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Appraisal of the Knowledge, Attitudes and Practices of the Populations on Cholera in Benin

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Abstract

Cholera is a disease that Benin has been fighting against for years but which continues to create economic losses for households. The aim of this study is to assess the level of knowledge of the population about this disease and to assess hygiene practices in order to identify the factors responsible for its sustainability. The data were collected through a survey of 720 households in the 12 departments of the country. These data were analyzed with SAS software and three groups of people were identified on the basis of hygiene measures. The majority of respondents know cholera. The main symptoms they mentioned were vomiting (84.83%) and diarrhea (81.04%). Diarrhea was more reported in group 3 (88.96%) than in groups 1 (86.58%) and 2 (83.19%). Low levels of hygiene were the main cause of this disease. In the absence of toilets, the interviewees pass stool in the bush and at the edge of water sources used in households. Some of them have bins (in particular group 1) for household waste but do not subscribe to refuse collection structures. Therefore, they throw garbage in sometimes unofficial landfills. Others, on the other hand, have not garbage cans (mainly group 2) and they empty garbage everywhere (street, gutters and bushes). In addition, hand washing is hardly ever done after using the toilet. Hygiene practices in some households are insufficient, which does not protect the population from cholera.

Keywords

Cholera, Hygiene, Respondents, Benin

1. Introduction

Cholera is a fecal peril disease associated with pollution of water contaminated by excreta carried by runoff or infiltration into freshwater sources. It's a notifiable disease transmitted orally through contaminated water and food. It remains a global public health problem, particularly in developing countries [1]. Historically, seven separate cholera pandemics have been recorded. The seventh pandemic was the most extensive in terms of duration and adopted a very different geographical distribution [2]. Globally, the World Health Organization estimates that there are nearly 3 million cases of cholera each year and more than 95,000 deaths. Africa remains the continent most affected by cholera in the world, with more than 50% of cases [1]. Nowadays, cholera evolves according to countries in an endemic or epidemic mode.

In Benin, several cholera epidemics have been recorded. Larger and longer epidemics have sometimes been observed during the rainy season where the risk of floods and stagnant water increases [3]. Cholera is a strictly human enteric infection caused by the pathogen *Vibrio cholerae* [1]. It is a bacterium with more than 200 serogroups that are distinguished from each other by the polysaccharides of the somatic O antigen. Among these serogroups, two of them, O1 and O139 producing cholera toxin cause epidemics [4]. Cholera manifests as acute diarrhea accompanied by vomiting and this can lead to severe dehydration and cardiovascular collapse [5]. In addition, some people infected with *Vibrio cholerae* do not show symptoms, but they can still transmit the disease. These are healthy carriers who are important vectors for the spread of cholera [6]. In the absence of prompt and appropriate treatment, cholera leads to death. It is a real public health emergency and remains a recurrent problem due to the lack of knowledge about good hygiene practices and the socio-economic conditions of the population [5]. It's therefore important to take adequate measures to effectively fight this disease.

Several actions have been carried out in Benin for an adequate control of cholera but despite the efforts made, cholera occurred in the years 2012 to 2016. It is then necessary to evaluate the practices, knowledge and attitudes of the population with regard to this disease. This will allow suggesting some strategies to forecast future epidemics. With this in mind, the objective of this study was to appraise the level of knowledge of the Beninese population on the risk factors of cholera.

2. Materials and Methods

2.1. Area of Study

The survey was conducted in the twelve departments of the Republic of Benin from January 18 to February 7, 2017. Benin is a coastal country, open to the Gulf of Guinea by a narrow 125 km frontage. It is located between the meridians 0˚40' and 3˚50' East and stretches over 750 km from South to North between the parallels 6˚10' and 12˚30' North. Its surface area is 114,763 km^2. It is located entirely

in the intertropical zone between the equator and the Tropic of Cancer south of the Sahara. It is bordered to the West by Togo, to the North-East by Burkina Faso, to the North by the Republic of Niger, to the East by Nigeria and to the South by the Atlantic Ocean. Two types of climate are represented in Benin: sub-equatorial with four seasons (two rainy and two dry seasons) in the south, Sudanese with two seasons (one rainy and one dry) in the north. The central zone of the country has a transitional climate that is similar to a sub-Sudanese climate.

2.2. Methodology

Data were collected using a questionnaire. The questions were semi-enclosed and focused on respondent identification, water sources, household hygiene practices, and knowledge of cholera. The study was conducted in 28 municipalities throughout the country. These communes were selected from the epidemiological assessment of cholera in Benin [3] and on the basis of the origin of samples during the epidemic of 2016. The sites surveyed were households. The two-stage stratified sampling method across neighborhoods was used for this survey. The selection of city and village neighborhoods was made based on the random number table. The sample size was first determined by Schwartz's formula. This formula yields 384 individuals, or 32 individuals per municipality. To get results that are closer to the population values, 28 people were added to this number per municipality, bringing the number of people surveyed to 60 per municipality. One person was surveyed per household and provides information about the household. The choice of households was therefore made according to a sampling frame. The questions were administered directly to the respondents. The respondent in the household was selected based on his or her availability to answer the questions. A total of 720 questionnaire sheets were completed.

2.3. Statistical Analysis

The data were analyzed with SAS software (SAS Institute Inc., Cary, NC, USA). The Proc corresp procedure was used for multiple correspondence analysis [7]. The variables considered were: availability of toilets, waste management (children's stool, feces, sewage sludge), wastewater management (shower water, dishwater, kitchen water), availability of garbage cans, subscription to a garbage collection structure, and level of knowledge about cholera. Multiple Correspondence Analysis (MCA) was followed by an ascending hierarchical classification based on hygiene practices taking into account the most significant MCA components. Groups of people were then identified and characterized by testing for differences in the relative frequencies of the group variables using the Chi^2 test. The comparison of relative frequencies between groups in pairs and between modalities was done by the bilateral Z-test. For each relative frequency, a 95% confidence interval (CI) was calculated according to the formula:

$$IC = P \mp 1.96\sqrt{\frac{P(1-P)}{N}},$$

where P is the relative frequency and N is the sample size.

The CA function of the FactoMineR library of R was used for correspondence factor analysis (CFA) [8] to explore the distribution of water sources and latrine types in the departments. An analysis of variance was performed using SAS' Proc GLM procedure for quantitative variables (age and family size). The only variation factor considered in the analysis of variance model was the effect of the livestock group. The Fisher F test was used to determine the significance of the breeding group effect and comparisons between the means of each variable were made two by two using the student t-test.

