« THE UNDERSTANDING OF DIARRHOEAL DISEASES BY THE POPULATION : EVOLUTIONARY TRENDS OF EPIDEMIOLOGICAL INDICATORS OF DIARRHOEAL DISEASES IN THE HEALTH ZONE OF KINDU »

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Abstract: -

Diarrheal diseases are a major public health problem for the Democratic Republic of Congo in general. Despite consistently high morbidity and mortality, endemic diarrheal disease remains under-documented. WHO estimates that there are 1.4 to 4.3 million cases of diarrhoeal diseases each year, with 28,000 to 142,000 deaths worldwide. The Kindu health zone is experiencing the repetitive appearance of cases of diarrheal diseases in epidemic mode, which motivated this research to determine the population's perception of diarrheal diseases in the Kindu health zone: path health problems.

A case-control study with 134 cases and 134 age- and sex-matched controls was conducted after the outbreak of recurrent diarrheal diseases from 2020 to 2021 experienced in this health zone. Cases were selected by systematic sampling from linear lists in the Kindu health zone, and controls were selected in the community in a simple random manner from plots adjacent to the cases. Odds ratio (OR) calculation with its confidence interval and logistic regression were used to identify risk factors for Diarrhoeal Disease.

A focus on providing clean water, toilet sanitation and behavior change communication in a comprehensive program would help prevent diarrheal diseases in the Kindu health zone.

Keywords: *understanding - population- diarrhoea- evolutionary- trends - epidemiological*

INTRODUCTION

In Maniema, diarrheal diseases are among the leading causes of consultation, 56.8% of children aged 0-59 months, and only 12.8% of women have a level of knowledge about diarrhea and oral rehydration therapy [1]. This reflects a lack of knowledge or poor application of hygiene, particularly regarding the use of water, which is polluted by human and animal waste and other forms of pollution. Water quality, including that of the reservoirs, is generally poor in Maniema.

However, populations have other references to explain diseases. Even if a certain crossbreeding appears in their interpretations because of the juxtaposition of modern medicine with traditional medicine, the fact remains that a large part of the population only superficially understands the content of awareness messages that convey concepts that are foreign to them.

While premature birth and complications during labor and delivery account for the majority of newborn deaths, diarrhea is one of the two leading causes of death among children ages 1-59 months, accounting for about 9 percent of deaths worldwide and 10 percent in Haiti [2].

Yet this cause of death is preventable or treatable quickly with proven interventions [3]. Some practices for the protection, prevention and treatment of diarrhoea have been advocated for several decades, such as breastfeeding, vitamin supplementation, vaccination, environmental sanitation, and oral rehydration [4] .

While mortality from diarrhea has been sharply reduced since the 1990s, many children still suffer from diarrhea. In fact, the incidence of the disease has been slowly decreasing since the 1980s [5]. In Haiti, there were more than 3,000 child deaths from diarrhea in 2010 compared to more than 4,500 in 2000 [6], but the incidence is estimated by Fischer Walker and colleagues to have fallen from 10.9 episodes per child per year to 8.9 episodes in 6-11 months between 1990 and 2010 [7].

Moreover, the number, severity and duration of diarrhea episodes are associated with malnutrition, which in turn is correlated with chronic nutritional deficiencies, stunted growth and limitations in cognitive development [8]. Finally, the prevalence is estimated to be close to one child in five in 2013 [9]. This confirms the usefulness of identifying avenues of intervention to reduce infant-juvenile diarrhoea in Maniema.

Building on traditional knowledge and techniques on diarrheal diseases, extracting viable practices, minimizes the risks of socio-cultural disruption and allows for selective cure of traditional knowledge retrogression. To analyze the needs and attitudes of the populations in the didactic process, the Public Hygiene and Sanitation Office, therefore, collected through a questionnaire the traditional and scientific knowledge of the populations in two health zones of the Province of Maniema. The work that is presented concerns the conceptions and obstacles on the methods of control and prevention of diarrheal diseases. Based on what the populations know, the appropriate message can be given. The approach of solutions in terms of the message to be brought to the populations will be modulated according to the answers of this study.

