

Study on the Infection Status of Hepatitis E Virus among Unpaid Blood Donors in Qinzhou Region and the Screening Strategy

Lilian Wei*, Lanqian Xie, Xiaoying Yuan#, Jun Lan, Dong Huang, Bochang Chen, Lisha Ye

Department of Clinical Laboratory, Qinzhou Central Blood Station, Qinzhou, China

Email: 441728908@qq.com, *912737328@qq.com

How to cite this paper: Wei, L.L., Xie, L.Q., Yuan, X.Y., Lan, J., Huang, D., Chen, B.C. and Ye, L.S. (2025) Study on the Infection Status of Hepatitis E Virus among Unpaid Blood Donors in Qinzhou Region and the Screening Strategy. *Advances in Infectious Diseases*, 15, 159-170.

<https://doi.org/10.4236/aid.2025.151013>

Received: February 14, 2025

Accepted: March 10, 2025

Published: March 13, 2025

Copyright © 2025 by author(s) and Scientific Research Publishing Inc. This work is licensed under the Creative Commons Attribution International License (CC BY 4.0).

<http://creativecommons.org/licenses/by/4.0/>



Open Access

Abstract

Objective: To investigate the infection status of Hepatitis E virus (HEV) among unpaid blood donors in Qinzhou region, and to provide a basis for the formulation of blood screening strategies in China. **Methods:** From May to October 2023, blood samples of 13,015 unpaid blood donors were randomly collected from Qinzhou Central Blood Station. Enzyme-linked immunosorbent assay (ELISA) was used to detect hepatitis E virus antigen (HEV-Ag), antibodies (HEV-IgG, HEV-IgM). Single-person nucleic acid testing for HEV RNA was performed on samples positive for HEV-Ag and/or HEV-IgM using real-time PCR technology. Meanwhile, the level of alanine aminotransferase (ALT) was determined by enzymatic detection technology (rate method), and the chi-square test was used to analyze the differences in the positive rates of HEV-Ag, HEV-IgG, and HEV-IgM among different age groups, genders, ethnic groups, occupations, and ALT level groups. **Results:** Among the 13,015 unpaid blood donors, the positive rates of HEV-IgG, HEV-IgM, and HEV-Ag were 11.59% (1509/13,015), 0.73% (95/13,015), and 0.054% (7/13,015), respectively. The HEV RNA tests of 95 HEV-IgM positive samples and 7 HEV-Ag positive samples were all negative. There were statistically significant differences in the positive rates of HEV-IgG among different genders, ages, ethnic groups, and occupations ($P < 0.05$), while the difference in the positive rate of HEV-IgM was only statistically significant among different age groups ($P < 0.05$). The positive rates of anti-HEV IgG and HEV-IgM increased with the increase of the age of unpaid blood donors, rising from 3.47% and 0.37% in the age group of 18 to 25 years old to 26.91% and 1.36% in the age group of 46 years old and above, respectively. **Conclusion:** There is a certain prevalence of hepatitis E virus infection among unpaid blood donors in Qinzhou region. The level of past infection (IgG) is relatively high, while the current infection

*First author.

#Corresponding author.

rate (HEV-IgM) is at a low level. There are differences in the HEV infection status among different populations. Therefore, it is necessary to formulate appropriate recruitment and screening strategies in combination with the HEV infection status of specific populations in Qinzhou region to reduce the risk of HEV transmission through blood transfusion.

