


Sero-epidemiology study of hepatitis B virus surface antibodies from 2017 to 2019 among Chinese young adults in Hunan Province

A three-year retrospective study

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Abstract

Background: Data on the epidemiology characteristics of hepatitis B surface antibodies (anti-HBs) are lacking among central southern undeveloped areas of China, especially for young adults. This study aims to demonstrate the sero-epidemiology characteristics of HBsAb among young adults.

Aims: The aim of this study is to demonstrate the epidemiological characteristics in prevalence of serum anti-HBs in college students of a university in Hunan Province, China.

Methods: Data were derived from the health records (including serum HBsAb data) among freshmen of a university from 2017 to 2019 in Hunan Province, China.

Results: A total of 13,426 freshmen with complete data who were born in Hunan Province were collected. The 3-year total prevalence of anti-HBs in freshmen was 44.75% with no statistically significant sex difference, the prevalence of anti-HBs is 46.93%, 53.13%, and 34.79% for 2017, 2018, and 2019, respectively. There are significant geographic differences of prevalence of anti-HBs in freshmen from different areas. The lowest prevalence of anti-HBs was 31.80% in freshmen from Xiangtan, and the highest prevalence of anti-HBs was 53.10% in freshmen from Yongzhou.

Conclusion: The prevalence of serum anti-HBs among the freshmen in Hunan from 2017 to 2019 is much lower than the average national level, and the prevalence in 2019 is significantly lower than that in 2017 and 2019. There are significant differences in different time and areas of the prevalence of anti-HBs. There is a necessity to carry out area-specific intensive immunization plan in a timely manner among young population in Hunan Province, China.

Abbreviations: anti-HBs = anti-hepatitis B surface antibodies, HBsAg = hepatitis B virus surface antigen, HBV = hepatitis B virus.

Keywords: anti-HBs, hepatitis B, sero-epidemiology, young adult

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MX and HQ contributed equally to this paper

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The datasets generated during and/or analyzed during the current study are available from the corresponding author on reasonable request.

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1. Introduction

Hepatitis B virus (HBV) infection is a major cause of chronic liver diseases, and is also closely related to hepatocellular carcinoma^[1] and pancreatic cancer,^[2] which poses a huge public health burden in China.^[3] Since the routine vaccination strategy against HBV has been carried out from the early 1990s in infants, the prevalence of HBV infection in China has decreased dramatically.^[4,5] From 1992 to 2014, the prevalence of HBV surface antigen (HBsAg) has dropped by 52%, and the HBsAg prevalence in 1 to 4, 5 to 14, and 15 to 29 years old children or young adults was 0.3%, 0.9%, and 4.4%, respectively.^[5] However, given the large population of China, even a low prevalence of HBV can be a serious public health problem. Notably, to monitor and demonstrate the epidemiology characteristics of HBV has crucial importance for defining the priority of vaccination strategy.

Several studies have been conducted in the northeastern China^[6–8] or the developed areas of China,^[9–11] the prevalence of HBV varied markedly overtime and between different areas. For example, the estimated prevalence of HBsAg was 7.44% in Anhui Province (2006),^[12] 3.49% in Beijing (2006),^[11] 4.38% in Jilin Province (2007),^[8] 5.17% in Henan Province (2006–2009),^[13] 9.73% in Shenzhen (2010),^[14] 2.73% in Beijing (2013–2014),^[10] 4.04% in Zhejiang Province (2014–2015),^[9] and 2.63% for 1 to 29-years old in a national survey (2014).^[5] However, few studies



Figure 1. Location characteristics of Hunan Province, China. Hunan Province is a developing province in Central Southern China, which is composed of 14 districts (namely Changde, Changsha, Chenzhou, Hengyang, Huaihua, Loudi, Shaoyang, Zhuzhou, Xiangtan, Xiangxi, Yiyang, Yongzhou, Yueyang, and Zhangjiajie).

have investigated the prevalence and the geographic variations of HBsAg in south provinces of China, especially in Hunan Province,^[15] which locates in central southern area of China. Additionally, the vaccination strategy and vaccination rate are quite different in different provinces.^[6] And each province can independently organize the vaccine bidding, then the manufacturer of the HBV vaccine is likely to be different in different provinces. Therefore, the vaccination strategy and prevention measure based on the sero-epidemiological characteristics of HBV in other provinces may be not suitable for Hunan Province.

