



A cross sectional study of the risk factors of hepatitis C infection in North Egypt

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Abstract Hepatitis C is a viral infection that has been declared as a global health problem by the World Health Organization. Egypt has the highest prevalence of hepatitis C virus (HCV) which results in a high morbidity and mortality from chronic liver disease, cirrhosis, and even hepatocellular carcinoma. Cities have lower rates of infection than rural areas. Studies about the abnormally high prevalence of HCV in Egypt ascribed that to the governmental campaign to treat *Schistosoma*. However, these treatment campaigns have stopped more than 35 years ago, which means that some other modes of transmission must have been involved. The objective of this work is to study the main reasons of HCV prevalence in the Egyptian Delta valley. A questionnaire-based study was conducted by members of the HCV Fighters project. Responses were collected from 949 volunteers (451 HCV patients and 498 healthy volunteers as control). The data were analyzed using SPSS version 19.0. The two-sample proportion test was used for statistical comparison between groups. The most probable risk factors of HCV transmission in Egypt included regular visits to dental clinics (55.2%), previous surgical operations (54.4%), former

blood transfusion (52%), intrafamilial HCV infection (45.9%) and history of bilharzial infection (44.3%). Increasing public awareness about modes of transmission and risk factors of HCV infection is a must, especially within family members of HCV patients. Strict commitment to proper medical care precautions by health care practitioners is required.

Keywords Hepatitis C virus · Egypt · Prevalence · Risk factors · Dental clinics · Surgical operations

Introduction

Hepatitis C virus (HCV) is a blood-borne viral infection which was declared as a global health problem by the world health organization (WHO) [3]. HCV has a major global apprehension as the persistent infection can be the leading cause of progressive liver diseases, cirrhosis, hepatocellular carcinoma and liver transplantation [21]. HCV species are classified based on genetic differences between the isolates into 7 different genotypes with at least 67 known subtypes [16, 24]. Among these diverse genotypes, genotype 4 is the most predominant form in Egypt (responsible for 93.1% of total cases) [7]. Unfortunately, genotype 4 only accounts for 8.3% to 16.8% of the global cases most of them are in developing countries, which direct less attention towards development of genotype 4 specific antiviral regimens compared to other genotypes. Figure 1 shows the genotype distribution of HCV worldwide [10].

In 2015, viremic prevalence of HCV in Egypt was estimated to be 6.3% (global prevalence was estimated to be 1.0% at the time), which was considered to be the highest prevalence rate in the world [3]. Figure 2 shows the

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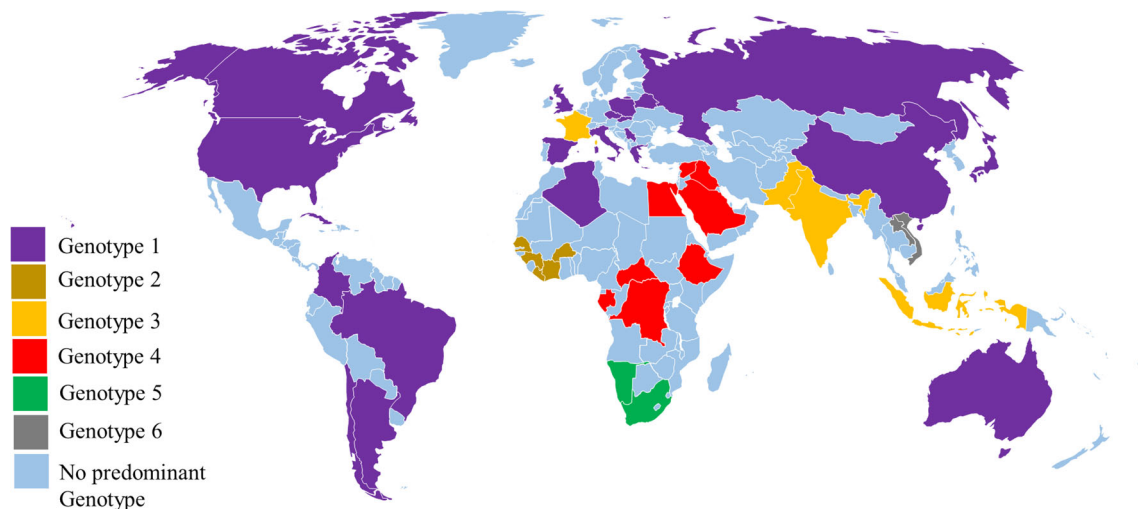


