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Access to Clean Drinking Water and Diarrhea Occurrence among Children Under Five Years Old in Informal Urban Settlements: A Case Study of Korogocho, in Nairobi County, Kenya

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Abstract:
World Health Organisation (WHO) has quantified the occurrence of childhood Diarrhea as a consequence of poor access to clean drinking water. This is because the water in informal urban centers is highly contaminated due to poor sanitation. The paper' sought to establish the relationship between access to clean and safe drinking water and childhood Diarrhea occurrence in Korogocho slum in Nairobi County. The study variables included treatment and sources of drinking water. Self-reporting and two-week recall was the data collection strategy adopted for Diarrhea outcome and its determinants. The selection of households for 90 respondents (mothers of the target population) used systematic random sampling. Data was collected using well designed open-ended questionnaires, and analysis used descriptive and chi-square statistics. Findings showed that the majority (73.3%) of respondents in Korogocho reported that their primary source of drinking water was from standpipes. Other water sources were water kiosks (23.3%) and small water vendors (3.3%). Concerning the treatment of drinking water to make it safe for drinking, the study found that not all households treated their water (41.1%). This is because they believed that water from standpipes, vendors, and tanks was chlorinated and, therefore, safe for consumption. Based on two weeks recall, 36.4% of mothers reported that their children within the age limit had contracted Diarrhea. Based on the results, the study identified several recommendations and suggested areas for further research. The key recommendations are to institutionalize deliberate interventions to provide slum dwellers with clean and quality drinking water and proper sanitation facilities to ensure the safe and effective disposal of fecal waste.

Keywords*: Diarrhea morbidity and occurrence, Infant mortality rate, environmental risk factors, informal urban settlement, access to water, diarrhea, household*

1. Introduction

Diarrheal diseases are a global burden, and living conditions in and around homes contribute to their influence. Households that lack adequate means of wastage disposal are significant sources of most environmental pollutants. In urban centers, the determinants of ill health are housing conditions, water, and sanitation. Overcrowding of people, such as slums, exerts pressure on infrastructure and social amenities (Maria et al., 2013). Approximately half a billion people globally lack adequate sanitation. The fact contributes to fatalities above five million annually, with children deaths accounting for more than half (United Nations, 2001). In developed nations, more than 50% of their population endure poor sanitation standards and polluted water.

In the world health report, WHO (2014) accounted for a minimum of four environmental health risks. The risks include outdoor pollution, unhygienic conditions, poor sanitation, and drinking water. Timaeus and Lush (1995) identify childhood Diarrhea as a critical risk emanating from environmental and household factors. Smith and Ezzati (2005) also assessed various disease burdens as consequences of either household or community ecological risks.

The former include contaminated water, indoor pollution from solid-fuel, unhygienic living conditions, improper disposal of waste, and mosquito exposure. The latter covers water pollution, industrial waste, and urban outdoor pollution. Furthermore, the indigent population in urban areas endures various health problems, with most having no significant influence on the physical environment (Smith & Ezzati, 2005).

The general aim of this paper seeks to evaluate the relationship between environmental risk factors of levels and access to clean drinking water and the contracting Diarrhea diseases for children below the age of five years in Korogocho slum. This study addressed the research question of the relationship between the source and treatment of drinking water and the occurrence of childhood Diarrhea in the Korogocho slum. The following hypothesis was the formation of evaluating critical relationships: The null Thesis is that there is no significant relationship that exists to correlate access to clean drinking water and the occurrence of Diarrhea for children sample in Korogocho slum (Muriithi DI, 2014).

WHO (2013) quantified risk factors out of data from prevalence, causation, and exposure of Diarrhea diseases into two. The study also associates almost 16% of Diarrhea globally as consequences of poor sanitation and contaminated water. Categorization of Diarrhea's environmental causes may follow many channels, such as by referring to medium which may transport hazards, as individual risk factors (agents), or according to the nature of the danger. Lopez and Murray (1998) characterize medium that carries hazards to include: water used for drinking, which gets contaminated by hazards that cause Diarrhea contaminated by either household waste or improper disposal of fecal matter.