University is the last stage for most college students to stay at school, and school is a well-organized place that is a very cost-effective place to implement health education program and vaccination programs that could be targeted in a large number of people at a time. For college students in China, there will be a test of anti-hepatitis B surface antibodies (anti-HBs) in their freshmen enrolment physical examinations, which could provide important evidences for vaccination strategy against HBV in this population. Understanding the epidemiological characteristics of this population could help to develop more reasonable and efficiently allocation strategy of medical resources or health services for controlling and prevention of HBV infection. Therefore, the present study aimed to demonstrate the epidemiological characteristics in prevalence of serum anti-HBs in college students of a university in Hunan Province, China.

2. Materials and methods

2.1. Study population

Hunan Province is a developing province that locates in the Central Southern China. It has a population of 70.9 million and covers an area of nearly 211,800 km², which is composed of 14 districts (namely Changde, Changsha, Chenzhou, Hengyang, Huaihua, Loudi, Shaoyang, Zhuzhou, Xiangtan, Xiangxi, Yiyang, Yongzhou, Yueyang, and Zhangjiajie) with a total of 122 counties (Fig. 1). This study retrospectively reviewed the health records of the Freshman enrolled to a university from 2017 to 2019 in Hunan Province, China. There are 6907, 6005, and 7450 Freshmen students for 2017, 2018, and 2019, respectively. We excluded a small proportion of the subject who are not born in Hunan Province, or lack of necessary data (birthdate, birthplace, or result of serum HBsAb). Finally, a total of 13,426 students were included in the current study (Fig. 2). The study was reviewed and approved by the Ethical Committee of Hunan Normal University (No. 2019-88). All information and participant identifiers were kept anonymous to protect the participants' confidentiality. Since all data we obtained were deidentified, and no biological sample was collected or required, written or oral consents from participants were waived.

2.2. Serological method

Blood sample (2–3 mL) for each student was collected in an anticoagulated tube for the test of HBsAb in Hospital of Hunan Normal University. Latex agglutination test was used for the