Children's health, beyond the etiology of the disease, is dependent on the living environment and individual characteristics. Mosley and Chen (1984) were among the first to conceptualize the relationship between distal socio-economic determinants (individual, family and community) and proximate determinants (maternal factors, environmental contaminants, nutritional deficiency, injury and individual disease control) and their role in the cycle of morbidity and mortality. Many authors have drawn on this framework, including Hatt and Waters (2006) and Millard (1994).

Given the Maniemian context described above, our work focuses on three main factors: individual factors, family factors, and contextual factors.

Individual factors

The age of the children is the first indicator to consider for diarrheal diseases.

Based on empirical data from a systematic review of the literature, the incidence of diarrhea in 139 low- and middle-economy countries is estimated at 2.9 episodes per child per year in 2010, rising to 4.5 for children aged 6-11 months (5.9 in Maniema), and falling to 2.3 for those aged 24-59 months [4]. As exclusive breastfeeding stops at around six months of age and motor skills develop, vulnerability to diarrheal disease pathogens increases in children 6-11 months of age [10]. Results are mixed on the effect of gender on the incidence of diarrhoea [12] . Some studies find no statistically significant difference [13], but those that do find a statistically significant difference estimate a lower occurrence in girls [14] . Major international organizations advocate measles vaccination in
Prevention of diarrhea [14].

Family factors.

We look at two important aspects that shape children's living environments: 1) environment and assets familiaux ; 2) maternal characteristics.

Environment and family property.

The majority of studies on low- and middle-income countries use asset holdings as a proxy for household wealth. These assets include television, radio, telephone, car, bicycle, motorcycle, refrigerator, toilet, drinking water, and housing construction materials [12]. Among the wealth indicators, drinking water, toilets and refrigerator are also used to assess the health environment that contributes to children's exposure to diarrhea. For the sake of brevity, we will not repeat here the information on Family Amenities that will be presented in the next chapter.

Maternal characteristics

Certain characteristics of the mother may compromise her ability or capacity to care for her children optimally. A young, poorly educated, unemployed woman will be more dependent on her spouse and will have less decision-making power, making it more difficult to direct family income toward the health of her children [19]. 19] These women would be less able to control their fertility. Having a pregnancy at the desired time would allow women to be better prepared physically and emotionally, which would allow them to take better care of their child [22].

Breastfeeding is an important maternal behavior that contributes to the development of children's immune systems in the neonatal and post-neonatal period and helps prevent preventable diseases [3].

Contextual factors

Contextual factors are used to approximate the effects on the occurrence of diarrhea among children of political and economic changes in a period or region, as well as the influence of home environment and climate. In terms of the period effect, we can think of the 1991-1994 embargo that was imposed on Haiti following the first exile of President Aristide. During these years, despite the humanitarian and medical aid granted, the

Morbidity and mortality rates have increased significantly compared to the previous or next period [30].

METHODOLOGY

Our study was conducted in the health zones of Kindu it is the main town of Maniema Province. The health zone of Kindu has 270,777 inhabitants with an area of 78 Km^2 and a density of 3,561 inhabitants per Km^2 according an annual report central health zone office,2020.

Nature, duration of the study and ethical consideration

Given the aspect of comparison of exposure between subjects with and without diarrhoeal diseases reflected in the background of this work. This study followed the path of a case-control study.

The population of our study was the population of the Kindu health zone. The case population consisted of the subjects who suffered from diarrhoeal diseases during the diarrhoeal episodes of 2020 -2021 and the controls were the subjects in the community who did not suffer from diarrhoeal diseases.

STATISTICAL UNITS

Cases: Cases were subjects who were one year old and older, had suffered from diarrhoeic disease, were in the linear lists, had a clear address in these lists, and met the WHO case definition used in health facilities.

Witnesses were neighbors of the cases in the same street, of the same sex and about 5 years of age, who had not had a diarrheal episode or choleriform diarrhea during the cholera epidemic.

