

Analysis of Knowledge, Attitude and Practice of Hepatitis B Among Freshmen in Jiangsu Based on Lasso-Logistic Regression and Structural Equation Model

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Objective: We aimed to describe the knowledge, attitude and practice (KAP) status of hepatitis B virus (HBV) among freshmen who were in the class of 2020 and from Jiangsu Province.

Methods: A random multistage sampling had been used to screen freshmen to conduct online questionnaire. The chi-square test was applied for pairwise comparison between sub-groups. Lasso regression and logistic regression were used to analyze the influencing factors of KAP about HBV. A structural equation model was established to explore the relationships among KAP of HBV.

Results: The total awareness rate of HBV among freshmen was 63.1%. More than 50% of freshmen reported that they were not willing to live with hepatitis B carriers. Only 51.0% of students had been immunized against HBV. The knowledge of HBV among students whose fathers had college/bachelor degree or above was 1.464 times higher than those whose fathers' education level was junior high school or below (95% CI = 1.277~1.677). Both of positive attitude and behavior among female students were 1.424 times (95% CI = 1.329~1.525) and 1.468 times (95% CI = 1.291~1.669) than that within male students, respectively. The positive behaviors of students whose mothers had college education or above were 1.347 times higher than those whose mothers had the degree of junior high or below (95% CI = 1.147~1.582). Students who living with their parents were 1.167 times likely to have positive behaviors than those who living in other methods (95% CI = 1.020~1.334). The structural equation model had shown that the direct effect of knowledge on preventive motivation, attitude and behavior was 0.28, 0.53 and 0.10, respectively.

Conclusion: The population of freshmen still was far from a comprehensive understanding of HBV prevention and treatment. It is suggested that administrators of colleges and universities should pay more attentions to education of HBV knowledge as well as take multi-channel measures for prevention and management.

Keywords: hepatitis B virus, knowledge attitude and practice, freshmen, Lasso-logistic regression, structural equation model

Introduction

As a kind of hepatotropic virus, Hepatitis B virus (HBV) can establish persistent and chronic infection among human race. In fact, it is a partially double-stranded hepatotropic DNA virus¹. Chronic HBV infection had become one of

primary social public health problems that could develop into recessive condition. Among some of carriers, the virus would rise the risk of cirrhosis and cancer in the liver, which eventually lead to death². The transmission route of HBV primarily are blood and bodily fluids, including perinatal transmission and mother-to-child transmission (MTCT) which as same as sexual and parenteral modes. Various types of molecular biological tools can be used to detect and quantify viral genomic components and analyze the sequences of HBV.^{3,4} At present, despite using vaccines as well as effective and well-tolerated viral suppressive medications, more than 250 million people are still infected with HBV worldwide.⁵ There are about 1.5 million new infections each year, and HBV had caused an estimated 820,000 deaths in 2019.⁶

Currently, the rights and interests of HBV infected patients in the way of further education, employment,⁷ and marriage are still seriously affected.⁸ It is still one of the most significant global public health issues which deserve far more attentions.⁹ In fact, China has a high incidence of HBV.¹⁰ Previous studies had reported the incidence rate of spontaneous HBsAg among chronic infections remained between 0.5% and 1.4% annually.¹¹ Regarding the transmission routes of HBV, students are an exposed population because of multiple risky behaviors.¹² One meta-analysis about HBV of college freshmen in China, mainland had shown that the total positive rate of surface antigen (HBsAg) was 7.0%,¹³ and the anti-HBs positive rate of college freshmen was low.¹⁴ Today, we are faced with a serious situation due to high population density and high mobility in these gathering places for students to study and live. Nevertheless, for most of students who just register in the university, their current knowledge mainly comes from middle and high school education which lack basic information of diseases, awareness of self-management and protection. These factors made them become a high-risk target population of hepatitis B without a hitch.