Fig. 1 A map of the genotype distribution of HCV worldwide. The color indicates the most predominant genotype in each country (> 50%) (color figure online)

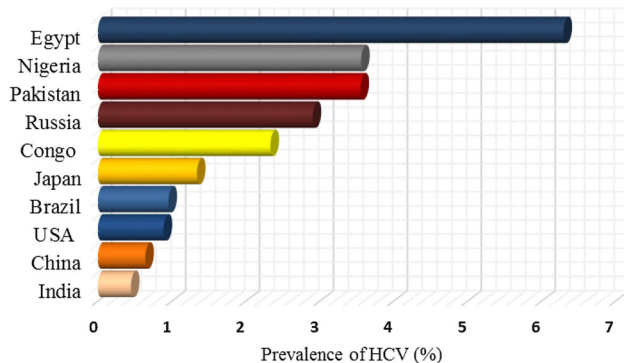


Fig. 2 The prevalence of HCV infection in the countries with the highest burden. These results are based on the number of HCV-infected individuals and the total population in each country

prevalence of HCV infection in countries with the highest burden, based on the number of HCV-infected individuals and the total population in each country [28]. The reported prevalence among Egyptian males applying for visa is up to 32%. About 20% of the blood donors in Egypt have antibodies for HCV which indicates a current or a former infection with the virus [2, 6]. Accordingly, Egypt bears higher burden and shows much higher prevalence rates than surrounding countries in the area and even in countries with comparable socioeconomic conditions [6]. This is particularly important for the Egyptian Delta valley that shows the highest prevalence rate (Fig. 3). The noticeably higher prevalence of HCV in Egyptian Delta valley has been indirectly correlated to parenteral anti-schistosomal therapy (PAT), which was practiced since 1920 with the governmental mass campaigns starting from the late 1950s to 1980s [9]. However, these treatment campaigns have stopped more than 35 years ago which means that some

other modes of transmission must have been involved. The aim of our study is to investigate the potential risk factors responsible for HCV clustering in Nile Delta to help better control the viral infection and by applying special protective measures for high risk groups. Literature showed that early diagnosis of HCV increase the opportunity for successful intervention. The incidence of liver decompensation was affected by the time of infection (11% within 1 year, additional 7% within 1–5 years and additional 5% if > 5 years of HCV diagnosis) [18].

Methods

Study design

A cross sectional study was performed using self-administered questionnaires. The influence of various factors on the prevalence of HCV in the Nile Delta was assessed using Yes/No/Do not know questions for 14 items based on common risk factors of HCV in literature [12]. The questions covered statements related to medical procedures (5 items), barber's precautions (3 items), dentist's precautions (2 items), bilharzial infection (2 items), family history (1 item), and habits (2 items). Demographic characteristics (age, sex, education level) were collected in the first section of the questionnaire. Table 1 summarizes the demographic data for the studied population.

Sample size and data collection

This study was conducted as a survey, and only included voluntary participants from the National Liver Institute in Menoufia University, the Hospital of Tropical Diseases in

