



Social and Environmental Determinants of Cholera in Hodeidah , Yemen : A Cross Sectional Study

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Received: 03 January 2024. Accepted: 20 June 2025. Published: 30 June 2025.

Abstract

Background: Cholera remains an important public health problem for many countries continuing to cause major morbidity and mortality worldwide. It is most likely to be found and spread in places with inadequate water treatment and hygiene, and poor sanitation.

Objective: The study aimed to determine the social and environmental determinants of cholera in Hodeidah, Yemen during January to August 2018. **Methodology :** A cross-sectional study was conducted in Hodeida governorate. All confirmed cholera patients were admitted in Authority of Public -ALThawara Public Hospital/ Cholera Treatment Center (CTC) during January to August 2018 were the study subjects. Data were collected by a questionnaire about socio-demographic characteristics, environment and social factors and about patients' awareness towards cholera prevention and control. Data were analyzed and presented in tables and graphs in descriptive and inferential statistical methods. **Results:** Family contacts, poverty and illiteracy were main social characteristics of studied cholera patients. About 38% of patients reported contact with a family former cholera patient. About 52% have low income and 18.7% have no income at all, in additional, about 25% of families borrow money to cover treatment which affects family financial capability. Illiteracy rate among adult cholera patients was about 24.7% and those who had only elementary education were 37%. Families of cholera patients in Hodeida are rarely to treating drinking water. Only 5.7% chlorinate water, but 2.3% were exposed to unsafe water. Hand washing was still not a regular practice, although 61% of patients wash their hands with water and soap. The transmission of the disease is probably increased more by exposure to contaminated food than to exposed water. The most preventive measure used by the patients are: Hand washing (59%), Eat covered/well cooked food (48%), washing vegetables and fruits (40.7%) and boiling /chlorination of the drinking water. **Conclusions:** Four social and four environmental determinants were identified regarding cholera in Hodeida. The social factors are: family contact, poverty, illiteracy, crowding houses; while the environmental factors are: exposure to contaminated food, drinking unsafe water, lack of proper hand washing and poor coverage of the proper sanitation system. Person to person transmission may be the probable patterns of transmission rather than the common source.

Keywords: Cholera, Outbreak, Determinants, Social, Environment, Hodeidah , Yemen

1. Introduction

Cholera remains an important public health problem for many countries and continue to cause major morbidity and mortality worldwide. The trends in cholera globally are alarming and there are an estimated 1.3 to 4.0 million cholera cases every year, and 21,000 to 143,000 deaths worldwide [1]. There is an increased frequency of large and protracted cholera outbreaks with high mortality, reflecting the weaknesses of existing mechanisms for prevention, early detection, control of spread and access to timely health care [2]. Cholera is endemic in over 50 countries and also causes large epidemics. Since 1817, seven cholera pandemics have spread from Asia to much of the world. The 7th pandemic began in 1961 and affects 3–5 million people each year, killing 120,000 [3]. So, cholera is still a great challenge to the global public health. Cholera is an extremely virulent disease that can cause severe acute watery diarrhea. It takes between 12 hours and 5 days for a person to show symptoms after ingesting contaminated food or water [4]. Although mild cholera may be indistinguishable from other diarrheal illnesses, the presentation of severe cholera is distinct, with dramatic diarrheal purging [3]. Cholera transmission occurs from person to person via faecal oral route through a contaminated waste. Uncontrolled water sources such as well, pose a great threat. Ingestion of contaminated food and drinks have been associated with outbreaks of cholera. Bottle-feeding could be significant risk factor for infants. Fruits and vegetables washed with contaminated water can be a source of infection. After preparation, cooked food may be contaminated through contaminated hands and flies. There is growing opinion that complex interaction of contaminated food, water and environment rather than through public drinking water supplies and