Although HBV can lead to a huge burden of disease, especially in endemic areas, it is preventable, and prevention is the only safe and cost-effective strategy against HBV. Sufficient knowledge and appropriate awareness of HBV infections is the key to preventing the spread of the virus.¹⁵ The purpose of this study is to determine the level of KAP towards HBV among college and university freshmen in Jiangsu Province, China, so as to provide targeted suggestions and scientific references for future prevention and control of HBV among certain population.

Methods

Ethics Approval and Consent to Participate

This study had been reviewed and approved by the Human Research Ethics Committee of the Zhongda hospital affiliated Southeast University, China (approval ID: 2017ZDKYSB045). All participating subjects had received written detailed information on the study, and signed consent forms for the interview and the processing of sensitive personal data. For participants who were under 18 years old, parental informed consent was required to be obtained. The procedure of the study had been performed following the guidelines outlined in the Declaration of Helsinki.

Respondent

Freshmen who were in the class of 2020 are considered as research respondents. Totally, 12 of undergraduate universities/colleges in Jiangsu Province had been selected by stratified cluster random sampling, 11–14 classes had been randomly selected from each university/college, and 32–36 of students had been randomly selected from each class as well. A total of 5346 undergraduate students had been selected in the study. We had used a flow chart to describe the selection of respondents,¹⁶ as it is shown in Figure 1.

Survey's Content and Method

“Propagandist Education Points of Knowledge for Hepatitis B Prevention and Control” and “Guidelines for the Chronic Hepatitis B Prevention and Control 2019” had been used as reference for the design of this questionnaire. The contents of the questionnaire include (1) General demographic baseline data; (2) Hepatitis B prevention and treatment knowledge; (3) Hepatitis B prevention and treatment attitudes, motivations and behaviors. The survey had been carried out online via Jiangsu University Freshman Health Data Management System. School counselors and professionals from health department in each university had served as quality control officers, and they had organized students who were involved in the study to complete the questionnaire in the computer lab anonymously.

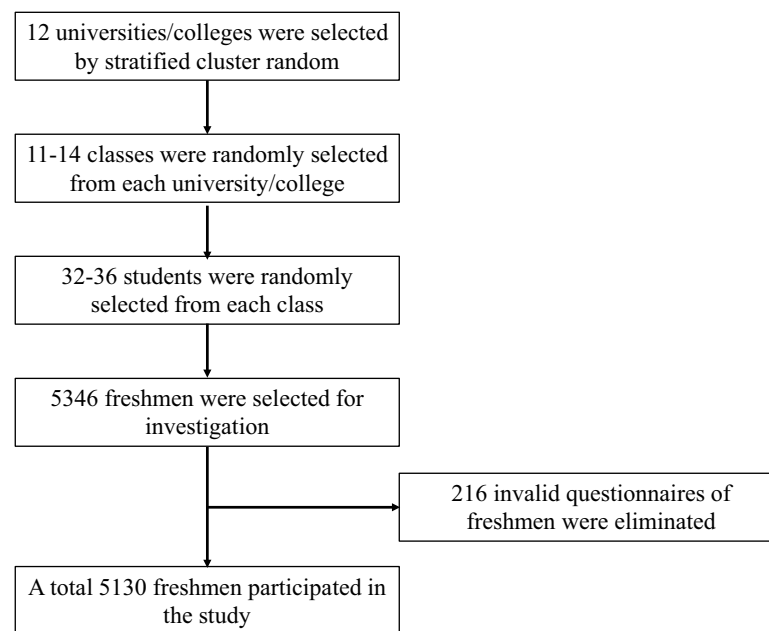


Figure 1 Flowchart of study participants.