3. Results

3.1. Characteristics of Surveyed Households

Three axes have been selected for the interpretation of the results of the Multiple Correspondence Analysis (MCA). Each axis corresponds to a group of people and each group corresponds to a type of household waste and wastewater management practice. The contribution to the total inertia of the three factor axes was 43.28% (17.15% for axis 1, 13.57% for axis 2 and 12.55% for axis 3). **Figure 1** shows the typology of households surveyed.

Group 1 is made up of 256 respondents with fewer toilets than those in the other two groups. Some do not have latrines and bury the children's feces. The mud from these toilets is emptied by trucks. This group of people empties shower water into the cesspools and dish water into the street. They also have garbage cans and some subscribed to garbage collection structures.

Group 2 is made up of 202 people with ordinary outhouse toilets and internal

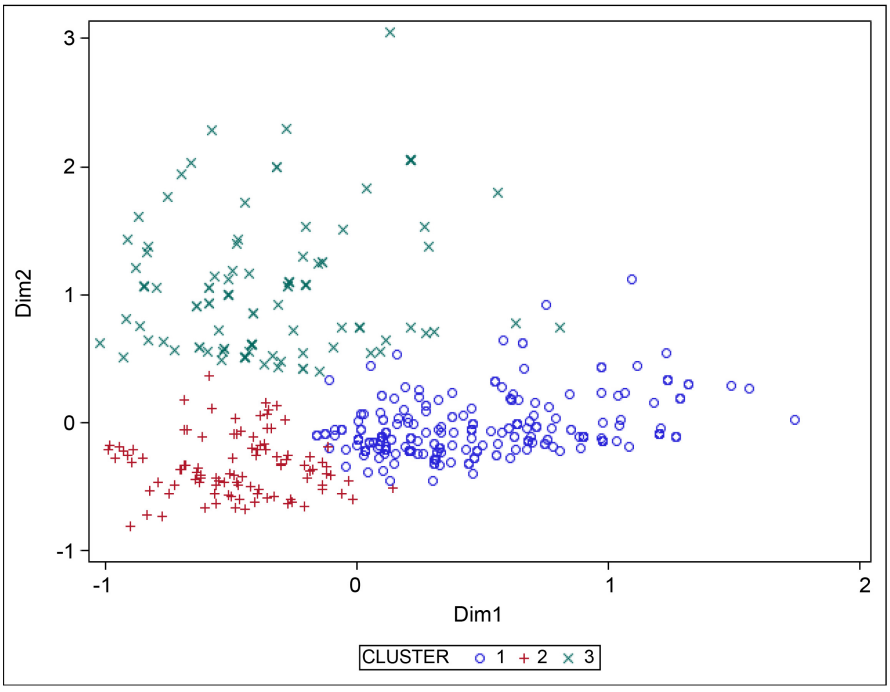

Figure 1. Typology of households surveyed.

toilets. What distinguishes them from the other groups is their sewage disposal technology. They do not have a fixed place to empty water and outside the cesspools, shower water can be emptied on the ground, in the river, the pond, etc.... The same applies to dishwater and kitchen water.

Group 3 is made up of 258 people who have ordinary outhouse toilets but do not empty them. When these latrines fill up, they plug them up and dig new ones. The wastewater is emptied in the courtyard and next to the houses. Very few subscribed to the garbage collection structures. **Figure 1** shows the Typology of households surveyed.

The respondents were more ($p < 0.05$) female (55.59%) than male (44.41%). The majority were uneducated, with primary and secondary education (**Table 1**). They lived more in cohabitation and practiced mainly trade and liberal professions.

Table 1. Profile of respondents.

Variable	General (n = 716)		Group 1 (n = 256)		Group 2 (n = 202)		Group 3 (n = 258)		Chi² Test
	%	CI	%	CI	%	CI	%	CI	
Gender									
Male	44.41b	3.64	44.92a	6.09	47.03a	6.88	41.86a	6.02	NS
Female	55.59a	3.64	55.08a	6.09	52.97a	6.88	58.14a	6.02	NS
Type of instruction									
Primary	28.49a	3.31	28.13a	5.51	26.73a	6.10	30.23a	5.60	NS
Secondary	30.03a	3.36	28.52a	5.53	32.18a	6.44	29.84a	5.58	NS
University	4.75b	1.56	3.52a	2.26	5.45a	3.13	5.43a	2.77	NS
Koranic school	2.23b	1.08	2.34a	1.85	0.99a	1.37	3.1a	2.11	NS
Literacy	4.05b	1.44	5.86a	2.88	4.46a	2.85	1.94a	1.68	NS
No instruction	30.59a	3.38	31.64a	5.70	30.69a	6.36	29.46a	5.56	NS
Main activity									
Civil servant	3.07c	1.26	2.34a	1.85	1.49a	1.67	5.04a	2.67	NS
Employee	9.09b	2.11	8.24a	3.38	8.42a	3.83	10.47a	3.74	NS
Trader	39.25a	3.58	41.8a	6.04	43.07a	6.83	33.72a	5.77	NS
Liberal profession	37.99a	3.56	35.55a	5.86	38.12a	6.70	40.31a	5.99	NS
Unemployed	10.61b	2.26	12.11a	4.00	8.91a	3.93	10.47a	3.74	NS
Marital status									
Single	14.66b	2.59	12.89a	4.10	14.85a	4.90	16.28a	4.50	NS
Legally married	13.55b	2.51	13.67a	4.21	13.37a	4.69	13.57a	4.18	NS
Widow/widower	6.42c	1.80	7.81ab	3.29	8.91a	3.93	3.1b	2.11	*
Divorced	2.38d	1.12	2.34a	1.85	3.47a	2.52	1.56a	1.51	NS
Live together	62.99a	3.54	63.28a	5.91	59.4a	6.77	65.5a	5.80	NS
Respondent's position in the household									
Father	37.71b	3.55	36.33a	5.89	40.1a	6.76	37.21a	5.90	NS
Mother	47.35a	3.66	48.44a	6.12	41.09a	6.78	51.16a	6.10	NS
Child	12.99c	2.46	13.67a	4.21	16.34a	5.10	9.69a	3.61	NS
Employed	1.96d	1.02	1.56a	1.52	2.48a	2.14	1.94a	1.68	NS

*: $p < 0.05$; ***: $p < 0.001$; NS: $p > 0.05$; CI: Confidence Interval; percentages in the same row followed by the same letter do not differ significantly at the 5% cut-off (for intergroup comparison); percentages within a class in the same column followed by the same letter do not differ significantly at the 5% cut-off (for overall percentage).

