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Sanitation and hygiene practices in relation to childhood diarrhoea prevalence: The case of households with children under-five years in Ghana

Leslie Danquah[1, *], Esi Awuah[2], Charlotte Monica Mensah[1], Seth Agyemang[1]

[1]Department of Geography & Rural Development, CASS, KNUST, Kumasi, Ghana
[2]Universtiy of Energy and Natural Resources (UENR), Sunyani, Ghana

Email address:

kwasileslie@yahoo.com (L. Danquah), esiawuahrt@gmail.com (E. Awuah), charlottemensah2012@yahoo.com (C. M. Mensah)
sagyemang.cass@knust.edu.gh (S. Agyemang)

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Abstract: Research evidence indicates that the household environment has significant implications for the health of the members of the household. The objective of this study was to assess selected sanitation and hygiene practices in relation to the prevalence of childhood diarrhoea in households with children under-five years from the Ghanaian setting. A systematic random sampling approach was used to select 378 households from two communities each in the urban and peri-urban areas of the Atwima Nwabiagya District of Ghana respectively. Structured questionnaires and observation schedules were used to collect quantitative data from mothers and analyzed using chi-square and odds ratios (OR). The study showed that private latrine possession was low (10%) and sanitation facilities used by households were largely unimproved (90%). Children who lived in households which had water closets (WCs) in their dwellings recorded the lowest diarrhoea prevalence rate (11.1%) whereas the highest rate was recorded in households where the WCs were located outside the dwelling. Childhood diarrhoea was most prevalent (36%) for children whose mothers reported that they did not wash their hands with water and soap after defecation. It is proposed that adequate sanitation and hygiene education be given to mothers of children under-five years in the district and further research carried into socio-demographic and behavioral determinants of childhood diarrhoea.

Keywords: Sanitation, Hygiene, Household, Childhood Diarrhoea, Ghana

1. Introduction

The domestic environment is a very crucial setting that has significant implications for the health and well-being of households [1, 2]. Research evidence indicates that the environment plays a significant role in determining the health of households and this is primarily due to the fact that most diseases and injuries are contracted in the house and the immediate surroundings [2]. Exposure to environmental hazards can occur in the three main spatial scales of the ambient environment, community and the home [3]. Children under-five years of age experience the highest rates of diarrhoeal mortality and are more vulnerable to smaller doses of pathogens than other members of the household due to their under developed immune systems [4, 5]. According to the Joint Monitoring Programme (JMP) of the WHO and UNICEF, in 2008, 87% and 13% of the Ghanaian population used unimproved and improved sanitation respectively. Of those who used unimproved sanitation, 54% used shared sanitation facilities, 13% used unimproved facilities and 20% practiced open defecation [6]. However in 2011, 87% of Ghanaians still used unimproved sanitation; 59% shared, 10% unimproved facilities and 18% open defecation [7]. The precarious sanitation situation in Ghana does not have negative implications for the general health and well being of the entire populace alone but it has significant health ramifications for children under-five in particular. Understanding the nature of sanitation and hygiene practices in relation to diarrhoeal morbidity of children under-five years is very important for the design and promotion of sanitation and hygiene education. Thus this study aimed at assessing sanitation and hygiene practices in relation to childhood diarrhoea prevalence at the household level.

2. Materials and Methods

2.1. Setting

This study was conducted during the wet season of 2012 (May – August) in the Atwima Nwabiagya District of the Ashanti Region of Ghana in four (4) communities whose health statistics from the district health directorate had shown an increasing trend in under-five diarrhoea cases from 2008-2011. Two were urban communities; Abuakwa and Nkawie whilst two others were peri-urban; Asuofua and Barekese. Five (5) research assistants were recruited from the study communities and given a one (1) week training in questionnaire administration, interviewing techniques, how to record data on observation schedules, data management, recording GPS coordinates and research ethics. Data was collected using an interviewer administered questionnaire, observation schedule, focus group discussions and in-depth interviews. GPS location data was collected using GARMIN Dakota^{TM} 10 GPS handsets.

