



# Factors Associated with the Recurrence of Waterborne Diseases in Children under Five in the Kemi Health Area, Lemba Health Zone, Kinshasa City

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## Abstract

**Introduction:** Despite all the measures taken over the years, diarrhoeal diseases occur almost cyclically in certain parts of the country, including the provincial city of Kinshasa and especially the Lemba area. Because of its repeated exposure to the resurgence of diseases linked to poor hygiene practices such as diarrhoeal diseases, this area is a regular surveillance zone. The eradication of these diseases has so far been a major challenge because all the measures that have been taken have only served to mitigate them. The objective of this study was to identify the factors associated with the resurgence of diarrhoeal diseases in the Lemba Health Zone and more particularly in the Kemi Health Area. **Method:** The study was carried out in the Kemi Health Area, in the Lemba Health Zone, located in the south of the provincial city of Kinshasa in the Democratic Republic of the Congo, with heads of households whose sample size was 150, selected on the basis of the inclusion criteria. The survey method and the interview guided by semi-open questions were used to collect data from these heads of households. **Results:** After analysis, two factors were found to be associated with the increase in waterborne diseases in the Lemba health zone and more particularly in the Kemi health area: the level of education of the population ( $p = 0.004$ ) and the type of water usually

given to children under 5 years of age by their parents ( $p = 0.002$ ). **Conclusion:** Thus, the most educated parents protect their children under 5 years of age against waterborne diseases better than the others, and children fed with untreated water or tap water contract more waterborne diseases than those whose parents give them bottled or canned water for example. Hence, a hygiene intervention programme should be designed to promote healthy behaviour to reduce the burden of diarrhoeal diseases among children.

## Subject Areas

Public Health

## Keywords

Associated Factors, Recurrence, Waterborne Diseases, Children under 5, Health Area

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## 1. Introduction

Diarrhoeal disease is a common condition in children under five years of age, especially in the first few months of life. It is usually found in the winter period, during epidemics of acute gastroenteritis [1]. It is a sometimes serious and urgent condition in children. Every year, 2 billion cases of diarrhoea are recorded in children under 5 years of age worldwide, half of them in Africa and South Asia. According to the WHO, the probability of developing diarrhoea is 39.1% for an African in the sub-Saharan region, compared to 7.2% in developed countries. In developing countries, statistics show that it is a major cause of death between the date of weaning and the age of five [2].

It is mostly benign but still kills in developing countries. Diarrhoea, which is easily prevented and treated, kills 1.5 million children each year. Although child mortality has declined overall over the past two decades, today this symptom of acute gastroenteritis is the second leading cause of death in children aged five weeks to five years, second only to pneumonia. Diarrhoea alone kills more than AIDS, malaria and measles combined [3].

Among these aetiologies, viruses occupy an important place (24.24%), particularly Rotaviruses (22.73%) and to a lesser extent Adenoviruses (1.52%). Intestinal parasites account for 18.18% of infectious aetiologies, with a greater frequency of protozoa (12.12%) than Helminths (6.06%). These intestinal parasites have been isolated mainly from children over 12 months of age [4]. Indeed, in industrialised countries, viral origin is the most frequently observed aetiology [1].

In Europe, acute diarrhoea is usually mild and progresses favourably within a few days. The main complications are dehydration and undernutrition. Deaths are infrequent in industrialised countries but are the second most common cause of death in children under five worldwide [1]. In low-income countries

like Haiti, children under three years of age experience an average of three episodes of diarrhoea per year. Each episode deprives the child of the nutrition needed for growth. As a result, diarrhoea is one of the main causes of malnutrition. Malnourished children are also the most likely to become ill from diarrhoea. Diarrhoeal infections in children have important implications for the rest of their lives, such as stunting, which affects 22% of children under five in Haiti. They also increase the risk of mortality from other infectious diseases such as malaria, measles and pneumonia [5].

The lack of access to safely managed basic water supply and sanitation services for 76% and 78% of the population of sub-Saharan Africa respectively contributes to the annual deaths from infectious diarrhoeal diseases of 180,000 children under 5 years of age [6] [7] [8].

Diarrhoeal diseases are responsible for one in nine child deaths worldwide. With an estimated 2195 children killed per day. This is higher mortality than AIDS, malaria and measles combined. According to a study by the WHO/UNICEF Child Health Epidemiology Reference Group [9], diarrhoea is the second leading cause of death in children under five. In Haiti, lack of sanitation and limited access to safe water are the main causes of diarrhoea in children under five [10].

