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The Analytical Descriptive Study of the Effect of Drinking Water Contamination on the Spread of Hepatitis A Virus in DARAA Governorate-Syria

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ABSTRACT

This study aimed to find out the effect of drinking water pollution on the spread of hepatitis A virus in "Al-Sabil neighborhood" in Daraa governorate in Syria and to know the infection rate in terms of sex (male, female), and age according to age groups (0-12, 13-18, 19-40, 41-60, over 60). Also according to the onset of symptoms (0-10, 11-20 and 21-30) days, and according to the recovery period (less than 100 days - more than 100 days).

The results of the analysis showed that the number of doubtful cases was (6526), where the positive cases were (2118) and the negative cases (4408), As it was shown that males were infected more than females, and the age group from (19-40)year was more susceptible to infection compared to the rest of the age groups, and symptoms began to appear during the first ten days of infection, with a rate of 59.73%, followed by the period from (21-30) days with a rate of 27%, and recovery occurred after one hundred days of infection, at a rate of 59.96%, and it was a significant correlation between the infection and the age, also between one set symptoms and Duration of recovery.

KEYWORDS: Hepatitis, Contamination of Drinking Water, Duration of Infection, Recovery Period, Sewage.

1. INTRODUCTION

Water is an important element within the ecosystem, as it represents the basic link in food chains, and it is indispensable, and the presence of fresh water is a basic condition for the ecosystem, which constitutes about 2.5% of the total sources of water [1], but despite the abundance of this component it is exposed to contamination by natural, biological, chemical and radiological pollutants, and this problem is often major in rural areas that depend on wells. The problem of treating wastewater is also a major problem as it contains a large and diverse group of microorganisms that cause harm to humans, animals and plants, while the majority of them, are harmless and may even be beneficial and used to purify water [2,3].

According to reports from the World Health Organization (WHO), the most common water-borne diseases are enteric viruses, which pose a serious threat to human health in all parts of the world. It causes the death of about two million people, especially in rural areas and children under five years of age, in the absence of sewage treatment and the lack of treatment plants [4]. This water is discharged into marine estuaries, springs and dams, which in turn undergo permanent changes in its physical, chemical and bacteriological composition [5,6].

Environmental pollution is a public health problem represented by greenhouse gases and acid deposition, which have reached a dangerous level all over the world, as well as industrialization processes that coincide with economic growth and thus more waste discharge [7,8].

In addition, human activities, chemicals and industrial materials play a major role in water pollution, and WHO reported that 80% of bacterial, viral and parasitic diseases are waterborne, which negatively affects human health and the spread of some diseases such as scabies, asthma, dysentery and respiratory diseases [9,10], as well as anemia, low platelets, increased risk of cancer, and many skin diseases[11].

The environmental effects of irrigation with wastewater on soil, plants, animal and human health were also studied, which contain bacteria, protozoa, viruses that cause diseases, or waste from pharmaceutical and pesticide factories, in addition to diseases transmitted through contaminated water as dengue fever, malaria, and yellow fever; Diversity of microbial communities are affected by changes in environmental conditions [12.13].

In developing countries social and economic inequality are the main reasons for the use of polluted water, such as poverty, the standard of living, health facilities, age, gender, and level of education These factors have a

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prominent role in increasing health awareness and education, as in developed countries [14,15].

The spread of contemporary viruses, such as Ebola and SARS-Cov-2, has contributed to increasing interest in the issue of water purity, especially water contaminated with viruses, which is the appropriate environment for their spread, as well as in developing countries that are characterized by low social and economic development and thus a low quality of services provided to the population [14].

The most important causes of intestinal diseases in developing and developed countries are enteric viruses such as cholera, typhoid, and hepatitis (Figure 1). They are of diverse groups and are transmitted by the fecal-oral route, which mainly causes diarrheal diseases.

The average presence of the various Sap virus viruses is 1.36 x 106. gc, which was significantly higher compared to Norovirus GII viruses, which reached an average of 2.94×104 gc. [4,16].

