Risky exposures and national estimate of HCV seroprevalence among school children in urban Egypt

Ekram W. Abd El-Wahab¹ · Ahmed Abdel Maksoud² · Hanan Z. Shatat¹ · Amira M. Kotkat¹

Received: 6 July 2016 / Accepted: 26 August 2016 / Published online: 12 September 2016
© Indian Virological Society 2016

Abstract Hepatitis C virus (HCV) is a significant cause of morbidity and mortality all over the world, particularly in Egypt. Limited data are available concerning the national seroprevalence and the possible modes of transmission of HCV in the pediatric age group. The aim of this study was to obtain a better estimate of the national hepatitis C seroprevalence and the possible risky exposures among healthy school children in Alexandria; the second biggest city in Egypt. HCV knowledge and counseling for school children were also investigated. A total of 500 school children, age between 6 and 15 years were evaluated for HCV seropositivity and interviewed for potential disease risk factors. The seropositivity for Anti-HCV Ab was 2.8 %. About 71.4 % of seropositive children were 10–15 years old. Urban residence, chronic disease, male circumcision and invasive procedures were detected as significant risk factors for acquiring HCV infection among the studied children. The level of awareness of hepatitis C among school children was very low (3.6 %) and was correlated with the age and educational level. HCV infection continues to occur in children and is frequently unrecognized. This mandates immediate intervention and robust control strategies in the settings of exposure combined with health education programs to limit further HCV spread.

Keywords HCV · School children · Egypt

Introduction

Data about Hepatitis C virus (HCV) infection in children is limited compared to adults. Many infected children remain unidentified as children are less likely to have symptoms from their HCV infection. New infections in children continue to occur as a result of maternal-neonatal transmission or infection transmitted from mother to newborn, which both accounts for a sizeable group of children with HCV infection [11, 13]. Horizontal transmission, either from adult to child in a household, or child-to-child at home or at school does not seem to be an important risk factor. The prevalence of pediatric infection varies from 0.05 to 0.36 % in the USA and Europe and a mount for 1.8–5.8 % in some developing countries, with the highest prevalence been found in Egypt [8, 11]. Parenteral acquisition of HCV remains a major route for infection among Egyptian children. Insufficient screening of transfusions, unsterilized injection equipment and re-used needles and syringes continue to be major routes of HCV transmission in developing countries, whereas vertical transmission and adolescent high-risk behaviors as injection drug abuse, are the major routes in developed countries [1, 8, 12, 15, 17]. Rural children and young adults who were not exposed to the parenteral antischistosomiasis injections campaigns led in Egypt between 1970 and 1980 have relatively high anti-HCV prevalence. This means that other modes of transmission have perpetuated the infection in the community [15].

Education about HCV and the potential routes of transmission is crucial for disease prevention [5]. One study conducted in Australia found children's knowledge

Electronic supplementary material The online version of this article (doi:10.1007/s13337-016-0345-5) contains supplementary material, which is available to authorized users.

✉ Ekram W. Abd El-Wahab
ekramwassim@mail.com

¹ Department of Tropical Health, High Institute of Public Health, Alexandria University, 165 El Horreya Road, Alexandria 21561, Egypt

² Ministry of Health, Alexandria, Egypt

about HCV is extremely poor [14]. Although school age children are not expected to know about HCV infection, infectious disease education and health promotion for school students is important in disease endemic countries.

Updated data on HCV infection among school age children in Egypt are lacking. Earlier studies pointing to a national prevalence of 3–9 % [12, 15] in rural areas in 2001 and 5.8 % in an urban city (Alexandria) in 2005 [3]. With the advances in methods of HCV screening and management, HCV prevalence is expected to be lower than previous reports. This study was therefore conducted to update the estimates the national prevalence and to identify the current risk factors of HCV infection among a representative sample of healthy Egyptian children from different residential areas and with different socioeconomic classes. The present work discerns also school children's knowledge and sources of information on HCV infection.