direct contact. The Environment and social factors are considered the main determinants of the health of the individual and population. The sustainable development goal 6 stated that: Ensure availability and sustainable management of water and sanitation for all, more specifically the related sub-targets stated that: By 2030, achieve universal and equitable access to safe and affordable drinking water for all (Target 6.1) and by 2030 achieve access to adequate and equitable sanitation and hygiene for all and end open defecation, paying special attention to the needs of women and girls and those in vulnerable situations (Target 6.2) [5]. The cholera bacterium may also live in the environment in brackish rivers and coastal waters [6]. Moreover, leakages in water pipes coupled with poor environmental sanitation were identified as reasons for contamination of drinking water. In developing countries, a considerable proportion of cholera cases may result from secondary transmission i.e. person to person transmission through contaminated fingers while carelessly handling excreta and vomit of patients, lead to quick spread of outbreak as the disease has a short incubation period of (Incubation period is from few hours up to 5 days, but commonly and may be very short of 1 - 2 days). Water and sanitation are among the most serious challenges confronting Yemen's development. Yemen's water resources are rapidly being depleted and only a small proportion of ground water is self-sustaining. Given the severe and chronic water scarcity challenges in the country, the domestic water usage constitutes a small and declining share of total usage. For example, in 2011, access to improved drinking water sources was 55 percent, which marked a deterioration in comparison to 1990 when was 66% [7]. Yemen is still facing the worst humanitarian crises since 2015 and the worst cholera epi-

demic in the world since 2016. Yemen has faced the “world’s worst cholera outbreak in the midst of the world’s largest humanitarian crisis,” according to a joint statement issued by UNICEF, the World Food Program (WFP) and the World Health Organization (WHO) in July 2017 [8]. As of end of March 2018, the WHO reported that over 1 million suspected cholera cases and 2,271 associated deaths had occurred since beginning of the outbreak, with 58% of cases being children under 18 years of age [9]. Although cholera is not new to Yemen, a host of factors have fueled this outbreak, among them: the ongoing armed conflict; the disintegration of healthcare systems in the country, attacks on hospitals; severe food insecurity and malnutrition, behavioral practices, weak infrastructure, poor governance and poverty. Whereas cholera is preventable and treatable under normal circumstances, the near collapse of Yemen’s health, water, and sanitation sectors amidst the ongoing armed conflict have fueled the disease’s spread across the country. The situation is further aggravated by high prevalence of severe food insecurity and malnutrition. By 2017, food insecurity had placed 60% of the population at risk of famine [10]. The world worst cholera outbreak occurred in Yemen since 2016 and the continuity of this outbreak till 2018 raising a lot of questions that the investigator takes these questions with high concern; and be able to capture them for this research, they are:

- **Q1** . What are the social determinates of the current cholera outbreaks in Hodeida?
- **Q2** . What are the environmental determinates of the current cholera outbreaks in Hodeida?
- **Q3**. How people and families deal with the cholera outbreak as a social, cultural and environmental response?

The aim of this study to determine the social and environmental determinants of the cholera in al Hodeidah, Yemen during the period from January - to August 2018.

2. Methodology

2.1. Study design

It is a cross-sectional survey among all confirmed cholera cases in Hodeidah during the period from January 2018 to August 2018.

2.2 Study area

The study is Hodeidah governorate, it is a community-based study conducted in Al-Hali district through house to house visits.

2.2. Study setting

Patients were identified from the cholera registry of the Authority of Public Al-Thawarah Hospital/ Cholera Isolation Center (CTC) 2018.

2.3. Study population

All cholera confirmed cholera cases in Hodeidah were invited to take part of this study as they infected during the period of January 2018 to August 2018.

2.4. Inclusion criteria

All Yemeni confirmed cholera patients from Hodeidah admitted to in CTC during the period of January 2018 to August 2018.

2.5. Exclusion criteria

Any Non-Yemen confirmed cholera cases or Yemeni but not from Al-Hodeida during the period of January 2018 to August 2018.

3.6 Study sample

A list of all the cholera confirmed cases admitted to Authority of Public AL Thawara Hospital , Hodeidah , Yemen / cholera isolation center in Al-Hodeida during the period from January 2018 to August 2018 was obtained from the hospital. It is a comprehensive sample.

3.7 Data collection and questionnaire

An interview based and pre-tested questionnaire was used for data collection. As the investigator obtained the address and the contact data of all the cholera confirmed cases admitted in Authority of Public Al-Thowara Hospital during January-August 2018; and accordingly, a plan of home visits of the targeted cholera cases was developed. The investigator conducted field work thorough home visits of the targeted patients who agree to participate in the study. The questionnaire included questions on the socio-demographic characteristics, environmental risk factors, possible exposure to cholera infection, and awareness about cholera prevention as well as epidemiological profile including status of lab confirmation and outcome. The questionnaire was validated by academics and experts in the field of cholera epidemiology. The researcher received the completed questionnaires and revised them for completeness. Participants were encouraged to complete the missing sections/questions if any. A data entry person was assigned to enter the data from the hard copies of the questionnaire once received.