Keywords

Unpaid Blood Donors, Hepatitis E, HEV-IgG, HEV-IgM, HEV-Ag

1. Introduction

Hepatitis E virus (HEV) is a single-stranded positive-sense non-enveloped RNA virus with a full-length genome of approximately 7.2 kb, which can cause viral hepatitis E (abbreviated as hepatitis E) [1]. Hepatitis E usually presents as asymptomatic or self-limiting recovery, and the symptoms generally subside within 2 to 6 weeks. However, pregnant women, organ transplant patients, the elderly, and immunocompromised individuals have a higher probability of developing severe hepatitis E and a higher mortality rate after infection [1]. The transmission routes of HEV include the digestive tract (fecal-oral), blood transmission, and mother-to-child transmission. In recent years, with an increasing number of cases reporting the transmission of hepatitis E virus through blood transfusion, the issue of HEV transmission through blood transfusion has become a serious public health challenge, attracting widespread attention in the field of blood transfusion [2]-[6]. China is a high-prevalence region of HEV, and currently, HEV has not been included in the blood screening program for blood donors. Therefore, it is urgent to conduct research on the prevalence of HEV in various regions to provide a reference for formulating appropriate recruitment and screening strategies. The Qinzhou region faces challenges in addressing the safety of blood transfusion regarding HEV and lacks detailed data support. In this study, the antigen and antibodies of hepatitis E virus in unpaid blood donors in the Qinzhou region were detected by the enzyme-linked immunosorbent assay (ELISA) method, and nucleic acid testing for HEV RNA was performed on samples positive for HEV-Ag and/or HEV-IgM. The aim is to understand the infection status and distribution of hepatitis E in the Qinzhou region, provide data support for the national blood screening work, and thus, it is of great significance for ensuring blood safety.

2. Materials and Methods

2.1. Specimen Source

In this study, the blood samples of unpaid blood donors from Qinzhou Central Blood Station during the period from May to October 2023 were selected, with a total of 13,015 cases. The age range of the donors was from 18 to 60 years old. Among them, there were 10,311 male blood donors and 2704 female blood donors; 11,087

blood donors were of Han ethnicity, 1751 were of Zhuang ethnicity, and 177 were of other ethnic minorities (including Yao, Miao, Dong, etc.). All blood donors met the relevant regulations of the “Requirements for Health Examination of Blood Donors” (GB18467-2011). Five milliliters of venous blood from the blood donors were collected, anticoagulated with EDTA-K2, and stored at 2°C to 8°C. This study has been approved by the Ethics Committee, and all participants signed the informed consent form before participation to ensure that the research process conforms to ethical standards and protects the privacy and rights of the participants.

2.2. Instruments and Reagents

2.2.1. Reagents

All detection reagents were provided by Beijing Wantai Biological Pharmacy Enterprise Co., Ltd., specifically including: Hepatitis E Virus IgM Antibody Detection Kit (Enzyme-Linked Immunosorbent Assay), batch numbers: EM20230503B, EM20230301B; Hepatitis E Virus IgG Antibody Detection Kit (Enzyme-Linked Immunosorbent Assay), batch numbers: EG202301B, EG20221104B; Hepatitis E Virus Antigen Detection Kit (Enzyme-Linked Immunosorbent Assay), batch numbers: EV20221103A, EV20230501A, EV20230702A; Hepatitis E Virus Nucleic Acid Detection Kit (PCR Fluorescent Probe Method), batch number: HEVP20230701. All reagents are qualified products in China, have passed the quality sampling inspection, and are used within the validity period.

2.2.2. Instruments

The instruments used in the experiment include: Shenzhen Aikang Automatic Enzyme Immunoassay Analyzer (URANUSAE188); Wantai Biological Automatic Nucleic Acid Extraction Instrument (WanTag 1.0); Fluorescent Quantitative PCR Instrument (Bio-Rad CFX96 Deep Well). The above instruments have all passed the calibration and are used in normal conditions.

2.3. Methods

2.3.1. Detection of HEV Antigen and Antibodies

Using the Shenzhen Aikang Automatic Enzyme Immunoassay Analyzer (URANUSAE188), the operation was carried out strictly in accordance with the reagent instruction manual. The enzyme-linked immunosorbent assay (ELISA) was performed to detect the hepatitis E virus antigen (HEV-Ag) and antibodies (HEV-IgG, HEV-IgM) in all samples. According to the judgment rules set in the instruction manual: if the OD value \geq cut off (*i.e.*, S/CO \geq 1), it is judged as positive; if the OD value $<$ cut off (*i.e.*, S/CO $<$ 1), it is judged as negative. All HEV-Ag and HEV-IgM positive samples were retested in duplicate wells. If at least one well has an OD value \geq cut off, it is judged as positive. The positive samples in the retest will be subjected to HEV RNA nucleic acid detection.