Statistical Methods

A total of 5346 students had been investigated, and 216 invalid questionnaires had been eliminated. The response rate of the survey was nearly 96%. Data processing and analysis had used IBM SPSS Statistics 25 (SPSS Inc., Chicago, IL), measurement data of normal distribution were represented by mean \pm standard deviation, and enumeration data had shown in frequency. The chi-square split test had been applied for comparing different groups when ($\alpha=0.05$). The “dplyr”, “stringr”, and “tidyr” software packages of R 4.0.2 software had been applied for dividing multiple-choice questions. Due to the large sample size and a larger number of independent variables, by the principle of simplifying model and avoiding over-fitting, firstly, Lasso regression had been used to strictly screen independent variables, and then the Logistic regression model had been constructed for multi-factor analysis. SPSS AMOS 25.0 had been applied for building a structural equation model.

Results

General Demographic Data

Among a total of 5130 respondents, there are 2491 of males (48.6%) and the average age is 18 ± 0.6 years old. More than 70% of students are 18 years old or under, 2719 of students (53.0%) are from urban regions, 1580 (30.8%) of them from towns, and 831 of students (16.2%) are from rural regions. Nearly 64.1% (3287/5130) of them are the only child in their families, and 2842 (55.4%) of students are currently living with their parents.

Knowledge Status of Hepatitis B Prevention and Treatment

Catalogue Selection

In single-choice questions, “Vaccination can effectively prevent hepatitis B” had the highest accuracy (95.0%); “Infect with hepatitis B is predisposed to cirrhosis or liver cancer” has shown 75.9% accurate, and “Will you still be infected with hepatitis B after vaccination?” has the lowest accuracy (39.5%). “The routes of transmission of hepatitis B” is a multiple-choice question that Cochran’s Q value is 9619.2, $P < 0.001$, which could point out the difference was statistically significant. Totally 8 options had different numbers: “Injected drug use” (20.3%) remained the highest probability of being chosen, “Hugs and handshake” (2.1%) had the least selectivity. It is judged that this question had

been answered correctly by choosing all 4 options, including unprotected sex, drug injection, tooth extraction, and tattooing/piercing at the same time.

Selection of Lasso Regression Variable and the Construction of Logistic Regression Model

Participants who had correctly answered 4 or more questions about hepatitis B prevention and treatment knowledge could be considered as aware respondents, and the number of aware participants is 3235 (63.1%). Knowledge awareness had been taken as dependent variable, and general demographic characteristics had been selected as independent variable to perform the Lasso regression analysis. To begin with, invoking the “glmnet” program package in the R software, and selecting the family = “binomial” model parameter. Figure 2 had shown that with λ increasing, the variable coefficients had continued to decrease. Secondly, the optimal harmonic parameter λ had been selected through cross-validation. In this case, lambda.min had been selected with a value of 0.005, as it had been shown in Figure 3. Lastly, by plugging optimal parameter values into the model, a total of 6 optimal independent variables had been screened out in Table 1. The logistic regression model is further constructed with the 6 of selected independent variables. It is concluded that the awareness of hepatitis B knowledge among students whose fathers had achieved college/bachelor or higher was 1.464

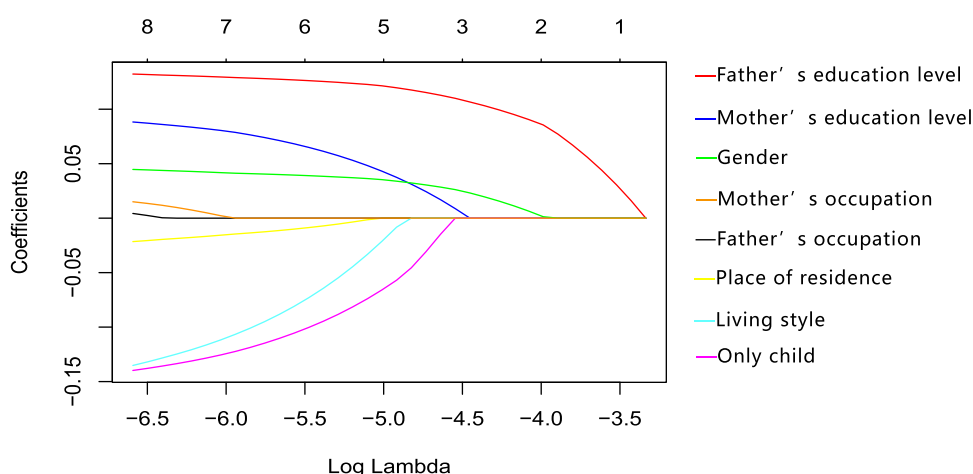


Figure 2 Dynamic process of Lasso screening knowledge variable.