Gupta et al. (2007) report poor environmental and living conditions for Chandigarh's suburban houses. The urban indigent population in slums with access to a sewer system account for 33.4%, a stark difference of the 98% record for the urban population. The urban centers also had a significant population that was very conscious of health status, with 94% of such households treating water through boiling or filtration before consumption. However, it was not the same for rural and slum households since only 10.8% and 2% used these techniques, respectively. Cairncross and Valdmanis's (2006) findings highlighted several countries in sub-Saharan Africa with high mortality rates from Diarrhea in urban areas compared to rural areas. WHO (2012) identifies Diarrhea for children below five years as a significant cause of illness for the children cluster. The most affected include children and infants in low-income settings.

In Kenya, Diarrhea accounts for the third-highest fatalities rate for children below five years, following malaria and tuberculosis (Ziraba et al., 2012). The pathogens lead to deaths of almost 100 children daily (UNICEF 2013). The mortality rate from Diarrhea for the slums is worse because of poor sanitation and hygiene. The country also identifies Diarrhea diseases as a leading cause of infrequent childhood morbidity and mortality (K'oyugi, 2004); 31% of the child mortality rate is a consequence of Diarrhea (WHO, 2012). The Ministry of Public Health and Sanitation (MOPHS, 2010) acknowledged that 16 million (48%) Kenyans find safe drinking water inaccessible.

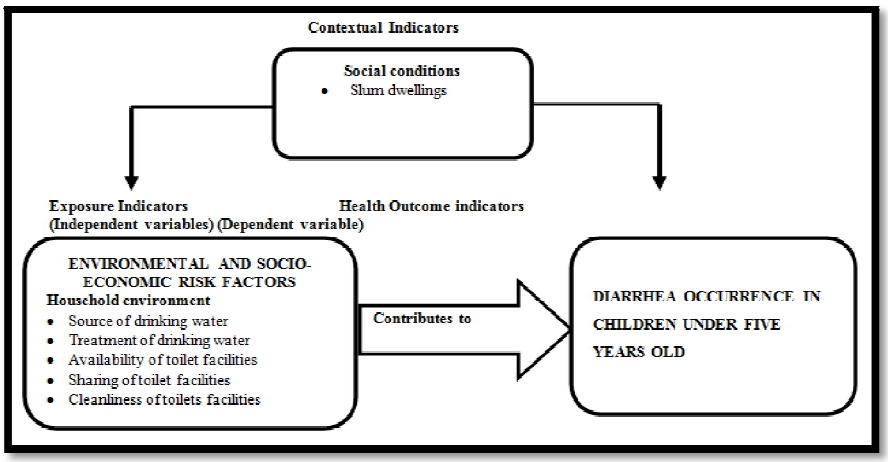


Figure 1: A Theoretical Model Showing the Conceptual Framework of the Study
Conceptual Framework (Adopted from Briggs, D. 2008)

2. Materials and Methods

The structure of the research questions sought out the provision of an informed evaluation of risk factors that lead to Diarrhea in children in Korogocho Slum in Nairobi, Kenya. The study provides essential data to all the sectors involved in health, national development, and policy setting and implementation. The research dwelt specifically on households that live in this slum area and have been affected directly by childhood Diarrhea.

2.1. Korogocho Slum

Korogocho is located 11 Kilometres on the North-Eastern side of Nairobi city center with a population of 41,946 people and a total of 12,909 households pressed in a 0.9square kilometers area (Census Report 2009). Korogocho comprises three sub-locations, namely; Nyayo, Korogocho, and Gitathuro. Each sub-location consists of villages, with those in Korogocho totaling to nine. Estimations from 2009 highlight Korogocho as the fourth largest slum in the city, following Kibera, Mathare, and Mukuru kwa Njenga. The area of study houses residents from more than thirty ethnic groups, but the most prevalent include the Luhya, Luo, Kikuyu, and Somali ethnic groups. The majority of residents fit the category of low-income earners, exposed to poor living conditions and an environment characterized by inadequate and ineffective waste disposal and contaminated water supply, which are likely to increase the incidence of Diarrhea among children below five years.