Hepatitis A virus had the highest percentage among the viruses detected in the metagenomic wastewater analysis, as it was significantly associated with an increase in disease cases within one week, as untreated sewage is one of the sure ways for the presence of hepatitis A virus [16].

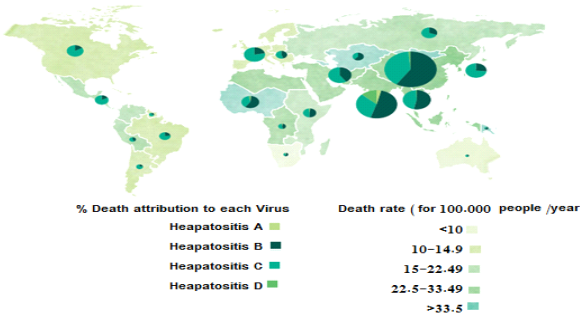

Figure 1. Regional distribution of hepatitis in the world

Source: Global health sector strategy on Viral Hepatitis

A relationship was also found between water pollution and infection with hepatitis A and waste accumulation, in addition to the fact that males are more infected than females: and those younger than those are more susceptible to infection with hepatitis [14].

Transmission of the hepatitis A virus occurs through food, as it is one of the most common viruses caused by food-borne infections. Contamination of these foods may occur by those infected without their knowledge. It is capable of resisting food preparation processes, which one of its most important goals is to neutralize pathogenic bacteria. The number of new infections is estimated at about 1.4 million in the world, and developing countries are among the countries where the number of infections is increasing due to the lack of treatment of wastewater or used water [17].

Hepatitis A is a highly contagious leads to infections that impair liver function, but it is a limited disease that does not cause chronic symptoms. This virus is transmitted in several ways, including eating foods manufactured by a person infected with the virus, drinking water contaminated with sewage, having direct contact with the infected person, even if he does not show symptoms, and having sexual relations with a person infected with hepatitis A .

The symptoms of the disease appear in adults, and range from severe to mild, including yellowing of the skin and eyes, abdominal pain, dark urine, nausea, vomiting, and high temperature.

Therefore, the purpose of this research was to conduct a descriptive and analytical study of the health situation that Al-Sabil neighborhood in the city of Daraa was exposed to, which contributes to developing the ability to respond more quickly to the epidemic and to contain it, and to increase the ability to treat cases of water contamination with hepatitis A type.

2. RESEARCH OBJECTIVE

The research aims to conduct a descriptive analytical study of contaminated drinking water and cases infected with hepatitis A in the Al-Sabil area in Daraa Governorate. In addition to analyzing the demographic factors associated with an increased risk of hepatitis A virus infection in the study population. Also, study the extent to which the occurrence of the epidemic is related to the degree of water pollution and the degree of independence of each.

3. RESEARCH JUSTIFICATIONS

As a large number of Al-Sabil neighborhood's residents were suffering from several medical cases such as diarrhea, vomiting, and high fever, most cases were admitted to the hospital and they were using the same source of drinking water which appeared to be mixed with sewage due to the occurrence of deterioration and fractures in the sewage system, this work was undertaken to evaluate Al-Sabil drinking water system,

4. MATERIALS AND METHODS

The descriptive analytical approach was used for samples and information and was completed through personal interviews of the patients by doctors, and nurses in the Health Directorate and the Syrian Arab Red Crescent branch in the city of Daraa, as well as oral and written reports were obtained by health care workers (doctors, nurses, administrators) to the researchers. Laboratory analyses of samples taken through the mobile clinic affiliated with the Health Directorate from almost all the residents of the Al-Sabil neighborhood, in addition to the patient lists in each city of Daraa for health centers and private clinics.

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Analysis of water samples from all regions of Daraa was performed in the laboratories of the Water, Environment and Health Directorates during the period from 30/03/2021 to 30/05/2021.

The specifications of the water that will be pumped from the Water Directorate in the city of Daraa must conform to the Syrian standard specifications and not exceed the permissible values according to table 1.