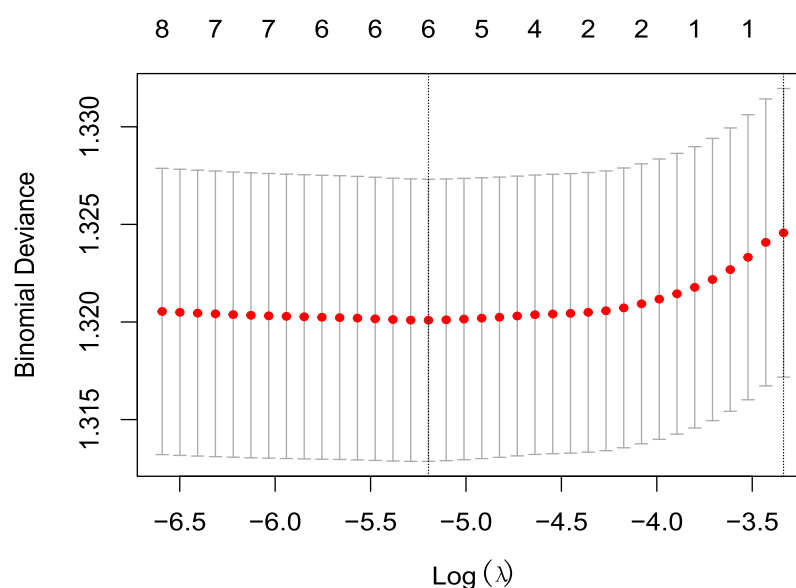


Figure 3 The plug process of the optimal parameter λ .

Table 1 Results of Lasso Variable Screening

No.	Name of Variables	B-Value
1	Gender	0.06
2	Place of residence	-0.01
3	Father's education level	0.12
4	Mother's education level	0.04
5	Father's occupation	-0.05
6	Mother's occupation	-0.09

Table 2 Logistic Regression Results of Hepatitis B Knowledge

Parameters	AOR	95% CI	P-value
Father's education level			
Junior high school and below	–	–	–
High school/Vocational college	1.08	0.94–1.24	0.268
College/Undergraduate and above	1.46	1.28–1.68	<0.001

times than these students whose fathers had the highest degree of junior high school or below (95% CI = 1.277~1.677). See [Table 2](#).

Attitudes and Practice/Behaviors Related to HBV

Among the total of 5130 respondents, 38.46% of students had minded associating with hepatitis B carriers, and 58.7% of them did not want to live with hepatitis B carriers. Most of students (96.2%) think it is necessary to take detection of hepatitis B antibody before marriage, but only 51.0% and 28.5% of students had confirmed they had been vaccinated against hepatitis B and had completed hepatitis B blood test. Taking attitude (positive = 1, negative = 0) and behavior (positive = 1, negative = 0) as binary variables, single-factor analysis had shown there were statistical differences in attitudes between genders ($\chi^2=18.94$, $P < 0.05$). In addition, there were statistically significant differences in behaviors between genders, place of residence, parents' education level, parents' occupations and living styles as well ($P < 0.05$). See [Table 3](#).

After accurately screening the variables by Lasso regression, Logistic regression had been constructed by considering attitude and behavior as the dependent variables. According to the outcomes, the positive attitudes and positive behaviors of female students were 1.424 times (95% CI = 1.329~1.525) and 1.468 times (95% CI = 1.291~1.669) than that of male students', the positive behaviors of students whose mothers had graduated from college/undergraduate or above are 1.347 times than that of whose mothers had only completed junior high school or below (95% CI = 1.147~1.582), and positive behaviors of students who were currently living with their parents were 1.167 times (95% CI = 1.020~1.334) comparing with other living styles. See [Table 4](#).