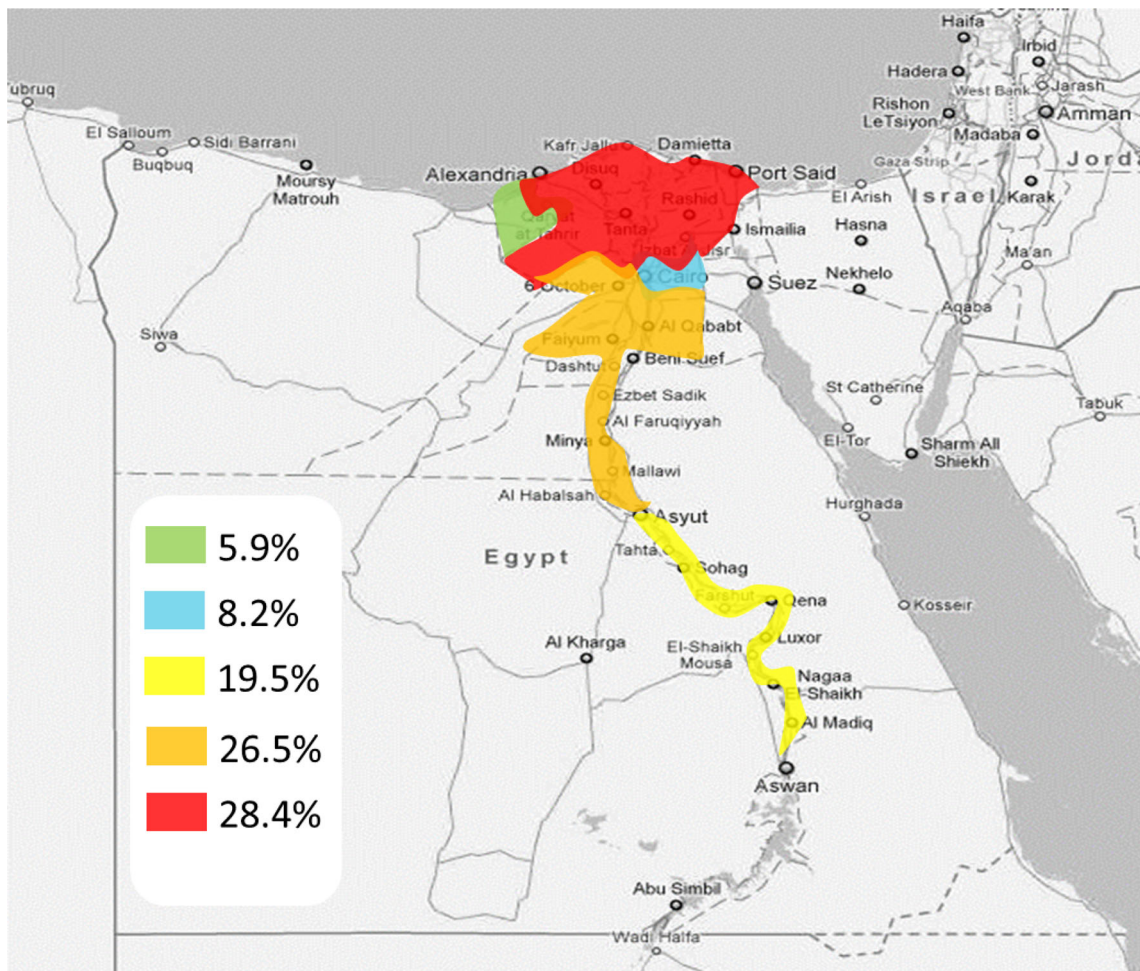


Fig. 3 Demographic distribution of HCV infection in Egypt

Table 1 Demographic data of the studied population

	Patient	Control
Gender		
Male	194	174
Female	257	324
Educational level		
Low	160 (35%)	179 (36%)
Medium	103 (23%)	112 (22%)
High	188 (42%)	207 (42%)
Age	17–82	11–70

Tanta and the Hospital of Tanta University. Sample size was calculated by assuming a 6.3% prevalence of HCV, a 99% level of significance, a ± 7 margin of error and a 20% missing-data rate [11]. The study excluded patients with only positive serological tests whose results were not confirmed by PCR.

Data quality assurance

Pretest of the data collection tool was conducted on 25 patients to check for clarity. Based on the result of the pretest, necessary corrections were done.

Data entry, analysis

All data were collected and fed to Microsoft Excel program[®] then analyzed with SPSS[®] 19 software (Statistical Package for the Social Sciences, SPSS Inc, and Chicago, USA). A two-sample proportion test was used to test for group differences (Patients vs control).

