



A retrospective study on cholera understanding and WASH (water, sanitation, and hygiene) behavior among adolescents in three regions of La Gonâve, Haiti



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ABSTRACT

Backgrounds: This study assesses the impact of Water, Sanitation, and Hygiene (WASH) interventions on cholera understanding and hygiene practices in La Gonâve Island, Haiti. It examines the changes after implementing interventions in seven villages across the Downtown, Mountain, and Seaside regions.

Methods: A retrospective investigation surveyed 210 school students from each region using a validated questionnaire. It assessed knowledge, attitudes, practices (KAP), and environmental aspects related to cholera and hygiene. Data analysis involved descriptive statistics and chi-square tests.

Results: The study highlights significant disparities in education levels, toilet ownership, and healthcare access. Challenges in finding public toilets (86.67%) and accessing water sources (67.78%) are consistent across regions, with Seaside facing financial constraints (85.00%) and water cost concerns (91.67%). Attitudes toward hygiene vary, with the Mountain region having the highest 'Never' responses for hand-washing (38.89%), and Downtown leading in water treatment practices (11.67%). There is a strong willingness to share health knowledge, particularly in Downtown (100.00%). Seaside (83.33%) and Downtown (73.33%) revealed a higher cholera awareness, while nearly half of Mountain students lacked knowledge (54.44%).

Conclusions: This study highlights significant disparities in WASH practices among La Gonâve's adolescents in Downtown, Mountain, and Seaside regions. Urgent interventions are crucial for improving sanitation, ensuring clean water access, and implementing targeted hygiene education, especially in the resource-constrained Mountain and Seaside areas. The findings underscore the vital roles of adolescents and schools in disseminating knowledge, with further research needed to explore intervention differences.

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Background

The intersection of Cholera and WASH (Water, Sanitation, And Hygiene) represents a critical nexus where understanding and addressing waterborne diseases, particularly Cholera, necessitate comprehensive strategies encompassing improved water sources,

sanitation facilities, and hygiene practices to ensure public health and prevent the spread of infectious diseases [1–3].

La Gonâve, marginalized by the Haitian government, faces challenges such as transportation issues, isolation, and systemic problems like economic crisis and political unrest, which increase the risk of disease resurgence [4–7]. Residents face persistent poverty, inadequate infrastructure, limited access to clean water, lack of electricity, and insufficient transportation options [8]. The island's rugged topography, with rough terrain and scarce freshwater sources, contributes to water scarcity, posing significant challenges to public health, especially with cholera [9]. Neglected in public health aid, La Gonâve remains vulnerable to disease outbreaks [4],

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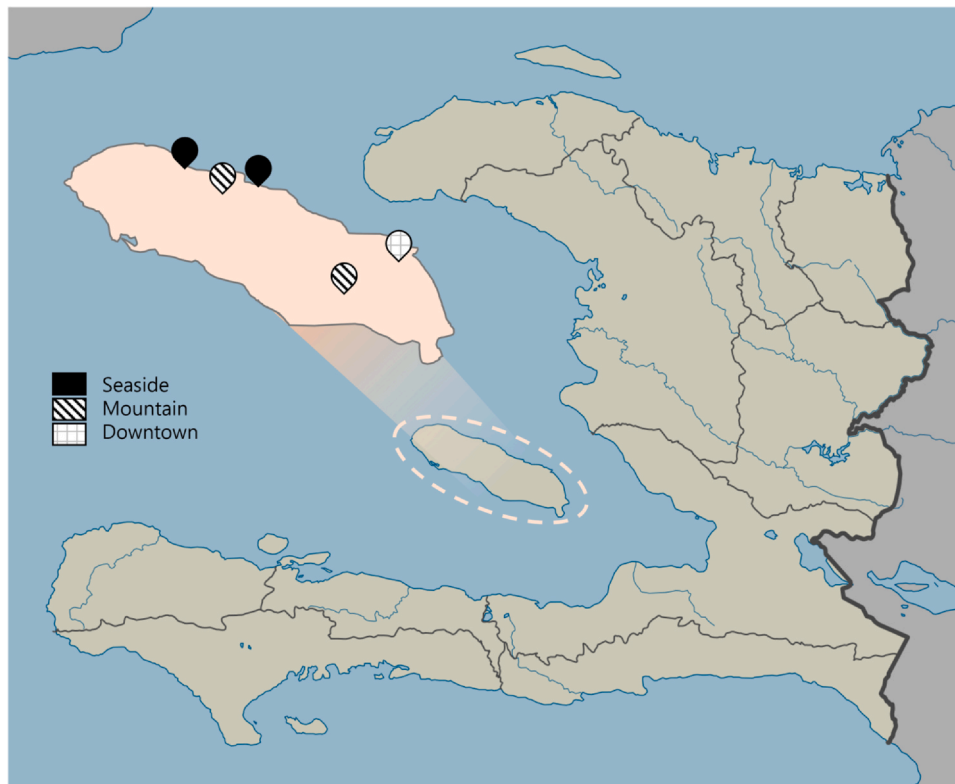