The Relationship Between Knowledge, Attitude and Practice/Behavior of Hepatitis B Prevention

During the exploratory analysis in this study, latent variable of prevention motivation has been included, and a structural equation model had been constructed together with all three latent variables of knowledge, attitude and behavior which are shown in [Table 5](#). According to the value of correction index MI, one correction for the model had been proceeded, and the path: $e1 \leftrightarrow e2$ had been increased as well. In the case of large sample size, the revised model CMIN/DF=9.35 had required to combine with other indicators in order to investigate the model fitting effect. In addition to the above indicators, RMSEA=0.04 (<0.05), GFI, AGFI, IFI, CFI were 0.99, 0.98, 0.94, 0.94 (all >0.90) respectively, which had indicated that the constructed structural equation model might be better. Model path analysis had shown that the direct

Table 3 Single-Factor Analysis of Positive Behaviors of Hepatitis B Among University and College Freshmen with Different Demographic Characteristics

Demographic Indicators	Positive Behaviors n (%)	χ^2 Value	P-value
Gender		25.04	<0.001
Male (n=2491)	528 (21.2)		
Female (n=2639)	741 (28.1)		
Place of residence		10.69	<0.001
Urban (n=2719)	717 (26.4) ^{ab}		
Town (n=1580)	356 (22.5)		
Rural (n=831)	185 (22.3)		
Only Child		0.45	0.501
Yes (n=3287)	816 (24.8)		
No (n=1843)	442 (24.0)		
Father's education level		18.38	<0.001
Junior high school or below (n=1864)	399 (21.4) ^{cd}		
High school/Vocational college (n=1499)	373 (24.9)		
College/Undergraduate or above (n=1767)	486 (27.5)		
Mother's education level		18.50	<0.001
Junior high school or below (n=2261)	496 (21.9) ^{ef}		
High school/Vocational college (n=1520)	381 (25.1)		
College/Undergraduate or above (n=1349)	381 (28.2)		
Father's occupation		7.38	0.007
Medical workers (n=113)	40 (35.4)		
Others (n=5017)	1218 (24.3)		
Mother's occupation		7.82	0.005
Medical workers (n=208)	68 (32.7)		
Others (n=4922)	1190 (24.2)		
Living style		9.45	0.002
Living with parents (n=2842)	744 (26.2)		
Others (n=2288)	514 (22.5)		

Notes: Using pair-wise comparison by chi-square method, "a" means $P < 0.05$ when compared urban areas with towns, "b" represents $P < 0.05$ when compared urban areas with rural areas; "c" means $P < 0.05$ by comparing father's education level is junior high school or below with high school education level, "d" indicates $P < 0.05$ by comparing father's education level is junior high school or below with college/undergraduate level or above, "e" indicates $P < 0.05$ by comparing mother's education level is junior high school or below with high school level, "f" indicates $P < 0.05$ by comparing mother's education level is junior high school or below with college/undergraduate level or above.

Table 4 Logistic Regression Results of Hepatitis B-Related Attitudes and Behaviors

Dependent Variable	Parameter	AOR	95% CI	P -value
Attitude	Gender	–		–
	Male	1.42	1.33–1.53	<0.001
Behavior	Female	–		–
	Gender	–		–
	Male	1.47	1.29–1.67	<0.001
	Female	–		–
	Mother's education level	–		–
	Junior high school or below	1.17	1.00–1.36	0.050
	High school/Vocational college	1.35	1.15–1.58	<0.001
	College/University	–		–
	Living style	–		–
	Others	1.17	1.02–1.33	0.024
	Live with parents	–		–