3.8 Statistical analysis

A descriptive statistical analysis for socio-demographic and other characteristics of the participants such as gender, sex, and personal information were done by using univariate analysis tools such as frequency, percentages, mean and standard deviation that to described the various quantitative and qualitative variables. The investigator designed a simple data-entry sheet in Excel for then exported to the statistical package for social sciences version 23 (SPSS).

3.9 Ethical considerations

The proposal was approved from the research ethical committee (REC) of Hadhramout University College of medicine (HUCOM). The investigator used an anonymous questionnaire in this survey. The questionnaire was not including any personal sensitive questions nor personal identifiers. The investigator shares a factsheet attached with each questionnaire, so participants can be informed about our study. The informed consent was obtained verbally; as the questionnaire is anonymous and the questionnaire did not contain any sensitive information.

3. Results

3.1. Description of participants

A total of 300 patients were identified had confirmed cholera during the period from January to 31 August 2018 were the study subjects. The investigator was able to access to all patients and a complete 300 patients interviewed by using a wells structured questionnaire. cholera patients. The mean age of the studied cholera patients was 28 years (± 20.7 years) while the median age was 24 years. According to the age; the sample is heterogeneous with a wide range from 1 year to 90 years. There were 50 children under 5 years of age (16.6%). Another age classification was applied showed that children between 6 - 15 years were 28.7 % of all cholera patients enrolled in this study while there were only 56 cholera patients with age above 45 years (18.7%). 36 % of cholera patients were reported between 16 – 44 years.

3.2. The socio-demographic

The most proportion of cholera patients were females (56.3%) and married (52.7%). Illiteracy rate among the adult cholera patients was 24.7% and those had only primary or preparatory education were 37%. The mean number of persons per room was 3 persons with a wide range from one to 15 persons while the mean number of persons living in the same building (house) was 5.4 persons with a range from one person to 25 persons indicated that cholera patients living in a crowded house. In addition, 51 % of patients were low income , 27.7 % of middle income , 20.3 % of non income and 5 % of high income. (Table 1 and 2)

3.3. Epidemiological and clinical characteristics

About 114 out of 300 cholera patients reported that there were other members in the family had cholera before, raising the secondary attack rate to 38%. And 64 patients (21.3%) said that they in contacts with another cholera patient within the five days before he/she develop cholera. Cholera presented as a severe watery diarrhea, in most of patients (91%) the frequency of watery diarrhea was more than four times per day. In 233 cases diarrhea is associated with vomiting (77.7%) and 92 patients developed to severe dehydration (30.7%) and 36 patients (12%) had fever (Table 3). The peak of the onset of the outbreak was in August and most of the cases came for different zones of Hodeidah city.

3.4. Poverty as a social determinant

Poverty is a main social characteristic of the studied cholera patients; 153 patients have a low income (52%) and 56 patients have no income at all (18.7%) as presented in table 4. When the investigator asked the targeted patients or his/her relative about what basic means their houses contain; they reported a tragedy figure. Electricity is present in Only 25% of the houses and another 34,3% use solar system. Only 4% of the houses have refrigerator; this figure affects negatively on the storage of the food. Television is present in about half of their houses (55.7%) but radio is present in only 6.3% of the houses, and 15.3% of the houses had motorcycles. (Figure 1)

3.5. The access to cholera treatment and prevention

Although about half of cholera patients (57%) be access to the CTC within half an hour but it is far away for others; 13.6% of patient spent more than 4 hours to arrive to the CTC. Only 49 patients (16.3%) reported that oral rehydration salt (ORS) was available at home while 70% received intravenous fluid (IV fluid). Only two cholera patients were vaccinated by oral cholera vaccine while 298 patients did not (99.3%). Before the cholera attack the studied patients; there was limited availability of preventive methods at home where only 25.3% of families had chlorine tablets to maintain the drinking water not contaminated, soap was available in 28.3% of houses, and only 18% of houses had cleaning materials. Only 53 patients (17.7%) receiving education message through leaflets. (Table 4)