However, the number of hospitalisations remains high, which results in high costs of care. This hospitalisation should only be reserved for patients who need hospital care (e.g. intravenous rehydration, high-risk patients) [11].

In Mali, diarrhoea is the 3rd most common reason for consultation of children under 5 years of age [8], and its prevalence remains high; indeed, 9% of children under 5 years of age had had a diarrhoeal episode in the 2 weeks preceding the EDMS-V survey. This prevalence is particularly high among infants aged 6 - 11 months (12.8%) and 12 - 23 months (13%) [2]. These high-prevalence ages are also the ages when children begin to receive foods other than breast milk and begin to explore their environment, making them more susceptible to pathogen contamination. Among the poor, especially in developing countries, diarrhoea is one of the major killers. Several factors contribute to the frequency and severity of diarrhoea in the tropics: lack of access to safe drinking water; hygiene deficits; high prevalence of pathogens in the environment; co-infection with measles, HIV/AIDS infection; and interaction with protein-energy malnutrition and avitaminosis [12]. However, therapeutic management, particularly oral rehydration therapy (ORT), which has become the reference since the 1970s, has led to a marked reduction in mortality in developing countries [13].

In DRC, the 2014 Demographic and Health Survey reported that under-five mortality was 104 deaths per 1000 live births and diarrhoea prevalence was 17% [14].

Socio-demographic, household and environmental characteristics play an important role in determining the risk and recovery from diarrhoeal episodes. Many risk factors for diarrhoeal disease are associated with favourable so-

cio-economic conditions [15]. Behavioural (indirect) factors play a major role in the epidemiology of diarrhoeal disease and various studies in Asia have confirmed a link between poor hygiene, including hand washing before food preparation, open defecation, the method used by mothers to clean children after defecation, and the disposal of children's faeces and hygiene, and increased risk of diarrhoea [16]. Studies have shown that handwashing alone resulted in a 33% - 47% reduction in the incidence of diarrhoea, and that hygienic disposal of children's faeces reduced the risk of diarrhoea in children by 30% - 40%. Other studies have found that maternal care and hygiene practices have a significant impact on the occurrence of diarrhoea in children [17] [18]. Improved feeding practices, including breastfeeding, have a positive influence on diarrhoeal disease in children under five. An Ethiopian study found an association between bottle-feeding and the risk of diarrhoea, linked to bottle contamination [19].

Despite all these measures taken over the years, diarrhoeal diseases occur almost cyclically in certain parts of the country, including the provincial city of Kinshasa and especially the Lemba area. Because of its repeated exposure to the resurgence of diseases linked to poor hygiene practices such as diarrhoeal diseases, this area is a regular surveillance zone. The eradication of these diseases has so far been a major challenge because all the measures that have been taken have only served to mitigate them.

Thus, determining the factors affecting the resurgence of these diarrhoeal diseases would be useful in planning and implementing prevention strategies at the community level. In the DRC, studies focusing on the factors explaining the resurgence of diarrhoeal diseases are rare. Thus, the objective of this study is to identify the factors associated with the resurgence of diarrhoeal diseases in the Lemba Health Zone and more particularly in the Kemi Health Area.

## **2. Material and Method**

### **2.1. Study Setting, Target Population and Sample Size**

Our study was carried out in the Kemi Health Area, in the Lemba Health Zone, located in the south of the provincial city of Kinshasa in the Democratic Republic of the Congo.

Our target population consists of all heads of households residing in the Kemi Health Area. The sample size is 150 heads of households selected on the basis of the inclusion criteria.

### **2.2. Data Collection**

The survey method and guided interview with closed and open-ended questions were used to collect data from these household heads.

Before starting the interview, the importance of the study was explained to the respondents in advance in order to obtain their free and informed consent, and to guarantee the anonymity and confidentiality of their responses.

## 2.3. Data Processing and Analysis

The raw data from the survey was entered into a file on Statistical package for the Social Sciences (SPSS 20.0) for analysis. The analysis consisted of

- Description of the socio-demographic and economic characteristics of the respondents;
- Determining the population with access to drinking water;
- Research into the relationship between socio-demographic and economic characteristics and access to drinking water;
- The comparison between the groups was done using a chi-square test. The level of significance was fixed at  $p < 0.05$ .