Materials and methods

Study population and sampling method

According to the Egyptian Central Agency for Public Mobilization and Statistics [4], the population in Alexandria governorate is stratified as 60 % Urban and 40 % Rural. Alexandria is composed of 7 municipal districts namely; El-Montazah (urban and rural), Shark (urban), Wasat (urban), Gharb (urban), El-Gomrok (urban), El-Ameryia (rural), and Borg El-Arab (rural) (Fig. 1). Using the computer Epi-info version 6.04, and based on the results of an earlier study for HCV prevalence among school children in Alexandria, that was estimated to be 5.8 % [3], desired degree of precision 3 %, and confidence limits 95 %, the minimum required sample size was

Fig. 1 Map of Alexandria (Egypt) showing the governorate grouped into 7 administrative districts. The number of schools selected from urban and rural areas are indicated by green and red triangle respectively

calculated to be 360. As the prevalence of HCV infection was expected to be low, a sample size of 500 healthy school children (aged between 6 and 15 years) were recruited. Since the community composition in Egypt is 60 % urban and 40 % rural, we used proportionate allocation sampling method to select proportionate number of schools from urban and rural areas in Alexandria. At the first stage of selection, using the school directory in Alexandria governorate, 10 schools were randomly selected from 10 different regions in Alexandria (6 urban and 4 rural) (Fig. 1). In April 2014, a sample of 500 children was proportionally allocated as 300 from urban and 200 from rural regions in Alexandria. Using simple random sampling, 50 children were selected from student sheets of each school. Children with any chronic illness were excluded during selection.

Data collection

Children below 12 years were interviewed in presence of their parents/caregivers. Responses were obtained from students themselves if they were above 12 years of age. Questionnaires were used to collect socio-demographic data, potential risk factors and knowledge for exposure to HCV. Sociodemographic, community acquired, behavioral, medical history and iatrogenic risk factors associated with HCV positivity. The socioeconomic status of the studied children was classified as high, middle, low and very low according to Fahmy and Sherbini [10].

Laboratory testing

About five ml blood samples were collected in vacutainer tubes through vein puncture and allowed to clot naturally and completely. Sera were separated and stored according to the standard guidelines until analyzed for the serologic evidence of HCV infection by detecting HCV antibodies in serum, using commercially available 4th generation Enzyme Linked Immunosorbent Assay (Adaltis® Srl. V. 4.0, EIAgen, Italy), according to the manufacturer's instructions. A second serum sample was retested for confirmation.

Statistical analysis

Data were fed to the computer using IBM SPSS (Statistical Package for the Social Sciences) software version 16.0 (SPSS Inc., Chicago, IL, USA). Qualitative data were described using number and percent, mean and standard deviation. All risk factors were tested for association with anti-HCV positivity in bivariate analysis using the Chi square test, Fisher's exact test or Monte Carlo correction with the calculation of odds ratios (OR) and 95 %

confidence intervals (95 % CI). Significance test results are quoted as two-tailed probabilities. Logistic regression has been used to determine most important risk factors in which [Exp (B) > 0.38] was considered to be statistically significant. A $P < 0.05$ was considered to be statistically significant.

Ethical statement

The study was approved by the institutional review board and ethics committee of the High Institute of Public Health, Alexandria University—Egypt. The investigator communicated with key personnel including authorized managers of each school centers in order to facilitate implementation of the study. An acquaintance visit was done to the localities and the researcher presented herself to the staff there, explained in details the aims and concerns study and administrated an institutional statement of request. The authorized managers accepted the implementation of the study in favors of school children after assuring the confidentiality of the data collected by the interview questionnaire, as well as that of the laboratory tests. The investigator received in-depth training specific to interviewing the children and sensitivity regarding the sexual behavior was considered. A written consent was obtained from parents/caregiver in addition to an assent from children before enrollment in the study. Data was collected by interviewing each parent/child separately in a private room to ensure the confidentiality of the responses.

Results

Overall prevalence of anti-HCV

Of the 500 children [284 (56.8 %) males and 216 (43.2 %) females, 14 (2.8 %)] were positive for anti-HCV (Table 1). No significant gender difference was observed but significant higher rates for urban residents [12 (4 %) compared to that of rural inhabitants [2 (1 %)], ($P = 0.045$). Seropositivity was highest in the age group (8–12 years), ($P = 0.017$), (Fig. 2). Middle social class has relatively higher prevalence compared to the low and high socioeconomic levels.

Frequency of exposures and association with HCV seropositivity

The most common behavioral and community acquired risk factors as well as health care related exposures among HCV seropositive children and seronegatives are detailed in (suppl. Tables 1 & 2).

In our multiple logistic regression model and after removing of confoundings, urban residence, chronic disease, male circumcision and invasive procedures although were not evident as risk factors in the univariate analysis, appeared as significant risk factors for acquiring HCV infection among the studied children (Table 2).