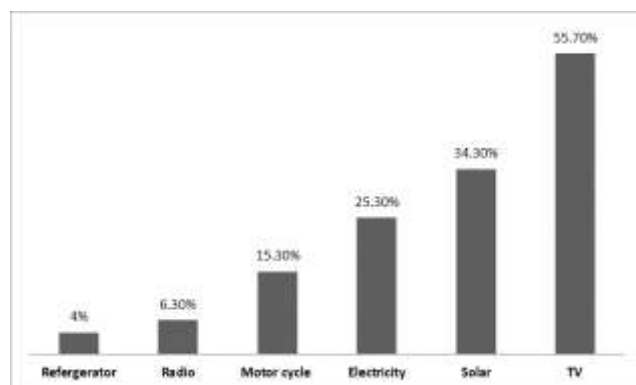


Figure 1. Proportion of the studied cholera patients contain in their houses basic means

3.6. Cost of the care

Although most of the families of the studied patients are poor but the health services provided for them were affordable. Most of patients reported that no direct expenses they spend while they had cholera (52 %) or very little expenses (15.3%). And only 25% reported that they borrow Money to cover the costs of treating Cholera this figure indicated that the out of pocket expenditure may overstretch the financial capacity of the affected families to cope with this outbreak. (Table 5)

Table 1. Socio-demographic characteristics of the studied cholera patients in Hodeidah 2018 (n=300)

Characteristics	n	%	
Age groups	≤ 5 years	50	16.6
	6 – 15 years	86	28.7
	16 – 44 years	108	36
	> 45 years	56	18.7
Sex	Males	131	43.7
	Females	169	56.3
Marital status	Single	94	31.3
	Married	158	52.7
	Divorced	3	1
	Widower	21	7
	Not wish to specify	24	8
Educational level (n=214, children under 15 years were excluded)	Illiterate	53	24.7
	Primary/preparatory education	79	37
	Secondary educa- tion	54	25.3
	Diploma after sec- ondary school	12	5.6
	University+	16	7.5
Income	High	15	5
	Middle	21	23.7
	Low	153	51
	No income	61	20.3

Table 2. Socio-demographic characteristics of the studied cholera patients in Hodeidah 2018

Mean number of persons living with cholera patient in the same room	5.4 (±4.9)	Range from 1 – 25 persons
Mean number of persons living with cholera patient in the same building	3 (±3.2)	Range from 1-15 persons

Table 3. Epidemiological and clinical characteristics of the studied cholera cases (n=300)

Epidemiological and clinical characteristics		n	%
History of cholera in the family	Yes	114	38
	No	186	62
Contact with another cholera patients within the five days before he/she develop cholera	Yes	64	21.3
	No	236	78.7
Watery Diarrhea	Yes	253	84
	No		8.7
Frequency of watery diarrhea	>4 times per day	273	91
	<4 times per day	27	9
Vomiting	Yes	233	77.7
	No	67	22.3
Severe dehydration	Yes	92	30.7
	No	208	69.3
Total		1,753	

Table 4. Access of cholera patients to cholera treatment and preventive services in Hodeidah

Treatment and Preventive Services		n	%
Time spent to arrive the health facility	Within half an hour	171	57
	½ hour – 4 hours	88	29
	>4 hours	41	13.6
Availability of ORS	Yes	49	16.3
	No	251	83.7
Receiving IV fluid	Yes	210	70
	No	90	30
Receiving antibiotic	Yes	28	9.3
	No	232	90.7
Vaccination by oral cholera vaccine	Vaccinated	2	0.7
	Not vaccinated	298	99.3
The Availability of preventive method at home before the cholera attack	Color tablet	76	25.3
	Soap	85	28.3
	Cleaning materials	55	18.3
	Education leaflet	53	17.7

3.7. The Environmental exposure

The analysis of the exposures of cholera patients to the environmental factors in this study were focused on: water, sanitation and hygiene (WASH) and exposure to food.

3.7.1. Exposure to unsafe drinking water

Although the most source of drinking water used by patients and their families are Water pipe (40.7%) or Public tip (23.7%) and most of cholera patients perceive that they drink safe water (77%) but families were rarely treated the drinking water they used (5.7%); treated the water by chlorination was very rare practice (2.3%), making people exposed to unsafe drinking water. (Table 6)

3.7.2. Sanitation and hygiene

About 61% of cholera patients wash their hands with water and soap After getting out of the bath room; and 46% before preparing food or before cooking but only 47% wash their hand before eating. The hand washing was still not a daily and regular practice. While half of the houses of the cholera patients have toilet and hole (52%) but only 25% of houses have modern toilet and connected with sewer network (Table 7).