2.2. Sampling Issues and Methodology

The study communities were mapped through reconnaissance surveys conducted from November 2011 to January 2012. Each community map was divided into 10 sectors using major road networks in the community and each given a unique alphabetical identification ranging from 'A' to 'J'. The household per sector was arrived at by dividing the total sample size by 10 sectors and each coded according to their sectors. At the enumeration stage, a systematic random sampling technique was adopted. Every other house within a sector was visited and the first household within the house that satisfied the inclusion criteria was enrolled for the study. The GPS location of the household was taken into a log book and the pre-coded household number was written on the respondent's wall to facilitate revisits.

2.2.1. Sample Size

A total of study households per households were arrived at using the formulae:

$$n = N / (1+N(a)^2) \quad (1)$$

where 'n' = sample size, 'N' = Total number of households and 'a' = margin of error estimated at 5% [8]. Total number of urban and peri-urban households studied were 240 (63%) and 138 (37%) households respectively. The research instruments were pre-tested in Kobeng, a community in the Atwima Nwabiagya District, prior to the start of the field data collection.

2.2.2. Eligibility

For a household to be eligible for study, it had to satisfy two criteria. First, the household should have had at least one child aged 5 years or below. Secondly, the mother should have agreed to participate in the study and signed a consent form. This procedure was repeated in each of the study communities till the minimum sample size for study per community was reached. All respondents were mothers who had at least one 'index' child aged 5 years or below.

Table 1. *Selected communities studied and their population characteristics.*

Community	Total Population (2012)	HH* Population (2012)	Sample size	%
Abuakwa	23, 634	4, 400	176	47
Nkawie	9, 054	1, 597	64	17
Barekese	10, 544	1, 812	72	19
Asuofa	8, 373	1, 645	66	17
Total	51, 605	9, 454	378	100

Source: Ghana Statistical Service [24].
*HH – Household.

2.1.3. Operational Definitions

The following terms were operationally defined and used in this research:

Immediate access – Households use of sanitation facilities that are located within their dwellings or on their home compounds.

Remote access – Households use of sanitation facilities that are located off their home premises. Eg. Public latrines.

Index child – One child ≤ 5 years whose health data has been captured exclusively for study in a household.

Odds ratio – The odds of disease among exposed individuals divided by the odds of disease among unexposed individuals. An odds ratio of 1 equals no association between exposure and outcome.

2.3. Statistical Analysis

Quantitative data was inputted into SPSS® v.16 and analyzed using non-parametric statistics. Statistical significance was set at $p \leq 0.05$.

2.4. The sample of variables

Based on a review of literature, nine environmental sanitation variables were hypothesized to be associated with childhood diarrhoea. They are latrine ownership, type of sanitation, availability of latrine door, availability of a latrine lid, presence of faeces around the pit hole, presence of faeces around the latrine, presence of faeces on the latrine floor, presence of faeces on the compound and refuse disposal method.

2.5. Ethical Approval

Ethical approval was given by the Committee on Human Research, Publication and Ethics (CHRPE), Kwame Nkrumah University of Science and Technology, (CHRPE/AP/187/12). Additional approval was given by the District Director of Medical Services (DDMS) and the Atwima Nwabiagya District Assembly.

3. Results

3.1. Socio-Demographic Information

The mean age for mothers was 31 years (±7 SD) whereas that of the household head was 38 years (±9 SD). Most mothers, 325 (86%) were married and the mean household size was 5 members (±1.7 SD). Majority, 293 (78%) of the mothers had completed Junior High School or had some form of basic education but only 31 (8%) had progressed beyond Senior High School. For 'household heads', 200 (56%) had completed Junior High School or some form of basic education whilst 99 (28%) had progressed beyond Senior High School. Whereas 151 (40%) mothers were predominantly engaged in trading and 119 (32%) self employment, their spouses were predominantly engaged in self employment 157 (43%) and driving 80 (22%). In terms of wealth, 238 (64.3%) of households were above the 'middle income' wealth category.