Fig. 1. Map of La Gonave Island, Haiti, Divided by Three Study Regions (Reproduced from Google Maps. Available from: https://commons.wikimedia.org/wiki/File:Haiti_location_map.svg. Accessed June 17, 2022.).

lacking public utilities [8] and with a toilet ownership rate below 7%, leading to open defecation (Supplementary material 1). Deforestation for charcoal production, the primary economic activity, exacerbates the island's the water scarcity [6]. So rainwater, the primary source, underscores the essential role of rainwater catcher tanks in the community [10].

La Gonave, Haiti's largest island, is geographically divided into two main regions, further subdivided into 11 sub-regions according to a specific study [6]. Due to the dispersion of the study population on the island, this study further categorizes the island into three primary areas: Downtown, Mountain, and Seaside regions. Each of these regions faces its unique set of challenges, primarily due to geographical isolation and a lack of proper infrastructural facilities.

Global Care International has implemented WASH interventions in La Gonave since 2014, focusing on preventive education. This study examines regional differences on the island and aims to gather improved retrospective data to inform policies addressing environmental weaknesses. It focuses on understanding the knowledge, attitudes, and practices related to WASH and cholera, considering environmental characteristics in different regions.

Methods

Study area

The study area consists of three main regions: Downtown, Mountain, and Seaside region. For this study, the most commonly used spelling based on local Haitian Creole pronunciation was adopted [11]. Fig. 1 illustrates the geographical locations of the Downtown, Mountain, and Seaside areas, categorized into three distinct study areas. Table A1 provides an overview of the study area, offering approximate data on demographics like sex ratio, income highest education level, and literacy. It also includes information on hardware infrastructure such as toilets, schools, clinics, and religious

facilities, as well as details on utilities like electricity, water supply, sewerage facilities, wells, and more.

The Downtown region serves as a port city and serves as the economic and administrative center of the island. Consequently, it is the most populous area, relatively affluent, and has better infrastructure. The mountain regions feature steep slopes that pose challenges for transportation, having the smallest population and face significant water scarcity and limited access to medical support. Lastly, the Seaside regions have the lowest monthly income and inadequate infrastructure, however, they have relatively more water sources available.

Study design

The study design employed for this research was a descriptive cross-sectional study. The socio-demographic characteristics of the subjects, including age, gender, literacy, religion, household head education, and ownership, were assessed. The WASH indicators included the hygiene environment, access to safe water and sanitation facilities, hygiene knowledge and practices, experiences with cholera, and basic knowledge about cholera. The participation of students in each school, whether they had received WASH intervention through the project or not, was conducted randomly. The analysis determined that a total of 207 study participants were required to achieve a medium effect size, a type 1 error of 0.05, and a power of 0.90 within the current study design [12]. Each school had 30 participants, resulting in a total sample size of 210 students (Table A2).

Questionnaire and analysis

The questionnaire used in this study was developed based on relevant literature on WASH and cholera intervention. The content of the questionnaire underwent a thorough review by public health practitioners and professionals to ensure its validity [13–16]. Prior to

Table 1
Characteristics of study population.

Characteristics	N (%)				χ^2
	Total (N = 210)	Downtown (N = 60)	Mountain (N = 90)	Seaside (N = 60)	
Age					
11–14	48(22.86)	11(18.33)	24(26.67)	13(21.67)	
15–19	144(68.57)	48(80.00)	59(65.56)	37(61.67)	
20–25	18(8.57)	1(1.67)	7(7.78)	10(16.67)	10.8160*
Sex					
Female	104(49.52)	29(48.33)	46(51.11)	29(48.33)	
Male	106(50.48)	31(51.67)	44(48.89)	31(51.67)	0.1587
Household head education					
None	41(19.52)	7(11.67)	29(32.22)	5(8.33)	
Primary school	73(34.76)	14(23.33)	27(30.00)	32(53.33)	
Secondary school	89(42.38)	38(63.33)	30(33.33)	21(35.00)	
Higher	7(3.33)	1(1.67)	4(4.44)	2(3.33)	31.5314***
Literacy					
No	79(37.62)	16(26.67)	40(44.44)	23(38.33)	
Yes	131(62.38)	44(73.33)	50(55.56)	37(61.67)	4.8667
Religion					
Catholic	35(16.67)	2(3.33)	24(26.67)	9(15.00)	
Christianity	141(67.14)	49(81.67)	56(62.22)	36(60.00)	
Voodoo	17(8.10)	5(8.33)	6(6.67)	6(10.00)	
None	16(7.62)	3(5.00)	4(4.44)	9(15.00)	
Missing	1(0.48)	1(1.67)	0(0.00)	0(0.00)	23.5863**
Toilet at home					
No	110(52.38)	10(16.67)	50(55.56)	50(83.33)	
Yes	100(47.62)	50(83.33)	40(44.44)	10(16.67)	54.0909***
Rain catcher tank					
No	171(81.43)	44(73.33)	74(82.22)	53(88.33)	
Yes	39(18.57)	16(26.67)	16(17.78)	7(11.67)	4.5292
Accessibility of healthcare					
No	77(36.67)	8(13.33)	42(46.67)	27(45.00)	
Yes	133(63.33)	52(86.67)	48(53.33)	33(55.00)	19.7368***