The average age of respondents was 37.42 years and the average household size was 6.29 persons. This size was higher in group 3, where it was 7 persons (Table 2). The average number of men per household was 3.16 persons and the average number of women was 3.13 persons. The number of women and men in Group 3 was higher.

3.2. Level of Knowledge on Cholera

3.2.1. Signs and Transmission of Cholera

Most respondents have some knowledge of cholera (Table 3). The main symptoms mentioned were vomiting (84.83%) and diarrhea (81.04%). Diarrhea was reported more in group 3 (88.96%) than in group 1 (86.58%) and group 2 (83.19%). Other signs reported were weight loss, fever, and dehydration.

More than half of the respondents (52.51%) were aware of the mode of transmission of this disease. These were: consumption of contaminated food and water, contact with a cholera patient, and uncleanliness. The proportion of people who mentioned transmission through consumption of unclean food was significantly higher ($p < 0.05$) than those who mentioned transmission through consumption of unclean water and dirty hands. Transmission through unclean water was more reported ($p < 0.05$) in groups 1 and 3 than in group 2. Transmission through unclean food was more reported ($p < 0.05$) in Group 3 than in Group 2. Transmission through contact with a sick person and uncleanliness was less reported by the respondents.

3.2.2. Means of Fighting Cholera

The majority (68.75%) of the respondents did not master the means of fighting cholera. The proportion of people with no knowledge of means of fighting cholera in group 3 (78.97%) was significantly higher ($p < 0.001$) than in groups 1 (62.56%) and 2 (61.64%). However, the majority (64.66%) of these respondents claimed that cholera was preventable. The populations concerned by this survey are not familiar with Oral Rehydration Solutions (ORS) and salt and sugar water solution. The proportion of people not familiar with the salt and sugar solution in group 3 (88.34%) was significantly higher ($p < 0.01$) than in group 1 (80.19%)

Table 2. Age and family size.

Variable	General			Group 1			Group 2			Group 3			ANOVA
	n	Moy.	ES	n	Moy.	ES	n	Moy.	ES	n	Moy.	ES	
Age	716	37.42	0.49	256	37.64a	0.82	202	37.84a	0.92	258	36.88a	0.81	NS
Men	714	3.16	0.08	256	3.16b	0.13	202	2.57c	0.15	256	3.63a	0.13	***
Women	714	3.12	0.08	256	3.19a	0.12	202	2.61b	0.14	256	3.46a	0.12	***
Total number of people	714	6.29	0.13	256	6.37b	0.21	202	5.19c	0.24	256	7.09a	0.21	***

***: $p < 0.001$; NS: $p > 0.05$; ES: Standard error, means of the same line followed by the same letter do not differ significantly at the 5% threshold.

Table 3. Cholera knowledge.

Variable	General			Group 1			Group 2			Group 3			Chi² Test
	n	%	CI	n	%	CI	n	%	CI	n	%	CI	
Hearing about cholera													
Yes	716	82.4a	2.79	256	78.91a	5.00	202	82.18a	5.28	258	86.05a	4.23	NS
No	716	17.6b	2.79	256	21.09a	5.00	202	17.82a	5.28	258	13.95a	4.23	NS
Knowledge of the signs of cholera													
Yes	596	70.97a	3.64	210	71.43a	6.11	166	71.69a	6.85	220	70a	6.06	NS
No	596	29.19b	3.65	210	28.57a	6.11	166	28.31a	6.85	220	30.45a	6.08	NS
Signs of cholera													
Vomiting	422	84.83a	3.42	149	86.58a	5.47	119	83.19a	6.72	154	84.42a	5.73	NS
Diarrhea	422	81.04a	3.74	149	79.87b	6.44	119	72.27b	8.04	154	88.96a	4.95	**
Weightloss	422	5.42c	2.16	149	4.03a	3.16	119	8.4a	4.98	154	4.55a	3.29	NS
Fever	422	4.03c	1.88	149	4.7a	3.40	119	6.72a	4.50	154	1.3a	1.79	NS
Dehydration	422	4.27c	1.93	149	3.36a	2.89	119	5.04a	3.93	154	4.55a	3.29	NS
Other	422	15.64b	3.47	149	18.12a	6.18	119	22.69a	7.53	154	7.79b	4.23	**
Knowledge of the mode of transmission of cholera													
Yes	697	52.51a	3.71	250	49.2a	6.20	194	51.55a	7.03	253	56.52a	6.11	NS
No	697	47.49b	3.71	250	50.8a	6.20	194	48.45a	7.03	253	43.48a	6.11	NS
Mode of transmission													
Soiled water	362	55.52b	5.12	122	63.93a	8.52	99	41.41b	9.70	141	58.16a	8.14	**
Soiled food	362	70.17a	4.71	122	68.85ab	8.22	99	60.61b	9.63	141	78.01a	6.84	*
Dirty hands	362	61.05b	5.02	122	63.11a	8.56	99	51.52a	9.84	141	65.96a	7.82	NS
Contact with a cholera patient	362	19.89c	4.11	122	17.21a	6.70	99	21.21a	8.05	141	21.28a	6.76	NS
Bad luck	362	1.38[e]	1.20	122	0.82a	1.60	99	1.01a	1.97	141	60a	8.09	NS
Uncleanliness	362	14.64c	3.64	122	17.21a	6.70	99	19.19a	7.76	141	9.22a	4.78	NS
Other	362	10.5d	3.16	122	9.02a	5.08	99	16.16a	7.25	141	7.8a	4.43	NS

*: $p < 0.05$; **: $p < 0.01$; n: Enrolment; NS: $p > 0.05$; CI: Confidence Interval, percentages in the same row followed by the same letter do not differ significantly at the 5% cut-off (for intergroup comparison); percentages within a class in the same column followed by the same letter do not differ significantly at the 5% cut-off (for overall percentage).

and group 2 (76.19%). Moreover, the techniques used to prepare this water are much diversified (Table 4).

Very few people (6.76%) have ever had cases of cholera in their household (Table 5). When these cases first appeared, the sick were more likely to have gone to a health center (76.6%). Among the remaining minority, some treated themselves at home (8.51%) and others with a traditional healer (8.51%).

Table 4. Fightingcholera.