Most mothers, 377 (84%), lived in one room apartments with their households and the modal rage of years resident in the dwelling was between 1-3 years. There was one under-five year old child in 250 (66.5%) households (n = 376) whilst 109 (29%) households had two and 17 (4.5%) households had three or more. With respect to dwelling materials, 365 (97%) households lived in dwelling units that were predominantly roofed with iron sheets, 329 (96%) of dwelling walls were cemented and the floors were cement screed 344 (91%).

3.2. Sanitation Aspects

3.2.1. Latrine Ownership and Usage

With respect to latrine usage, 113 (32%) households had 'immediate access' whereas 244 (68%) had 'remote access' to latrines. Of the total number of households which had access to latrines (n=113), 37 (32.7%) indicated that their households owned the latrines whilst 76 (67.3%) indicated that they were shared. The most dominant facility used by households which had 'immediate access' to latrines (n=113) was the 'in compound pit with slab' 42 (37.2%). This was followed by the 'in compound KVIP' 30 (26.5%), the 'WC in dwelling' 18 (15.9%) and 'in compound WC' 15 (13.3%). Though there is a ban on the use of bucket/pan latrines in Ghana, 8 (7.1%) households used it.

An assessment of the facilities used by households in the study communities shows that a large proportion of residents living in Asuofua (59.3%) used the 'in compound KVIP'. This is partly due to the use of houses that were built to resettle households in the Asuofua township during the construction of the Barekese dam in the 1970s. The 'in compound pit with slab' was predominantly used in Nkawie (50%) whereas that of the ' in compound bucket was used in Barekese (24.1%). Most households (29.8%) which used WCs in dwellings were resident in Abuakwa, an urban community. Thus there was a sharp contrast in the use of WCs between urban (28.1%) and peri-urban households (3.6%)

A distinction between the use of shared facilities and private facilities also aided in the determination of 'improved and unimproved' facilities as defined by the WHO/UNICEF [7].

A distribution of households by their types of latrine ownership shows that more than half, 76(67.3%), shared sanitation facilities. At the residential location level, more prei-urban households, 39 (69.6%), shared sanitation facilities compared to that of their urban counterparts, 37 (64.9%). However chi-square analysis showed that urban and peri-urban households were not distributed differently across type of latrine ownership, χ^2 (1, n = 113) = 0.28, p = 0.59 (Table 2).

With respect to the study communities, sharing of sanitation facilities was predominant in Nkawie, 8 (80%) and least practiced in Abuakwa, 29 (61.7%). Private use of sanitation facilities was predominant in Abuakwa, 18(38.3%) and less practiced in Nkawie, 2 (20%). Table 3 shows a distribution of the type of latrine by ownership scheme and the data presented shows that the most shared sanitation facility which was used by households with immediate access was the 'in compound KVIP', 25 (32.9%) whereas the least shared sanitation facility was the 'in compound bucket', 7 (9.2%).

The most exclusively used sanitation facility was the 'in compound pit with slab, 18 (48.6%) whereas the least exclusively used sanitation facility was the 'in compound bucket', 1 (2.7%). A chi-square test showed those households that did not share and ones that shared sanitation facilities were distributed differently across the type of latrine, χ^2 (4, n = 113) = 8.28, p = 0.08. Thus there was no statistically significant difference in the distribution.

Table 2. *Type of latrine ownership by residential location.*

Type of latrine ownership	Communities			Location			Total (%)
	Abuakwa (%)	Nkawie (%)	Asuofua (%)	Barekese (%)	Urban (%)	Peri-urban (%)	
Privately owned by household	18 (38.3)	2 (20)	10 (37)	7 (24.1)	20 (35.1)	17 (30.4)	37 (32.7)
Shared with other households	29 (61.7)	8 (80.0)	17 (63)	22 (75.9)	37 (64.9)	39 (69.6)	76 (67.3)
Total	47 (100)	10 (100)	27 (100)	29 (100)	57(100)	56 (100)	113 (100)