Table 1 Water specifications according to Syrian standard specifications

Analysis	The maximum permitted according to Syrian specifications	
	value	UNIT
Turbidity	5	NTU
Electrical conductivity	2000	Us/cm
Solid phase	1200	mg/l
pH	6.5-9	--
Hardness	700	mg/l
NH4+	0.5	mg/l
Na+	300	mg/l
Ca+	-	mg/l
Mg+	-	mg/l
F-	1.5	mg/l
Cl-	500	mg/l
SO4	500	mg/l
NO3	60	mg/l
NO2	0.2	mg/l
PO4	1	mg/l

5. ANALYSIS OF DRINKING WATER

1. Devices used in water analysis:

The analysis conducted in the Water, Environment, and Health Directorates in the city of Daraa studied water before, during, and after the occurrence of the pandemic, and Hygiene water bacterial detection device was used, which is a field device to detect bacterial presence in water immediately, as the percentages must be less than 5. It is affiliated with the Health Directorate in Daraa.

2. 2- Devices used to analyze blood samples of infected and suspected patients:

The analysis devices used in the comprehensive clinic laboratories of the Daraa Health Directorate, in addition to the laboratories of the Syrian Red Crescent Organization and private laboratories, were SAT 450, an automated chemistry device made in Italy, that measures liver enzymes, MEMMERT dry bacterial sterilizer, German made, sterilizing dishes and tools used in the analysis, A Memmert bacterial incubator at a temperature of 37 °C to incubate the bacterial culture media, A wet sterilizer to sterilize and prepare bacterial media, Bacterial culture media EMB-SS, MacConkey medium, Tryptone medium, and Ptry medium, AST and ALT analysis, which are specific to liver enzymes, as their elevation above 50 indicates infection with hepatitis C, and HAV analysis, which is specific for hepatitis A type.

6. STATISTICAL ANALYSIS

SPSS version 23 was used and descriptive statistics, frequency tables, percentages, correlation coefficient, and chi-square will be measured.

7. RESULTS AND DISCUSSION

Analysis of the sample was conducted on both contaminated drinking water and blood from people who showed symptoms of hepatitis in the contaminated area (Al-Sabil neighborhood), which were represented by nausea, vomiting, and abdominal pain. It was found that there was contamination of the water with sewage after bacterial and biological cultivation of the water.

According to the Syrian standard specifications for water specifications, the percentage of metals and other pollutants was high, and according to the statistics submitted by the Directorate of Health in Daraa to the Ministry of Health regarding the numbers of final examined cases as in Table (2), the results showed that 2118 out of 6526 were positive case for AST – ALT whereas 4408 cases were negative.

Table 2 Statistics provided by the Daraa Health Directorate

Negative cases	Positive cases	Total cases
4408	2118	6526

From Table (3), it is clear that the number of positive male cases was high in the case of the male variant and amounted to and accounted for (55.71%) of the total positive cases, while the percentage of infection among females reached (44.29%) of the total number of positive cases, accounted for (2118) people.

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Table 3 Percentage and frequencies of examined cases according to gender variable

Variable	Range	Total		Percentage			
				negative		positive	
		%	number	%	Number	%	number
Sex	male	55.9	3648	55.99	2468	55.71	1180
	female	44.1	2872	44.01	1940	44.29	938
overall		100	6526	100	4408	100	2118

Table (4) shows that the age group (19-40) has the highest infection rate with 27.9% of positive infection rate, followed by the age stage (0-12) with the 26.8%, and the lowest infection rate was in the sample with over than 60 years, but the spread of the virus varies from region to another where it reaches 57% for those ranged 15 to 19 in the Caribbean countries and reached to 96% for Andean regions [18].

Table 4 Percentage and frequencies of examined cases according to age variable

Variable	Range	Total		Percentage			
				Negative		Positive	
		%	Number	%	Number	%	Number
Age	**0-12**	27.9	1821	27.89	1229	27.95	592
	13-18	26.8	1751	26.86	1184	26.77	567
	19-40	41	2675	40.94	1805	41.08	870
	41-60	3.5	226	3.5	154	3.4	72
	60<	0.8	53	0.81	36	0.80	17
Overall		100	6526	100	4408	100	2118

Table (5) shows that the severity of infections with hepatitis A virus began during the first ten days of contamination and reached approximately (59%) with a frequency of (1265) positive cases. The number of people who showed symptoms of the disease reached 21 days after exposure to contaminated water and continued to increase.