Variable	General			Group 1			Group 2			Group 3			Chi^2 Test
	n	%	CI	n	%	CI	n	%	CI	N	%	CI	
Fightingmeans													
Yes	576	31.25b	3.79	203	37.44a	6.66	159	37.11a	7.51	214	21.03b	5.46	***
No	576	68.75a	3.79	203	62.56b	6.66	159	61.64b	7.56	214	78.97a	5.46	***
Can cholera be prevented?													
Yes	580	64.66a	3.89	199	59.3a	6.83	161	69.57a	7.11	220	65.91a	6.26	NS
No	580	20.34b	3.28	199	18.09a	5.35	161	20.49a	6.23	220	22.27a	5.50	NS
Don't know	580	15c	2.91	199	22.61a	5.81	161	9.94b	4.62	220	11.82b	4.27	***
Knowledge of ORS													
Yes	581	22.72b	3.41	201	24.88a	5.98	161	26.71a	6.83	219	17.81a	5.07	NS
No	581	77.28a	3.41	201	75.12a	5.98	161	73.29a	6.83	219	82.19a	5.07	NS
Knowledge of the salt-sugar solution													
Yes	598	17.89b	3.07	207	19.81a	5.43	168	23.81a	6.44	223	11.66b	4.21	**
No	598	82.11a	3.07	207	80.19b	5.43	168	76.19b	6.44	223	88.34a	4.21	**
Salt water preparation													
Lemon + water + sugar + salt	96	35.42a	9.57	38	34.21a	15.08	35	28.57a	14.97	23	47.83a	20.42	NS
Sugar + water + salt	96	30.21ab	9.19	38	34.21a	15.08	35	22.86a	13.91	23	34.78a	19.46	NS
Water + lemon + salt	96	21.88b	8.27	38	26.32a	14.00	35	25.71a	14.48	23	8.7a	11.52	NS
Water + salt	96	9.38c	5.83	38	5.26a	7.10	35	14.29a	11.59	23	8.7a	11.52	NS
Lemon + sugar + yésinkin + salt	96	3.13c	3.48	38	0a	0.00	35	8.57a	9.27	23	0a	0.00	NS

**: $p < 0.01$; ***: $p < 0.001$; NS: $p > 0.05$; CI: Confidence Interval, percentages in the same row followed by the same letter do not differ significantly at the 5% cut-off (for intergroup comparison); percentages within a class in the same column followed by the same letter do not differ significantly at the 5% cut-off (for overall percentage).

Sometimes the sick remain without any treatment. In fact, the majority of respondents, especially in group 3, did not know that cholera treatment is free of charge.

3.3. Hygiene Practices in Households

3.3.1. Household Water Supply and Use

Overall, respondents used multiple water sources (Table 6). SONEB water (tap water) was used more ($p < 0.05$) than borehole, well, pond, and public drinking fountain water. The sources of water used varied among the groups. SONEB water was more reported ($p < 0.001$) in group 2 (52%) than in groups 1 (45.52%) and 3 (33.6%). Group 3 (24.0%) used more ($p < 0.001$) water from protected wells than groups 1 (11.81%) and 2 (14.5%). Unprotected well water was used more in groups 1 (29.53%) and 3 (23.2%) than in group 2 (8.5%). Water from

Table 5. Cholera case management arrangements.

Variable	General			Group 1			Group 2			Group 3			Chi² Test
	n	%	CI	N	%	CI	n	%	CI	n	%	CI	
Cholera cases in your home													
Yes	710	6.76b	1.85	255	7.84a	3.30	201	6.47a	3.40	254	5.91a	2.90	NS
No	710	93.24a	1.85	255	92.16a	3.30	201	93.53a	3.40	254	94.09a	2.90	NS
Behaviour adopted													
Go to hospital	47	76.6a	12.10	21	80.95a	16.80	14	78.57a	21.49	12	66.67a	26.67	NS
Home care	47	8.51b	7.98	21	4.76a	9.11	14	7.14a	13.49	12	16.67a	21.09	NS
Going to a GT	47	8.51b	7.98	21	9.52a	12.55	14	7.14a	13.49	12	8.33a	15.64	NS
Did nothing	47	6.38b	6.99	21	4.76a	9.11	14	7.14a	13.49	12	8.33a	15.64	NS
Knowledge that it is free to take care of him/her													
Yes	591	11.17c	2.54	202	14.36a	4.84	164	8.54a	4.28	225	10.22	3.96a	NS
No	591	39.76b	3.95	202	41.58a	6.80	164	49.39a	7.65	225	31.11	6.05b	**
Don't know	591	49.07a	4.03	202	44.06b	6.85	164	42.07b	7.56	225	58.67	6.43a	**

**: $p < 0.01$; NS: $p > 0.05$; CI: Confidence Interval, percentages in the same row followed by the same letter do not differ significantly at the 5% cut-off (for the inter-group comparison); percentages within a class in the same column followed by the same letter do not differ significantly at the 5% cut-off (for the overall percentage).

ponds was used more in group 1 (9.45%) than in group 2 (2%) and group 3 (2.41%).

These different types of water were used for a variety of purposes, but more ($p < 0.05$) in the kitchen (100%) and in the shower (99.02%) than after using the toilet (48.46%) and during meals (52.23%). People in group 1 (100%) used more ($p < 0.001$) of this water in the shower than those in group 2 (97.03%). Similarly, water was used more for hand washing after using the toilet and during meals in group 3 than in group 1. The water was not disinfected before use by the majority of respondents (78.77%). In the case of disinfection (21.23%), the use of Aquatabs (water disinfection and purification tablets) was the most common means used (61.84%), followed by boiling (28.95%) and the use of bleach (7.89%).

After supply, water was stored more ($p < 0.05$) in covered containers (86.93%) than uncovered containers (13.49%). Covered containers were more used ($p < 0.01$) in group 2 (93%) than in group 1 (82.07%) and group 3 (86.96%).

3.3.2. Management of Sanitary Facilities

The majority of respondents (68.58%) had ordinary outhouse toilets. These latrines were more ($p < 0.001$) available in groups 2 (75.74%) and 3 (79.46%) than in group 1 (51.95%). The latrines were mostly (72.27%) regular latrines. However, some households (28.34%) had internal toilets.

When there were no latrines in the households (31.42%), family members emit the stools in the bush, in the public latrine or at the neighbor's house. The proportion of people who went to the toilet in the bush (43.78%) was significantly

Table 6. Water supply.