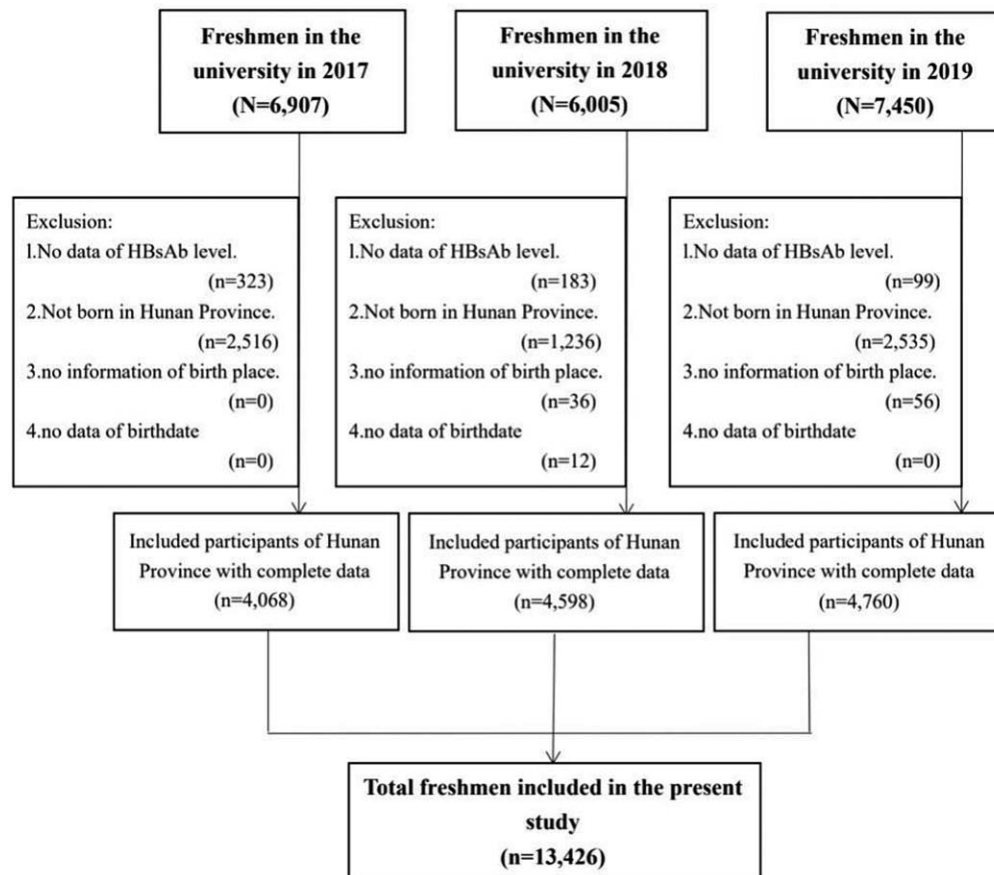


Figure 2. Flowchart of the sample selection.

antibody measurement, with Hepatitis B virus surface antibody test kit from Abbott Biomedical Company Ltd. As previous studies, we define seroconversion as the presence of serum HBsAb level ≥ 10 IU/L was defined as anti-HBs positive, and only subjects with serum HBsAb level below 10 IU/L were categorized as anti-HBs negative.^[6,10]

2.3. Statistical analysis

The data were collected and merged using Microsoft Excel 2020 software (Microsoft Corporation, New York, NY). The basic characteristics, comparison of different groups, and multivariable logistic regression analysis were conducted with SPSS version 20.0 (IBM Analytics, New York, NY). Since Changsha is the capital city of Hunan Province and with the best medical resources, we used Changsha as a reference group for comparison. For comparison of prevalence of anti-HBs in different groups, χ^2 tests were performed. The prevalence of anti-HBs was defined as the proportion of freshmen who were anti-HBs positive among the total subjects who were tested. Visualization of our data was conducted by software ArcGIS (version 10.2, ESRI Inc, Redlands, CA). $P < .05$ was considered statistically significant.

3. Results

3.1. The general characteristics of the study population

A total of 13,426 freshmen from 2017 to 2019 with complete data were included in our study. In total, 44.75% of the subjects

were anti-HBs positive. The prevalence of anti-HBs was 44.71% in males and 44.77% in females. In years 2017, 2018, and 2019, the prevalence of anti-HBs in college freshmen was 46.93%, 53.13%, and 34.79%, respectively. There is no significant sex difference between males and females in different years or in the total population (all P values $> .05$, Table 1). However, there is a significant difference between different areas in the prevalence of anti-HBs ($\chi^2 = 117.458$, $P < .001$). For the prevalence of anti-HBs, the lowest 3 cities are in Xiangtan (31.8%), Xiangxi (36.9%), and Chenzhou (40.4%), and the highest 3 cities are in Zhangjiajie (48.8%), Changde (51.5%), and Yongzhou (53.1%), respectively (Table 2). Visualization of the prevalence of anti-HBs in different cities from 2017 to 2019 in Hunan Province, China was present in Figure 3. In total, the north western and south eastern cities near the borderline of Hunan Province have the lowest prevalence of anti-HBs.