HCV knowledge and counseling

The results indicate that the level of awareness of hepatitis C among school children was very low (3.6 %). This was strongly correlated with age (100.0 % in age group 12–15, $P < 0.0001$). There was no statistically significant difference in HCV prevalence between those who have heard of HCV infection and those who have not ($P = 0.6$). Awareness of the disease and modes of transmission was higher among males (66.7 %) and urban residents (66.7 %). Among those who had heard about hepatitis C, 3 children (16.7 %) had previously received information about the illness though physicians either at school or at school health insurance clinic. Only the later were able to name at least one way the illness can be transmitted; that it could be contracted through a blood transfusion. Others mentioned food (66.7 %), clothes (27.8 %) and water (11.1 %) as sources of infections.

Discussion

The prevalence of viral hepatitis C among 0–15 year-olds have not been extensively studied so far in Egypt. The objective of this study was to determine the exact seroprevalence of HCV infections in 6–15 year-old children living in Alexandria. Previous studies conducted in rural communities, reported a seroprevalence of 12.1 % of anti-HCV among rural primary school children [2]. Other community-based studies reported that HCV prevalence among subjects under 19 years old is 3 and 9 % in Upper Egypt and in the Nile Delta, respectively [12, 15]. A recent study conducted in Alexandria [3], found that HCV infection among school children was 5.8 %, which is twofold higher than what we report in the present study. This could be attributed to different sampling techniques. Moreover, the later study, despite being published in 2011 was conducted in 2005, almost a decade earlier than the present survey. Also, with the dramatic improvement in HCV therapy, the reservoir of infection must have been diminished.

Consistent with previous studies [3, 12, 15], children above 10 years old have an estimated 2.5-fold higher odds of being anti-HCV-positive compared to those below 10 years old. Since the screening of blood for blood borne viruses has been put in place, children are primary infected

Table 1 Sociodemographic data and community acquired risk factors of the enrolled children

	Total participants n = (500) No (%)	Anti HCV-anti BS		OR (95 % CI)	P value
		Normal (n = 486) No (%)	HCV (n = 14) No (%)		
Age					0.017*
6–	99 (19.8)	98 (99.0)	1 (1.0)	1	
8–	123 (24.6)	120 (97.6)	3 (2.4)	2.4 (0.3–24)	
10–	114 (22.8)	106 (93.0)	8 (7.0)	7.4 (1–60)	
12–15	164 (32.8)	162 (98.8)	2 (1.2)	1.2 (0.1–13.5)	
Sex					0.979
Male	284 (56.8)	276 (97.2)	8 (2.8)		
Female	216 (43.2)	210 (97.2)	6 (2.8)		
Residence					0.045*
Urban	200 (60.0)	288 (96.0)	12 (4.0)	4.2 (0.9–19.4)	
Rural	200 (40.0)	198 (99.0)	2 (1.0)		
Education					0.636
Illiterate	5 (1.0)	5 (100.0)	0 (0.0)		
Primary	376 (75.2)	364 (96.8)	12 (3.2)		
Preparatory	119 (23.8)	117 (98.3)	2 (1.7)		
SES					0.653
Low	152 (30.4)	149 (98.0)	3 (2.0)		
Middle	275 (55.0)	267 (97.1)	8 (2.9)		
High	73 (14.6)	70 (95.9)	3 (4.1)

Fig. 2 Seropositivity of HCV with age

at time of birth from HCV positive mothers [13]. The rise in anti-HCV positivity with age could be the result of continuous exposure. In the present study, males were equally affected as females. This disagrees with previous reports where HCV infection was significantly higher among male population [3, 12, 15]. In Egypt, the bulk of HCV transmission among population is attributed to behavioral and community-derived risky practices and exposures [15] which were found more common among males and decline among younger age clusters [1, 16, 18].

The impact of the majority of HCV risk factors could not been evaluated in this study since numbers of positive cases were very small and in HCV positive cases, none had achieved even univariable significant level. This could also reflect that the population at large is exposed to the same

risk factors. However, in the present multiple logistic regression model, urban residence, chronic disease, male circumcision and invasive procedures appeared as significant risk factors for acquiring HCV infection among the studied children.

Children with a history of chronic disease have 1.8-folds more risk for HCV infection than those without any history of chronic illness. This association may be due to intervention of multiple risk factors as children with chronic disease are more vulnerable to frequent hospitalization which increases possibility of contact with HCV infected persons, also those children are more exposed to injection and invasive procedures. This association was not reported in the previous studies was done in Egypt [3, 7, 12, 15]. However, Barakat et al. [3] excluded children with a history of chronic disease.

