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Epidemiological Features of Hepatitis A among Children in Hodeidah, Yemen

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Authors' contributions

This work was carried out in collaboration among all authors. Author BM collected the data, analyzed samples and wrote the manuscript. Author AAH supervised the master thesis, revised the data analysis, results, discussion and conclusion. Author ABG contributed in writing of proposal and study design. Author EG contributed in study design and data analysis. Author MAAK wrote, revised and edited the final manuscript. All authors read and approved the final manuscript.

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ABSTRACT

Background: Hepatitis A virus (HAV) infection is the most common cause of acute viral hepatitis, with approximately 1.5 million cases reported globally each year.
Objectives: The purpose of this study was to determine the incidence rate of HAV infection, socio-economic indicators and risk factors in children of primary schools, Hodeidah, Yemen.
Methods: A cross-sectional study was conducted (from January to December 2019) among children at the three public primary schools (Al-Nour, Asma'a Bint Abi Baker and Legislator's) in Al Hawak district, Hodeidah city, Yemen. 422 blood samples were collected from children (7 – 10 years old). HAV was detected by enzyme linkage immunosorbent assay (ELISA) on serum specimens of children. The study was carried out in Center of Tropical Medicine and Infectious Diseases (CTMID) of AL-Thawra Public Hospital Authority, Hodeidah, Yemen. Statistical Package for the Social Sciences (SPSS) was used for data analyses.
Results: The results showed that HAV infection was detected in 22/422 cases (5.21%). HAV infection was represented in the males as 14/22 cases (63.63 %) while in the females it was represented as 8/22 cases (36.36 %). However, this difference was not statistically significant (p = 0.414). The higher frequency of HAV infection was in children between 7 and 8 years (20/22 cases; 90.90 %) and the lower frequency was in infants between 9 and 10 years (2/22 cases; 9.09 %), with a significant association (p -value = 0.022). On the other hand, major risk factors were recorded that seem to have effect in the transmission of HAV infection. 21/22 cases (95.5%), 1/22 cases (4.5%) of children in primary schools had sewages disposal at home namely general disposal and special disposal respectively. The Knowledge Attitude and Practices (KAP) for prevention of HAV infection in children were assessed, child who close contact with person with HAV infection (17/22 cases; 77.3%), child who do not practice personal hygiene (hand washing) after outside from bathroom (16/22 cases; 72.7%), child who have not special towels (15/22 cases; 68.2%) and child who shares clothes with others (14/22 cases; 63.6%).
Conclusion: This study concluded low HVA infection among children of primary schools in Al-Hawak district, Hodeidah, Yemen. The most risk factors of infection with HAV were close contact, poor sanitary conditions, house structure and crowding in house.

Keywords: Hepatitis A virus; children; primary schools; hodeidah; Yemen.

1. INTRODUCTION

"Hepatitis A virus (HAV) infection is the most common cause of acute viral hepatitis, especially in children with approximately 1.5 million cases reported globally each year" [1]. "HAV spreads mostly via fecal oral route through contact with an infected person and ingestion of contaminated water or food" [2,3]. "HAV infection is often without symptoms in the early years of the life, but the severity of illness increases with increased age. In rare cases, HAV infection can cause liver failure and death, with mortality rates reaching nearly 2% in older adults" [4].

HAV is single stranded, nonenveloped Ribonucleic acid (RNA) virus. It is acid resistant and thermostable [1]. "According to the World Health Organization (WHO) estimates, HAV infection resulted in 13.7 million illnesses and 28000 deaths" [5]. "Safe water supply, food safety, hand washing, improved sanitation and the HAV vaccine are the most effective ways to combat the disease" [6]. "The incidence rate of HAV infection is strongly related to socioeconomic indicators and access to safe drinking water: as incomes rise and access to clean water, the incidence of HAV infection is low. The association of HAV infection risk with standards of hygiene and sanitation, the age dependent clinical expression of the disease, and lifelong immunity determine the different patterns of HAV infection observed worldwide" [7,8].

"In least developed countries with very poor hygiene and sanitary conditions, HAV infection is highly endemic and most persons become infected in early childhood" [9]. "Because infection occurs at an early age when the disease is often without symptoms, reported rates of the disease in these areas are relatively low and outbreaks are not common" [10]. The infection is endemic in Africa except in south Africa. Moreover, Eastern Europe, Asia are at high risk of infection [11]. Therefore , the purpose of this study was to determine the incidence rate of HAV infection, socio-economic indicators and risk factors in children of primary schools , Hodeidah, Yemen.