2.3.2. HEV RNA Nucleic Acid Detection

The 95 HEV-IgM positive samples and 7 HEV-Ag positive samples were sent to the R&D Center Laboratory of Beijing Wantai Biological Pharmacy Enterprise

Co., Ltd. Single-person HEV RNA detection was carried out by the PCR fluorescent probe method. The primer probes of the kit were designed for the highly conserved region of HEV RNA, which can detect genotypes 1, 2, 3, and 4, and the minimum detection limit is 10 IU/mL. The experimental operation and result judgment were carried out in accordance with the instruction manual.

2.4. Statistical Methods

In this study, SPSS 27.0 software was used for statistical analysis. First, descriptive statistics were performed on the basic information of the blood donors. Categorical variables were expressed using frequency and percentage, and continuous variables were expressed using mean \pm standard deviation. The chi-square test (χ^2 test) was used for comparison between groups to evaluate the differences in the positive rates of HEV antibodies and antigens among different genders, age groups, and ethnic groups. The significance level was set at $\alpha = 0.05$. The Spearman rank correlation coefficient was used for correlation analysis to explore the relationships between the positive rate of HEV antibodies and age, gender, and ethnicity. If necessary, Logistic regression analysis was used to evaluate the relevant factors affecting HEV infection, and a regression model was constructed to identify the statistically significant influencing variables. All results were presented through tables and figures, and a comprehensive discussion was carried out combining statistical and clinical significance.

3. Results

3.1. Results of HEV Serological Detection

Among the samples of 13,015 blood donors, a total of 1,509 cases were detected as positive for HEV-IgG, with a positive rate of 11.59% (1509/13,015); 95 cases were positive for HEV-IgM, with a positive rate of 0.73% (95/13,015); and 7 cases were positive for HEV-Ag, with a positive rate of 0.054% (7/13,015). Among the HEV-IgM positive samples, 65.26% (62/95) were also detected as positive for HEV-IgG; while among the HEV-Ag positive samples, 42.86% (3/7) were also detected as positive for HEV-IgG. See **Table 1** for details.

Table 1. HEV infection status of 13,015 blood donors.

Group	IgG	IgM	Ag	IgG + IgM	IgG + Ag	IgM + Ag
Positive number (n)	1509	95	7	62	3	0
Positive rate (%)	11.59	0.73	0.054	0.48	0.02	0

3.2. Results of HEV RNA Nucleic Acid Detection

Among the 95 HEV-IgM positive samples and 7 HEV-Ag positive samples, after being detected by the R&D Center Laboratory of Beijing Wantai Biological Pharmacy Enterprise Co., Ltd., no HEV RNA positive samples were found. The specific results are shown in **Table 2**.

Table 2. Nucleic acid detection results of 95 HEV-IgM and 7 HEV-Ag positive samples sent for inspection

Group	Number of HEV-RNA positive samples	HEV-RNA positive rate
HEV-IgM positive (n = 95)	0	0
HEV-Ag positive (n = 7)	0	0

3.3. Analysis of Influencing Factors of HEV Infection and ALT

Among the 13,015 blood donors in this study, there were 12,889 cases in the normal ALT group and 126 cases in the elevated ALT group. The positive rates of HEV-IgG, HEV-IgM, and HEV-Ag in the normal group were 11.61%, 0.73%, and 0.054%, respectively; while the positive rates of HEV-IgG, HEV-IgM, and HEV-Ag in the elevated ALT group were 9.52%, 0.79%, and 0, respectively. The detailed information is shown in **Table 3**.

Table 3. Analysis of influencing factors of HEV infection and ALT in 13,015 blood donors (n, %).

