Prevalence of hepatitis C virus infection and risk factor analysis in Changsha, central China, about population undergoing routine check-up, 2013–2015

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Research article

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Abstract

Background Currently, Hepatitis C virus (HCV) infection remains a major public health problem. The aim of current study wanted to determine the prevalence of HCV virus infections, and to explore the risk factors for HCV infection in the general adult population undergoing routine check-ups in Changsha City. Methods We collected 59688 blood samples from the adult population undergoing routine check-ups in 2013–2015 and obtained relevant information using a standardized questionnaire. We then conducted association and logistic regression analyses. We used the enzyme immunoassay method to test for anti-HCV antibodies in the serum samples. Results The positivity rate of anti-HCV was about 0.57% (340/59688) in the general population. Participants from rural areas showed significantly higher HCV seroprevalence rates than did those from the urban area (0.83% vs 0.19%, $p < 0.001$). HCV seropositivity increased progressively with age, peaking at 55–64 years (1.23%), and decreasing in participants aged 65 and older. The positivity rate of anti-HCV for males was slightly higher than that of females (0.67% vs 0.48%, $p = 0.002$). The results of multiple logistic regression showed that history of blood transfusion, surgery, living in rural areas, and transmission in families were the main risk factors for HCV infection. Conclusions: The prevalence of HCV infection is low in the general population in Changsha. This information vital for healthcare settings and health education entities in public, especially in rural areas.

Background

Hepatitis C virus (HCV) is an RNA virus that is a hepacivirus in the flaviviridae family. It is primarily transmitted through sexual contact and blood products [1]. Some patients with chronic HCV infections may develop cirrhosis or even hepatocellular carcinoma [1, 2], which is becoming a severe public health problem. According to WHO statistics, in 2014 approximately 130 to 150 million people were infected chronic hepatitis C (CHC), and more than 350 thousand people died from HCV infection related liver diseases, cirrhosis and liver cancer. According to previous reports, male gender, blood transfusion history, medication history, and familial HCV infection are common risk factors for HCV infection [3, 5]. Because of insufficient information regarding the prevalence of HCV infection in Changsha, we investigated the general population to evaluate the prevalence characteristics and risk factors of HCV infection.

Methods

Study area and population

Changsha is one of the largest cities in central China; it is located in Hunan province and is home to 800 thousand citizens. The distribution of residents in urban and rural areas is equal, enhancing the reliability of this investigation. Cluster random sampling was adopted to screen out 59688 patients presenting for physical examinations at our hospital from 2013 to 2015, when testing for hepatitis C antibody was carried out. These subjects had an average age of 48.31 ± 14.62, range 15–92 years. A total of 27543 were male and 32145 were female.

Data collection

We designed unified questionnaire to acquire general information including age, gender, and residential area. All subjects were asked about their exposure history including history of blood donation, surgery, blood transfusion, ear piercing, dental treatment, invasive procedure, unsafe sexual contact, tattooing and intravenous drug abusers. (The specific content of the questionnaire is shown in supplementary material 1). Trained physicians administered questionnaire and recorded relevant information.

Sampling method

The sample size was calculated as follows:

Detection of anti-HCV antibodies

Fasting venous blood (5 mL) for serum isolation was collected under sterile conditions, and then cryopreserved at -20 ° C. Enzyme-linked immunosorbent assay (ELISAs) (Xinchuang Core Anti-HCV ELISA kit, Xiamen, China) were used to measure serum anti-HCV, according to manufacturer's instructions. When the OD value of sample was near the "gray area," the sample was repeated to determine the final testing results.

Statistical analysis

The experimental results were analyzed using SPSS 11.7 software. Continuous variables were expressed as mean standard difference, and counting data were expressed as percentages. The $\chi 2$ test was used to measure the overall distribution difference of classification variables and the global distribution difference of continuous variables in line with normal distribution was measured by the T test. When $p < 0.05$, the results were considered statistically significant. The risk factors for the disease were analyzed using univariate and multivariate logistic regression. Odds ratio (OR) and 95% confidence interval were calculated.