Table 3. *Type of latrine ownership by ownership scheme.*

Type of latrine	Ownership		Total (%)
	Privately owned by household (%)	Shared with other households (%)	
WC in dwelling	6 (16.2)	12 (15.8)	18 (15.9)
In compound pit with slab	18 (48.6)	24 (31.6)	42 (37.2)
In compound bucket	1 (2.7)	7 (9.2)	8 (7.1)
In compound KVIP	5 (13.5)	25 (32.9)	30 (26.5)
In compound WC	7 (18.9)	8 (10.5)	15 (13.3)
Total	37 (100)	76 (100)	113 (100)

Table 4. *Distribution of latrine type by JMP definition.*

Type of latrine regularly used by household	Type by JMP definition		Total
	Improved (%)	Unimproved (%)	
Public toilet	0 (0)	244 (76)	244 (68.4)
WC in dwelling	6 (16.6)	12 (3.7)	18 (5.0)
In compound pit with slab	18 (50)	24 (7.5)	42 (11.8)
In compound bucket	0 (0)	8 (2.5)	8 (2.2)
In compound KVIP	5 (14)	25 (7.8)	30 (8.4)
In compound WC	7 (19.4)	8 (2.5)	15 (4.2)
Total	36 (100)	321 (100)	357 (100)

Table 4 shows a distribution of all the study households by their use of improved and unimproved sanitation facilities respectively. With reference to the type of sanitation facilities regularly used by the study households (n=357), irrespective of the type of access, the 'public toilet' ranked highest in terms of use by 244 (68.4%) households. This was followed by 'in compound pit with slab' 42 (11.8%), 'in compound KVIP' 30 (8.4%), 'WC in dwelling' 18 (5.0%) and the 'in compound WC 15 (4.2%). As per the JMP definitions of improved and unimproved sanitation facilities, 36 (10%) of study households (n = 357) used improved sanitation facilities whereas 321 (90%) used unimproved sanitation facilities (Table 4).

Chi-square analysis results, χ^2 (5, n = 357) = 112.3, p ≤ 0.00, indicated that households which used improved and unimproved sanitation facilities were distributed differently across type of latrine regularly used and the difference in the distribution was statistically significant.

3.2.2. Household Sanitation Type and Childhood Diarrhoea Prevalence

This study assessed the relationship between the type of sanitation facility used and two weeks diarrhoea prevalence for children under-five years (Table 5). The two week childhood diarrhoea prevalence for households was 13%.

Table 5. *Distribution of sanitation facility by prevalence of diarrhoea*

Type of sanitation facility	Number of cases	Childhood diarrhoea prevalence
In compound bucket	1	1/8 = 12.5%
WC in dwelling	2	2/18 = 11.1%
Public toilet	31	31/244 = 12.7%
In compound KVIP	4	4/30 = 13.3%
In compound pit with slab	6	6/42 = 14.2%
In compound WC	4	4/15 = 26.7%
Total	48	48/357 = 13.4%

Index children who lived in households where the 'in compound water closet (WC)' was used, recorded the highest prevalence rate (26.7%). Also children which lived in households which used the 'in compound pit with slab' and 'in compound KVIP' had 14.2% and 13.3% childhood diarrhoea prevalence rates respectively. Children who lived in households that used public toilets also recorded 12.7% prevalence rate whilst those that lived in households that used the 'in compound bucket' recorded a 12.5% prevalence rate. The lowest rate (11.1%) was recorded for index children who lived in households which had WCs in their dwellings (Table 5).

In the crude odds ratio and chi-square analysis of environmental factors in the wet season (Table 6), none of the hypothesized variables (factors) showed a statistically significant association with childhood diarrhoea. However, four out of nine factors had a p-value less than 0.30 and these were the use of improved sanitation (OR= 1.66, 95% CI 0.68 – 4.02), observation of faeces around the pit hole or slab (OR= 2.90, 95% CI 0.80 – 10.43), observation of faeces on the home compound (OR= 1.50, 95% CI 0.75 – 3.00) and where safe refuse disposal was practiced by the household (OR= 0.64, 95% CI 0.33 – 1.23) (Table 6).