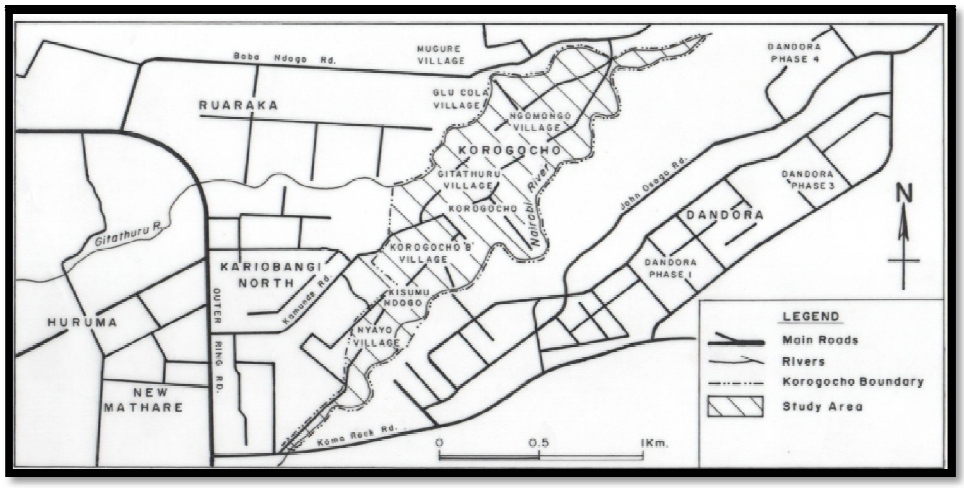


Figure 2: Map of Korogocho Showing the Study Area
Source: Author 2020

2.2. Methodology

Korogocho slum was purposively sampled and selected from other slums like Kibera, Mathare, and Mukuru kwa Njenga within Nairobi County because the researcher had prior knowledge about the administrative and location of the tenement better than other slums within Nairobi. Korogocho being an enumeration area located in Ruaraka Constituency, comprises three sub-locations, namely; Nyayo, Korogocho, and Gitathuro. Each sub-location has been further subdivided into villages totaling nine in the entire area. These villages are; Kisumu Ndogo, Korogocho, Korogocho B, Highridge, Gitathuro, Grogan A, Grogan B, and Ngomongo. Based on this distribution, three out of nine villages were selected based on social and cultural attributes like ethnicity and mode of living (Kisumu Ndogo, Korogocho B, and Gitathuro). The population of interest in this study was women with children aged five years or less in a household selected through systematic random sampling.

The research used Fisher et al. (1998) formulae of calculating the desired sample size of 90 respondents, as shown below, based on the established 31% Diarrhea prevalence among the children below five in Korogocho (APHRC, 2002).

$n = z^2pq/d^2$ Where:-

n= the desired population sample size (when the population is greater than 10,000)

z= the normal standard deviation (1.96) that corresponds to 95% confidence levels

p= the Proportion of target population estimated to portray a particular characteristic (31% of the population is children aged less than 5yrs with Diarrhea infection. APHRC, 2002) thus

p= 0.31, q=1.0-p=0.69,

d= degrees of accuracy desired (0.05)

Sub Location	Total Pop (Census2009)	No of Household	No/Names of Villages	Village Selected	Selected No. of Households (n)	% of the Total Sample Size
Nyayo	9,638	3,300	Kisumu ndogo Nyayo Highridge	Kisumu Ndogo	23	25.6%
Korogocho	10,370	3,129	KorogochoB Ngomongo Grogan A	Korogocho B	22	24.2%
Gitathuro	21,735	6,480	Gitathuro Korogocho Grogan B	Gitathuro	45	50.2%
Total	41,743	12,909			90	100%

Table 1: Population and Sample Size Distribution Table
Source: Author's computations 2020

3. Results

Based on two weeks recall, 35.6% of the child mothers reported that their children had suffered Diarrhea-related illness two weeks before the study against 64.4% who claimed non-occurrence. The response rate was 100%

Total sample size	90	100%
The sample size that reported Diarrhea	32	35.6%
The sample size that did not report Diarrhea	58	64.4%

Table 2: Diarrhea Occurrence Two Weeks before The Survey

3.1. Sources of Drinking Water in Korogocho

The majority (73.3%) of respondents in Korogocho reported that their primary source of drinking water was from standpipes. Other sources of water were water kiosks (23.3%) and small water vendors (3.3%).

