka, C. Open Defecation in Newly Created Kenyan Counties: A Situational Analysis. *J Health Care Poor Underserved* **2017**, *28*, 71–78, doi:10.1353/hpu.2017.0009.
33. Irawaty, D.K.; Utomo, W.; Kependudukan, B.; Keluarga, D.; Nasional, B. Open Defecation: Risk Factors for Adverse Outcomes in Indonesia. *Res Sq* **2022**, 1–14.

34. Abebe, T.A.; Tucho, G.T. Open Defecation-Free Slippage and Its Associated Factors in Ethiopia: A Systematic Review. *Syst Rev* **2020**, *9*, 252, doi:10.1186/s13643-020-01511-6.
35. Patwa, J.; Pandit, N. Open Defecation-Free India by 2019: How Villages Are Progressing? *Indian J Community Med* **2018**, *43*, 246–247, doi:10.4103/ijcm.IJCM_83_18.
36. Mumbi, T.L.; Wilberforce, C. An Assessment of Open Defecation among Residents of Thika East Sub-County, Kiambu County, Kenya. *International Journal of Medicine Research* **2017**, *2*, 09–20.
37. Abubakar, I.R. Exploring the Determinants of Open Defecation in Nigeria Using Demographic and Health Survey Data. *Science of The Total Environment* **2018**, *637–638*, 1455–1465, doi:10.1016/j.scitotenv.2018.05.104.
38. Ntaro, M.; Owokuhaisa, J.; Isunju, J.B.; Mulogo, E.; Ssempebwa, J.C. Contextual and Psychological Factors Influencing Open Defecation Free Status: An Exploratory Qualitative Study in Rural South Western Uganda. *BMC Public Health* **2022**, *22*, 414, doi:10.1186/s12889-022-12759-z.
39. Giné-Garriga, R.; Flores-Baquero, Ó.; Jiménez-Fdez de Palencia, A.; Pérez-Foguet, A. Monitoring Sanitation and Hygiene in the 2030 Agenda for Sustainable Development: A Review through the Lens of Human Rights. *Science of The Total Environment* **2017**, *580*, 1108–1119, doi:10.1016/j.scitotenv.2016.12.066.
40. O'Reilly, K.; Dhanju, R.; Goel, A. Exploring "The Remote" and "The Rural": Open Defecation and Latrine Use in Uttarakhand, India. *World Dev* **2017**, *93*, 193–205, doi:10.1016/j.worlddev.2016.12.022.
41. Duku, G.A. Development and Field-Testing of a Low-Cost Latrine for Rural and Peri-Urban Communities. MSc Thesis. MSc Thesis, Kwame Nkrumah University of Science and Technology, 2017.
42. Adhikari, R.; Ghimire, S. Open Defecation Free: Where Do We Need to Focus ? *Health Prospect* **2020**, *19*, 1–6, doi:10.3126/hprospect.v19i0.27394.
43. WHO/UNICEF JMP *Progress on Drinking Water, Sanitation and Hygiene: 2017 Update and SDG Baselines*; Geneva: World Health Organization (WHO) and the United Nations Children's Fund (UNICEF) Joint Monitoring Programme, 2017; ISBN 9789241512893.
44. NGWU, U.I. The Practice of Open Defecation in Rural Communities in Nigeria: A Call For SBCC Intervention. *International Journal of Communication Research* **2017**, *7*, 201–206.
45. Chatterjee, A.; Agarwal, S. Can Women Empowerment Help to Reduce Open Defecation in India: Evidence from NFHS 4. **2019**.
46. Aboagye, R.G.; Ahinkorah, B.O.; Seidu, A.-A.; Adu, C.; Hagan, J.E.; Amu, H.; Yaya, S. Mass Media Exposure and Safer Sex Negotiation among Women in Sexual Unions in Sub-Saharan Africa: Analysis of Demographic and Health Survey Data. *Behavioral Sciences* **2021**, *11*, 63, doi:10.3390/bs11050063.
47. Santah, C. Patterns of Human Excreta Disposal in Ayikuma, Shai-Osudoku District.; 2013.
48. Sara, S.; Graham, J. Ending Open Defecation in Rural Tanzania: Which Factors Facilitate Latrine Adoption? *Int J Environ Res Public Health* **2014**, *11*, 9854–9870, doi:10.3390/ijerph110909854.
49. Crocker, J.; Saywell, D.; Bartram, J. Sustainability of Community-Led Total Sanitation Outcomes: Evidence from Ethiopia and Ghana. *Int J Hyg Environ Health* **2017**, *220*, 551–557, doi:10.1016/j.ijheh.2017.02.011.
50. Seyoum, S.; Graham, J.P. Equity in Access to Water Supply and Sanitation in Ethiopia: An Analysis of EDHS Data (2000–2011). *Journal of Water, Sanitation and Hygiene for Development* **2016**, *6*, 320–330, doi:10.2166/washdev.2016.004.
51. Makhfudli, M.; Rachmawati, P.D.; Andini, S.A. Factors Related to Open Defecation Behavior Among School-Age Children in West Lombok. *Jurnal Ners* **2017**, *12*, 119–125, doi:10.20473/jn.v12i1.4028.
52. Maliti, E. Evolution of Open Defecation Prevalence in Tanzania 2002–2015: Evidence from National Demographic and Health Surveys. *Dev Pract* **2021**, *31*, 112–124, doi:10.1080/09614524.2020.1828283.

 doi:10.20944/preprints202212.0199.v1

53. The World Bank Reaching for the SDGs : The Untapped Potential of Tanzania's Water Supply, Sanitation, and Hygiene Sector Available online: https://openknowledge.worldbank.org/handle/10986/28435 (accessed on 1 December 2022).
54. Hathi, P.; Haque, S.; Pant, L.; Coffey, D.; Spears, D. Place and Child Health: The Interaction of Population Density and Sanitation in Developing Countries. *Demography* **2017**, *54*, 337–360, doi:10.1007/s13524-016-0538-y.
55. Lawson, N.; Spears, D. What Doesn't Kill You Makes You Poorer: Adult Wages and Early-Life Mortality in India. *Econ Hum Biol* **2016**, *21*, 1–16, doi:10.1016/j.ehb.2015.11.006.
56. Spears, D.; Coffey, D.; Kapur, A. Changes in Open Defecation in Rural North India : 2014-2018 Changes in Open Defecation in Rural North India : 2014-2018. *IZA Institute of Labor Economics Discussion Paper Series* **2019**, 2014–2018.