*P < 0.05, **P < 0.01, ***P < 0.001

the survey, a pre-seminar was conducted at the Global Care Haitian office, where staff and local community health workers were briefed on the purpose and procedure of the survey. They were provided with detailed information, familiarized with necessary precautions, and given the opportunity to ask questions. Local translators were employed to translate the handwritten data from Haitian Creole to English, with a third translator reviewing for clarity if discrepancies were noticed. Descriptive statistics, including frequencies and means, were calculated to provide a concise overview of the data. The chi-square test, a statistical method employed to ascertain significant associations between categorical variables, was utilized in this study. Specifically, the chi-square test was applied to evaluate potential differences in Knowledge, Attitudes, and Practices (KAP) concerning WASH (Water, Sanitation, and Hygiene) variables among the three regions [16]. All statistical analyses were performed using STATA (version 14.0; Stata Corp, College Station, TX, USA).

This study has been approved by the Institutional Ethical Review Board of Korea National Institute for Bioethics Policy (P01–202205–01–008). Written consent forms were obtained from participants by the facilitator of each team prior to conducting each survey. The study took appropriate measures to obtain consent, ensuring that participants were fully informed about the purpose and procedures of the study.

Results

In this study, 210 respondents participated, with an almost equal distribution of males and females aged between 15 and 19. There were significant differences in education levels among the regions, with higher education levels observed in the downtown (65.00%) compared to the mountain and seaside regions (62.00% and 63.00%, respectively). Christianity was the dominant religion across all regions. Approximately half of the respondents (47.62%) had access to

a toilet at home, with the downtown having the highest proportion of toilet ownership (83.33%). Access to healthcare services was also highest in the downtown (86.67%), while the mountain and seaside regions had relatively lower access.

Table 2 highlights significant variations in hygiene and sanitation experiences among the Downtown, Mountain, and Seaside regions. The majority of respondents (86.67%) faced challenges finding public toilets, with consistent patterns across regions. Difficulties accessing water sources were reported by 54.76% of respondents, with the Mountain region facing the highest difficulties (67.78%). Rainwater was the primary source in all regions. Financial constraints were a significant barrier to public toilets availability (74.76%), especially in the Seaside region (85.00%). Concerns about water expenses were highest in the Seaside region (91.67%). A significant proportion (66.18%) reported falling ill due to a lack of clean water, particularly in the Downtown region (88.33%). The Mountain region had the highest percentage (75.56%) of respondents experiencing at least one episode of diarrhea per year. Encounter with cholera patients was the most reported in the Mountain region (66.67%).

Table 3 highlights differences in attitudes and willingness to practice hygiene across regions. The Mountain region has the highest proportion of respondents answering 'Never' to handwashing when going out and returning (38.89%), followed by Seaside (15.00%) and Downtown (14.56%). Similarly, for handwashing with soap after using the toilet, the Mountain region (31.11%) had the highest 'Never' responses, followed by Seaside (6.67%) and Downtown (5.00%). Overall, only 20.57% consistently wash their hands when going out and returning, and 37.62% always wash their hands with soap after using the toilet. 'No soap' was cited as primary reason for not washing hands in both situations (Table A3).

Regarding the question of routine water treatment in the community, the Downtown (11.67%) had the lowest proportion of respondents who never treat their water, followed by Seaside (31.67%)

Table 2
Differences in environment and sanitation experiences.