INCLUSION CRITERIA

To be included in the cases for this study, the cases met the following criteria:

Cases confirmed positive in the laboratory and found in the linear lists of the Kindu Health Zone;

Unconfirmed positive cases that meet the WHO case definition and are included in the linear case lists;

Survivors of the epidemic residing in the Kindu health zone;

Subjects meeting one of the above criteria and having agreed to answer our questionnaire.

Witnesses in turn were selected based on the following criteria:

Subjects with no history of diarrhea o r cholera during the epidemic period;

Subjects of the same sex and at least 5 years old, living in the neighbouring plot on the same avenue ;

Subjects meeting both of the above criteria and having agreed to participate in the study.

EXCLUSION CRITERIA

Excluded from the study were all cases that were found in the linear lists with the criteria below:

Subjects who did not meet the case definition of diarrheal disease ;

Cases less than 1 year old ;

Deceased cases ;

Cases that do not have a specific address in the linear lists ;

Cases that met the inclusion criteria that refused to be included in the

Participate in the study.

Controls were excluded from the study when they had any of the following characteristics :

Show symptoms of cholera or diarrhea during the period of

The epidemic;

Witnesses less than one year old ;

Witnesses from other health zones other than the Kailo health zone ;

Witnesses who met the inclusion criteria but refused to answer the questionnaire ;

SAMPLING

Proportional stratified sampling with each health zone as a stratum was used for this study. Systematic random sampling from the linear lists of cases and deaths from diarrheal diseases was then used to complete the sampling.

The sample size was calculated using the statcalc function of the software epi info version 7 by considering the consumption of unheated food left out of the freezer as a risk factor with an Odds Ratio of 4.19 as well as the following other parameters according to the study by Moradi Ghobad and collaborators [30].

PRESENTATION OF THE RESULTS

This chapter presents the main results of the survey of drinking water system users and their controls in the Kindu health zone.

These results, organized in table form, took into account the following points:

1. Socio-demographic characteristics of the respondents;
2. Environmental characteristics of respondents;
3. The human behavior of respondents;
4. Factors associated with the onset of diarrheal disease.

Table I: Distribution of respondents according to sociodemographic characteristics and location of their home in the Kindu health zone, 2021

Characteristics		**cases**		**Witnesses**		
		Staff	%	Staff	%	p
Age range	<5 years old	14	10,4	8	6,0	**0,749**
	5-14 years old	23	17,2	25	18,7	
	15-24 years old	30	22,4	37	27,6	
	25-34 years old	16	11,9	14	10,4	
	35-44 years old	24	17,9	25	18,7	
	≥45ans	27	20,1	25	18,7	
	Total	**134**	**100,0**	**134**	**100,0**	
Age (years)	Average	27,9		28,4		**0,830**
	Standard deviation	18,4		17,4		
Sex	Male	58	43,3	58	43,3	**1**
	Female	76	56,7	76	56,7	
	Total	**134**	**100,0**	**134**	**100,0**	
Level of education	None	28	20,9	17	12,7	**0,155**
	Primary	41	30,6	40	29,9	
	Secondaire	58	43,3	73	54,5	
	Superior/ universitaire	7	5,2	4	3	
	Total	**134**	**100,0**	**134**	**100,0**	
Location of The address	Along the river	23	17,2	26	19,4	**0,972**
	Location swamp ux	20	14,9	19	14,2	
	Location sec	86	64,2	84	62,7	
	Others	5	3,7	5	3,7	
	Total	**134**	**100,0**	**134**	**100,0**	

The table above shows that diarrheal diseases affected all age groups in the Kindu health zone.
The 15-24 age group was the most affected, with a proportion of 22.4% of cases.The average ages of the cases and controls are 27.9 years and 27.9 years, respectively. 28.4 years. The female sex was more affected by cholera with 56.7%.
Nearly half of the cases and controls (51.5% of cases and 43.6% of controls) had less than a high school education.
Our respondents lived more in dry areas with 64.2% of cases and 62.7% of controls. Along the river and in swampy areas, 17.2% and 14.9% of cases and controls, respectively.
The distribution of cases and controls is homogeneous according to age group, education level and location of residence (p>0,05).
The mean age of the cases is equal to the mean age of the controls (p=0.830).