2. MATERIALS AND METHODS

2.1 Study Area

This study was conducted at three public primary schools (Al-nour primary school, Asma Bint Abi Baker elementary school and Legislator's primary school) in Al Hawak district, "Hodeidah city selected Yemen country that is tropical region Hodeidah Governorate borders the Red Sea and is part of the narrow Tihamah region. It serves as an important local port city. With a population of 2,687,674 and an area of 17,509 km². It contains 26 districts, three of them in the urban (Al Hali, Al Hawak and Al Meena districts), the remaining districts are in the rural areas. Hodeidah climate is semi tropical (warm and humid in the summer and moderate in winter). The highest temperature reaches 40°C during the summer and the temperature in winter amounts to 24°C" [12]. Also, several notable disease outbreaks including cholera, diphtheria, malaria and dengue fever were reported in Yemen. Cholera alone has affected nearly every Yemeni family in some way, with almost two million suspected cases since 2016 [13-16]

2.2 Study Design

The research was designed in a cross- sectional study that included students aged 7-10 years at three public primary schools (Al-Nour, Asma'a Bint Abi Baker and Legislator's) in Al Hawak district in Hodeidah city and the data were collected from parents of children. The study was done from 1st April to 30th November 2019.

2.3 Samples and Data Collection

About 5 ml of blood was collected in plain tube from each child, allowed to clot and centrifuges at room temperature. Then sera was separated and stored at -20°C till analyses. Pre-tested structured questionnaire were used for the interview. The questionnaire were divided into several sections. (A): personal children information (age, sex, education level); (B): socio-demographic characteristics of the parents of children that included the education level , socioeconomic status , number of persons living in this household; (C): knowledge about the source of drinking water and the mode of sewage disposal; (D): knowledge, attitudes and practice (KAP) towards personal hygiene.

2.4 Hepatitis A Analysis

"The specific serodiagnosis was accomplished by examining anti-HAV antibodies of the IgM class, which are the main markers of acute infection with HAV. Generally, the detection of these antibodies is performed by enzyme immunoassay (sandwich assay)" [17]. HAV IgM was detected by enzyme-linked immunosorbent assay (ELISA) test namely designed for the qualitative detection of IgM antibodies to HAV in human serum [18].

2.5 Data Analysis

Analyzed by using Excel 2016 and Statistical Package for the Social Sciences (SPSS) version 15 to calculate the descriptive analysis and Chi-squared test at p = 0.05 that were used to explore the epidemiological features of HVA infection among children in Hodeidah, Yemen.

3. RESULTS

3.1 Participants Characteristics

Out of 422 children, including 301 cases (71.3%) males and 121 cases (28.7%) females. The results found that 139 cases (32,9%), 142 cases (33.6%), 103 cases (24.4%) and 38 cases (9.0%) were in age groups of 7, 8, 9 and 10 years, respectively. This study showed that 358 cases (84.8%) of children were with low socioeconomic status (SES), while 64 cases (15.2%) of children with moderate SES. Most of them live in random houses (408 cases; 96.7%). In the current study, the number of persons in household (11-15 person) were 211 cases (50%) while the number of persons in household (6-10 person) were 191 cases (45.3%). Also this study obtained that 18 cases (4.3%) were with the illiteracy rate of the parents, but 208 cases (49.3%) of parents were with just read and write (Table 1).

3.2 Relationship between the Socio-demographic Characteristics and HAV IgM

3.2.1 Sex and age

Serum samples were collected from 422 children. HAV infection was detected in 22/422 cases (5.21%). HAV infection was represented in the males as 14/22 cases (63.63 %) while in the females it was represented as 8/22 cases (36.36 %). However, this difference was not statistically significant (X^2= 0.671; p = 0.414). The higher frequency of HAV infection was in children between 7 and 8 years (20/22 cases; 90.90 %) and the lower frequency was in children between 9 and 10 years (2/22 cases; 9.09 %), with a

significant association (X^2= 6.385; p -value = 0.022) (Table 2).

3.2.2 Income, residence and education

Moreover, participants with low economic level were more susceptible to have HAV IgM antibody (20/22 cases; 90.9%). The higher frequency of HAV IgM antibody was noticed in the children who live in random houses. The number of persons (11-15 person) in household were more likely to have HAV IgM antibody which was 13 cases (59.1%) compared with the number of persons (6-10 person) in household 9 cases (40.9%). Regarding the education level of the parents; the highest percent were among children's of parents who just read and write (14/22 cases; 68.2%), while the lowest percent were among children's of illiterate parents and parents had primary education (1/22 cases; 4.5%) for each, but there was no significant association (X^2= 3.551; p = 0.120) (Table 2).