## 3. Results

### 3.1. Univariate Analysis Results

In **Table 1**, the results of this table show that 25.3% of respondents are at least 47 years old, followed by 18.7% who are in the 29 - 34 and 41 - 46 age groups. The vast majority, 87.3% of respondents, are women.

**Table 1.** Sociodemographic, cultural and economic characteristics.

Age range (years)	n = 150	%
≤22	25	16.7
23 - 28	25	16.7
29 - 34	28	18.7
35 - 40	6	4.0
41 - 46	28	18.7
47 or more	38	25.3
<b>Sex</b>		
Male	19	12.7
Feminine	131	87.3
<b>Educational level</b>		
uneducated _	84	56.0
Primary	18	12.0
Secondary	29	19.3
Higher and university	19	12.7
<b>Marital status</b>		
Single	87	58.0
Married	34	22.7
free Union	20	13.3
Divorce	9	6.0
<b>Professional occupation</b>		
without occupation/household	95	63.3
Official	6	4.0
Resourceful	33	22.0
Student	16	10.7

The results in **Table 2** show that 56% or 56% of the respondents had no education. 87% or 58% of respondents were single; and 63.3% of respondents were unemployed. The results of this table show that 60% of respondents have taps in their plots and among those who have a tap, 81.1% have taps in good condition. More than half, 53.3% of respondents, think that the water they give to their children under five is of good quality, compared to 46.7% who think the opposite.

In **Table 3**, we note that the vast majority, *i.e.* 80% of respondents, are fully aware of waterborne diseases; 57.3% of respondents mentioned insalubrity as the main factor favouring the emergence of waterborne diseases in this part of the Congolese capital; 86.7% admitted to having experienced at least one case of waterborne disease in their children under five years of age; 50.8% of respondents who had experienced the problem of waterborne disease spoke mainly of malaria, followed by 29.2% for whom their children had developed it during the month preceding our survey.

**Table 2.** Use of a water tap in the plot and quality of water consumed by the child aged 0 - 5 years.

<b>Presence of tap</b>	<b>n/150</b>	<b>%</b>
Yes	90	60.0
Nope	60	40.0
<b>Faucet status</b>	<b>n/90</b>	
Good	73	81.1
Bad	17	18.9
<b>Water quality</b>	<b>n/150</b>	
Good quality	80	53.3
Bad quality	70	46.7

**Table 3.** Knowledge of respondents about waterborne diseases.

<b>Knowledge of waterborne diseases</b>	<b>n = 150</b>	<b>%</b>
Yes	120	80.0
Nope	30	20.0
<b>Factors favoring waterborne diseases</b>		
Unsanitary	86	57.3
Bad water quality	45	30.0
Poor food hygiene	2	1.3
Others	3	2.0
I do not know	14	9.3
<b>Have had a case of waterborne illness in the child</b>		
Yes	130	86.7
Nope	20	13.3
<b>Type of illness suffered by the child</b>	<b>n/130</b>	
Malaria	66	50.8
Typhoid fever	38	29.2
Amebiasis	26	20.0

The results of **Table 4** show that almost all (99.3%) of the respondents admit that their living environment is unhealthy; the vast majority (81.3%) have septic tanks; and 99.3% of the respondents do not take any hygienic measures before breastfeeding their children, after using the toilet or any other activity that puts their hands at risk.

### 3.2. Results of Bivariate Analyzes

In this section, our results will be interpreted in relation to the p-value of 5% (0.05) with the confidence interval of 95%. Thus, if the p-value is less than 0.05, the difference is significant (S\*), but if the p-value is less than 0.01, the difference is highly significant (S\*\*), and if the p-value is greater than 0.05, the difference is not significant (DNS).

**Table 5** shows that among the socio-demographic, cultural and economic characteristics of our respondents who experienced the resurgence of waterborne diseases in children under 5 years of age, there is a highly significant relationship (S\*\*) between the level of education of our respondents and the resurgence of waterborne diseases in children under 5 years of age ( $p = 0.004$ ). In other words, the most educated parents protect their children under 5 years of age better against waterborne diseases than the others.

When analysing **Table 6**, a highly significant relationship (S\*\*) is observed between the type of water usually given to children under 5 years of age by our respondents and the increase in water-borne diseases in the latter ( $p = 0.002$ ). That is, children fed with untreated water or tap water contract more waterborne diseases than those whose parents give them bottled or canned water for example.