3.2. Logistic regression analysis of prevalence of anti-HBs

With multivariate logistic regression analysis, significant differences of the prevalence of anti-HBs between college freshmen from different cities and different entrance years were observed (Table 3). Compared with the prevalence of anti-HBs in college freshmen in 2018 significantly increased by 28.9% (OR = 1.289, 95% CI = 1.184–1.403, $P < .001$), while the prevalence in college freshmen in 2019 decreased substantially with OR of 0.598 (95% CI = 0.548–0.652, $P < .001$). Compared with the prevalence of anti-

Table 1
The rate of anti-HBs positive in different years and different sex.

Year	Sex	Anti-HBs negative		Anti-HBs positive		χ^2	P
		N	Frequency	N	Frequency		
2017	Male	662	52.79%	592	47.21%	0.058	.81
	Female	1497	53.20%	1317	46.80%		
	Total	2159	53.07%	1909	46.93%		
2018	Male	653	46.48%	752	53.52%	0.124	.724
	Female	1502	47.04%	1691	52.96%		
	Total	2155	46.87%	2443	53.13%		
2019	Male	1025	65.16%	548	34.84%	0.002	.961
	Female	2079	65.23%	1108	34.77%		
	Total	3104	65.21%	1656	34.79%		
Total	Male	2340	55.29%	1892	44.71%	0.004	.947
	Female	5078	55.23%	4116	44.77%		
	Total	7418	55.25%	6008	44.75%		

anti-HBs = anti-hepatitis B surface antibodies.

HBs of Changsha city (the capital of Hunan Province), the prevalence among subjects from Changde significantly increased by 37.6% (OR = 1.376, 95% CI = 1.196–1.582, $P < .001$); while subjects from Xiangtan have a significantly lower prevalence (OR = 0.573, 95% CI = 0.462–0.710, $P < .001$) (Table 3).

4. Discussion

As far as we know, this was the first study to demonstrate the sero-epidemiology characteristics of anti-HBs in Hunan Province, China. In our study, 44.75% of the subjects were anti-HBs positive with no statistically significant sex difference, and the prevalence of anti-HBs was 46.93%, 53.13%, and 34.79% for 2017, 2018, and 2019, respectively. There were significantly geographic differences of prevalence of anti-HBs. Our findings imply that timely area-specific prevention strategies should be developed for different areas of the HBV infection in young adults of Hunan Province, China.

Compared with the previous study, the prevalence of anti-HBs was slightly lower than Wang et al's study in 2016,^[7] which showed that the adjusted prevalence of anti-HBs of 0 to 59 years

old was 55.2% (55.4% for male and 54.9% for females) in Changchun City, Jilin Province, China. In Wang et al's study, in age group of 15 to 29 years old the prevalence of anti-HBs was 62.9%, which was much higher than that of our study.

Our result was very similar to the findings of Meng et al's study in First Hospital of Jilin University from 2010 to 2014.^[4] In their study, 46.58% of the male and 47.2% of the female was anti-HBs positive, but in the 11 to 20 age group, the prevalence (60.87%) is also much higher than that in our study. Tao et al's study^[16] also reported a higher prevalence of anti-HBs than that in the present study (71.23%), which was conducted in Shenzhen, from August 2015 to September 2018. The difference may be partially explained by the difference of sample selection, as Meng et al's study and Tao et al's study was hospital based, while our study was school-based. Moreover, the subjects from their study were highly likely to be urban residents, while in our study the subject were from both urban area and rural area. Actually, the prevalence of anti-HBs varied substantially in different time and provinces, with 37.79% in a general population aged >1 year in Beijing (2006),^[11] 35.66% in 18 to 70+ adult population of Jilin Province (2007),^[8] 44.72% in a general population aged >1 year

Table 2
The rate of anti-HBs positive in different areas.