Group	HEV-IgG	HEV-IgM	HEV-Ag
Normal ALT group (n = 12,889)	1497 (11.61)	94 (0.73)	7 (0.054)
Elevated ALT group (n = 126)	12 (9.52)	1 (0.79)	0 (0)
Total (n = 13,015)	1509 (11.59)	95 (0.73)	7 (0.054)

3.4. Analysis of Group Characteristics of HEV Infection

There were statistically significant differences in the positive rate of HEV-IgG in terms of gender, age, ethnicity, occupation, and educational level ($P < 0.05$); while there were no significant differences in the positive rate of HEV-IgM in terms of gender, ethnicity, occupation, and educational level ($P > 0.05$), but there was a statistically significant difference in age ($P < 0.05$). With the increase of age, the positive rates of HEV-IgG, IgM, and Ag all showed an upward trend; the infection rate of the student group was the lowest, while that of the Miao ethnicity was the highest; the infection rate of people with a junior high school education or below was higher than that of people with other educational levels. The specific situation is shown in **Table 4**.

Table 4. Analysis of group characteristics of HEV infection in Qinzhou region (n, %).

Items	Classification elements	Number of blood donors (n)	HEV-IgG	HEV-IgM	HEV-Ag
Gender	Male	10,311	1246 (12.08)▲	80 (0.78)◆	5 (0.05)
	Female	2704	263 (9.73)▲	15 (0.55)◆	2 (0.07)
Age	18 - 25	2739	95 (3.47)△	10 (0.37)◇	0 (0)
	26 - 35	4407	331 (7.51)△	23 (0.52)◇	2 (0.05)
	36 - 45	4104	608 (14.81)△	38 (0.93)◇	5 (0.12)
	46-	1765	475 (26.91)△	24 (1.36)◇	0 (0)

Continued

Ethnicity	Han	11,087	1248 (11.26)▼	85 (0.77)■	6 (0.05)
	Zhuang	1751	216 (12.34)▼	6 (0.34)■	1 (0.06)
	Yao	73	11 (15.07)▼	1 (1.37)■	0 (0)
	Miao	23	9 (39.13)▼	1 (4.35)■	0 (0)
	Jing	19	2 (10.53)▼	0 (0)■	0 (0)
	Dong	11	3 (27.27)▼	0 (0)■	0 (0)
	Others	51	20 (39.22)▼	2 (3.92)■	0 (0)
Occupation	Farmer	2207	341 (15.45)▽	19 (0.86)□	0 (0)
	Teacher	499	56 (11.22)▽	2 (0.40)□	1 (0.02)
	Civil servant	435	72 (16.55)▽	2 (0.46)□	0 (0)
	Soldier	71	12 (16.90)▽	1 (1.41)□	0 (0)
	Worker	1631	197 (12.08)▽	15 (0.92)□	3 (0.18)
	Clerk	1694	205 (12.10)▽	11 (0.65)□	0 (0)
	Medical staff	899	73 (8.12)▽	7 (0.78)□	0 (0)
	Student	1019	35 (3.43)▽	5 (0.49)□	0 (0)
Others	4560	518 (11.36)▽	33 (0.72)□	3 (0.07)	
Educational level	Junior high school and below	4665	649 (13.91)▶	40 (0.86)★	4 (0.09)
	Technical secondary school	1574	162 (10.29)▶	10 (0.64)★	0 (0)
	Senior high school	1439	163 (11.33)▶	9 (0.63)★	2 (0.14)
	Junior college	2632	252 (9.57)▶	13 (0.49)★	0 (0)
	Undergraduate and above	2703	283 (10.47)▶	23 (0.85)★	1 (0.04)
	Others	2	0 (0)▶	0 (0)★	0 (0)
Total	13,015				

▲ $x^2 = 11.619$, $P < 0.001$; △ $x^2 = 693.699$, $P < 0.001$; ▼ $x^2 = 60.668$, $P < 0.001$; ▽ $x^2 = 122.29$, $P < 0.001$; ▶ $x^2 = 41.226$, $P < 0.001$; ◆ $x^2 = 1.446$, $P > 0.05$; ◇ $x^2 = 19.502$, $P < 0.001$; ■ $x^2 = 15.788$, $P > 0.05$; □ $x^2 = 3.957$, $P > 0.05$; ★ $x^2 = 4.042$, $P > 0.05$.