A significant association between residence in urban areas and HCV seropositivity was detected in the present study. Studied children were too young to be exposed to the mass antischistosomiasis injection campaigns that resulted in large HCV reservoir found in rural communities. Alexandria has a particular population composition. Populations from nearby rural governorates migrate and settle in Alexandria particularly in the eastern part. This explains that most of the seropositive cases were found in the eastern urban districts. On the other hand, this could suggest the involvement of unreported/unidentified risk factor in urban societies.

Table 2 Multiple logistic regression model for HCV risk factors among the enrolled school children

Risk factor	Sig.	OR	95.0 % CI	
			LL	UL
Residence (Rural)	0.05	0.255	0.025	0.991
Chronic disease	0.048	1.804	1.1	6.072
Invasive procedure	0.018	5.016	1.36	10.96
Circumcision	0.039	1.33	1.14	14.94
Constant	0.117	0.074		

OR Odds Ratio, CI confidence interval, LL lower limit, UL upper limit

Some of the known HCV risk factors are universal practices among all children. Male circumcision is a culturally ubiquitous exposure among Muslim children, although it is now practiced by some Christians. The same tools may be used by the barber or some other informal male practitioner without adequate cleaning between consecutive boys' circumcisions. This would remain a relatively low risk for HCV transmission, because the infection rates among infants and young children are low, unless the same tools are used to perform wound sutures and abscess drainage on adults [3, 15]. Practice of female circumcision is now prohibited by law in Egypt, although it occurs frequently in most of rural areas, and is therefore more likely to be performed by informal practitioners particularly midwives. The little percentage of female circumcision in the study cannot indicate community perception about its harm; the result is only due to little age of most of females in the study which is not suitable yet for this practice.

Ear piercing among females, having the hair cut at local barber shops, life time injections, and dental treatment and hospitalizations were common practices. Therefore, the impact of these practices cannot be evaluated in this age group. Hospitalization particularly in temporary clinics was significantly associated with the risk of HCV infection. This reflects improper sterilization of instruments.

Unexpectedly, blood transfusion did not increase the risk among the seropositives compared to seronegatives. This reflects the use of effective and reliable blood screening methods in blood banks.

One public health measure in Egypt has been raising awareness over the last decade about HCV by both governmental and nongovernmental stakeholders [6]. Generally, basic knowledge of HCV in Egypt is high [5]. As of 2005, 68 % of women and 74 % of men in age group 15–20 responding to the Egyptian Demographic and Health Survey, knew about hepatitis C illness and its modes of transmission although this is not considered satisfactory in a country with such a level of disease burden [9]. Nevertheless, the present work revealed a gap in the specific knowledge of HCV and its modes of transmission among

young ages. The majority of the studied children reported never hearing of HCV. Moreover, a substantial proportion had poor levels of knowledge and misconceptions in relation to several HCV modes of transmission. All seropositives, did not hear about HCV illness, although this does not provide support for an effect of awareness on reducing the risk of HCV infection. Although some schools implement health education programs for raising awareness of the disease among children, this is still marginal and needs scaling up. It is worth noting that health education messages directed at school children should be combined with appropriate prevention programs to reinforce disease control in the settings of exposure.

Media outlets constituted the main sources of HCV knowledge among adults with television appearing to be the primary source [9], although this did not appear among the means disseminating knowledge for school children.

Although the prevalence of anti-HCV among school age children in the present study showed a decline than that has been previously reported, the impact of HCV infection on this age group can be significant in terms of lost years of healthy well-being as children have a lifetime to develop the severe complications of HCV. The results of this study pointed to some risk factors for HCV infection that can guide intervention programs to be appropriately focused. At present, ensuring good infection control in health care-setting are of highest priority.

One limitation to our study was that it might not reflect the true prevalence in all regions of Egypt and the sample size was small; however, this was the preliminary study from Alexandria, second biggest city in Egypt. Epidemiological studies with larger populations from different areas of Egypt, which might reflect the true status of country regarding HCV infection prevalence among children, are of utmost importance. The lack of HCV RNA confirmation is a second limitation for this study. However study was aiming to study the seroprevalence and highlighting the important risk factors among seropositives (previously exposed even if they have already cleared the virus). The study was also limited by lack of controls thus could not provide an appropriate judgment. The analysis of risk factors was not evidence based rather than being based on the subjects' memory thus prone to recall bias. We were also confronted with responder bias due to some sensitized and private questions concerning taboo and social stigmatic issues particularly among children like smoking, sexual practices and substance abuse and theses together could influence the results.