Table 2 Summary of questionnaire results and their statistical analysis for test and control groups

Question	Patients			Control			Statistics				
	Yes	No	DNK	Yes	No	DNK	SE	p-hat	q-hat	z-value	p-value
1 Have you ever been infected with bilharzia?	200 (44.3)	221 (49.0)	30 (6.7)	25 (5.0)	458 (92.0)	15 (3.0)	0.029	0.237	0.763	14.683	<0.0001
2 Have you ever been treated using the anti-Schistosomal glass syringe?	49 (24.5)	122 (61.0)	29 (14.5)	NA	NA	NA	NA	NA	NA	NA	NA
3 Have you ever had blood transfusion?	95 (21.1)	351 (77.8)	5 (1.1)	28 (5.6)	450 (90.4)	20 (4.0)	0.023	0.130	0.870	7.276	<0.0001
4 Do you regularly visit dentist's clinics?	249 (55.2)	198 (43.9)	4 (0.9)	186 (37.3)	305 (61.2)	7 (1.4)	0.033	0.458	0.542	5.467	<0.0001
5 Do you tell the dentist/barber if you are HCV patient or not?	189 (41.9)	196 (43.5)	66 (14.6)	NA	NA	NA	NA	NA	NA	NA	NA
6 Do your dentist/barber ask you if you are suffering from HCV or any other chronic disease?	92 (20.4)	303 (67.2)	56 (12.4)	60 (12.0)	384 (77.1)	54 (10.8)	0.027	0.160	0.840	3.67	0.00028
7 Are any of your family members having HCV infection?	207 (45.9)	227 (50.3)	17 (3.8)	153 (30.7)	317 (61.2)	28 (1.4)	0.033	0.379	0.621	4.647	<0.0001
8 Have you ever had a surgical operation?	247 (54.8)	203 (45)	1 (0.2)	209 (42.0)	281 (56.4)	8 (1.6)	0.033	0.481	0.519	3.75	0.0002
9 Have you ever used cupping therapy?	37 (8.2)	396 (87.8)	18 (4.0)	23 (4.6)	464 (93.2)	11 (2.2)	0.016	0.063	0.937	2.344	0.019
10 Do you have a renal failure?	13 (2.9)	427 (94.7)	11 (2.4)	5 (1.0)	483 (97.0)	10 (2.0)	0.009	0.019	0.981	2.129	0.03
11 Have you ever been punctured by a used syringe needle?	72 (16.0)	314 (69.6)	65 (14.4)	63 (12.7)	408 (81.9)	27 (5.4)	0.025	0.142	0.858	2.11	0.03552
12 Did you ever make a tattoo?	3 (0.7)	388 (86.0)	60 (13.3)	4 (0.8)	491 (98.6)	3 (0.6)	0.006	0.007	0.993	- 0.068	0.94571
13 Do you use your personal tools at the barber's shop?	37 (19.1)	108 (55.7)	49 (25.3)	44 (25.3)	85 (48.9)	45 (25.9)	0.055	0.220	0.780	- 1.556	0.122
14 Do you check on changing the shaving blades every time you visit the barber's shop?	62 (32.0)	58 (29.9)	74 (38.1)	63 (36.2)	35 (20.1)	76 (43.7)	0.067	0.340	0.660	- 1.874	0.06339

Values between brackets represent the percent in each case

Result and discussion

Table 2 shows a summary of the questionnaire results and their statistical analysis for test and control groups. The results are arranged according to the z-score from the highest (the most significant) to the lowest (the least significant). According to these results, the most probable risk factors of HCV transmission in Egypt included regular visits to dental clinics (55.2%), previous surgical operations (54.4%), former blood transfusion (52%), intrafamilial HCV infection (45.9%) and history of bilharzial infection (44.3%). The highest z-score was observed in HCV patients co-infected with bilharziasis. Other factors including cupping therapy, renal failure dialysis, accidental needle puncture, tattooing and barbers' shops were found nonsignificant

For a long time, PAT campaigns were held responsible for HCV pandemic in Egypt [9, 17]. Our results showed that 44.3% of patients had schistosomal infection compared to 5% of the control group. Only HCV patients who had a bilharzial infection were asked if they were ever injected with the anti-Schistosomal glass syringe. Surprisingly, only 24.5% of the HCV/Schistosoma patients were previously immunized using the non-disposable glass syringe. This means that most of the HCV patients in the studied sample were not subject to PAT campaigns which put a query mark on the alleged strong correlation between the high prevalence of HCV in Egypt and these campaigns. On the other hand, the high z-score observed for the previous Schistosomal infection in HCV patients indicated a strong correlation between bilharziasis and hepatitis C, other than the overestimated PAT campaigns. That was supported by previous reports on the negative effect of Schistosoma infection on the cellular immune responses to core HCV peptides [8], which increased the risk of HCV chronicity, and accelerated the disease progression [27].