4. Discussion

In recent years, the number of cases of hepatitis E (HEV) transmitted through blood transfusion has gradually increased globally, which has attracted widespread attention. According to the report of the World Health Organization (WHO), there are approximately 20 million cases of hepatitis E virus infection worldwide every year, resulting in about 3.3 million symptomatic cases of hepatitis E. WHO estimates that in 2015, hepatitis E caused about 44,000 deaths, accounting for 3.3% of the deaths from viral hepatitis [7]. According to the data of the National Disease Prevention and Control Bureau, from 2015 to 2021, a total of 185,946 cases of hepatitis E were reported in the whole country (excluding the Hong Kong and Macau Special Administrative Regions and Taiwan Region), with 103 deaths. The average annual incidence rate was 2 per 100,000, ranking third in both incidence and mortality among viral hepatitis [8]. In the “Technical Operation Procedures

of Blood Stations (2019 Edition)” in China, HEV has not been included in the blood screening strategy, and there is a lack of sufficient data support on whether to conduct routine or selective screening of blood donor samples. Many blood collection and supply institutions in China have carried out epidemiological investigations on the HEV infection status of unpaid blood donors, and the results show that there are significant regional differences in HEV infection. According to a Meta-analysis in 2023 on the prevalence of HEV infection markers in unpaid blood donors in China [9], the prevalence rates of HEV-IgG, HEV-IgM, and HEV RNA in unpaid blood donors in China were 23.0%, 1.13%, and 0.028%, respectively, with significant differences among different cities and regions. This study shows that the positive rates of HEV-IgG, HEV-IgM, and HEV-Ag in unpaid blood donors in the Qinzhou region were 11.59%, 0.73%, and 0.054%, respectively. The positive rate of HEV in the Qinzhou region is only higher than that in Tongzhou, Beijing (1.17%, 0.5%) [10], but generally lower than that in other domestic regions, such as Wuhan (16.44%, 1.0%, 0.08%) [11], Guangzhou (20.05%, 0.76%, 0.04%) [12], Liuzhou, Guangxi (26.03%, 1.67%, 0%) [13], Jiangsu (19.23%, 1.49%) [14], Xiamen (23.10%, 0.67%, 0.19%) [15], Chongqing (49.19%, 1.67%, 0.20%) [16], Lishui, Zhejiang (24.81%, 1.67%) [17], Hong Kong (15.17%, 0.8%, 0.02%) [18], and Qingdao (12.94%, 0.78%, 0) [19], etc. The research results show that although there is a potential risk of HEV transmission through blood transfusion in the Qinzhou region, the prevalence rate of HEV is at a relatively low level in China, which may be closely related to local factors such as the economy, health conditions, medical environment, and vaccination policies. It is worth noting that Qinzhou City was rated as a “National Hygienic City” in 2021. In recent years, the municipal Party committee and government have attached great importance to consolidating and enhancing the achievements of creating a national hygienic city, continuously strengthening the construction of public health environment infrastructure, accelerating the improvement of urban and rural environmental hygiene, comprehensively improving the environmental hygiene level, enhanced the joint control ability of infectious diseases, and effectively reduced the risk of disease transmission.

HEV RNA detection is widely regarded as the “gold standard” for the diagnosis of hepatitis E infection. Previous studies have shown that there are significant differences in the positive rate of HEV RNA among blood donors in different cities and regions. For example, it is 0.26% (3/1144) in Nanjing, 0.13% (8/6263) in Xiamen, and 0.002% (1/46,837) in Shangrao. A Meta-analysis in 2023 showed that the pooled prevalence rate of HEV RNA in unpaid blood donors in China was 0.028% [9]. In this study, no HEV RNA positive samples were detected among the 95 HEV-IgM positive samples and 7 HEV-Ag positive samples were sent for inspection. There may be several reasons for this: First, a positive antibody and negative nucleic acid may indicate that the blood donor is in the recovery period of HEV. At this time, the HEV RNA has turned negative, but the antibody still exists in the body due to its long half-life. Some studies have shown that IgM antibodies can persist for five months or even up to three years after the recovery of hepatitis