Questions	N (%)				χ^2
	Total	Downtown	Mountain	Seaside	
Public toilets easily around you?					
No	182(86.67)	49(81.67)	83(92.22)	50(83.33)	
Yes	28(13.33)	11(18.33)	7(7.78)	10(16.67)	4.2788
I think we have so few public toilets due to lack of money					
No	41(19.52)	15(25.00)	22(24.44)	4(6.67)	
Yes	157(74.76)	40(66.67)	66(73.33)	51(85.00)	11.8707*
I feel the comfort of my surroundings when I defecate.					
No	147(70.00)	30(50.00)	69(76.67)	48(80.00)	
Yes	63(30.00)	30(50.00)	21(23.33)	12(20.00)	16.1905***
Can find water source easily around you?					
Hard	115(54.76)	31(51.67)	61(67.78)	23(38.33)	
Normal	74(35.24)	22(36.67)	22(24.44)	30(50.00)	
Easy	21(10.00)	7(11.67)	7(7.78)	7(11.67)	13.3449**
Main water source?					
Rainwater	123(58.57)	28(46.67)	67(74.44)	28(46.67)	
Pumps	45(21.43)	21(35.00)	5(5.56)	19(31.67)	
Water hole	5(2.38)	1(1.67)	3(3.33)	1(1.67)	
Market	35(16.67)	8(13.33)	15(16.67)	12(20.00)	31.8491***
Drinking water source?					
Rainwater	122(58.10)	29(48.33)	67(74.44)	26(43.33)	
Pumps	52(24.76)	20(33.33)	12(13.33)	20(33.33)	
Rain & pump	2(0.95)	2(3.33)	0(0.00)	0(0.00)	
Market	31(14.76)	6(10.00)	11(12.22)	14(23.33)	32.4845***
Feeling safe to drink water?					
No	157(74.76)	36(60.00)	68(75.56)	53(88.33)	
Yes	51(24.29)	24(40.00)	21(23.33)	6(10.00)	15.3277**
Have you ever gotten sick because you had no clean water?					
No	70(33.82)	7(11.67)	38(42.22)	25(43.86)	
Yes	137(66.18)	53(88.33)	52(57.78)	32(56.14)	18.5628***
How many times do you have massive diarrhea a year?					
None	84(40.00)	23(38.33)	22(24.44)	39(65.00)	
1–2	70(33.33)	26(43.33)	27(30.00)	17(28.33)	
3 ≤	56(26.67)	11(18.33)	41(45.56)	4(6.67)	40.0153***
Think about the Price of Water					
Expensive	142(67.62)	37(61.67)	50(55.56)	55(91.67)	
Regular	25(11.90)	2(3.33)	21(23.33)	2(3.33)	
Cheap	26(12.38)	15(25.00)	9(10.00)	2(3.33)	
Don't know	17(8.10)	6(10.00)	10(11.11)	1(1.67)	41.1019***
Have you ever seen a cholera patient?					
Never	105(50.24)	45(75.00)	30(33.33)	30(50.85)	
Normally	89(42.58)	10(16.67)	51(56.67)	28(47.46)	
Always	15(7.18)	5(8.33)	9(10.00)	1(1.69)	30.0131***

*P < 0.05, **P < 0.01, ***P < 0.001

Table 3
Practices and perceptions of hygiene.

Questions	N (%)				χ^2
	Total	Downtown	Mountain	Seaside	
Do you wash your hands when you go out and return?					
Never	52(24.88)	8(13.56)	35(38.89)	9(15.00)	
Normal	114(54.55)	33(55.93)	38(42.22)	43(71.67)	
Always	43(20.57)	18(30.51)	17(18.89)	8(13.33)	22.7264***
I wash my hands with soap after using the toilet.					
Never	35(16.67)	3(5.00)	28(31.11)	4(6.67)	
Normal	96(45.71)	30(50.00)	20(22.22)	46(76.67)	
Always	79(37.62)	27(45.00)	42(46.67)	10(16.67)	53.2763***
Do people in your community routinely treat their water?					
Never	57(27.14)	7(11.67)	31(34.44)	19(31.67)	
Normal	133(63.33)	45(75.00)	50(55.56)	38(63.33)	
Always	20(9.52)	8(13.33)	9(10.00)	3(5.00)	11.887*
For the people who treat their water, is it easy to get these products?					
No	172(81.90)	46(26.74)	72(41.86)	54(31.40)	
Yes	36(17.14)	14(38.89)	18(50.00)	4(11.11)	11.3320*
Willing to share medical knowledge					
No	26(12.38)	0(0.00)	17(18.89)	9(15.00)	
Yes	184(87.62)	60(100.00)	73(81.11)	51(85.00)	12.3714**

*P < 0.05, **P < 0.01, ***P < 0.001

Table 4
Experiences and knowledge of cholera and diarrhea.