Table IV: Evolutionary trends of epidemiological indicators of diarrheal diseases in the health zone of Kindu

feature		n	Cholera cases Staff	%	n	Witnesses Staff	%	OR	95% CI	P
Toilets in the plots	No	134	15	11	134	8	6,0	1,98	[0,812□4,	**0,133**
	Yes		119	88		126	94,0	1		
Fecal matter on the ground or at the edge	Presence	119	58	48 ,7	126	37	29,4	2,28 7	[1,352□3, 868]	**0,002 ***
toilets	Absence		61	51		89	70,6	1		
Flies in the toilet	Presence	119	81	68 1	126	68	54,0	1,81 8	[1,080□3, 061]	**0,024 ***
	Absence		38	31 9		58	46,0	1		
Odors in the toilet	Presence	119	86	72 ,3	126	81	64,3	1,44 8	[0,842□2, 490]	**0,181**
	Absence		33	27 7		45	35,7	1		
Fecal matter accessible to insects and animals	Presence	119	22	18 ,5	126	16	12,7	1,55 9	[0,775□3, 138]	**0,213**
servants	Absence		97	81 5		100	79,3	1		
Lid in regular pit	Absence	119	103	86	126	99	78,6	1,75	[0,892□3,	**0,103**
	Presence		16	13 4		27	21,4	1		
Nature of latrine floor	Claymaker	119	89	74 8	126	94	74,6	1,01 0	[0,568□1, 797]	**0,973**
	Sandblaster		30	25		32	25,4	1		
Sources of drinking water supply	Unimproved source	134	77	57 ,5	134	31	23,1	4,48 8	[2,648□7, 608]	**0,000 ***
	Enhanced source		57	42 5		103	76,9	1		
Water supply sources for others household needs	Unimproved source	134	123	91 ,8	134	125	93,3	0,80 5	[0,322□2, 011]	**0,643**
	Enhanced		**11**	**8,**		**9**	**6,7**	**1**		

Analysis of Association between environmental characteristics and the occurrence of diarrheal diseases in the Kindu health zone, 2021.This table shows that 11.2% of cases and 6% of controls did not have a toilet.
Feces were found in the toilet in 48.7% of cases and 29.4% of controls. The onset of diarrhoeal disease was 2.3 times more common among people with feces in the toilet than among those without. (OR=2.287; 95% CI: 1.352-3.868)
The presence of flies in toilets and the consumption of drinking water from unimproved sources have been associated with the onset of diarrheal disease. Cholera was respectively 2 times and 4.5 times more common among people whose toilets had flies in them (OR=1,818; 95% CI:1,080-3,061) and among those who consumed drinking water from unimproved sources (OR=4,488; 95% CI:2,648-7,608).
For other household needs other than drinking, 91.8% of cases and 93.3% of controls used water from unimproved sources.
Ordinary pit toilets did not have lids in 86.6% of case households that suffered from diarrheal diseases. This absence was not significantly associated with the onset of diarrhoeal disease cases. (OR=1,756; 95% CI 0.892-3.455)
The foul odors in the toilets were noticed in 72.3% of cases that caused cholera and the toilets were built on 75% clay soil in both cases and controls.