E [20] [21]. Second, a positive antigen and negative nucleic acid may be due to the blood donor being in the early stage of infection with a low viral load. Since hepatitis E is an RNA virus and is easily degraded, HEV RNA cannot be detected in the body. Third, the possibility of false positives of antigen and antibody cannot be excluded. Due to the large mobility of blood donors, some blood donors are not in the local area all year round. This study did not conduct follow-up tests on this group of people. Future research can increase the follow-up monitoring of such people. Fourth, the number of specimens sent for inspection is limited, and the scope of HEV nucleic acid detection is small, so the HEV RNA infection situation in Qinzhou City cannot be comprehensively evaluated.

Many studies suggest that an elevated alanine aminotransferase (ALT) level may be a non-specific marker of hepatitis E virus (HEV) infection. The results of this study show that there was no statistically significant difference in the positive rate of HEV-IgG between the normal ALT group (11.61%) and the elevated ALT group (9.52%) ($P > 0.05$). Similarly, there was no significant difference in the positive rate of HEV-IgM between the normal ALT group (0.73%) and the elevated ALT group (0.79%) ($P > 0.05$), and the difference in the positive rate of HEV-Ag between the normal ALT group (0.054%) and the elevated ALT group (0%) was also not statistically significant ($P > 0.05$). The results of this study are similar to those of You Qingzhu *et al.* [12] and Zhang Longmu *et al.* [19], but differ from other reports [11] [17]. The reasons for these differences may be as follows: First, an elevated ALT level is not a sensitive marker of HEV infection. Second, all samples in this study passed the initial ALT screening before blood donation. Even if the test results show an elevated ALT level in the laboratory, in most cases, the ALT value is only 1 - 2 times the normal value. There are numerous factors affecting ALT within this range, and the clinical significance is limited [11]. The research results indicate that routine ALT testing can screen out some HEV-infected individuals, but there are still HEV-infected individuals among blood donors with normal ALT levels. Therefore, relying solely on ALT testing cannot effectively prevent the transmission of HEV through blood.

To understand the population distribution characteristics and risk factors of HEV infection among unpaid blood donors in the Qinzhou region, this study analyzed factors such as the gender, age, ethnicity, occupation, and educational level of blood donors positive for HEV-IgG/IgM/Ag. The results show that the infection rates of HEV-IgG/IgM among blood donors in this region are higher in males than in females ($P < 0.05$). This may be related to the fact that males have more opportunities for infection, such as greater job mobility, more social interactions, and certain living habits. This result is consistent with the studies of Li Meilin [10], Liu Qiaomei [13], Li Wei [16], etc. However, studies by Yu Qin [11], You Qingzhu [12], etc., suggest that gender is not an independent risk factor for HEV infection. The inconsistent conclusions may be due to factors such as differences in the study population, regional public health conditions, reagent variations, sample size, and statistical methods. Age is considered a risk factor for HEV infection in this region.

With the increase in age, the positive rates of HEV-IgG/IgM/Ag show an upward trend. The positive rate of IgG in the age group over 46 years old reaches 26.91%, which is consistent with the finding reported by Hu Liping [22] *et al.* that the incidence of hepatitis E virus in Guangxi is higher in middle-aged and elderly people. This may be because the older a person is, the more life experiences they have, and the greater the risk of exposure to HEV infection. In addition, the older group may have a weakened immune function and reduced resistance to the virus, making them more susceptible to HEV infection.

In terms of ethnicity, this study found that the HEV infection rates among blood donors of certain ethnic groups are relatively high, which may be related to the living habits, dietary structures, and hygiene conditions of different ethnic groups. For example, some ethnic groups may be more inclined to eat raw or undercooked foods, which may increase the risk of HEV transmission. In terms of occupation, the research results show that certain occupations (such as farmers and fishermen) are significantly associated with the risk of HEV infection. This may be related to the fact that people in these occupations are more frequently exposed to potential virus sources, such as through contact with contaminated water sources or consumption of contaminated foods.