Table 5. Cost of the cholera treatment

Cost related questions		n	%
How Much Did You Spend while You had Cholera?	Too much	4	1.3
	Much	46	15.3
	Little	47	15.7
	Very little	46	15.3
	No expenses	157	52.4
Did You Borrow Money to Cover the Costs of Treating Cholera?	Yes	75	25
	No	225	75

Table 6. Exposure to untreated water

Questions		n	%
During the 5 days before you had Cholera, what are the sources of water that you drank from, whether at home, outside the home, at work or at school:	Water pipe in the dwelling	122	40.7
	Public tip	71	23.7
	Open well	6	2
	Covered well	5	1.7
	Mineral water	55	18.3
	Boiled water	6	2
	Kothar	12	4
	Others	23	7.7
During the 5 days before you had Cholera did you drink untreated or unsafe water?	Yes	17	5.7
	No	231	77
	I did not know	52	17.3
During the 5 days before you had Cholera, did you or your family take any measures to treat the water you drink at home?	Yes	17	5.7
	No	231	77
	I did not know	52	17.3
Methods used to treat the water sources at home	Water boiling	8	2.7
	Water coloration	7	2.3
	Water filtration	2	0.7
	Nothing	283	94.3

3.7.3. Exposure to the food

About 42% of the studied cholera patients reported that during the 5 days before they had Cholera, they ate contaminated food or uncovered badly cooked foods (52%), and about 34% of them usually buy food / drink from street vendors. The most food items that cholera patients used during the 5 days before they had Cholera were: Potato/ food from street (16.3%), Fish (16.3%), chicken (12.3%) and untreated rice (10.7%). (Table 8)

Table 7. WASH determinant among cholera patients

Questions		n	%
Hand washing with water and soap	Before preparing food or before cooking	139	46.3
	Before eating	141	47
	Before cleaning or washing children	37	12.3
	After getting out of the bath room	184	61.3
	Never wash hands with soap	3	1
The place of defecate at home	Modern toilet connected with sewer network	77	25.7
	Toilet with home grove	26	8.7
	Toilet with a hole	156	52
	Toilet with bowl	2	0.7
	Defecating in the open	1	0.3

Table 8. Exposure of cholera patients to contaminated food

Questions		n	%
During the 5 days before you had Cholera, did you eat any of the foods you think are contaminated	Yes	128	42.7
	No	122	40.7
	I did not know	50	16.6
During the 5 days before you had Cholera, did you eat covered and well-cooked foods	Yes	144	48
	No	156	52
Do you usually buy food / drink from street vendors	Yes	102	34
	No	193	64.3
	I did not know	5	1.7
How often you buy food / drink from street vendors	Daily	61	20.3
	Once every 3 days	21	7
	Weekly	20	6.7
	I did not buy at all	193	64.3
	I did not know	5	1.7
During the 5 days before you had Cholera did you have one of the following foods:	Untreated rice	32	10.7
	Potato/ food from street	49	16.3
	Chicken	37	12.3
	Meat	11	3.7
	Fish	49	16.3
	Milk	18	6
	Soup	4	1.3
	Vegetable/fruits	13	4.3

4.8. Knowledge behavior and practice

Knowledge behavior and Practice of the cholera patients and their families toward cholera prevention and control. The studied cholera patients have good knowledge about when they asked what to do if you have cholera most of them (77%) reported that they go to the cholera treatment center. The most preventive measure used by the patients are: Hand washing (59%), Eat covered/well cooked food (48%), Washing vegetables and fruits (40.7%) and boiling /chlorination of the drinking water. Although most of the patients know ORS (66%) but only 47.3% of them use it. The perception of the cholera patients about how they got infected concerned source of infection and the pattern of transmission; patients considered eating contaminated food (27%) is a source of infection than drinking unsafe water (11.7%) (Table 9) . Transmission from person to person as in the case of shaking hands (22%) was an important finding rather than a common source. (Table 9). Most of the cholera patients received an educational message about cholera exposure, treatment and prevention. The preferable method to receive an educational message are health workers (27%), television (18%), and friends or family members (10.7%) (Figure 2).