Variable	General			Group 1			Group 2			Group 3			Chi² test
	n	%	CI	n	%	CI	n	%	CI	n	%	CI	
Opportunity to use water													
Kitchen	716	100a	0	256	100a	0	202	100a	0	258	100a	0	NS
Shower	716	99.02a	0.72	256	100a	0.00	202	97.03b	2.34	258	99.61ab	0.76	**
After toilet	716	48.46b	3.66	256	44.14b	6.08	202	47.03ab	6.88	258	53.88a	6.08	
Before and after eating	716	52.23b	3.66	256	49.61b	6.12	202	43.56b	6.84	258	61.63a	5.93	***
Other	716	2.65c	1.18	256	0.78b	1.08	202	6.44a	3.39	258	1.55b	1.51	***
Water supply source													
Tap water	704	42.05a	3.65	254	42.52b	6.08	200	52a	6.92	250	33.6c	5.86	***
Public drinking fountain	704	0.99e	0.73	254	1.18a	1.33	200	1.5a	1.68	250	0.4a	0.78	NS
Drilling	703	21.45b	3.03	254	18.11a	4.74	200	24a	5.92	250	22.8a	5.20	NS
Protected well	704	16.9b	2.77	254	11.81b	3.97	200	14.5b	4.88	250	24a	5.29	***
Unprotected well	704	21.31b	3.02	254	29.53a	5.61	200	8.5b	3.87	250	23.2a	5.23	***
Pond	704	4.83c	1.58	254	9.45a	3.60	200	2b	1.94	250	2.4b	1.90	***
Other	704	1.85d	1.00	254	1.97a	1.71	200	4a	2.72	250	0b	0.00	**
Home water storage													
Covered container	704	86.93a	2.49	251	82.07b	4.75	200	93a	3.54	253	86.96b	4.15	**
Uncovered container	704	13.49b	2.52	251	19.92a	4.94	200	6.5c	3.42	253	12.65b	4.10	***
Other	704	1.42c	0.87	251	1.59a	1.55	200	0.5a	0.98	253	1.98a	1.72	NS
Frequent disinfection of drinking water													
Yes	716	21.23b	3.00	256	25.78a	5.36	202	19.31a	5.44	258	18.22a	4.71	NS
No	716	78.77a	3.00	256	74.22a	5.36	202	80.69a	5.44	258	81.78a	4.71	NS
Mode of disinfection													
By boiling	152	28.95b	7.21	66	25.76a	10.55	39	30.77a	14.49	47	31.91a	13.33	NS
By bleach	152	7.89c	4.29	66	9.09a	6.94	39	7.69a	8.36	47	6.38a	6.99	NS
Aquatabs	152	61.84a	7.72	66	62.12a	11.70	39	61.54a	15.27	47	61.7a	13.90	NS
Other	152	1.32d	1.81	66	3.03a	4.14	39	0a	0.00	47	0a	0.00	NS

**: $p < 0.01$; ***: $p < 0.001$; NS: $p > 0.05$; CI: Confidence Interval, percentages in the same row followed by the same letter do not differ significantly at the 5% cut-off (for intergroup comparison); percentages within a class in the same column followed by the same letter do not differ significantly at the 5% cut-off (for overall percentage).

higher ($p < 0.05$) than the proportion of people who used public and neighboring toilets (Table 7). These people who went to toilet in the bush were largely from Group 1.

Children's feces were disposed of in the latrine in the majority of cases (54.42%). Group 3 (67%) was more concerned than groups 1 (40.81%) and 2 (54.6%) ($p < 0.05$). In the minority of cases, the feces were thrown in the garbage (3.47%), in the bush (6.31%) or buried (6.94%).

Table 7. Sanitation facilities and sewage sludge management.

Variable	General			Group 1			Group 2			Group 3			Chi² test
	n	%	CI	N	%	CI	n	%	CI	n	%	CI	
Latrine layout													
Yes	716	68.58a	3.40	256	51.95b	6.12	202	75.74a	5.91	258	79.46a	4.93	***
No	716	31.42b	3.40	256	48.05a	6.12	202	24.26b	5.91	258	20.54b	4.93	***
Toilet facilities (if not)													
A Neighbor's place	217	17.97c	5.11	122	19.67a	7.05	47	17.02a	10.74	48	14.58a	9.98	NS
Public latrine	217	26.73b	5.89	122	22.95a	7.46	47	31.91a	13.33	48	31.25a	13.11	NS
Bush	217	43.78a	6.60	122	50.82a	8.87	47	29.79b	13.08	48	39.58ab	13.83	*
Other	217	11.98c	4.32	122	5.74c	4.13	47	23.4a	12.10	48	16.67a	10.54	**
Type of latrine													
Internal toilets	494	28.34b	3.97	135	29.63b	7.70	155	43.23a	7.80	204	16.18c	5.05	***
Ordinary pit	494	72.27a	3.95	135	71.85b	7.59	155	57.42c	7.78	204	83.82a	5.05	***
Other	494	0.2c	0.39	135	0a	0.00	155	0a	0.00	204	0.49a	0.96	NS
Where children's faeces are discarded													
Latrine	634	54.42a	3.88	223	40.81c	6.45	174	54.6b	7.40	237	67.09a	5.98	***
Garbage can	634	3.47c	1.42	223	3.59a	2.44	174	2.87a	2.48	237	3.8a	2.43	NS
Buried	634	6.94c	1.98	223	13.9a	4.54	174	2.87b	2.48	237	3.38b	2.30	***
Not applicable	634	24.92b	3.37	223	24.66a	5.66	174	30.46a	6.84	237	21.1a	5.19	NS
Bush	634	6.31c	1.89	223	12.11a	4.28	174	3.45b	2.71	237	2.95b	2.15	***
Other	632	5.05c	1.71	223	4.93a	2.84	174	6.9a	3.77	237	3.8a	2.43	NS
Sludge disposal technique													
By truck	716	23.74a	3.12	256	34.38a	5.82	202	16.83b	5.16	258	18.6b	4.75	***
Landfill	716	2.37c	1.11	256	0.39b	0.76	201	1.98ab	1.93	258	4.65a	2.57	**
Blocking and digging a new	716	13.55a	2.51	256	4.69c	2.59	202	11.39b	4.38	258	24.03a	5.21	***
Not yet	716	8.1b	2.00	256	3.12b	2.13	202	5.94b	3.26	258	14.73a	4.32	***
Other	716	2.51c	1.15	256	0b	0.00	202	4.95a	2.99	258	3.1a	2.11	*

*: $p < 0.05$; **: $p < 0.01$; ***: $p < 0.001$; NS: Not significant; CI: Confidence Interval, percentages in the same row followed by the same letter do not differ significantly at the 5% cut-off (for the inter-group comparison); percentages within a class in the same column followed by the same letter do not differ significantly at the 5% cut-off (for the overall percentage).