Table 1. Socio-demographic characteristics of the studied children, Al Hawak district, Hodeidah city, Yemen 2019

Characteristics		N=422	%
Sex	Male	301	71.3
	Female	121	28.7
	7	139	32.9
Age (years)	8	142	33.6
	9	103	24.4
	10	38	9.0
	Illiterate	18	4.3
	Read and write	208	49.3
Education level for parents	Primary	39	9.2
	Secondary	97	23.0
	University	60	14.2
	Moderate	64	15.2
Socioeconomic status (SES)	Low	358	84.8
House structure	Random	408	96.7
	Apartment	14	3.3
Number of persons in household	≤5	20	4.7
	6-10	191	45.3
	11-15	211	50.0

Table 2. Relationship between the Socio-demographic characteristics of the studied children and HAV IgM antibody

Characteristics		IgM (N: 422)				Total		X^2	*p*-value
		Positive		Negative					
		No.	%	No.	%	No.	%		
Sex	Male	14	63.6	287	71.8	301	71.3	0.671	0.414
	Female	8	36.4	113	28.2	121	28.7		
Age (years)	7	10	45.5	129	32.2	139	32.9		
	8	10	45.5	132	33.0	142	33.6	6.386	0.022*
	9	2	9.0	101	25.2	103	24.4		
	10	0	0.0	38	9.5	38	9.0		
House structure	Random	22	100	386	96.5	408	96.7	0.796	0.373
	Apartment	0	0.0	14	3.5	14	3.3		
Socio-economic status(SES)	Moderate	2	9.1	62	15.5	64	15.2	0.666	0.416
	Low	20	90.9	338	84.5	358	84.8		
Level education of parents	illiterate	1	4.5	17	4.2	18	4.3	3.551	0.120
	Read and write	15	68.2	193	48.2	208	49.3		
	Primary	1	4.5	38	9.5	39	9.2		
	Secondary	3	13.6	94	23.5	97	23.0		
	University	2	9.1	58	14.5	60	14.2		
Number of persons in household	≤ 5	0	0.0	20	5.0	20	4.7	1.581	0.974
	6-10	9	40.9	182	45.5	191	45.3		
	11-15	13	59.1	198	49.5	211	50.0		

**Significant: p-value ≤ 0.05 is significant*

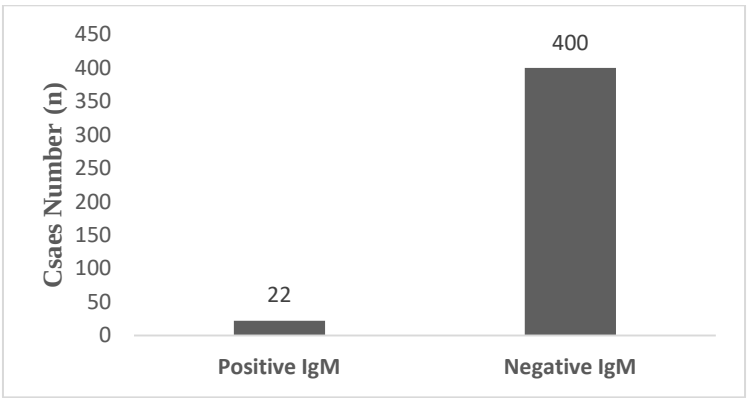

Fig. 1. Incidence rate of HAV IgM amongst children aged 7-10 years in Al Hawak district, Hodeidah city, Yemen, 2019

Table 3. HAV infection with some risk factors associates the infection

Risk factors		IgM (N: 422)				Total		X^2	*p*-value
		Positive		Negative					
		No.	%	No.	%	No.	%		
Source of drinking water?	Tap water	18	81.8	265	66.2	283	67.1	2.288	0.131
	Water treated with chlorine	4	18.2	135	33.8	139	32.9		
Method of sewages disposal	General disposal	21	95.5	357	89.2	378	89.6	0.860	0.355
	Special disposal	1	4.5	43	10.8	44	10.4		
Are you practice personal hygiene after outside from bathroom? (Hand washing)	Yes	6	27.8	42	10.5	48	11.4	5.820	0.016*
	No	16	72.2	358	89.5	374	88.6		
Did you have special towels?	Yes	7	31.8	210	52.5	217	51.4	3.571	0.059
	No	15	68.2	190	47.5	205	48.6		
Have you share your clothes with others?	Yes	14	63.6	145	36.2	159	37.7	6.661	0.009*
	No	8	36.4	255	63.8	263	62.3		
Is a family member infected with HAV ?	Yes	17	77.3	379	94.750	377	89.3	11.017	0.0009*
	No	5	22.7	21	5.2	26	6.2		
	I don't Know	0	0.0	19	4.8	19	4.5		