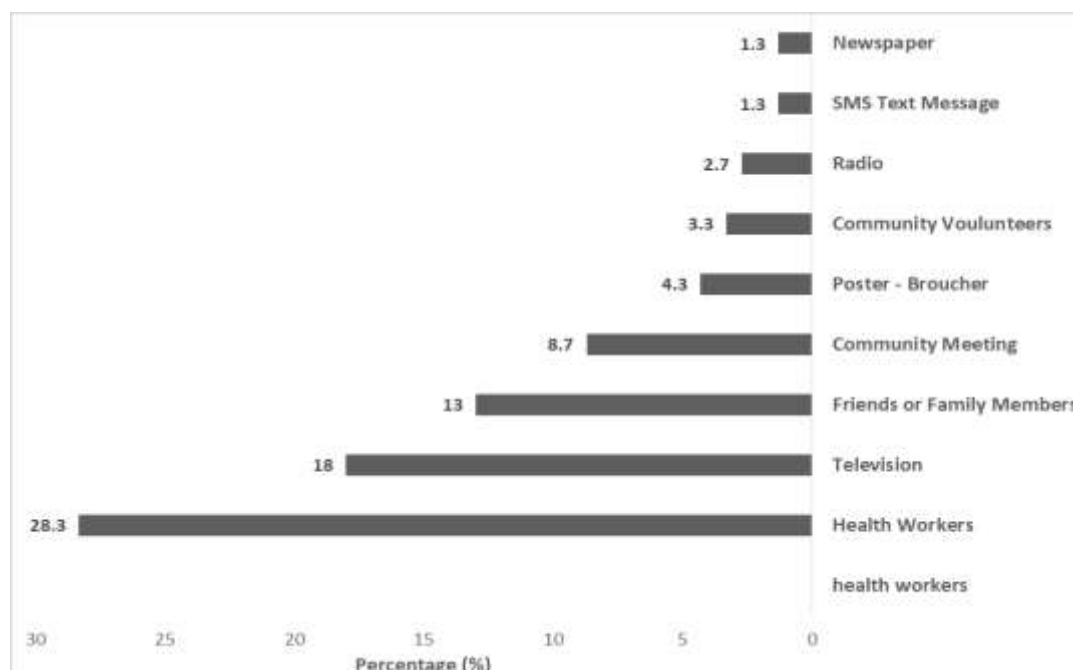


Figure 2. Sources of information about cholera prevention among 243 patients receiving education messages in Hodeidah, Yemen

Table 9. Knowledge and behavior and practice of cholera patients toward cholera prevention and control

Questions	n	%	
Do you know what to do if you have Cholera	Go to the cholera treatment center	231	77
	Use ORS	21	7
	Go to traditional healer	2	0.7
	cholera cannot be cure	1	0.3
	I did not know	14	4.7
	no response	31	10.3
Do you know how you can prevent Cholera	Boiling/chlorination of water	111	37
	Eat covered /well cooked food	144	48
	Washing vegetables and fruits	122	40.7
	Hand washing with safe water and soap	177	59
	Cleansing the house with chlorine	77	25.7
	Cholera vaccine	2	0.7
	Taking antibiotic pills	28	9.3
	The ideal disposal of human waste	27	9
	There is no protection	300	100
	I did not know	33	11
	Do you know what is the Oral Re-Hydration Solution (ORS)?	Yes	198
No		99	33
I did not know		3	1
Do you know how to prepare the Oral Re-Hydration Solution (ORS) at home?	Yes	142	47.3
	No	48	16
	I did not know	110	43.7
How do you think you have been infected by Cholera	Drinking contaminated water	35	11.7
	Eating contaminated food	81	27
	Eating unwashed fruits or vegetables	8	2.7
	Lack of hand washing with soap and water	18	6
	From person infected with cholera	23	7.7
	Through the air	9	3
	Through flies	6	2
	From dirty unclean environment	5	1.7
	Bury a deceased	3	1
	By shaking hands	66	22
	I do not know	11	3.6