City	Anti-HBs negative		Anti-HBs positive		χ^2	P
	N	Frequency	N	Frequency		
Xiangtan	337	68.20%	157	31.80%	117.458	<.001
Xiangxi	198	63.10%	116	36.90%		
Chenzhou	473	59.60%	321	40.40%		
Huaihua	480	59.00%	334	41.00%		
Zhuzhou	479	57.60%	353	42.40%		
Shaoyang	794	57.50%	586	42.50%		
Yiyang	424	56.50%	327	43.50%		
Changsha	927	55.70%	737	44.30%		
Hengyang	827	55.40%	667	44.60%		
Yueyang	574	54.40%	481	45.60%		
Loudi	477	54.30%	401	45.70%		
Zhangjiajie	189	51.20%	180	48.80%		
Changde	779	48.50%	828	51.50%		
Yongzhou	460	46.90%	520	53.10%		

anti-HBs = anti-hepatitis B surface antibodies.

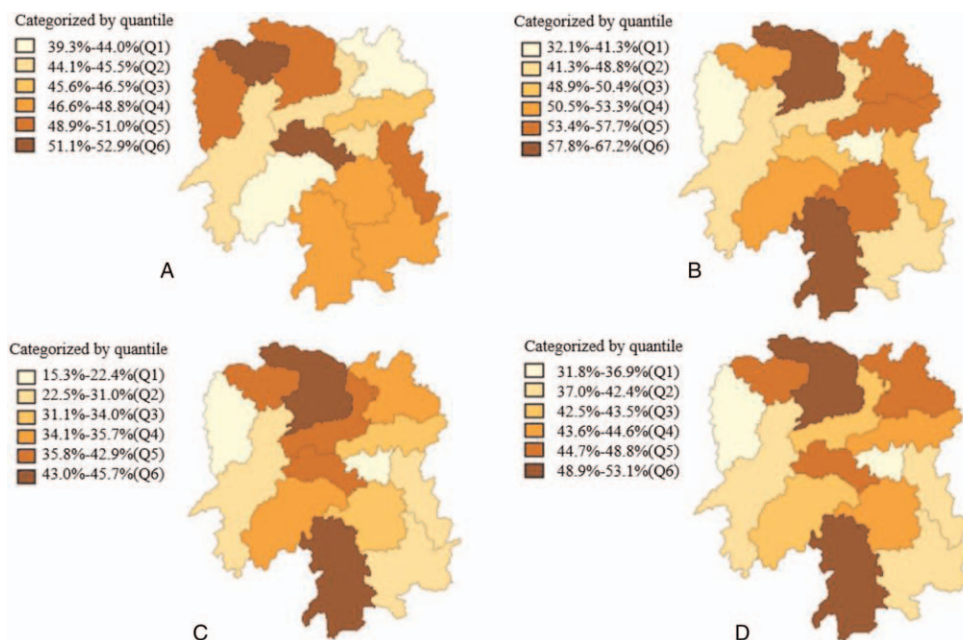


Figure 3. Visualization of the prevalence of anti-HBs in different cities from 2017 to 2019 in Hunan Province, China. A to D present the prevalence of anti-HBs in year 2017, 2018, 2019, and total 3 years, respectively.

in Beijing (2013–2014),^[10] 72.83% in a population aged 1 to 59 years in Shenzhen (2010),^[14] 71.23% in a hospital-based population in Shenzhen (2015–2018),^[16] 30% in a national male population aged 21 to 50 years old (2010–2012).^[17] These tempo and spatial disparities in different provinces may be attributed to the different vaccination strategies in different periods of different provinces, and also to the different prevalence of HBV infection.

In our study, there were significant spatial variations in the prevalence of anti-HBs in Hunan Province. As far we know, no

previous studies reported spatial characteristics of prevalence of anti-HBs in Hunan Province, China. But similarly, Xu et al’s study also demonstrated that there were spatial patterns regarding the infection of HBV in Beijing–Tianjin–Hebei area of China.^[6] These significant spatial diversities may be due to different genetic background,^[18] personal activity (sexual activities, drug use, etc),^[19] socioeconomic status,^[20] population density,^[21] and other factors.^[22]

In our study there was no statistically significant sex difference in the prevalence of anti-HBs. Our result was similar with Lo

Table 3
Logistic regression analysis of rate of anti-HBs positive.