**Significant: p-value < 0.05 is significant*

3.3 Risk Factors Associated with HAV Infection

Some associated risk factors were studied evaluating the emergence of HAV infection including source of drinking water and method of sewages disposal, they were shown to associate the presence of HAV IgM antibody, although they have not shown a significant association with HAV infection (*p*-value > 0.05) clarified in Table 3. Another risk factors that were statistically significant (*p*-value < 0.05) with HAV infection including child who close contact with person with HAV infection (17/22 cases; 77.3%), child who do not practice personal hygiene (hand washing) after outside from bathroom (14/22 cases; 72.7%), child who have not special towels (15/22 cases; 68.2%) and child who share clothes with others (14/22 cases; 63.6%) as shown in Table 3.

4. DISCUSSION

No previous studies have examined the incidence of HAV IgM in the children in Hodeidah governorate, although no clinical reports of infections have been made. Screening for incidence of HAV IgM antibody is very important because of many risk factors associate the presence of HAV in Hodeidah Governorate, such as the close contact with person with HAV infection and poor sanitary conditions including personal hygiene conditions such as child who do not practice personal hygiene (hand washing)

after outside from bathroom, child who have not special towels and child who share clothes with others.

Our study found that HAV IgM antibody present in about 5.2%, several studies were published locally and international about epidemiological features of HAV, in Aden by Bawazir et al. 2010 showed that HAV IgG antibody were 86.6% [19]. In our study there was a significant difference with HAV infection between males and females (63.6% and 36.4% respectively). This study was different with Al Rashed working in Saudi Arabian showed that no significant difference with HAV infection between males and females (51.3%, 53.5% respectively) [20].

The results were agreed with study that carried out in Nigeria by Aliyu Ibrahim 2015, his findings showed that HAV IgM antibody were 7.8% [21]. Children aged 7 and 8 years old were more likely to have HAV recent infection which was 45.5% for each in this study compared with children aged 9 years which was 9.0% for IgM antibody. "There was no significant association between sex and seropositivity to anti-HAV antibody in this study. This was demonstrated by Gomes et al. working in Brazil. This is possibly due to the fact that both sexes live in the same endemic environment and are exposed to the same predictors of the infection" [22].

The present study revealed that lower levels of parents education were no significantly association with HAV infection. This study was different with Salama et al. [23] in Cairo, showed significantly association between lower levels of parents education and HAV infection.

"In our study, the majority of low SES children who gave a history of symptomatic HAV infection were under 10 years of age while for children of high SES the majority who gave history of symptomatic infection were aged more than 10 years. Children who got symptomatic infection above age of 10 years reported severe form of symptoms compared to younger children. Similarly, Arguedas and Fallon reported that the severity of HAV illness increases with age" [24].
"A incidence of IgM antibody was noted with greater family size but it was not statistically significant. However, Fix et al. in Santiago, Chile found a significant association between HAV infection and crowded living situations" [25].

Also no significant association was showed between HAV infection and 3 public primary schools, although the students in Legislator's primary school were less likely to be infected with HAV than other schools , these findings were similar to findings in a study in Nigeria [19].

However, method of fecal waste disposal and source of drinking water were not significantly associated with the HAV infection in this study. Escobedo-Melendez et al. in Mexico showed "no association between sewage disposal method with HAV infection" [26]. Vancelik et al. in eastern Turkey, "showed no significant association between source of drinking water and HAV infection [27].

"A history of hepatitis or contact with a case of hepatitis has been shown to be associated with anti-HAV seropositivitiy" [28]. In the present study, statistically significant association was found. This study was different with Salama et al. [23] in Cairo, showed no significant association between contact with a case of hepatitis and HAV infection. "In the current study, there was a significant relationship between HAV infection and poor sanitary conditions (personal hygiene conditions) (e.g. no have special towels). HAV seropositivity were higher among children living in poor sanitary conditions and were the most important significant risk factors for the prediction of HAV seropositivity. This is in accordance with studies done in Saudi Arabia and in Santiago" [20,25].

5. CONCLUSIONS

This study concluded low HAV incidence among children of primary schools in Al- Hawak district, Hodeidah, Yemen. The most risk factors of infection with HAV were close contact, poor sanitary conditions, house structure and crowding in house.

CONSENT

As per international standard or university standard, patients' written consent has been collected and preserved by the author(s).

ETHICAL APPROVAL

As per international standard or university standard written ethical approval has been collected and preserved by the author(s).

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COMPETING INTERESTS

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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