Table V: Water use and population movement associated with the risk of diarrheal disease in the Kindu Health Zone in 2021

Characteristics		**Cases (n=134)**		**Witnesses (n=134**	**) OR**	**95%**	**CI p**	
		Staff	%	Staff	%			
Water treatment	No	132	98,5	115	85,8	10,904	[2,486□47,82	**0,002**
	Yes	2	1,5	19	14,2	1		
Availability of pieces of soap	No	45	33,6	44	32,8	1,034		**0,897**
	Yes	89	66,4	90	67,2	1		
Cleaning of containers	No	1	0,7	3	2,2	0,328	[0,033□3,197]	**0,313**
keeping drinking water	Yes	133	99,3	131	97,8	1		
Travel to a location in	Yes	10	7,5	4	3	2,621	[0,801□8,575]	**0,111**
risk of cholera	No	124	92,5	130	97	1		
Water consumption	Yes	79	59,0	80	59,7	0,970	[0,595□1,579]	**0,901**
sold packaged in	No	55	41,0	54	40,3	1		
the bags								
Hand washing	No	12	9,0	8	6,0	1,549	[0,612□3,921	**0,356**
	Yes	122	91,0	126	94,0	1		
Knowledge of the steps of	No	126	94,0	125	93,3	1,134		**0,802**
hand washing	Yes	8	6,0	9	6,7	1		
Use of a hand	No	123	91,8	116	86,6	1,735	[0,786□3,830	**0,173**
	Yes	**11**	**8,2**	**18**	**13,4**	**1**		

It can be seen from this table that the occurrence of diarrheal diseases in the Kindu health zone was associated with human behavior including non-treatment of drinking water (OR=10.904 95% CI:2.486-47.822), p=0.002.
The movement of respondents to places at risk of diarrheal diseases (Kisangani, bukavu, Kongolo and Kabalo) was not observed in 92.5% of cases and 97% of controls. Soap was present in 66.4% of cases and 67.2% of controls.
The containers containing drinking water were cleaned on a regular basis.
in 100% of cases and 97.8% of controls.

Table VIII: Factors associated with the onset of diarrheal disease cases in the Kindu health zone,2021.

Factors		**Emergence of cholera cases**					
		Bivariate analysis Logistic			**regression**		
		Raw	**gold 95%**	**P**	**Adjusted**	**gold 95% CI**	**p**
Fecal matter in	**Presence**	**2,287**	**[1,352□3,868]**	**0,002**	**1,954**	**[1,088□3,509]**	**0,025**
toilets	Absence	1			1		
Flies in the	Presence	1,818	[1,080□3,061]	0,024 *	1,193	[0,621□2,294]	**0,596**
toilets	Absence	1			1		
Sources water supply	Unimproved source	4,488	[2,648□7,608]	0,000 *	3,978	[2,191□7,221]	**0,000 ***
of drink							
	Source improved	1			1		
Water treatment	No	10.904	[2.486□47.822]	0.002	6.392	[1.352□30.211]	**0.019**
	Yes	1			1		
Consumption of food sold in the restaurants of street(Malewa)	Yes	2,610	[1,587□4,292]	0,000 *	1,747	[0,997□3,126]	**0,060**
	No	**1**			**1**		

(*)Statically significant value (p<0.05)

The bivariate analysis showed that 5 factors were associated with the appearance of the case of diarrheal diseases in the Kindu health zone, including:
- The occurrence of diarrheic diseases in the Kindu health zone was twice as high among people whose toilets contained faeces (OR=2.287IC at 95%:1.3523.868) p=0.002 ;
- It is observed twice as often in people with toilets with flies (OR=1.818; 95% CI:1.080-3.061) p=0.024 ;
- The occurrence of diarrheal diseases in the Kindu health zone was 11 times more common among people who did not treat drinking water before consumption (OR=10.904; 95% CI:2.486-3.061) p=0.002
- Theoccurrence of cholera cases was 4.5 times higher in people who use drinking water from unimproved sources (OR=4.448; 95% CI at 95% :2,648-7,608) p=0,000 ;
- And finally, this appearance was 3 times higher among people consuming food in street restaurants (malewa). (OR=2.610 95% CI(1.587- 4,292) p=0,000

The logistic regression including these 5 risk factors retained by the bivariate analysis (P<0.05) as predictors, identified three risk factors associated with the appearance of cases of diarrheal diseases in the Kindu health zone, namely :
- The presence of feces in the toilet significantly increases the risk of diarrheal disease by 2 times compared to the absence of feces in the toilet (OR=1.954 95% CI:1.088-3.509) p=0.025 ;
- Non-treatment of drinking water at home significantly increases the risk of cholera cases by 6 times compared to water treatment (OR=6.392 95% CI:1.352-30.211) p=0.019
- Consumption of drinking water from unimproved sources significantly increases the risk of diarrheal disease by a factor of 4 compared to consumption of water from improved sources OR=3.978 95% CI: 2.191-7.221)p=0.00.