Acknowledgments We would like to thank Dr. Shehata Farag, lecturer of Biostatistics, High Institute of Public Health, Alexandria University, Egypt, for his great help in data processing and statistical analysis.

References

1. Abd El-Wahab EW, Mikheal A, Sidkey F, Shatat HZ. Factors associated with hepatitis C infection among chronic HCV Egyptian patients. *Iran J Public Health*. 2014;43(11):1510–8.
2. Abdel-Wahab MF, Zakaria S, Kamel M, Abdel-Khaliq MK, Mabrouk MA, Salama H, et al. High seroprevalence of hepatitis C infection among risk groups in Egypt. *Am J Trop Med Hyg*. 1994;51(5):563–7.
3. Barakat SH, El-Bashir N. Hepatitis C virus infection among healthy Egyptian children: prevalence and risk factors. *J Viral Hepat*. 2011;18(11):779–84.
4. Campas. The Egyptian Central Agency for Public Mobilization and Statistics. <http://www.citypopulation.de/Egypt-Cities.html> (2013) Accessed 3 Nov 2013.
5. Chemaitelly H, Abu-Raddad LJ, Miller FD. An apparent lack of epidemiologic association between hepatitis C virus knowledge and the prevalence of hepatitis C infection in a national survey in Egypt. *PLoS One*. 2013;8(7):e69803.
6. Eassa S, Eissa M, Sharaf SM, Ibrahim MH, Hassanein OM. Prevalence of hepatitis C virus infection and evaluation of a health education program in el-ghar village in Zagazig, Egypt. *J Egypt Public Health Assoc*. 2007;82(5–6):379–404.
7. El-Raziky MS, El-Hawary M, El-Koofy N, Okasha S, Kotb M, Salama K, et al. Hepatitis C virus infection in Egyptian children: single centre experience. *J Viral Hepat*. 2004;11(5):471–6.
8. El-Shabrawi MH, Kamal NM. Burden of pediatric hepatitis C. *World J Gastroenterol*. 2013;19(44):7880–8.
9. El-Zanaty F, Way A. Egypt Demographic and Health Survey 2008. Cairo: Egyptian Ministry of Health and Population; El-Zanaty and Associates and Macro International. 2008.
10. Fahmy S, El-Sherbini A. Simple parameters for social classifications for health research. *Bull High Inst Public Health*. 1983;13(5):95–107.
11. Gower E, Estes C, Blach S, Razavi-Shearer K, Razavi H. Global epidemiology and genotype distribution of the hepatitis C virus infection. *J Hepatol*. 2014;61(1S):S45–57.
12. Habib M, Mohamed MK, Abdel-Aziz F, Magder LS, Abdel-Hamid M, Gamil F, et al. Hepatitis C virus infection in a community in the Nile Delta: risk factors for seropositivity. *Hepatology*. 2001;33(1):248–53.
13. Jafri W, Jafri N, Yakoob J, Islam M, Tirmizi SF, Jafar T, et al. Hepatitis B and C: prevalence and risk factors associated with seropositivity among children in Karachi, Pakistan. *BMC Infect Dis*. 2006;6:101.
14. Lindsay J, Smith AM, Rosenthal DA. Uncertain knowledge: a national survey of high school students' knowledge and beliefs about hepatitis C. *Aust N Z J Public Health*. 1999;23(2):135–9.
15. Medhat A, Shehata M, Magder LS, Mikhail N, Abdel-Baki L, Nafeh M, et al. Hepatitis c in a community in Upper Egypt: risk factors for infection. *Am J Trop Med Hyg*. 2002;66(5):633–8.
16. Mir-Nasseri MM, Mohammadkhani A, Tavakkoli H, Ansari E, Poustchi H. Incarceration is a major risk factor for blood-borne infection among intravenous drug users: incarceration and blood borne infection among intravenous drug users. *Hepat Mon*. 2011;11(1):19–22.
17. Muro FJ, Fiorillo SP, Sakasaka P, Odhiambo C, Reddy EA, Cunningham CK, et al. Seroprevalence of hepatitis B and C viruses among children in Kilimanjaro region, Tanzania. *J Pediatric Infect Dis Soc*. 2013;2(4):320–6.
18. Zamani F, Sohrabi M, Poustchi H, Keyvani H, Saeedian FS, Ajdarkosh H, et al. Prevalence and risk factors of hepatitis C virus infection in Amol city, North of Iran: a population-based study (2008–2011). *Hepat Mon*. 2013;13(12):e13313.