Common practices that may cause patient to patient transmission of HCV inside hospitals include surgical operation [15], blood transfusion [25], invasive diagnostics [4] and communal dialysis equipment [20]. Taking into consideration poor infection control and sterilization procedures in the developing countries, high prevalence of nosocomial infections in Egypt may participate to the elevated national HCV levels. The studied HCV patients were asked if they ever had blood transfusion. Significantly higher percentages were observed in the patient group compared with the control group (z score = 7.3). This can be attributed to inadequately screened blood donors [14] and unnecessary blood transfusions [6].

Invasive dental procedures are recently emphasized as possible risk factors for HCV transmission. Our results show a significant difference between percent of patients

who regularly visit dental clinics (55.2%) compared to the control group (37.3%). These results highlight the importance of applying universal infection control protocols in the dental operating room. Oral and dental procedures are also a suspect for patient-to-patient transmission of HCV. Lack of proper sterilization protocols and poor infection control in dental clinics can be correlated to transmission of viral hepatitis between patients [13, 26] 41.9% of the patients declared that they do not tell the dentist/the barber that they have an HCV infection. What makes the situation even worse is that dentists/barbers rarely ask if the client has HCV or any other infection (20.4% in the patient group and 12.0% in the control group). These results show that dentists are required to be more strict in following the standard operating procedures and applying the proper infection control measures.

HCV transmission through family member is another interesting and controversial suggestion which has been previously reported in various Egyptian regions [22, 23]. A significant difference is evident between patients and control groups (Table 2) with 45.9% of patients report that at least one of their family members has HCV comparing to 30.7% of control. The risk of intrafamilial transmission can increase by increasing the duration of exposure to the patient, the number of family members suffered from HCV and long term heterosexual contact with the patient [5, 22].

Renal failure and chronic kidney disease are considered primary causes for frequent hemodialysis and/or blood transfusion. A previous report showed that the percentages of anti-HCV reactive patients were correlated with the onset of dialysis (17% if less than 1 year, 43% for 1–5 years and 76% if more than 5 years) [19]. Knowing that HCV is mainly transmitted through invasive procedures, a link maybe established between clustering of HCV and hemodialysis [1, 20]. However, the results showed no significant differences between the patient group and the control group. Similarly, no significant differences were obtained for tattooing, cupping therapy, and being punctured by a syringe needle.

Although barbers' shops are probable places of infection transmission due to the use of sharp objects and the possibility of sharing tools with others, neither using personal tools nor checking that barbers change the shaving blades between clients was found responsible for the prevalent infection as evidenced by the high *p* value and the very low z-score. It is ironical that barbers' shops were found less likely a reason for HCV transmission while dental clinics were. That could be because getting injured during dental procedures is something expected and acceptable. In addition, the high credibility of dentist in the Egyptian society makes it unusual to ask about the sterilization precautions.

The historical exposure to PAT campaigns was considered the major cause for considerably higher prevalence rate of HCV in Egypt, yet the clustering of HCV infection is not well correlated with the distribution of PAT campaign in the past. Other risk factor may have shared responsibility for the high viremic prevalence in Egypt. These factor include intrafamilial transmission, poor sterilization process and inadequate infection control during surgical and dental operation, patient to patient transmission in shared dialysis unit and blood transfusion. Hence, improvements in infection control protocols and strict hygiene practice in hospitals along with increasing awareness among health care providers is expected to reduce risk of HCV infection.

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Compliance with ethical standards

Competing interests The authors declared no competing interests.

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