3.3. Hygiene Aspects

An assessment of mothers' reported hand washing at critical periods showed that childhood diarrhoea was most

prevalent (36%) for children whose mothers reported that they did not wash their hands with water and soap after defecation than for children whose mothers reported that they washed their hands less often (16.7%), often (9.4%) and very often (10.7%) (Table 7).

With respect to washing hands before feeding children, children who lived in households where mothers washed their hands 'less often' before feeding their children had the highest childhood diarrhoea rates (20.3%) whereas children who lived in households where mothers washed their hands less often after cleaning the bottom to their children had the highest diarrhoea prevalence rates (19.3%). However, these results need to be interpreted with caution because reported cases of hand washing may be subject to over reporting [10].

Table 6. *Crude odds ratio and chi-square analysis of hypothesized environmental factors.*

Variables (Wet Season)	Diarrhoea (2 weeks)		Crude OR (95% CI)	χ 2 (df. = 1)	*p*
	Yes (%)	No (%)			
Latrine ownership					
Private	7 (19)	30 (81)	0.64 (0.22 – 1.87)	0.64	0.42
Shared	10 (13)	66 (87)	1		
*HH Sanitation					
Improved	7 (19)	30 (81)	1.66 (0.68 – 4.02)	1.28	0.26
Unimproved	42 (12)	299 (88)	1		
Latrine door					
Available	11 (14)	68 (86)	1.13(0.12 – 10.11)	0.01	0.91
Not available	1 (12)	7 (88)	1		
Latrine lid					
Available	5 (14)	32 (86)	0.98 (0.28 – 3.37)	0.00	0.97
Not available	7 (14)	44 (86)	1		
Faeces seen around pit hole / slab					
Yes	5 (25)	15 (75)	2.90 (0.80 – 10.43)	2.83	0.10
No	7 (10)	61 (90)	1		
Faeces seen around latrine					
Yes	5 (14)	32 (86)	0.98 (0.28 – 3.37)	0.00	0.97
No	7 (14)	44 (86)	1		
Faeces seen on latrine floor					
Yes	4 (13)	28 (87)	0.85 (0.23 – 3.10)	0.05	0.81
No	8 (14)	48 (86)	1		
Faeces seen on compound					
Yes	30 (14)	181 (86)	1.50 (0.75 – 3.00)	1.35	0.24
No	13 (10)	118 (90)	1		
Refuse disposal					
Safe	15 (10)	132 (90)	0.64 (0.33 – 1.23)	1.78	0.18
Unsafe	34 (15)	193 (85)	1		

* HH-Household

Table 7. *Distribution of mothers' self reported frequency of washing hands with soap by childhood diarrhoea prevalence rate.*

Critical period	Number of cases	Childhood diarrhoea prevalence
After using the toilet		
No washing with soap	8	8/22 = 36%
Less often	15	15/90 = 16.7%
Often	23	23/244 = 9.4%
Very often	3	3/28 = 10.7%
Uncertain	14	0/14 = 0%
Total	49	49/378 = 12.9%
Before feeding children		
No washing with soap	11	11/96 = 11.4%
Less often	13	13/64 = 20.3%
Often	23	23/188 = 12.2%
Very often	2	2/15 = 13.3%
Uncertain	0	0/15 = 0%
Total	49	49/378 = 12.9%
After cleaning bottom of children		
No washing with soap	9	9/52 = 17.3%
Less often	17	17/88 = 19.3%
Often	19	19/189 = 10.1%
Very often	4	4/23 = 17.4%
Uncertain	0	0/26 = 0%
Total	49	49/378 = 12.9%

4. Discussion

Diarrhoea is the second leading cause of death among children under-five globally with about 4 billion cases of diarrhoea occurring each year among children under-five [11]. The home remains the first point of contact for children who are known to be very curious about their environment, yet they lack the capacity to discern the hazards and avoid them by their own effort. Other researchers were of the view that any behaviour which prevents stools from getting into the domestic area, the child's main habitat, were likely to have a greater impact on health than those practices which prevented pathogens in the environment from being ingested [12]. In the Ghanaian context, much of the responsibility of keeping the household environment clean lies at the door step of the mother. Her ability to keep sanitation facilities clean and practice good hygiene is crucial because risk factors for diarrhoeal diseases include poor domestic sanitation and hygiene [13]. Some studies have shown a relationship between the use of sanitation facilities and prevalence of diarrhoea [9]. This study showed that in households where children under-five years lived, latrine possession was low and the sanitation facilities used by their households were largely unimproved. The observation of faecal matter on the latrine floor and around the latrine pit hole indicated that stools were not adequately disposed of in some households. When attracted, flies could have settled on them and served as potential agents for the transmission of diarrhoeal pathogens within the domestic environment [12].