Variable	Groups	OR	95% CI	P
City	Changsha	1 (ref.)		
	Changde	1.376	1.196–1.582	<.001
	Chenzhou	0.892	0.749–1.061	.196
	Hengyang	1.029	0.893–1.187	.692
	Huaihua	0.887	0.746–1.053	.17
	Loudi	1.086	0.919–1.282	.334
	Shaoyang	0.95	0.821–1.099	.491
	Xiangtan	0.573	0.462–0.710	<.001
	Xiangxi	0.75	0.583–0.964	.025
	Yiyang	0.956	0.802–1.140	.619
	Yongzhou	1.47	1.252–1.727	<.001
	Yueyang	1.076	0.920–1.259	.361
	Zhangjiajie	1.22	0.970–1.533	.089
Zhuzhou	0.912	0.769–1.081	.289	
Sex	Male	1 (ref.)		
	Female	1.01	0.937–1.088	.801
Year	2017	1 (ref.)		
	2018	1.289	1.184–1.403	<.001
	2019	0.598	0.548–0.652	<.001

anti-HBs = anti-hepatitis B surface antibodies.

et al's study in Senegal^[23] (56.6% and 55.1% in boys and girls) and Tao et al's study in Shenzhen,^[16] China (a developed southern city of China), and Tao et al's study showed that the prevalence of anti-HBs was 71.8% and 70.7% in males and females, respectively. However, the previous study has indicated that there is a sex disparity in HBV infection, which may be a result of the different function of immune system or response in male and female.^[24] This inconsistency may be because that our study only tested the antibodies of HBV, which could not reflect the infection status of HBV. Future studies including surface HBsAg, hepatitis B virus core antibody, hepatitis B virus core antigen should be conducted to clarify this.

Of note, there was a significant difference of the prevalence of anti-HBs in different years from 2017 (46.93%) to 2019 (34.79%). Interesting, the prevalence in 2019 decreased sustainably (OR=0.598, increased by 12.14%) compared with that in 2017, while the prevalence in 2018 (53.13%) increased by 6.2% compared with that in 2017. But the underlying reason for this trend of prevalence of anti-HBs positive from 2017 to 2019 is not clear; further studies are necessary. The government of China has made lots of efforts to prevent and control HBV infection, and also great progress has been made.^[25] But considering the spatial disparity in the prevalence of anti-HBs positive, which may due to the imbalance of economic development, there is still a long way to go in preventing and control of HBV, especially in undeveloped areas.

4.1. Limitations

There are several limitations in the current study. First, the study focused on the freshmen aged about 18 years old of a university in Hunan Province, it may not be generalized to the whole population, and can only represent the young adult population in Hunan Province. Second, only serum HBsAb concentration was measured in the study, inclusion of other indicators for HBV infection (such as serum HBsAg, hepatitis B virus core antigen, and hepatitis B virus core antibody level, etc) could provide a more comprehensive view of the HBV infection status. Third, only 1 university was included for this study, future studies may collect more data from different universities to verify the findings.

5. Conclusion

In summary, a relatively low prevalence of anti-HBs was reported in 2017 to 2019 among young adults of Hunan Province, China, implying that this population may need more enforced further HBV test services and vaccination strategies against HBV infection. Also, there are spatial disparities in the prevalence of anti-HBs. Importantly, the prevalence in 2019 decreased sharply when compared with the prevalence in 2017. Hence, we should develop timely area-specific prevention and control measures for HBV infection for young adult.

Author contributions

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Methodology: Hongjiao Quan.

Writing – original draft: Ming Xie.

Writing – review & editing: Hongjiao Quan, Yide Yang.

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