Source of Drinking Water	**Total Count**	**% Count**	**Diarrhea Occurrence In Children Less Than Five Years- 2 Weeks Before the Survey**	
			Yes	No
Standpipes	66	73.3	27	39
Water Kiosks	21	23.3	5	16
Vendors	3	3.3	0	3
Totals	90	100	32	58

Table 3: Sources of Water in Korogocho

Source of Drinking Water and Diarrhea Occurrence in Children Younger Than Five Years in a House Hold- 2 Weeks Before the Survey -Cross Tabulation for Chi-square Analysis				
Source of drinking water		Diarrhea occurrence in **children younger than five years** in a house hold-2 weeks before the survey		Total
		Yes	No	
Standpipes	Observed Count	27	39	66
	Expected Count	23.5	42.5	66.0
Water Kiosks and Vendors	Observed Count	5	19	24
	Expected Count	8.6	15.4	24.0
Total	Observed Count	32	58	90
	Expected Count	32.0	58.0	90.0

Table 4: Contingency Table for the Source of Drinking Water and the Occurrence of Childhood Diarrhea

χ^2 =3.745 d=2 p=0.05 Critical value = (5.99)

Source: Author 2020

The Chi-square test for this variable (χ^2 =3.745) did not show a significant relationship between the source of drinking water and diarrhea occurrence among children below five years. This could be interpreted that water could have been polluted mainly at the point of drawing, during transportation or storage. This test was not statistically significant at (p> 0.05), implying that this relationship of the association was likely to have happened by chance.The null hypothesis was that there was no significant relationship between the source of drinking water and the Diarrhea's occurrence, which failed to be rejected.

3.2. Treatment of Drinking Water

Concerning the treatment of drinking water to make it safe for drinking, the study found that not all households treated their water. However, most of the residents were aware there was a high probability of contamination of water from taps and other sources with germs. Most of the residents who never treated water (41.1%) believed that water from standpipes, vendors, and tanks were chlorinated and, therefore, safe for consumption.

Treatment of Drinking Water	**Total Count**	**Percentage Count**	**Diarrhea Occurrence in Children Younger Than Five Years- 2 Weeks Before the Survey**	
			Yes	No
Yes	53	58.9	11	42
No	37	41.1	21	16
Totals	90	90	32	58

Table 5: Treatment of Drinking Water

Treatment of Drinking Water and Diarrhea Occurrence in Children Below Five Years in a Household. Cross Tabulation for the Chi-square Test				
Treatment of drinking water		Diarrhea occurrence in **children younger than five years** in a house hold-2 weeks before the survey		Total
		Yes	No	
Yes	Observed Count	11	42	53
	Expected Count	18.8	34.2	53.0
No	Observed Count	21	16	37
	Expected Count	13.2	23.8	37.0
Total	Observed Count	32	58	90
	Expected Count	32.0	58.0	90.0

Table 6: Contingency Table for Treatment of Drinking Water and Occurrence of Childhood Diarrhea

$\chi^2 = 12.325$ *d=1* *p=0.05* *Critical value = (3.84)*

The Chi-square analysis for this variable $\{\chi^2 = 12.325\}$ revealed a significant relationship between the treatment of drinking water and diarrhea occurrence in children below five years. This means that the households that treated water were less likely to experience diarrhea incidences than those who did not treat water. The null hypothesis that there was no significant relationship between the treatment of drinking water and the occurrence of diarrhea disease in children below five years was rejected. This statistical test was significant at $p<0.05$, meaning that the association achieved was not likely to be contributed by the chance of random sampling.



Figure 3: A Photograph Showing Raw Fecal Matter Being Dumped across a River Within the Study Area

4. Discussion

Children bear the highest health burden associated with poor water and sanitation (WHO/UNICEF, 2013). Moreover, a study carried out in Tumpat District, Malaysia, by (Sabina M.K 1992) also identified the risk factors for Diarrhea of children under five years as drinking unboiled water, storage of cooked food before consumption, bottle feeding and absence of washing water in latrines. This is because of running surface water, which becomes contaminated by poorly disposed of human waste. This water collects into collection points and is sometimes consumed without treating it. In this study, community environmental risk factors were taken to mean those factors that are borne by individual households by virtue of belonging to that particular community, whereas the household factors were specific to individual households while community factors were shared by all who live within the research area. These were identified as urban outdoor pollution and others.

The study sought to establish which of these risk factors caused a direct relationship with Diarrhea among children below five years of age. This aspect of data captured the essence of the current study. The study found that the source of drinking water, access to, and sharing of toilet facilities were not related to the occurrence of Diarrhea in children less than five years in Korogocho. This meant that water might have been contaminated during drawing as a result of the use of dirty containers and mishandling of water already fetched. Poor sanitation and hygiene constituted the most significant household environmental risk factors that cause Diarrhea among children below five years.