4. Discussion

In this study a total of 300 patients had cholera in Hodeidah governorate during the period from January 2018 to August 2018 were carried out . The mean age of the studied patients was 28

years with nearly third of patients were below fifteen years of age (28.7%); this is consistent with similar studies that found almost all patients to be adults in the first stage of the outbreak and the numbers of affected infants and children younger than 5 years old increased gradually as the epidemic continued [11]. About 56.5 % of patients were females and 43.7 % were males. demographic and socioeconomic factors, including age, sex, nutritional

status, social status, economic status, and history of travelling, are known to play a crucial role in susceptibility to cholera [12]. Female predominance was reported elsewhere; women and girls are responsible for a disproportionate amount of the domestic work to prevent and respond to cholera – fetching and treating water, preparing food, caring for sick family members [13]. Cholera may appear seasonal variation; the majority of outbreaks occurred in the warm seasons and the summer [14]. The peak of Hodeidah outbreak in 2018 was occurred in August. Although cholera has not been documented to spread directly from one person to another without the intermediary of food or contamination water with limited evidence exists regarding the role of family contacts in the transmission of infections [15]. The findings of this study revealed that found nearly 114 cases had a previous contact with other member in the family had cholera before, raising the secondary attack rate to 38%. Weil AA et al (2014) in their follow-up study in Bangladesh found that 24% of 294 household contacts developed a positive *V. cholerae* rectal swab, signifying bacterial shedding [16]. *V. cholerae* infections within the same household are common [18,19]. Some studies have found that the presence of a cholera patient at home is a risk factor [20-22]. And that family members can spread cholera via contact with food and water at home [23,18]. So contact with a person with diarrhea had a significant association with cholera infection [24]. But a controversial findings were reported in one Iranian study concluded that no relationship exist between cholera infection and contact with patients of diarrhea in the previous five days [12]. In this study it was found that the average number of persons per room was 3 persons a range between one and fifteen persons while the mean number of persons living in the same building (house) was 5.4 persons with a range from one person to 25 persons indicated that cholera patients living in a crowded house which favor the condition for cholera transmission. Cholera disease is a disease of poverty; It is one of the key indicators of social development [25]. Poverty was a major finding in this study; about 52% of the studied cholera patients had low family income and 18.7% of patients has no income at all, moreover 25% of families of the patients borrow money to cover the costs of treating cholera indicated that the out of pocket expenditure may overstitch the financial capacity of the affected families to cope with this outbreak. In Western Africa; The social impact of cholera was mainly characterized by financial concerns that were manifested by people reporting loss of family income [26]. Poor housing conditions are associated with a wide range of health conditions [27]. Only 4% of the houses have refrigerator; this affects negatively on the storage of the food. Penrose K et al (2010) mentioned that as a result of poor economic opportunities and an increasing shortage of affordable housing. Crowding and other poor living conditions can have a significant impact on the spread of infectious diseases [28]. In this study a television is present in about half of their houses (55.7%) but radio is present in only 6.3% of the house which limit the delivery of health education messages to the population. Along with relatively high Illiteracy rate among the adult cholera patients was 24.7%. Media play an important role in building awareness about cholera among decision-makers and the public. Informative and timely media outputs, such as educational television and radio programs would help mobilize policymakers. It is important to highlight public service messages in national and local languages through television, radio and newspapers [29]. Availability and accessibility to curative and preventive health services are the main principles of quality primary health care. Ensuring access to primary health care is widely accepted as key to improving health outcomes [30]. Evidence suggests that access to primary health care can be improved when services are tailored to the needs of, or owned and managed by Indigenous communities themselves [31,32]. The current humanitarian crisis in Yemen remains the worst in the world driving the country to the brink of famine and exacerbating needs in all sectors. An estimated 80 percent of the population – 24 million people – require some form of humanitarian or protection assistance, including 14.3 million who are in acute need [33]. Moreover, the health-care system is on the brink