When the latrines were filled, households emptied the pits with emptying machines (23.74%) or blocked them and dug others (13.55%). Emptying of latrines is more done ($p < 0.05$) in group 1 (34.38%) than in group 2 (16.83%) and group 3 (18.6%). Furthermore, pits were more blocked ($p < 0.05$) in group 3 (24.03%) than in groups 1 (4.69%) and 2 (11.39%).

3.3.3. Spatial Distribution of Water Sources and Latrines

The results of the correspondence factor analysis (CFA) are presented in Figure 2. Three axes were used to interpret the CFA results ($\chi^2 = 1284.1$; $p < 0.001$).

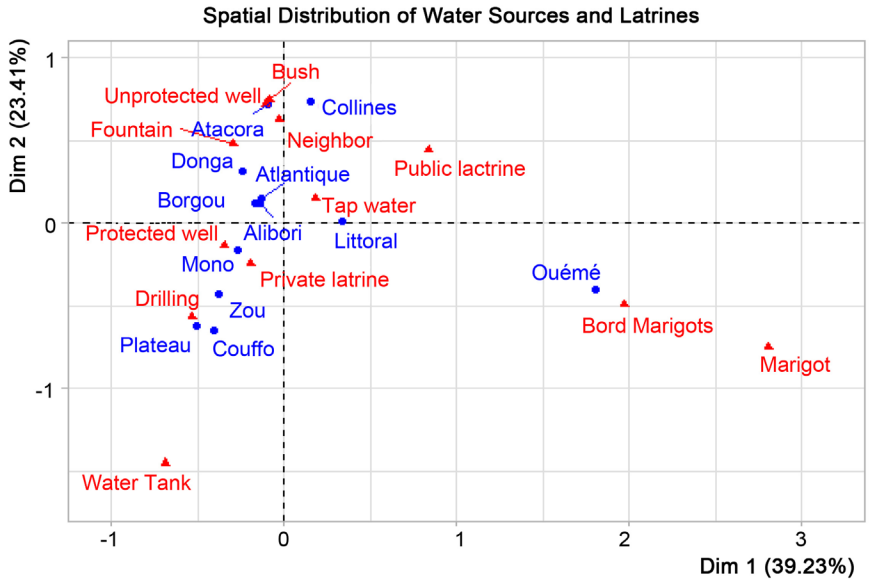

Figure 2. Spatial distribution of water sources and latrines.

These three axes correspond to a total inertia of 75.96% (39.23% on axis 1, 23.41% on axis 2 and 13.32% on axis 3). This exploration shows that pond water and the practice of getting a bath at the edge of water sources were more observed in the Ouémé. Cistern water is mainly used by the inhabitants of Couffo. Inhabitants of the Plateau, Zou, Mono, Alibori, and Atlantique departments used more water from boreholes and protected wells and had latrines. In Atacora and Donga, the populations used water from public drinking fountains and unprotected wells and made their needs in the bush and with their neighbors. Finally, the inhabitants of Borgou, Collines and Littoral used tap water and went to the toilet more often in public latrines and at neighbors' homes.

3.3.4. Management of Waste and Household Refuse

The majority of respondents (57.72%) had shower sumps. The remainder did not have and shower water flows around the houses and in the yard. The proportion of those with sumps in Group 2 was significantly higher ($p < 0.001$) than in Groups 1 and 3. In contrast, the proportion of households without sumps in groups 1 and 3 was significantly higher ($p < 0.05$) than in group 2.

Dishwater was poured more ($p < 0.05$) into the yard (45.08%) and street (32.02%) than into a sump (5.06%). Respondents in groups 1 (46.85%) and 2 (47.08%) poured more ($p < 0.05$) dishwater on the street than those in group 3 (5.47%). However, more ($p < 0.05$) dishwater was poured into a sump in group 2 (9.9%) than in group 1 (3.15%) and group 3 (3.11%).

Kitchen water was more ($p < 0.05$) poured in the yard (54.27%) than on the street (26.01%) and beside houses (8.67%). Respondents in group 3 (73.54%) and group 1 (62.5%) poured more ($p < 0.05$) kitchen water in the yard than those in group 2 (19.31%). The proportion of respondents in group 3 who poured kitchen water in the yard was significantly higher ($p < 0.05$) than in

group 1 (Table 8).

Overall, more than half of the households (54.11%) had garbage cans for solid waste. These garbage cans, for the most part (70.16%), were placed in the yard. It should be noted that a few respondents (18.85%) placed the garbage cans at the gate (Table 9). The majority of respondents who used garbage cans did not subscribe (83.26%) to garbage collection structure. The proportion of non-subscribers in Group 3 (93.83%) was significantly higher ($p < 0.05$) than in Group 2 (83.2%), which is in turn higher than the proportion of non-subscribers in Group 1 (73.06%). The majority (54.59%) of these non-subscribers emptied their garbage in landfills. More garbage was emptied ($p < 0.05$) in landfills in Group 3 (61.11%) than in Group 2 (45.03%).

3.3.5. Hand Washing

Household handwashing opportunities were before eating (96.36%), after eating (74.24%), after using the toilet (66.36%), and before preparing the meal (30.45%). The proportions of respondents who washed their hands on these various occasions varied significantly (Table 10). The most frequent occasion

Table 8. Disposal technique for different types of domestic wastewater.

Variable	General			Group 1			Group 2			Group 3			Chi² test
	n	%	CI	n	%	CI	n	%	CI	n	%	CI	
Shower water													
Sump	712	57.72a	3.63	254	53.54b	6.13	202	69.31a	6.36	256	52.73b	6.12	***
Court	712	8.29c	2.03	254	7.87b	3.31	202	1.98c	1.92	256	13.67a	4.21	***
Street	712	5.62d	1.69	254	7.48a	3.24	202	2.48a	2.14	256	6.25a	2.97	NS
Next to the house	712	20.65b	2.97	254	29.13a	5.59	202	6.44b	3.39	256	23.44a	5.19	***
Latrine	712	5.06de	1.61	254	1.97b	1.71	202	9.9a	4.12	256	4.3b	2.48	***
Other	712	3.09e	1.27	254	0.39b	0.77	202	9.9a	4.12	256	0.39b	0.76	***
Dish													
Sump	712	5.06d	1.61	254	3.15b	2.15	202	9.9a	4.12	256	3.13b	2.13	***
Court	712	45.08a	3.65	254	50.79b	6.15	202	7.43c	3.62	256	69.14a	5.66	***
Street	712	32.02b	3.43	254	46.85a	6.14	202	47.03a	6.88	256	5.47c	2.79	***
Next to the house	712	9.69c	2.17	254	1.97b	1.71	202	0.99b	1.37	256	24.22a	5.25	***
Other	712	11.1c	2.31	254	0.79b	1.09	202	38.12a	6.70	256	0b	0.00	***
Kitchen													
Court	715	54.27a	3.65	256	62.5b	5.93	202	19.31c	5.44	257	73.54a	5.39	***
Street	715	26.01b	3.22	256	35.16a	5.85	202	40.1a	6.76	257	5.84b	2.87	***
Next to the house	715	8.67d	2.06	256	1.17b	1.32	202	0.99b	1.37	257	22.18a	5.08	***
Other	715	13.01c	2.47	256	2.73b	2.00	202	42.57a	6.82	257	0c	0.00	***