Questions	N (%)			χ^2
	Total	Downtown	Mountain Seaside	
Have you ever attended a cholera education meeting?				
No	92(43.81)	22(36.67)	55(61.11)	15(25.00)
Yes	115(54.76)	38(63.33)	33(36.67)	44(73.33)
I think the cause of diarrhea is bad food				
No	46(21.90)	22(36.67)	18(20.00)	6(10.00)
Yes	164(78.10)	38(63.33)	72(80.00)	54(90.00)
I think the cause of diarrhea is untreated water				
No	69(32.86)	10(16.67)	44(48.89)	15(25.00)
Yes	141(67.14)	50(83.33)	46(51.11)	45(75.00)
I think the cause of diarrhea is dirty environment				
No	191(90.95)	47(78.33)	87(96.67)	57(95.00)
Yes	19(9.05)	136(21.67)	3(3.33)	3(5.00)
Do you know what cholera is exactly?				
No	75(35.71)	16(26.67)	49(54.44)	10(16.67)
Yes	134(63.81)	44(73.33)	40(44.44)	50(83.33)
I think the cause to spread cholera is dirty water				
No	113(53.81)	30(50.00)	70(77.78)	13(21.67)
Yes	96(45.71)	30(50.00)	20(22.22)	46(76.67)
Main symptom of Cholera? -watery diarrhea				
No	53(29.12)	9(18.00)	41(53.25)	3(5.45)
Yes	129(70.88)	41(82.00)	36(46.75)	52(94.55)
Main symptom of Cholera? -vomiting				
No	63(34.62)	16(32.00)	42(54.55)	5(9.09)
Yes	119(65.38)	34(68.00)	35(45.45)	50(90.91)
Can someone die from cholera?				
Never	79(37.62)	22(36.67)	43(47.78)	14(23.33)
Normal	43(20.48)	17(28.33)	24(26.67)	2(3.33)
Always	88(41.90)	21(35.00)	23(25.56)	44(73.33)
Do you think practicing open defecation may be a way to spread cholera?				
Never	124(60.78)	22(36.67)	62(69.66)	40(72.73)
Normal	56(27.45)	26(43.33)	21(23.60)	9(16.36)
Always	24(11.76)	12(20.00)	6(6.74)	6(10.91)

*P < 0.05, **P < 0.01, ***P < 0.001

and Mountain (34.44%). Among those who treat their water, 81.90% of respondents from all three regions reported that it was not easy to obtain the necessary treating products. When asked if they are willing to share health knowledge related to hygiene, 87.62% of respondents from all three regions answered that they are eager to do so, with Downtown (100.00%) having the highest proportion of respondents answering 'Yes', followed by Seaside (85.00%) and Mountain (81.11%).

Table 4 illustrates variations in experiences and knowledge related to cholera across the three different regions. Notably, the Seaside region (73.33%) had the highest proportion of students who attended cholera education, followed by Downtown (63.33%), while the Mountain region (36.67%) had a relatively lower attendance rate. Overall, students in the Seaside and Downtown regions displayed a higher proportion of correct answers to cholera-related questions compared to their counterparts in the Mountain region. In terms of cholera knowledge, a significant majority of students in the Seaside region (83.33%) and Downtown (73.33%) indicated familiarity with cholera. In contrast, nearly half of the students in the Mountain region (54.44%) reported a lack of knowledge about cholera. Similarly, when asked about watery diarrhea as the main symptom of cholera, the majority of Seaside (94.55%) and Downtown (82.00%) students answered 'Yes', while half of the Mountain students (53.25%) answered 'No'. Similarly, for the question of vomiting as the main symptom of cholera, the majority of Seaside (90.91%) and Downtown (68.00%) students answered 'Yes', but half of Mountain students (54.55%) answered 'No'. Regarding the understanding of the fatality of cholera, Seaside (73.33%) had the highest proportion of students who answered 'Always', followed by Downtown (35.00%) and Mountain (25.56%).

When asked about the relationship between untreated water and diarrhea, the majority of Seaside (75.00%) and Downtown (83.33%)

students answered 'Yes', while half of the Mountain students (51.11%) gave the same response. Regarding the perception of a dirty environment as a cause of diarrhea, diarrhea, the majority of students from all three regions (90.95%) answered 'No', with only a few students responding 'Yes', mainly in Downtown (21.67%), Mountain (3.33%), and Seaside (5.00%). In terms of the belief that open defecation can cause the cholera transmission, Downtown (20.00%) had the highest proportion of students answering 'Always', followed by Seaside (10.91%) and Mountain (6.74%). The results from Tables 1, 2, and 3 collectively underscore significant regional disparities in demographics, hygiene practices, and sanitation experiences across the Downtown, Mountain, and Seaside regions, aligning with the research objectives. The findings reveal challenges in infrastructure, water access, and hygiene practices, emphasizing the urgent need for targeted interventions.