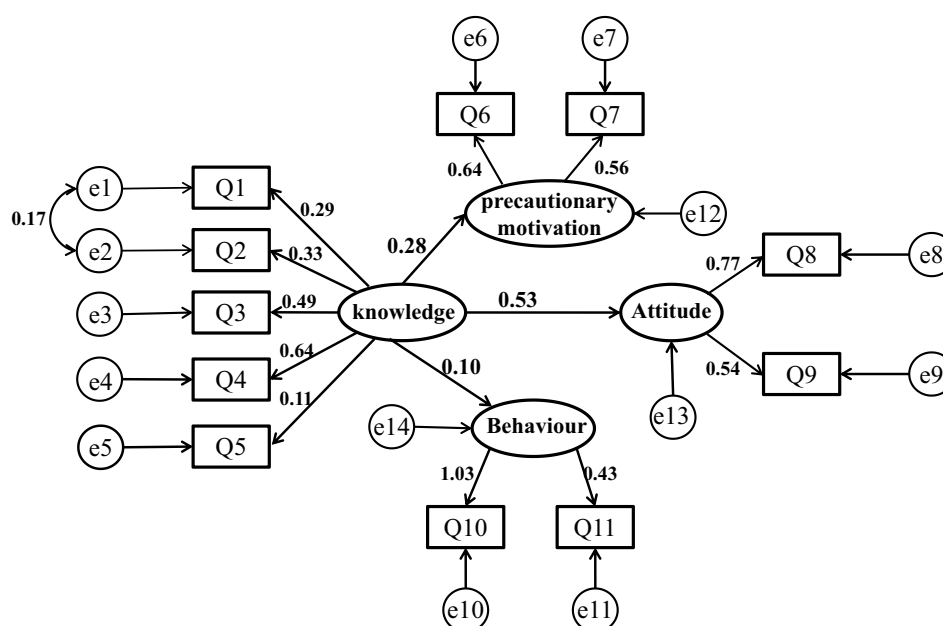
Table 5 Latent Variable and Observation Variable Assignment

Latent Variable	Observation Variable Assignment
Knowledge	Q1 Can vaccination be effective in hepatitis B prevention? Q2 Does hepatitis B infection develop liver cirrhosis or liver cancer easily? Q3 Can companies reject or dismiss antigen-positive employees? Q4 Can hepatitis B virus carriers get married? Q5 What are the routes of transmission of hepatitis B?
Preventive motivation	Q6 If you do not have hepatitis B antibodies, will you get the vaccine? Q7 If you suspect that you have been infected, would you take the initiative to do hepatitis B relevant examinations?
Attitude	Q8 Do you mind associating with hepatitis B virus carriers? Q9 Would you like to live with carriers of hepatitis B in the same dormitory?
Behavior	Q10 Have you been taken hepatitis B vaccine? Q11 Have you done hepatitis B serology (two half-and-half) test?

effects of knowledge on prevention motivation, attitude and behavior were 0.28, 0.53, and 0.10, respectively, which had provided reliable evidence that could prove knowledge was the main influencing factor of prevention motivation, attitude, and behavior. See Figure 4 and Table 6.

Discussion

The results of our study had shown that freshmen who were from university and college in Jiangsu province had far less knowledge of HBV prevention and treatment. Although as the susceptible population to HBV,¹⁷ they had not given rise to high attentions yet. The awareness rate of the questions “hepatitis B vaccination effect” (39.5%) and “whether HBV could be cured” (59.5%) had both remained in low-grade, and the percentage of students who had correctly answered all transmission routes of hepatitis B virus was only 4.7%. Our study had indicated that lack of awareness about HBV among students, which was in agreement with some other studies in this field,^{18–20} This had reflected publicity may not be