According to UNICEF and WHO, unimproved sanitation facilities are ones that do not ensure hygienic separation of human excreta from human contact and they include pit latrines without a slab or platform, hanging latrines and bucket latrines. Shared sanitation facilities are acceptable types that are shared between two or more households. Thus when reference is made to unimproved sanitation, it encompasses all facilities that are shared or public [7]. Improved sanitation facilities are defined by the JMP as facilities that are likely to ensure hygienic separation of human excreta from human contact. They include flush/pour flush to piped sever system, septic tank or pit latrines. Other improved sanitation were ventilated improved pit (VIP) latrine, pit latrine with slab and composting toilet [7].

Coupled with poor latrine hygiene, over 30% of mothers reportedly did not wash their hands after defecation. This is consistent with similar studies which suggested that less than 5% of Ghanaian mothers washed their hands with water and soap after defecation or handling children's stools [14]. The stools of children were inappropriately disposed of by mothers through throwing into garbage or encouraging open defecation. However studies by J. C. Baltazar, and F. S. Solon, 1989 showed that households where children's stools were inadequately disposed had a 64% increase in diarrhoea [15].

Research evidence has also shown that children who live in unsanitary households have the highest risk of contracting diarrhoea [16, 17]. The unsanitary conditions serve as breeding grounds for flies and other vectors who convey enteropathogens from the environment, food and water [18]. In other studies, the lack of excreta disposal facilities, presence of excreta in the yard, lack of latrines and absence of refuse disposal pits were associated with diarrhoeal morbidity [19, 20, 21, 22]. In a recent study of environmental determinants of diarrhoea among children under-five years, two variables were associated with under-five diarrhoeal morbidity; faeces around the pit-hole and absence of refuse disposal facilities [23]. In contrast, there was no statistically significant association in this study between childhood diarrhoea and factors such as observation of faeces around the pit hole or slab, safe refuse disposal, presence of faeces on the latrine floor, availability of a latrine lid, availability of a latrine door or the use of improved sanitation. That notwithstanding, the presence faecal matter around the pit hole and around the observed latrines in this study indicated a health risk to members of the household.

Households which have latrines and good hygiene practices may reduce diarrhoeal infection by a quarter and this is particularly important for households that have children below five years because they are more susceptible to diarrhoea due to their lower immune systems [9, 4]. Given the fact that there was evidence which suggested poor sanitation in some households coupled with the vulnerability of children under-five years to smaller doses of pathogens than other members of the household, children under-five years were at risk of environmentally related diseases like diarrhoea in the study communities.

5. Study Limitations

Data on hand washing practices were self reported by mothers and could be prone to under reporting. The hygienic state of public latrines were not observed and in addition, data on hygiene aspects such as food hygiene, nipple hygiene, demonstrated hand washing practice and previous diarrhoea history of the mother were not collected in the survey.

6. Conclusions

This study has provided a brief overview of sanitation and hygiene practices in relation to childhood diarrhoea prevalence in households with children under-five years of age. We conclude that though environmental sanitation factors did not have a statistically significant association with childhood diarrhoea, there was evidence of unsafe disposal of children stools, low improved sanitation coverage and poor hygienic state of some latrines which poses a health risk to members of the household, especially children below the age of five years. We recommended that the use of improved sanitation in dwellings be promoted in addition to giving mothers adequate sanitation and hygiene

education. Additionally, it is recommended that, further research should be carried out into the socio-demographic and behavioural determinants of childhood diarrhea in the Atwima Nwabiagya District.

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