Discussion

This study aimed to explore the practices and perception of hygiene among adolescents in La Gonâve, Haiti, with a focus on three regions: Downtown, Mountain, and Seaside. The findings revealed notable disparities between the regions in terms of knowledge, attitudes, practices, and environmental aspects related to cholera and WASH. The Downtown exhibited better infrastructure, higher household education levels, and greater access to healthcare services. In contrast, the Mountain region faced challenges with infrastructure related to geography and water scarcity, and the Seaside region, had lower monthly income and inadequate infrastructure. These regional differences reflect the longstanding marginalization and isolation of La Gonâve, exacerbating the health vulnerabilities of its residents.

Respondents across all regions reported difficulties in finding public toilets and accessing clean water sources, indicating inadequate sanitation infrastructure and limited availability of safe drinking water. The reliance on unsustainable water collection methods, such as rainwater, further highlights the severity of water scarcity.

This study's key finding highlights a significant disparity in access to basic hygiene facilities and services among the three regions. In contrast to Bourzac, B (2017), who emphasized the lack of infrastructure as a primary challenge in project implementation on La Gonâve [9], our study further elucidates this issue. Respondents across all regions reported difficulties in finding public toilets and accessing clean water sources, indicating inadequate sanitation infrastructure and limited availability of safe drinking water. The reliance on unsustainable water collection methods, such as rainwater, further underscores the severity of water scarcity. Additionally, in comparison to Guillaume Y, et al. (2019), who reported people resorting to using unsafe water, such as unpurified river water, when safe water sources are inaccessible [17], our study provides a nuanced understanding of the challenges faced in hygiene practices and sanitation experiences within the studied regions. WHO data from 2010 also align with our findings, revealing a low percentage of the population with access to improved water sources and sanitation facilities in Haiti [18]. These distinctions emphasize the unique contributions of our study in shedding light on the specific regional dynamics of water and sanitation challenges in La Gonâve.

Differences in toilet ownership and rain catcher tank usage among regions further emphasize the inequalities in access to sanitation facilities [18]. The Downtown shows the highest rates of ownership and usage, indicating better infrastructure and resources. Conversely, the Mountain and Seaside regions exhibited lower rates, highlighting the need for improved sanitation infrastructure and access to clean water sources. Similar regional disparities were identified in a study conducted by Gage, A. J., & Calixte, M. G. (2006), which revealed environmental disparities between mountainous and non-mountainous regions [19].

Furthermore, the Mountain and Seaside regions exhibit a higher prevalence of feeling unsafe while defecating and consuming drinking water compared to Downtown. This suggests that poor infrastructure, such as a lack of toilets or accessible water sources, may contribute to a heightened sense of insecurity and an unsafe environment. Open defecation, driven by the absence of proper sanitation facilities, poses hygiene and security risks, particularly for adolescents [20]. Bourzac, B. (2017) also emphasizes the need for infrastructure improvement in La Gonâve as the demand for environmental support is high but faces challenges due to a lack of access [9]. In summary, this study highlights the urgent need for interventions to improve hygiene practices and access to clean water and sanitation facilities in La Gonâve, especially in the Mountain and Seaside regions.

One key finding of this study is the difference in awareness and knowledge of cholera and hygiene practices among the three regions. Downtown and Seaside students reported having knowledge about cholera, while approximately half of the Mountain students lacked about cholera. This knowledge gap highlights limited educational opportunities in the Mountain region, hindering the dissemination of information and access to resources for disease prevention. Identifying these disparities is crucial to design targeted educational campaigns and interventions for each region.

Significant variations in hygiene practices were observed among the regions, with many respondents displaying a lack of awareness and adherence to basic hygiene practices, contributing to the spread of infectious diseases. The study found that a considerable proportion of respondents never wash their hands when going out, returning, or after using the toilet. The Mountain region had a higher proportion of respondents in who reported never washing their

hands, indicating the need for targeted hygiene education and intervention.

Moreover, most students answered that open defecation is not related to cholera transmission. This lack of awareness about the impact of the external environment on disease outbreaks aligns with similar findings in a study conducted in Kenya [21]. Interestingly, although respondents perceived cholera as a severe disease and had higher overall knowledge levels, this did not significantly affect good defecation practices [21]. This highlights the need for further investigation into the factors influencing hygiene behaviors and the development of targeted interventions, particularly regarding defecation.

The study revealed a deficiency in accurate education regarding WASH, including cholera, even in regions where cholera education was frequently conducted. Evaluating the quality of education provided and implementing improved educational strategies are necessary to address this issue [22,23]. Future research should examine knowledge and practice levels based on interventions in each region through regression analysis to explore causal relationships.