**Figure 4** Schematic diagram of structural equation model.

Abbreviations: Q1, Can vaccination be effective in hepatitis B prevention?; Q2, Does hepatitis B infection develop liver cirrhosis or liver cancer easily?; Q3, Can companies reject or dismiss antigen-positive employees?; Q4, Can hepatitis B virus carriers get married?; Q5, What are the routes of transmission of hepatitis B?; Q6, If you do not have hepatitis B antibodies, will you get the vaccine?; Q7, If you suspect that you have been infected, would you take the initiative to do hepatitis B relevant examinations?; Q8, Do you mind associating with hepatitis B virus carriers?; Q9, Would you like to live with carriers of hepatitis B in the same dormitory?; Q10, Have you been taken hepatitis B vaccine?; Q11, Have you done hepatitis B serology (two half-and-half) test?

Table 6 Model Results of Each Path

Path	Coefficient	Normalized Coefficient	SE	P-value
Preventive motivation ← Knowledge	2.24	0.28	0.41	<0.001
Behavior ← Knowledge	1.35	0.10	0.63	0.031
Attitude ← Knowledge	15.87	0.53	2.58	<0.001
Q5 ← Knowledge	1.00	0.11	-	-
Q1 ← Knowledge	2.65	0.29	0.45	<0.001
Q2 ← Knowledge	5.90	0.33	0.98	<0.001
Q3 ← Knowledge	9.77	0.49	1.57	<0.001
Q4 ← Knowledge	11.85	0.64	1.90	<0.001
Q6 ← Preventive motivation	1.00	0.64	-	-
Q7 ← Preventive motivation	0.58	0.56	0.07	<0.001
Q8 ← Attitude	1.00	0.77	-	-
Q9 ← Attitude	0.63	0.54	0.04	<0.001
Q11 ← Behavior	1.00	0.43	-	-
Q10 ← Behavior	2.42	1.03	0.95	0.011

Abbreviations: Q1, Can vaccination be effective in hepatitis B prevention?; Q2, Does hepatitis B infection develop liver cirrhosis or liver cancer easily?; Q3, Can companies reject or dismiss antigen-positive employees?; Q4, Can hepatitis B virus carriers get married?; Q5, What are the routes of transmission of hepatitis B?; Q6, If you do not have hepatitis B antibodies, will you get the vaccine?; Q7, If you suspect that you have been infected, would you take the initiative to do hepatitis B relevant examinations?; Q8, Do you mind associating with hepatitis B virus carriers?; Q9, Would you like to live with carriers of hepatitis B in the same dormitory?; Q10, Have you been taken hepatitis B vaccine?; Q11, Have you done hepatitis B serology (two half-and-half) test?

enough as well as incomplete promotions for HBV prevention and treatment among college and university freshmen. Due to the outcomes, it should bring more attentions among administrators of schools and directors of local health departments.

Over half of them would not like to live in the same dormitory with HBV carriers (58.7%). This is contrary to other research findings,²¹ which had shown that students had negative attitudes towards people living with HBV. The discrimination is more serious than we ever imagined.²² It also had reflected a lack of knowledge about transmission of HBV. By having sufficient knowledge and a positive attitude towards HBV infection, people may reduce stigma and discrimination against HBV.²³ It requires schools to promptly provide positive guidance, increase efforts to conduct peer education, and promotes relevant knowledge of HBV transmission pathways to create an equal and harmonious campus environment for HBV carriers.

As a vaccine-preventable disease, vaccinate is cost-effective in reducing the burden of HBV among high-risk and high-prevalence populations.²⁴ This study had revealed that the most of respondents had an appropriate knowledge on vaccination can effectively prevent hepatitis B, despite this awareness only 51.0% of respondents had confirmed that had been received a full-dose of the HBV vaccine, the vaccine coverage was higher than previous studies.^{25,26} However, the vaccination rate is much lower than the requirement of “China Viral Hepatitis Prevention and Control Program (2017–2020)”,²⁷ which makes them vulnerable to hepatitis B. Obviously, it warns the ministry of health to formulate and implement relevant policies as soon as possible to improve HBV vaccination progress for improving students’ knowledge of HBV vaccinations.²⁸ Moreover, it is necessary to streamline vaccination programs in colleges and universities in order to provide certifications of vaccination for students at the time of admission. Besides, to encourage non-vaccinated students to receive HBV vaccination²⁹ and ensure availability and accessibility of the vaccine to students³⁰ are still important as well.