***: $p < 0.001$; n: Enrolment; NS: Not significant; CI: Confidence Interval, percentages in the same row followed by the same letter do not differ significantly at the 5% cut-off (for intergroup comparison); percentages within a class in the same column followed by the same letter do not differ significantly at the 5% cut-off (for overall percentage).

Table 9. Householdgarbage management.

Variable	General			Group 1			Group 2			Group 3			Chi² test
	n	%	CI	n	%	CI	n	%	CI	n	%	CI	
Possession of garbage cans													
Yes	706	54.11a	3.68	256	59.77a	6.01	200	42b	6.84	250	58a	6.12	***
No	706	45.89b	3.68	256	40.23b	6.01	200	58a	6.84	250	42b	6.12	***
Location of garbage													
In the yard	382	70.16a	4.59	150	70.67a	7.29	85	70.59a	9.69	147	69.39a	7.45	NS
At the gate	382	18.85b	3.92	150	22a	6.63	85	16.47a	7.89	147	17.01a	6.07	NS
Outside the home	382	8.64c	2.82	150	4b	3.14	85	9.41ab	6.21	147	12.93a	5.42	*
Other	382	2.88d	1.68	150	3.33a	2.87	85	3.53a	3.92	147	2.04a	2.29	NS
Subscription for garbage collection													
Yes	661	16.64b	2.84	245	26.94a	5.56	173	16.76b	5.57	243	6.17c	3.03	***
No	661	83.26a	2.85	245	73.06c	5.56	173	83.24b	5.57	243	93.83a	3.03	***
Place of garbage disposal (non-subscribers)													
Street	588	7.14b	2.08	183	6.01b	3.44	171	14.62a	5.30	234	2.61b	2.06	***
Gutters	588	0.34c	0.47	183	0.55a	1.07	171	0a	0.00	234	0.43a	0.84	NS
Dump sites	588	54.59a	4.02	183	55.19ab	7.21	171	45.03b	7.46	234	61.11a	6.25	**
Landfill	588	7.48b	2.13	183	9.84a	4.32	171	4.09a	2.97	234	8.12a	3.50	NS
Incineration	588	0.51c	0.58	183	0a	0.00	171	1.75a	1.97	234	0a	0.00	NS
Bush	588	7.31b	2.10	183	10.38a	4.42	171	29.08a	6.81	234	5.98a	3.04	NS
Other	588	10.2b	2.45	183	7.65b	3.85	171	16.96a	5.62	234	7.26a	3.02	**
Breeding in the yard													
Yes	716	45.25b	3.65	256	44.53b	6.09	202	33.66c	6.52	258	55.04a	6.07	***
No	716	54.75a	3.65	256	55.47b	6.09	202	66.34a	6.52	258	44.96c	6.07	***

*: $p < 0.05$; **: $p < 0.01$; ***: $p < 0.001$; n: Enrolment; NS: Not significant; CI: Confidence Interval, percentages in the same row followed by the same letter do not differ significantly at the 5% cut-off (for the inter-group comparison); percentages within a class in the same column followed by the same letter do not differ significantly at the 5% cut-off (for the overall percentage).

for handwashing was before eating and the least frequent occasion was during meal preparation. Respondents in groups 1 and 2 washed their hands after using the toilet more than those in group 3. This washing was done with water (96.8%) and soap (86.63%) without disinfectant.

4. Discussion

4.1. Level of Knowledge on Cholera

4.1.1. Signs and Transmission of Cholera

The majority of respondents heard of cholera because the disease is not new and is epidemic in Benin. Indeed, from 2009 to 2015, Benin experienced an estimated 3860 cases of cholera [9]. The symptoms of cholera according to the respondents were diarrhea and vomiting, confirming that they have information

Table 10. Hand washing.

Variable	General			Group 1			Group 2			Group 3			Chi² test
	n	%	CI	n	%	CI	n	%	CI	n	%	CI	
Hand washing moments													
Before eating	660	96.36a	1.43	230	97.39a	2.06	187	95.19a	3.07	243	96.3a	2.37	NS
After eating	660	74.24b	3.34	230	77.83a	5.37	187	76.47a	6.08	243	69.14a	5.81	NS
After using the toilet	660	66.36c	3.60	229	69.57a	5.96	187	72.19a	6.42	243	58.85b	6.19	**
Before preparing food	660	30.45d	3.51	230	30.87a	5.97	187	28.34a	6.46	243	31.69a	5.85	NS
Hand washing products													
Soap	688	86.63b	2.54	238	87.39a	4.22	197	85.28a	4.95	253	86.96a	4.15	NS
Water	688	96.8a	1.32	238	96.22a	2.42	197	96.45a	2.58	253	97.63a	1.87	NS
Other	688	0.58c	0.57	238	1.26a	1.42	197	0a	0.00	253	0.4a	0.78	NS

**: $p < 0.01$; n: Enrolment; NS: Not significant; CI: Confidence Interval, percentages in the same row followed by the same letter do not differ significantly at the 5% cut-off (for the intergroup comparison); percentages within a class in the same column followed by the same letter do not differ significantly at the 5% cut-off (for the overall percentage).

about the disease. According to Boya *et al.* [10] and Roux *et al.* [11], the main symptoms of cholera are diarrhea, vomiting, and dehydration. Dehydration was reported very little by respondents because the word is more technical; the respondents were mostly uneducated or reached the primary school level. Some respondents have a good knowledge of the mode of transmission of the disease. Consumption of unclean food or contaminated water, dirty hands and lack of hygiene were mentioned as modes of transmission. However, a significant number of respondents (47%) were unaware of the mode of transmission of cholera. They should therefore be made aware of this disease.

4.1.2. Means of Fighting Cholera

The populations do not master the means of preventing cholera. This situation can be explained by their very low level of education. Moreover, in case of illness, they turn to health centers. However, the respondents claim that this disease can be avoided while ignoring the means of fighting. This analysis of the respondents is not erroneous because the disease can be prevented if household hygiene measures are improved [10] [11].