Results

Demographic characteristics

A total of 59688 serum samples were collected from the participants who were available for HCV testing. A total of 24560 (41.15%) were from the urban area and 35128 (58.85%) were from the rural area. There were 27543 (46.14%) males and 32145 (53.86%) females. The ages ranged from 15 to 92 years, with a mean of 48.31 ± 14.62 years. There were no significant differences between the genders ($\chi 2 = 9.403$, $p = 0.002$). We grouped all individuals into seven age groups: 15–24, 25–34, 35–44, 45–54, 55–64 and ≥ 65 years. The specific demographic characteristics are shown in table 1.

Area, age and gender distribution of anti-HCV positive rate

A total of 340 individuals were anti-HCV positive by ELISA. The anti-HCV positive rate of the entire population was 0.57%. The rate in the rural population was 0.83%, significantly higher than that of the

urban area ($p < 0.001$). The anti-HCV positivity rate for male subjects was 0.67%, compared with 0.48% in females. The difference in prevalence between men and women was not statistically significant ($p = 0.002$). The rate of anti-HCV seropositivity increased with age ($p < 0.001$), peaking in the 55–64 group (1.24, 183/14793), and then decreased. The lowest anti-HCV prevalence was in the 15–24 group (0%, 0/6763) (Table 2).

Risk factors for HCV infection

In univariate analyses, gender, age, living in rural area, blood transfusion, history of surgical procedures, dental treatment, invasive procedures and ear piercing and transmission in families were associated with anti-HCV seropositivity ($p < 0.05$ or $p < 0.01$) (Table 2). However, the multivariate analysis showed that blood transfusion, living in the rural area, surgical procedures and transmission in families remained independently associated with HCV infection ($p < 0.05$ or $p < 0.01$) (Table 3).

Discussion

We found that the anti-HCV-positive rate of the general population in Changsha was 0.57% (340/59688), significantly lower than the previously reported rate of 2.26% in Hebei province in 1992 [6, 7]. This possibly due to improvements in medication and quality of life in recent years, especially the safety of blood transfusion. The rate was very close to the screening result of 157,168 people in Jiangsu province, where the total positive rate of anti-HCV was 0.79% [8]and the screening result of 438,575 people in the city of Mianyang, west China, where the total positive rate of anti-HCV was 0.80% [9].

Min et al. reported that blood transfusion, surgery, or with a previous diagnosis of hypertension were significant risk factors for HCV infection in 2015 in the city of Mianyang [9]. A study by Yuliang Zhao in 2013 in Hebei Province found that history of blood transfusion and transmission in families, lived in rural area and aged 40–59, were significantly associated with HCV seropositivity [10]. Our results showed a significant association between the gender, age, a history of dental treatment, invasive procedures, ear piercing surgery, blood transfusion, transmission in families and living in a rural area and HCV.

In particular, the last four factors were the independent variables associated with HCV infection. Many of the identified risk factors in our study were similar to those of previously reports.

In the present study, the anti-HCV positive rate in rural areas was significantly higher than that in urban areas corresponding with previous study results in China [11, 12]. We considered that this phenomenon may be caused by different economies, lifestyles and education in the two regions. Another important reason might be commercial blood selling in rural areas. Some studies had showed that the paid blood donors had a comparatively higher HCV infection rate [13, 14]. Before 1998, there were number of people selling blood in the countryside in China. Individuals sell blood to illegal blood collection agencies who had no legal business license for payment [15]. Therefore, some of the illegal collection agencies generally used unsafe blood collection methods, and reused of non-sterilized needles, that could easily spread HCV infection.

We found that participants who had a history of blood transfusion were more likely to have HCV infection. Many studies in China showed that having a history of blood transfusion is a very important risk factor [16, 17] for HCV infection, primarily because of illegal blood donation in some rural areas in the late 1980s.

We found that participants who had a history of surgery had a higher infection rate of HCV. More than 20 years ago, the hospitals in some underdeveloped areas often spread HCV infection due to inadequately sterilized medical equipment, in the context of no HCV test before surgery.

Furthermore, transmission in family members was important risk factor for HCV infection. The same results were obtained in other studies [10,18]. It might be that the corresponding family members were infected from a common source instead of the index patients; however, the high infection rate of intra-familial clustering was based on the assessment of risk factors for person-to-person viral transmission. Moreover, in past decades, the general population lacked healthcare and HCV transmission knowledge due to their lower levels of education.

There were several limitations in this study. First, HCV virological assessments including HCV RNA levels and HCV genotypes were not performed. Second, based on the subjects' memories, recall bias was a limitation. Therefore, future surveillance studies of this virus are warranted in a broader population. Moreover, it may be difficult to self-report some behaviors, such as injecting drug use.