The study also highlighted the importance of routine water treatment in preventing waterborne diseases. The low proportion of respondents in the Downtown who reported never treating their water indicates a relatively higher awareness of the need for water treatment. However, the Mountain and Seaside regions had higher proportions of respondents who reported never treating their water, indicating a lack of awareness or access to water treatment products. This finding also emphasizes the need for improved access to water treatment products and comprehensive WASH education in these regions. Targeted hygiene education programs, provision of sanitation facilities, and promotion of water treatment practices are crucial to addressing the disparities and improving public health outcomes in these regions.

In the last key findings, the study highlights the important role of adolescents in driving behavioral change and knowledge dissemination. Targeting the 15 to 19 years age group is crucial for effective public health interventions due to their potential influence on peers, families, and communities. Schools serve as a well-functioning facility with regular funding, making them an effective medium for spreading knowledge among students.

In La Gonâve, the school system reveals a unique environment. Public schools in Haiti have been poorly operated, leading to a significant number of them being run as private schools, primarily managed by Christian-based NGOs [24]. This has resulted in a bias towards Christianity, as the Catholic population constitutes 80% of Haiti's total population, and the number of Protestants has been steadily increasing [25,26]. Most schools in La Gonâve are supported by Christian-based NGOs, leading to a high proportion of Christian students in the study.

Involving schools and youths in health education policies can play a significant role in implementing effective hygiene strategies. Table 3 shows that most students are willing to share their knowledge and learning experiences regarding hygiene through the school, indicating their motivation to practice good hygiene and contribute to their community. This willingness to take action has the potential to impact the outcome of cholera as demonstrated by previous study. Guillaume et al. (2019) reported that a sanitation project, combined with health education during the cholera epidemic, had a positive effect on health behaviors and it significantly contributed to the prevention of water-borne diseases, even in the absence of adequate environmental support [17].

However, it is important to acknowledge the limitations of this study. The cross-sectional design and small sample size limit the ability to establish causal relationships and generalize the findings. Translation challenges of Haitian Creole and the lack of standardized spelling affected the accuracy of interpretations. The scarcity of literature specifically focused on La Gonâve and WASH projects also

restricted opportunities for comparison and contextualization. Despite these limitations, this study provides valuable insights into cholera and WASH issues in La Gonave and contributes to the understanding of water, sanitation, and hygiene in the regions.

Conclusion

In conclusion, the study provides valuable insights into water, sanitation, and hygiene (WASH) practices among adolescents in La Gonave, Haiti. Notable disparities in knowledge, attitudes, and practices were found between regions, emphasizing the urgent need for improved infrastructure and targeted interventions in the Mountain and Seaside areas. The research acknowledges limitations, such as the cross-sectional design and small sample size, impacting the ability to establish causal relationships and generalize findings. Translation challenges and a lack of literature on La Gonave pose additional constraints. Despite these limitations, the study highlights the importance of targeting adolescents for behavioral change and knowledge dissemination, particularly in the unique school environment of La Gonave. Moving forward, addressing identified limitations and conducting further research to explore causal relationships and broader WASH contexts in Haiti is crucial for informing effective policies and interventions tailored to specific regional needs.

Declaration of Competing Interest

We have no conflict of interest to declare.

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Author agreement

This statement is to certify that all Authors have seen and approved the manuscript being submitted. We warrant that the article is the Authors' original work. We warrant that the article has not received prior publication and is not under consideration for publication elsewhere. On behalf of all Co-Authors, the corresponding Author shall bear full responsibility for the submission.

This research has not been submitted for publication nor has it been published in whole or in part elsewhere. We attest to the fact that all Authors listed on the title page have contributed significantly to the work, have read the manuscript, attest to the validity and legitimacy of the data and its interpretation, and agree to its submission to the *Journal of Infection and Public Health*.

All authors agree that author list is correct in its content and order and that no modification to the author list can be made without the formal approval of the Editor-in-Chief, and all authors accept that the Editor-in-Chief's decisions over acceptance or rejection or in the event of any breach of the Principles of Ethical Publishing in the *Journal of Infection and Public Health* being discovered of retraction are final.

Appendix A. Supporting information

Supplementary data associated with this article can be found in the online version at doi:10.1016/j.jiph.2023.12.025.