## 4. Discussion

With regard to our results, the data on age shows that the age group most observed is 47 years and over, *i.e.* 25.3%, followed by 29 to 39 and 41 to 46 years, *i.e.* 18.7%. However, in a similar study conducted in Mali, the 20 - 29 age group was in the majority with 42.0% followed by the under-20 age group with 25.5%

**Table 4.** Conditions of the environment, toilets and hand hygiene practice.

Environment Condition	n = 150	%
Wholesome	01	0.7
Unsanitary	149	99.3
<b>type of toilet used</b>		
Septic tank	122	81.3
sewer hole	28	18.7
<b>Hand hygiene practice</b>		
Wash yourself	01	0.7
Nothing	149	99.3

**Table 5.** Relationship between the socio- demographic, cultural and economic characteristics of our respondents and the resurgence of water in their children under 5 years old.

Features	Resurgence of waterborne diseases among children		df	$\chi^2$	p	S
	Yes n/130	Nope n/20				
<b>Age (age group)</b>						
≤22	18	7	5	7852	0.161	DNS
23 - 28	20	5				
29 - 34	26	2				
35 - 40	5	1				
41 - 46	26	2				
47 - at most	35	3				
<b>Sex</b>						
Male	17	02	1	0.157	0.692	DNS
Feminine	113	18				
<b>Educational level</b>						
Uneducated	77	7	3	8634	0.004	S**
Primary	17	1				
Secondary	23	6				
Sup/university	13	6				
<b>Professional occupation</b>						
Without occupancy / menagerie	79	16	3	2001	0.132	DNS
Official	6	0				
Resourceful	30	3				
Student	15	1				

**Table 6.** Relationship between use of a water tap in the plot, the quality of water consumed by children aged 0 - 5 years and the increase in water levels among their children under 5 years of age.

Features	Resurgence of waterborne diseases among children		df	$\chi^2$	p	S
	Yes n/130	Nope n/20				
<b>Presence of taps in the plot</b>						
Yes	74	16	1	0.157	0.692	DNS
Nope	56	4				
<b>Type of water usually given to children under 5 years old</b>						
Bottled/canned water	28	11	2	8913	0.002	S**
Locally treated water	10	1				
Tap water	92	8				



[2]. In our study, the study population is of considerable age of maturity. For this reason, Tshimungu believes that age is a factor of maturity and understanding of the facts. But also too much age can influence the practice of attitude honour. This is not the case in this study [20].

As for the gender of the respondents, there were 87.3% women. This can be explained by the fact that households are much more occupied by women than men. Despite this important role they play in the household, they are also the major source of disease transmission in their households. A study conducted on the impact of household waste management on health showed that 82% of women were the object of disease transmission to their children [21].

Concerning the level of education of the respondents, our study shows that the majority of our respondents were uneducated, *i.e.* 56%, followed by 19.3% of those who had a secondary level of education. This shows that our respondents are less educated. Studies explain that subjects with a high level of education have easy comprehension compared to those with a low or lower level of education [22].

The majority of our respondents are single (58%) and 63.3% are not employed. Working subjects can better cope with unsanitary diseases because of their financial means compared to those who do not work. This is not the case in our study. These subjects are exposed to waterborne diseases [22].

The presence of taps in the plot was noted in 60% of the subjects surveyed, 81.1% of whom were in good condition. 40% of the respondents did not have taps in their plots, yet water use can guarantee a level of prevention of waterborne diseases, so those with taps in good condition may have a small chance of avoiding all these diseases. This study showed that the quality of water given to children under 5 years old is not good, as 60.7% of respondents give only untreated tap water to their children against 26% of those who give bottled or canned water synonymous with drinking water, while drinking water must be very well treated to prevent waterborne diseases. Certainly because of the poor quality of water and the bad environmental conditions, this has exposed the children to diseases which they themselves report, 50.8% spoke of malaria, 29.2% for their children developed typhoid fever during the previous month, although 80% of the subjects surveyed know perfectly well the waterborne diseases, this also corroborates with their low level of education. In addition, they believe that these diseases are due to the poor quality of the water consumed due to the lack of hygiene and sanitation services in this area of the health zone.

The respondents (99.3%) are aware that their living environment is unhealthy; the vast majority (81.3%) use septic tanks. However, the proliferation of household waste, wastewater due to the lack of sanitation infrastructure and risky behaviour are factors that trigger diarrhoeal diseases [23].