DISCUSSION

The present study was initiated to estimate the Perception of the populations on diarrhoeal diseases and Covid-19 in the health zone of Kindu. To do so, 134 cases of diarrhoeal diseases and 134 controls were interviewed. We started from the hypothesis that the appearance of cases of diarrhoeal diseases in the Kindu health zone would be associated with the consumption of unclean or unsafe water and the displacement of the population to the place where one of the diarrhoeal diseases is endemic.

The points relating to the socio-demographic characteristics of the respondents, environmental characteristics dealing with water supply sources and toilets as well as the respondents' risk behaviours and climatic characteristics were successively addressed during this discussion.

Socio-demographic characteristics

The study found that the average age of cases was 27.9 years and the average age of controls was 28.4 years. The 15-24-year age group was the most affected with 22.4%, similar to results of Michel Makoutodé et al. who found that the 15-24-year age group accounted for
18.8% female cases [21].

Also, Kone Coulibaly and André Arsène Bita Fouda also attested in their studies respectively that the average age of the cases was 28.5 years and the age group of 16 to 34 years was the age group most affected by cholera with 58.2% [20,22].

The low level of education was 91.8% among the cholera cases in our study. This low level of education could not influence the occurrence of cholera cases, contrary to studies by Muhumu Mututa along Lake Edouard in eastern DRC, Kone Coulibaly in Harare, Zimbabwe, and Doudou Tubaya in Lubumbashi, DRC, who found that low education was associated with cholera resurgence [19,22,23].

The results of our study indicated that 64.2% of the cases lived in dry areas compared to 17.2% of cases along the river. The fact that the proportion of cholera cases along the river is low compared to cases found in the dry environment meets the argument of Rebaudet, in his study on cholera in coastal Africa, who argues that cholera epidemics in coastal areas account for only a tiny fraction of the cholera burden in Africa. The author further argued that cholera epidemics in coastal towns were likely to be imported from remote areas by sick voyeurs. Coastal areas remained calm for a long time despite the high risk in these areas [27].

Environmental features.

In this study, the environmental factors that attracted our attention were related to the sources of supply for drinking water and other household needs and the use of toilets by households (toilet types and toilet hygiene).

Of these two factors, two have been identified as factors associated with the occurrence of cholera cases including :

- With the presence of feces in toilets, the occurrence of cholera was twice as high among people with toilets containing feces at the edge of holes or on the floor (OR=1.954 95% CI:1.088-3.509) p=0.025 than those who did not.

This presence of feces would call upon flies and cockroaches that can facilitate the mechanical transport of microorganisms to the food to be consumed and maintain all kinds of diseases of dirty hands including cholera. This factor can be aggravated in the case of a cholera patient who can deposit his faeces in the toilet and the food has been left open and eaten without being heated. As demonstrated in one of the results of this study on the morning consumption of unheated food that represents 38.1% no less in cases.

- The second factor identified is the consumption of drinking water from unimproved sources which are river water, unprotected wells and springs. Consumption of drinking water from unimproved sources significantly increases the risk of cholera cases by a factor of 4 compared to consumption of drinking water from improved sources (OR=3.978 95% CI:2.191-7.221) p=0.000.

These two factors have also been identified by other authors who confirm that cholera is a disease that occurs in regions or countries that lack the basic infrastructure for access to safe water and sanitation due to lack of running water and hygienic latrines [17,24,25,32].

Gaston and Faye had shown through their respective studies in Haiti and Senegal that people without toilets were at risk of cholera [28,29]..

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