The analysis results in terms of educational level showed that the HEV positive rates among blood donors with lower educational levels are relatively high. This may be related to the lack of health awareness, hygiene habits, and preventive measures among people with low educational levels. Improving public health awareness and the level of health education, especially among high-risk groups, may help reduce the transmission of HEV.

The limitations of this study are that the sample size is relatively limited and only covers blood donors in Qinzhou City, which may not fully reflect the HEV infection situation in the entire region. In addition, the research design is a cross-sectional survey, and the long-term health conditions of infected individuals cannot be tracked. Future research can consider conducting long-term longitudinal studies to more comprehensively understand the epidemiological characteristics and influencing factors of HEV infection.

In conclusion, although the overall infection rate of HEV among unpaid blood donors in the Qinzhou region is low, the study reveals the characteristics of HEV infection in terms of gender, age, ethnicity, and occupation in this region, as well as the potential risks of HEV-infected individuals with normal ALT levels. Therefore, it is necessary to strengthen the screening and monitoring of high-risk groups, improve public awareness, and prevent HEV infection to reduce the risk of the virus's transmission through blood.

5. Conclusion

There is a potential risk of hepatitis E virus (HEV) transmission through blood transfusion in the Qinzhou region. Although the overall prevalence of HEV in this region is relatively low in China, there are still high-risk groups, and the current

blood screening strategy has not effectively prevented the blood-borne transmission of HEV. The study found that male blood donors over 45 years old have a relatively high infection rate, and the infection rates of ethnic minority blood donors such as the Miao and Dong ethnic groups are higher than that of the Han ethnic group. To ensure blood safety and reduce the risk of HEV transmission through blood, the following effective measures are recommended: First, strengthen publicity and education, expand the publicity targets, especially health education for middle-aged and elderly people, to enhance public health awareness, prevent “disease from entering through the mouth”, and cut off the transmission routes. Second, when recruiting blood donors, priority should be given to recruiting blood donors with a low risk of HEV infection. Finally, for the high-risk HEV-infected population in this region, it is recommended to selectively increase the detection of HEV infection markers, and conduct appropriate epidemiological investigations and etiological monitoring of hepatitis E among the low-educated and middle-aged and elderly groups, so as to understand the infection status, transmission routes, and risk factors of the high-risk population, and provide a basis for scientific prevention and control measures and blood safety.

6. Limitations of the Study

This study has several limitations. First, the selection of samples may affect the generalizability of the results, especially in some specific populations, and may not fully reflect the HEV infection situation. Second, this study relies mainly on the cross-sectional survey method, which may not fully capture the dynamic changes of HEV infection. In addition, the time and geographical limitations of data collection may also affect the accuracy of the results, resulting in the failure to fully identify the infection trends of some high-risk groups. Future research should consider introducing more variables and a wider range of samples to improve the reliability and applicability of the research results.

Acknowledgements

During the conduct and completion of this study, we received support and assistance from many people. Here, we would like to especially thank the medical institutions and blood donors in the Qinzhou region for their valuable data and support. We also thank every member of the research team for their hard work in data collection, analysis, and discussion. In addition, we are grateful to the institutions that funded this study and all the participants for their active cooperation, which has ensured the smooth progress of this study. Finally, we thank our family and friends for their understanding and support during the research period.

Fund Project

Scientific Research Project of the Health Commission of Guangxi Zhuang Autonomous Region (NO.: Z-N20221921).

Conflicts of Interest

The authors declare that there are no personal conflicts of interest in this study. All the researchers involved have no financial or non-financial interests with any commercial institutions or organizations that may affect the research results. The research process adhered to strict academic ethics norms to ensure the objectivity and fairness of the research results. If there are any potential conflicts of interest, they will be disclosed in future relevant publications.