In general, African cities are subject to strong demographic growth and suffer from a deterioration of sanitary conditions. Indeed, rapid urbanisation leads to deficiencies in the areas of access to drinking water, sanitation and household waste management, resulting in the spread of numerous infections, particularly

diarrhoeal diseases, which are particularly dangerous for young children who are more vulnerable to environmental pollution, as confirmed by several epidemiological studies. The excessive concentration of populations and activities without adequate facilities means that the urban environment is a condensation of complex health problems [24].

The assessment of hand hygiene practice shows that 99.3% of respondents do nothing as a hygiene measure before breastfeeding their children, after using the toilet or any other activity that puts hands at risk. While good hygiene practices by mothers with children under 5 years of age can spare them from multiple diseases originating from the unsanitary and unclean environment of the latter. A study conducted in Mali supports this by showing that poor handwashing by mothers before feeding their children was found to be responsible for 50.0% of diarrhoea with a significant statistical test. The Malian Demographic Health Survey (EDSM-V) shows that good handwashing was practiced in only 26% of the households visited [25]. Poor handwashing of children after defecation was associated with diarrhoea in 42.0% of cases, also with statistical significance. Of the mothers interviewed, 44% admitted to not washing the drinking water storage container, most of them stating that the soap made the water smell and taste bad. Thus, thanks to the statistical test, the inappropriate container was retained as a factor favouring diarrhoea. With regard to mothers' knowledge of diarrhoea, our study found that knowledge of the means of transmission and preventive measures was a factor in the occurrence of diarrhoea in children [2].

In the bivariate analyses, the socio-demographic, cultural and economic characteristics of our respondents who experienced the resurgence of waterborne diseases in children under 5 years of age, there was a highly significant relationship ( $S^{**}$ ) between the level of education of our respondents and the resurgence of waterborne diseases in children under 5 years of age ( $p = 0.004$ ). That is, the most educated parents protect their children under 5 years of age better against waterborne diseases than the others. A similar study supports the finding that the incidence of diarrhoea decreases as the level of education of mothers increases [26]. But this is contradicted by a study from Mali, which argues that there is no scientifically valid relationship between the level of education of mothers and the occurrence of diarrhoea, which can be explained by the standard of living and the effect of the media among the study population [2].

Our results also reveal a highly significant relationship ( $S^{**}$ ) between the type of water usually given to children under 5 years of age by our respondents and the recrudescence of waterborne diseases in the latter ( $p = 0.002$ ). This means that children fed with untreated water or tap water contract more waterborne diseases than those whose parents give them bottled or canned water for example. Poor quality drinking water is a factor in the growth of infectious diarrhoeal diseases. The objective of this study is to determine the microbiological quality of well water in Agboville and the associated risk of infectious diarrhoea. Microbiological analyses were carried out in the dry and rainy seasons on water from

50 wells according to French standards (AFNOR) for the determination of water quality. Quantitative Microbial Risk Analysis (QMRA) was used to quantify the risk of infectious diarrhoea due to pathogenic *Escherichia coli*. In both seasons, the well water has a poor microbiological quality according to the WHO guide values for total and faecal coliforms, *Escherichia coli* and faecal streptococci [27] [28].

Some studies also show the influence of socio-cultural factors (the ethnicity of the mother), socio-economic (the mother's activity), environmental (the health region and the place of residence), behavioral (introduction of other solid or semi-solid foods) and demographic (the mother's age, the age and the sex of the child) on the studied phenomenon [29] [30]. In this, our study has some limitations in the sense that it has not touched the research of cultural and economic factors in order to understand the phenomenon in depth.

## 5. Conclusions

In the Lemba health zone and more particularly in the Kemi health area, the recrudescence of waterborne diseases is associated with the level of education of the population ( $p = 0.004$ ) and the type of water usually given to children under 5 years of age by their parents ( $p = 0.002$ ).

Thus, the most educated parents protect their children under 5 years of age against waterborne diseases better than the others, and children fed with untreated water or tap water contract more waterborne diseases than those whose parents give them bottled or canned water, for example. Hence, a hygiene intervention programme should be designed to promote healthy behaviour to reduce the burden of diarrhoeal diseases among children.

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## Conflicts of Interest

The authors declare no conflicts of interest.

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