References

- [1] Cronin AA, Shrestha D, Cornier N, Abdalla F, Ezard N, Aramburu C. A review of water and sanitation provision in refugee camps in association with selected health and nutrition indicators—the need for integrated service provision. *J Water Health* 2008;6:1–13.
- [2] Sack DA, Sack RB, Nair GB, Siddique AK. Cholera. *Lancet* 2004;363:223–33.
- [3] Connolly MA, Gayer M, Ryan MJ, Salama P, Spiegel P, Heymann DL. Communicable diseases in complex emergencies: impact and challenges. *Lancet* 2004;364:1974–83.
- [4] Earth from Space - Image Information. 1994. Available: <https://web.archive.org/web/20061010152505/http://eol.jsc.nasa.gov/sseop/EFSP/photoinfo.pl?PHOTO=STS060-84-56>. Accessed: 23th May 2023.
- [5] Francois J. Cholera remains a public health threat in Haiti. *Lancet Glob Health* 2020;8:e984.
- [6] White J, Shao Y, Kennedy LM, Campbell JB. Landscape dynamics on the island of La Gonave, Haiti, 1990–2010. *Land* 2013;2:493–507.
- [7] Republic of Haiti MoPH, Population NDFWS, Sanitation. National Plan for the Elimination of Cholera in Haiti, 2013–2022. Republic of Haiti Port-au-Prince; 2013.
- [8] Myers K. La Gonave: Haiti's Forgotten Island. 2016. Available: <https://www.concernusa.org/story/la-gonave-haitis-forgotten-island/>. Accessed.
- [9] Bourzac B. An island within an island: 19 years of rural WASH programmes implementation in La Gonave, Haiti. 40th WEDC International Conference; Loughborough. UK: WEDC, Loughborough University; 2017. p. 2656.
- [10] Troester JW, Turvey MD. Water-resources reconnaissance of Ile de la Gonave, Haiti. *Hydrogeol J* 2004;12:224–36.
- [11] Les Affiches Americaines. 1766. Available: <https://ufdc.ufl.edu/aa00000449/00002>. Accessed: 23th May 2023.
- [12] Faul F, Erdfelder E, Lang A-G, Buchner AG. Power 3: a flexible statistical power analysis program for the social, behavioral, and biomedical sciences. *Behav Res Methods* 2007;39:175–91.
- [13] D'Mello-Guyett L, Gallandat K, Van den Bergh R, Taylor D, Bulit G, Legros D, et al. Prevention and control of cholera with household and community water, sanitation and hygiene (WASH) interventions: a scoping review of current international guidelines. *PLoS One* 2020;15:e0226549.
- [14] Tutu RA, Gupta S, Busingye JD. Examining health literacy on cholera in an endemic community in Accra, Ghana: a cross-sectional study. *Trop Med Health* 2019;47:31.
- [15] Williams HA, Gaines J, Patrick M, Berendes D, Fitter D, Handzel T. Perceptions of health communication, water treatment and sanitation in artibonite department, Haiti, March-April 2012. *PLoS One* 2015;10:e0142778.
- [16] Anetor G, Abraham F. Knowledge of cholera and its prevention amongst urban residents of a district in Abuja: the pivotal role of health education. *Res J Health Sci* 2020;8:102–12.
- [17] Guillaume Y, Raymond M, Jerome GJ, Ternier R, Ivers LC. It was a ravage!': lived experiences of epidemic cholera in rural Haiti. *BMJ Glob Health* 2019;4:e001834.
- [18] 2012 Annual Report WHO/UNICEF Joint Monitoring Programme for Water Supply and Sanitation (JMP). UNICEF, Division of Communication, 3 United Nations Plaza, New York 10017, USA: UNICEF and World Health Organization, 2013.
- [19] Gage AJ, Guirlène Calixte M. Effects of the physical accessibility of maternal health services on their use in rural Haiti. *Popul Stud* 2006;60:271–88.
- [20] Saleem M, Burdett T, Heaslip V. Health and social impacts of open defecation on women: a systematic review. *BMC Public Health* 2019;19:158.
- [21] Orimbo EO, Oyugi E, Dulacha D, Obonyo M, Hussein A, Githuku J, et al. Knowledge, attitude and practices on cholera in an arid county, Kenya, 2018: a mixed-methods approach. *PLoS One* 2020;15:e0229437.
- [22] van Driel WG, Keijsers JF. An instrument for reviewing the effectiveness of health education and health promotion. *Patient Educ Couns* 1997;30:7–17.
- [23] Loiselle CG, Delvigne-Jean Y. Health education programs: elements of critiquing. *Can Nurse* 1998;94:42–6.
- [24] Four Things You Need to Know About Education in Haiti. 2015. Available: <https://www.worldbank.org/en/news/feature/2015/03/12/four-things-you-need-to-know-about-education-in-haiti>. Accessed: 23th May 2023.
- [25] Conserve DF, Iwelunmor J, Whembolua GL, Sofolahan-Oladeinde Y, Teti M, Surkan PJ. Factors associated with HIV testing among men in Haiti: results from the 2012 demographic and health survey. *Am J Mens Health* 2017;11:1322–30.
- [26] Religious Beliefs In Haiti. 2017. Available: <https://www.worldatlas.com/articles/religious-beliefs-in-haiti.html>. Accessed: 23th May 2023.