Compared with traditional chi-square analysis and other methods, Lasso regression would be easier to produce a sparse model by adjusting the value of penalty parameter within parameter estimation.³¹ In addition, it also could simultaneously achieve dimension reduction process and optimal selection of variables. It is often used to deal with a large number of independent variables in general cases to avoid model over-fitting. Therefore, this study had adopted Lasso regression to strictly screen independent variables and then constructed the Logistic regression model. The results had shown that females, parents with high education and students who were living with their parents had produced better

knowledge, attitudes and behaviors. This may be because females are more likely to be concerned about the accumulation of knowledge and their health than males, similar findings had been reported Vietnam³² and Saudi Arabia,¹⁸ while this is contrary to other research findings.³³ Higher level of parents' education lead to higher degree of children's health literacy by playing as examples for their children.³⁴ This finding had supported that of Mora and Trapero in Spain³⁵ and Balegha et al in Ghana.³³ This finding had also been explainable that highly educated parents had greater access and understanding of hepatitis B infection prevention, and had been more willing to pay for hepatitis B infection preventive services, such as hepatitis B screening, vaccination.³³ During this period, living with parents had made students get parents' cares and education fully and timely. In general, these factors had played a positive role together in HBV prevention and treatment.

Finally, the structural equation model had concluded that the awareness of hepatitis B knowledge had a significant positive effect on prevention motivation (0.28), attitude (0.53) and behavior (0.10), which means by popularizing and propagating hepatitis B knowledge. It could correct their discriminatory attitude towards hepatitis B virus carriers. It is significant for them to form early prevention awareness and produce positive behaviors such as voluntary vaccination and hepatitis B detection to reduce infection rate and morbidity of hepatitis B.¹⁹ This is similar to the study conclusion of previous studies.^{36,37} This study had involved prevention motivation as latent variable in the process of building the model, unlike the traditional "knowledge, attitude and practice" model. With certain latent variables increased, it would optimize evaluative indicators of the model. This also reminds us that while paying attention to the relationship between "knowledge, attitude and practice" in future health education work, we should emphasize the formation of prevention motivation and its important role. On the other hand, for continuing to explore the relationship between attitudes and behaviors, it is necessary to involve more diseases attitude other than discrimination during questionnaire design stage in the future as well as comprehensively consider the process of behavior dynamic development so that we could be able to achieve in-depth information of attitudes and behaviors.

Conclusion

In summary, due to a lack of precise KAP about hepatitis B in freshmen who were from colleges and universities in Jiangsu, the work of health education of HBV requires to be further strengthened among this certain population. In addition, administrators of colleges and universities should focus on promotion and education of vulnerable knowledge spots and promptly publicize certain national policies and regulations toward HBV in order to carry out prevention and health education via multiple ways. Remarkably, it is also recommended that to take an initiative in hepatitis B screening for freshmen and provide gratis HBV vaccination to all the students who had incompletely vaccinated or non-vaccinated. This strategy would achieve great significance for increasing the inoculation rate of hepatitis B vaccine.

Limitations of the Study

There are several limitations in our study. Firstly, the information had been collected by using a self-administered questionnaire. Secondly, the honesty and seriousness of the respondents to the questions were difficult to access and validate. Thirdly, we had not investigated the education level of students in high schools. However, we believed that the region of students can reflect the education level within high schools, and the education level of high school in urban areas is usually higher than that in rural areas.

Data Sharing Statement

The datasets analyzed in this study are available from the corresponding author Pingmin Wei (mpw1963@126.com) after co-authors' approval of the request.

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Disclosure

The authors declare that they have no competing interests.

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