Access to safe drinking water was a critical variable in this study; childhood diarrhea occurrence was not related to the source of drinking water. There was no significant relationship found between the two variables ($p>0.05$). This could have been because different water providers in Korogocho slum could interfere with water either at the point of drawing or during transportation hence contaminating it. Poor storage at homes could have also contributed to this relationship. This means that sources and storage of water did not guarantee water safety. The spot checks also indicated that some pipes that transported water were broken, thus contaminating water with either raw sewage or household waste. However, the reliance on water from vendors and water kiosks in Korogocho was due to a shortfall of appropriate water sources. In agreement with the previous study (Roots, G 2001), Diarrhea was independent of the origin of water

supplied to homes, which meant that water sources did not guarantee water safety. In this case, the null hypothesis that there was no significant relationship between the source of drinking water and the occurrence of Diarrhea among children below five years was failed to be rejected.

Treatment of drinking water is one way of purifying drinking water by killing germs that might contribute to diarrhea infections in children. In this study, it was found to be an effective way of reducing incidences of Diarrhea among children below five years. A significant direct association was noted between the treatment of drinking water in a household and Diarrhea in children below five years (p<0.05). The conventional method of water treatment in the study area was boiling drinking water, though some households were noted to have used "water guards." In this case, the null hypothesis that there was no significant relationship between the treatment of drinking water and the occurrence of Diarrhea was rejected. This meant that households that treated water for drinking were less likely to encounter Diarrhea in children less than five years compared to the houses that did not treat water for drinking.

5. Conclusion

One of the many conclusions is that Diarrhea infections in children below five years have a significant impact on these children's families. The incidence of Diarrhea causes an increase in poverty as a result of the increased cost of medication. In Korogocho, the indicators for water and sanitation conditions in the home and community environment depicted shortage and exposed children to pathogens and pollutant risks. The lack of convenient and affordable access to water has left residents to buy water from the vendors or walk long distances to public supply sources.

The findings in this study lead to an overall conclusion that poor sanitation and inadequate water increase the prevalence of childhood Diarrhea morbidity in Korogocho slum. The outcome also accompanies by inappropriate hygiene behaviors, overcrowding, and poverty, which predispose children to more risk of Diarrhea illness. However, the interactions between multiple risk factors and Diarrhea morbidity are complex within the home and environment context, beyond access to water and sanitation.

The conclusions above lead to the following recommendations:

- There is a need to institute deliberate interventions by Nairobi County Government to provide slum dwellers with clean water and sanitation facilities, and also ensure safe disposal of solid waste and fecal matter.
- The provision of clean and quality drinking water should be a pre-requisite to the lives of people living in a poor urban environment by County and central Governments.

6. Competing Interests

Authors have declared that no competing interests exist.

7. Acknowledgments

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8. Authors' Contributions

This work was carried out by author[1] under the guidance and supervision of authors[2]. Author[1] conducted the study, executed the statistical analysis, and composed the draft of the manuscript.

9. Abbreviations

CBS: Central Bureau of Statistics; CDD: Control of Diarrhoea Disease; CDR: Crude Death Rate; DHS: Demographic and Health Surveys; ICPD: International Conference on Population and Development; IMCI: Integrated Management of Childhood Illnesses; IMR: Infant Mortality Rate; IRC: International Research Centre; KPHC: Kenya Population and Housing Census; KNBS: Kenya National Bureau of Statistics; MDG: Millennium Development Goals; MEME: Multiple Exposure-Multiple Effect Model; MOPHS: Ministry of Public Health & Sanitation; ORS: Oral Rehydration Salts; ORT: Oral Rehydration Therapy; UNDP: United Nations Development Programme; UNEP: United Nations Environmental Program; UNFPA: United Nations Population Fund; UNICEF: United Nation Children Funds; WHO: World Health Organization

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11. Availability of Data and Materials

The data used in this article is part of the primary data extracted from the author's Thesis submitted to the University of Nairobi for partial fulfillment of the requirement of the Degree of Master of Arts in Environmental Planning and Management in the Department of Geography and Environmental Studies.

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