Conclusions

This large-scale study revealed that the infection rate of HCV among the population in Changsha was slightly lower in the general population than the national average. Despite its limitations, our study provided reference data for improving the level of infection control in healthcare settings as well as public health education regarding HCV infection, especially in rural areas.

Abbreviations

HCV: Hepatitis C virus; CHC: Chronic hepatitis C; ELISAs: Enzyme-linked immunosorbent assay; OR: Odds ratio

Declarations

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Availability of data and materials

All data generated or analyzed during this study are included in this published article

Author's contributions

MFX, SHL, CZ conceived and designed the study. MFX, CZ, XTK, YT, WZ performed the experiments, analyzed data, and wrote the paper. MFX, SHL, CZ reviewed and edited the manuscript. All authors read and approved the final manuscript.

Ethics approval and consent to participate

The Research Ethics Committee of the Xiangya Hospital reviewed and approved this research. According to the study protocol procedures, written informed consent was obtained from all individual participants included in the study.

Consent for publication

Not applicable.

Competing interests

The authors declare that they have no competing interests.

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Tables

TABLE 1. Demographic characteristics of study population

Risk factors	N□59688□	%
Sex		
Female	32145	53.9
Male	27543	46.1
Age group		
15-24	6763	11.33
25-34	8738	14.64
35-44	10951	18.35
45-54	12503	20.95
55-64	14793	24.78
>65	5940	9.95
Area		
Rural	35128	58.85
Urban	24560	41.15
Educational level		
High school/University	28502	47.75
Secondary school	26785	44.88
Illiteracy/Primary school	4401	7.37
Occupation		
Farmer	9200	15.41
Student	10721	17.96
Teacher	8448	14.15
Government	13533	22.67
Health worker	8576	14.37
Pensioner	9210	15.43
Marital status		
Single	17906	30
Married	41782	70
Monthly income		

<5000	8002	13.41
5000-10000	39795	66.67
>10000	11891	19.92

TABLE 2. Single factor analysis of HCV infection and related risk factors

Risk factors	No. of Samples	No. of Positive	Positive Rate (%)	χ2	*P* value
Sex					
Female	32145	155	0.48	9.403	0.002
Male	27543	185	0.67		
Age group					
15-24	6763	0	0	197.652	<0.001
25-34	8738	10	0.11		
35-44	10951	39	0.36		
45-54	12503	67	0.54		
55-64	14793	183	1.24		
>65	5940	41	0.69		
Area					
Rural	35128	293	0.83	105.423 <0.001	
Urban	24560	47	0.19		
Ever had surgery					
Yes	3101	36	1.16	20.191	<0.001
No	56587	304	0.54		
Family members are anti- HCV positive					
Yes	9306	79	0.85	15.183	<0.001
No	50382	261	0.52		
Blood donation					
Yes	3603	27	0.75	2.187	0.139
No	56085	313	0.56		
Blood Transfusion					
Yes	2264	64	2.83	211.694	<0.001
No	57424	276	0.48		
Ever had dental treatment					

Yes	20956	31	0.15	101.396	<0.001
No	38732	309	0.80		
Invasive procedures					
Yes	10048	25	0.25	21.956	<0.001
No	49640	315	0.63		
Unsafe sexual contact					
Yes	12	0	0		1.000
No	59676	340	0.57		
Get ears pierced					
Yes	12038	35	0.29	20.707	<0.001
No	47650	305	0.64		
Tattooing					
Yes	140	1	0.71	0.052	0.820
No	59548	339	0.57		
Intravenous drug abusers					
Yes	1	0	0		1.000
No	59687	340	0.57		

*Fisher's excat test

TABLE 3 Factors associated with seropositivity of Hepatitis C identified in multiple logistic regression

Risk Factor	OR	95%CI	P value
Living in rural	4.96	1.95~13.43	0.005
Ever had surgery	4.64	1.43~13.34	0.005
Blood transfusion	9.31	3.72~27.63	<0.001
Family members are anti-HCV positive	12.55	5.30~43.42	<0.001

Supplementary Files

This is a list of supplementary files associated with this preprint. Click to download.

- QuestionnaireforhighriskpopulationofhepatitisC.doc