Table 5 Percentage and frequencies of examined cases according to Onset of symptoms variable

Variable	Rang	Total		Percentage			
				Negative		Positive	
		%	Number	%	Number	%	Number
Onset of symptoms	**0-10**	58.5	3820	57.96	2555	59.73	1265
	11-20	13.2	861	13.16	580	13.27	281
	21-30	28.3	1845	28.88	1273	27	572
	Overall	100	6526	100	4408	100	2118

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Up to 30 days, there were (572) positive cases, compared to the period from (11-20) days, which was the least in the appearance of symptoms of the disease, and the percentage of positive cases was (13.27%).

As for the cases that were cured, the highest recovery rate occurred 100 days after the infection and accounted for approximately 60% of the infected people, compared to 40% of the infected people who recovered 100 days before the infection, as in Table (6).

Table 6 Percentage and frequencies of examined cases according to the variable of recovery duration

Variable	RATE	Percentage	
		%	Number
recovery duration	100>	40.04	848
	100<	59.96	1270
	Total	100	2118

The length of the recovery period also varied. The duration of recovery ranged and differed according to the infected people, their ages, and their gender, as table 7 shows. The percentage of people who recovered before 100 days in the childhood group was 12% compared to the period after 100 days, which amounted to approximately 16%. The same applies to the teenage age group, the youth age group, and the stages of manhood and adulthood.

Table 7 Statistical analysis of recovery cases according to the relationship between variables

Variable	Recovery period	%	>100	%	<100
Age	0-12	15.58	330	12.37	262
	13-18	17.85	378	8.92	189
	19-40	23.70	502	17.37	368
	41-60	2.22	47	1.18	25
	>60	0.61	13	0.189	4
Sex	male	33.71	714	22	466
	female	26.25	556	18.04	382
Onset of symptoms	0-10	24.17	512	35.55	753
	11-20	8.88	188	4.4	93
	21-30	26.91	570	0.1	2

In addition, the recovery rate for males 100 days after infection with hepatitis C disease was higher, reaching 33.71% compared to females, and this is due to the higher infection rate for males than for females.

By performing the correlation coefficient between the studied variables, as in table (8), it is apparent that there is a strong positive correlation between the variable of the stage of onset of symptoms and the length of the recovery period. It was also observed that there is a negative significant correlation between the variables of age and the onset of symptoms with the variable of gender, and there was no correlation between age variable and other variables.

Table 8 Correlation coefficient between the studied variables

Variables	Age	onset of symptoms	duration of recovery
Sex	*0.048-	*0.049-	ns
Age	--	ns	ns
onset of symptoms	----	---	**0.523

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By conducting an analysis of variance, it was observed that there were

significant differences according to the variables of gender, age, the onset of symptoms, and the length of the recovery period. Likewise, the differences were significant between age and gender, and between the period of appearance of symptoms with age, gender, and the length of the recovery period, the differences between them were significant, as shown in Table (9).

Table 9 significant differences between the studied variables

Variables	Duration of recovery	ONSET symptoms	Age	Sex
Sex	**Un**	**	**	**
Age	**Un**	**un**	**	**
Onset symptoms	**	**	**un**	**

Un: unsignificant ****: significant at 0.01**

8. CONCLUSIONS & RECOMMENDATIONS

1. Males are more susceptible to infection than females, and young people are more susceptible to infection compared to other age groups.
2. Symptoms begin within the first ten days of the disease, and most recovery occurs after one hundred days from the beginning of the infection.
3. The importance of correct sterilization of the equipment used for analysis and not repeatedly using the tools.
4. The locations of sewage pipes must be far from drinking water sources so that if a leak occurs, it does not lead to health risks.
5. Periodic detection of sewage sources and pipes and increasing citizens' awareness of the dangers of pollution and not throwing waste, which in turn leads to an increase in the percentage of pollution.
6. Environmental and health awareness through print and audio media to increase protection, prevention and awareness.

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