of collapse as more than 55% of health facilities are partially functioning or destroyed [34]. The largest and fastest spreading cholera outbreak recorded since the WHO began recording cholera outbreaks in 1949 has erupted [35]. This case of Yemen is similar to the situation of cholera outbreak in South Sudan in 2006. An outbreak of cholera has spread quickly across southern Sudan, emphasizing the scale and urgency of postwar reconstruction in a region where almost half the population is displaced and only one in four people have access to medical services [36]. Most of cholera patients were not vaccinated against cholera, and only two patients reported that they had oral cholera vaccine. The advent of safe and effective, new-generation oral vaccines against cholera has created renewed interest in the use of vaccines as a tool to control cholera [37]. On the other hand, chlorination of drinking water is widely recognized as an important factor to prevent cholera. Even if the water is clean when it is first drawn from a deep well, it can be heavily contaminated by the time it reaches the unsuspecting recipient. It is proved that using water without home chlorination was statistically associated with spreading the disease [11]. Another studies emphasized the importance of the microbial safety of water immediately before consumption for reducing diarrheal rates [38,39]. One study in Haiti was conducted early in the cholera epidemic that occurred in 2010 demonstrated that treating drinking water was strongly protective [40]. These findings were not unexpected, because most cholera outbreaks are spread through contaminated water. This is does not contradict that access to a piped water distribution system is protective against cholera transmission [41]. In urban African settlements, Improving water, sanitation and other infrastructure was associated with a 39% decline in waterborne disease [42]. Also drinking water collected from shallow wells was identified as an important risk factor for cholera. These results support the assumption that transmission of cholera happens when rain flood water causes feces from defecation around cholera patients' houses to contaminate shallow wells. Moreover; The underground water in all Yemeni cities is contaminated with sewage and treatment plants are not functioning because of lack of fuel and maintenance [34]. And may become increasingly important during outbreaks as cholera contamination becomes widespread and disease dissemination is through multiple routes [43]. In this study, only 47% wash their hand before eating and hand washing was not a daily and regular practice. Although about 61% of cholera patients wash their hands with water and soap after getting out of the bath room and before preparing food or before cooking (46%). Also, we found soap was available in 28.3% of houses, and only 18% of houses had cleaning materials. Similar finding reported in different literatures, a study found presence of soap for hand washing in the home was associated with protection against cholera. Experts of Centers for Disease Control and Prevention of USA (CDC – US) were invited to Africa to assist in a study of the cholera outbreak and implicated that the presence of soap in the home, which an important for improved hygiene, resulted in decreasing cholera transmission [44,45]. Other studies suggest hand washing reduces the risk of diarrhea by 40% [46]. Given that sharing a house with an infectious cholera patient is a risk factor [47], However there is a weak evidence regarding the impact of improved sanitation to reduce transmission of diarrheal disease, it may still be effective [48]. In this study; the most food items that cholera patients used during the 5 days before they had cholera were: Potato/ food from street (16.3%), fish (16.3%), chicken (12.3%) and untreated rice (10.7%). Unlike another study that showed food items such as rice, dried fish, and citrus fruit juice have been found to decrease the risk for cholera in previous outbreaks [44,49]. Another study concluded that cholera infection was associated with consumption of vegetables and fruits in the previous three days, consumption of unrefrigerated leftover food. which is consistent with those that have been reported by other studies [50]. A previous study in Yemen investigated role of food contamination in spreading cholera found that people in Yemen regularly chew khat on a daily basis, and it has been proposed to be a potential risk factor for cholera because many people chew khat without washing it

properly [51]. In other hand, other studies found the consumption of drinks and foods purchased from street vendors has been identified as an important risk factor [52,53]. This is may be due to street food vendors represent a possible method of transmitting cholera throughout the population [54]. Items sold by vendors are most likely to be contaminated through the environment and by poor handling. An evidence from study in Zambia showed that contaminated food was a major path of transmission of cholera during an outbreak [55]. Consumption of unrefrigerated food, had a strong relationship with cholera [11,56]. In fact, a delay between cooking and eating food contaminated with cholera is necessary for disease to occur [57,58].

5. Conclusion

Four social and four environmental determinants were identified regarding cholera in Hodeidah, Yemen. The social factors are: family con-tact, poverty, illiteracy, crowding houses; while the environmental factors are: exposure to contaminated food, drinking unsafe water, lack of proper hand washing and poor coverage of the proper sanitation system. Person to person transmission may be the probable patterns of transmission rather than the common source. Therefore, from a public health perspective and the prevention and control of cholera point of view, not only early detection of epidemics but also education to promote good personal hygiene among adults should be emphasized.

Data Availability

No data were used to support this study.

Conflicts of Interest

The authors declare that they have no conflicts of interest.

Acknowledgments

This work was conducted during our work at CTMID – Al Thawara Public Hospital Authority, Hodeidah, Yemen.

Ethical Approval

The studies involving human participants were reviewed and approved by Ethics Committee of Department of Community Medicine – Faculty of Medicine and Health Sciences, Hadrhmut University, Mukalla, Yemen.

How to Cite : Zuhairy, A., Bin Ghouth, A., & Amood Al Kamarany, M. (2025). Social and Environmental Determinants of Cholera in Hodeidah, Yemen : A Cross Sectional Study. *Abhath Journal of Basic and Applied Sciences*, 4(1), 20–27.

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