4.2. Hygiene Practice in Households

4.2.1. Household Water Supply and Use

The different water sources reported in this study have already been reported in Benin [12] [13]. The majority use of SONEB's water shows that the respondents live mainly in peri-urban areas that have access to this water thanks to the extension of SONEB's water networks in recent years. On the other hand, in some localities and given the lack of means, access to this water is very difficult and the inhabitants use water from boreholes, wells, ponds and cisterns [12] [14] [15]. This justifies the variation in water sources between departments. This is the

case of the commune of Aguégués in the Ouémé where the inhabitants mainly use surface water (river water). The same observation has already been made by Dan *et al.* [16] in this commune. While efforts are made in rural areas to ensure good water quality [14], some water sources such as wells, ponds, cisterns and boreholes contain pathogenic microorganisms, notably fecal Streptococci, *Salmonella*, fecal Coliforms, *Escherichia coli, shigella*, *Clostridium perfringens* and *Proteus* spp. [16] [17] [18] [19] [20]. However, borehole water is considered potable; contamination of this water sometimes occurs in the environment and during transport [14] [19]. In sum, rainwater consumed in the couffo, marigot water consumed in the Ouémé, and well water consumed in the Atacora and Donga must be properly treated before consumption to avoid cholera. For water treatment, actions should focus on the market garden water in group 1, unprotected well water in group 2 and protected well water in group 3.

Water was mainly used for vital needs such as human consumption and showering as reported by Vissin *et al.* [12]. Some households in groups 2 and 3 did not collect water for showering and sometimes showered in the backwaters. This practice was reported by Vissin *et al.* [12] in South Benin. It is not recommended because these waters are not only loaded with microbial agents but also contain animals that are harmful to humans [19] [21]. These microbes often come from runoff, trucks, wild and domestic animals, etc. [21]. One of the diseases caused by this practice is dracunculiasis caused by gastropods entering the body of those who bathe in contaminated water [12]. Given the poor quality of well and pond water, users should disinfect it before use. Reported water storage in most households shows that water is sometimes not nearby [22], and they should be careful with water transport equipment to limit external contamination [23]. To reduce such contamination, Amoukpo *et al.* [23] recommend the use of a single container with a tap for transport and storage.

4.2.2. Management of Sanitation Facilities

Group 1 respondents had fewer latrines than those in groups 2 and 3. The latter were mainly from the departments of Atacora, Ouémé, and Littoral, where some inhabitants did not have latrines and passed stool in the bush and at the water'sedge. The profile of the respondents justifies the lack of latrines in these localities because the Ouémé and Littoral departments are sufficiently developed to have latrines. In fact, the surveys in the Ouémé were conducted in the Aguégués, Dangbo and Sèmè-Podji, which are less developed communes (except Sèmè-Podji) in the department. The inhabitants do not have the means to afford latrines. Moreover, ordinary latrines are sometimes difficult to dig because of the presence of water. The same is true for the Littoral department where surveys were carried out in Djidjè, Ladji and Avotrou. Toilets and the disposal of feces by children in the bush pose sanitary and hygienic problems because the feces and the parasites they contain are washed away by rainwater into the marigots and onto the crops [17] [24] [25]. Sometimes this runoff also contaminates well water in case of flooding [17] [18]. This risk is higher for feces deposited at the

edges of marigots in the Ouémé (Aguégués).

The practice of blocking latrines when they are filled is bad because it will eventually lead to several fecal pits in the concession. This multiplication of feces is a danger to households because liquids containing pathogens can seep into wells used for family water supply [20] [26]. Consumption of this water causes not only waterborne diseases but also cholera [27].

4.2.3. Household Waste Management and Hand Hygiene

The lack of wastewater collection systems observed in some households (kitchen water, shower water) was also reported in households in Benin and Ivory Coast [28] [29] [30]. As in this study, this water was poured in the wild mostly in the immediate environment of the inhabitants and constitutes an enormous health risk for the population. The same observation was made by Hountondji *et al.* [31] in Southern Benin. The diseases to which the population is exposed are malaria, diarrheal diseases (cholera), dermatoses and typhoid fever [29] [30].

A significant number of people, especially in group 2, do not have garbage cans for household waste management. This lack of garbage cans means that garbage is often deposited in the countryside near households [32] [33] and is a source of nuisance for the household, especially for children who frequent these places to play or to recover discarded objects [34]. Respondents who have garbage cans do not subscribe to garbage collection services. This lack of subscription is linked not only to the availability of these services throughout the country but also to the lack of resources and the level of education of respondents [33] [35]. The majority of respondents were uneducated or with a primary school education, whereas the level of education influences the decision to subscribe to the garbage collection structures [35]. The absence of a subscription obliged the majority of respondents, especially in group 3, to empty the garbage cans directly at the sometimes-unofficial dumps that pollute environment and the immediate living environment. The dangers associated with this practice are not far removed from those associated with dumping garbage on the street in group 2. These dangers are mainly related to environmental degradation and diseases such as gastroenteritis, cholera, dysentery, intestinal parasitosis, bilharzia, yellow fever, eye infections, salmonellosis, and leptospirosis [32] [34] [35] [36].

Most respondents (especially in groups 1 and 2) do not wash their hands after using the toilet, and these individuals are at risk of illness because hands can carry microbial agents that will enter the body on various occasions. This lack of handwashing among these people is believed to be related to the type of regular latrine that does not have handwashing facilities.

4.4. Risk Factors for Cholera Outbreaks in Households

The risk factors associated with the occurrence of cholera identified in this study include lack of hygiene. These factors include consumption of poor-quality water (surface and well water), storage of water in uncovered containers, lack of latrines, poor waste management, and lack of handwashing before eating and after

using the toilet. These risk factors have already been identified in various studies [10] [11] [37] [38]. Their persistence shows that households need to be made more aware of the dangers they face.

5. Conclusion

This study identified three groups of people based on hygiene practices. These practices are not sufficient in all groups and do not provide protection from cholera. Beninese people know very well this disease because of its seriousness. However, they unfortunately do not respect all the preventive measures to eradicate it. The lack of hygiene that promotes its emergence and transmission is still the prerogative of many households. These include the use of water of insufficient quality, lack of latrines in households, lack of subscription to garbage collection structures, lack of hand washing, and poor wastewater management. In response to these cholera epidemics, it would be advisable to deploy control measures involving three major components: treatment, improvement of the health situation, and health education.

Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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