References

- [1] Liu, M. (2023) Research Progress on Hepatitis E Virus and Blood Safety. *Chinese Journal of Blood Transfusion*, **36**, 359-364.
- [2] Khuroo, M.S., Kamili, S. and Yatoo, G.N. (2004) Hepatitis E Virus Infection May Be Transmitted through Blood Transfusions in an Endemic Area. *Journal of Gastroenterology and Hepatology*, **19**, 778-784. <https://doi.org/10.1111/j.1440-1746.2004.03437.x>
- [3] Matsubayashi, K., Kang, J., Sakata, H., Takahashi, K., Shindo, M., Kato, M., *et al.* (2008) A Case of Transfusion-Transmitted Hepatitis E Caused by Blood from a Donor Infected with Hepatitis E Virus via Zoonotic Food-Borne Route. *Transfusion*, **48**, 1368-1375. <https://doi.org/10.1111/j.1537-2995.2008.01722.x>
- [4] Vollmer, T., Diekmann, J., Johne, R., Eberhardt, M., Knabbe, C. and Dreier, J. (2012) Novel Approach for Detection of Hepatitis E Virus Infection in German Blood Donors. *Journal of Clinical Microbiology*, **50**, 2708-2713. <https://doi.org/10.1128/jcm.01119-12>
- [5] Denner, J., Pischke, S., Steinmann, E., Blümel, J. and Glebe, D. (2019) Why All Blood Donations Should Be Tested for Hepatitis E Virus (HEV). *BMC Infectious Diseases*, **19**, Article No. 541. <https://doi.org/10.1186/s12879-019-4190-1>
- [6] Harvala, H., Hewitt, P.E., Reynolds, C., Pearson, C., Haywood, B., Tettmar, K.I., *et al.* (2019) Hepatitis E Virus in Blood Donors in England, 2016 to 2017: From Selective to Universal Screening. *Eurosurveillance*, **24**, Article 1800386. <https://doi.org/10.2807/1560-7917.es.2019.24.10.1800386>
- [7] World Health Organization (2023) Hepatitis E. <https://www.who.int/en/news-room/fact-sheets/detail/hepatitis-e>
- [8] National Health Commission of the People's Republic of China (2021) General Situation of Notifiable Infectious Diseases in China from 2015 to 2021.
- [9] Xie, Y.N., Li, F.Y., Liu, M., *et al.* (2023) Meta-Analysis of the Prevalence of HEV infection Markers in Unpaid Blood Donors in China. *Chinese Journal of Blood Transfusion*, **36**, 167-171. <https://doi.org/10.13303/j.cjbt.issn.1004-549x.2023.02.018>
- [10] Li, M.L., Ma, J.M., Li, T.J., *et al.* (2016) Study on the Infection Status of Hepatitis E Virus among Unpaid Blood Donors in Some Areas of Beijing. *Chinese Journal of Viral Diseases*, **6**, 360-362.
- [11] Yu, Q., Zhao, L., Xu, T.T., *et al.* (2022) Analysis of the Infection Status of Hepatitis E Virus among Unpaid Blood Donors in Wuhan Area. *Chinese Journal of Blood Transfusion*, **35**, 848-851.
- [12] You, Q.Z., Huang, J.T., Xu, R., *et al.* (2019) Epidemiological Investigation of Hepatitis E Virus Infection among Unpaid Blood Donors in Guangzhou Area. *Chinese Journal of Zoonoses*, **35**, 363-368.
- [13] Liu, Q.M., Wang, L., Wu, S.K., *et al.* (2021) Investigation on the Infection Status of

- Hepatitis E among Qualified Blood Donors in Liuzhou Area. *Chinese Journal of Blood Transfusion*, **34**, 62-64.
- [14] Zhu, S.W., Zhu, S.J., Cai, B.G., et al. (2016) Investigation on the Infection Status of Hepatitis E Virus among Qualified Unpaid Blood Donors in Jiangsu Area. *Chinese Journal of Blood Transfusion*, **29**, 1246-1249.
- [15] Ou, S.H., Lin, Y.C., Xie, J.Z., et al. (2017) Study on Hepatitis E Virus Infection among Blood Donors in Xiamen Area. *Chinese Journal of Blood Transfusion*, **30**, 258-261.
- [16] Li, W., Ouyang, X.Y., Wei, L., et al. (2018) Preliminary Analysis of Serological Screening of Hepatitis E Virus among Blood Donors in Chongqing Area. *Chinese Journal of Blood Transfusion*, **31**, 412-415.
- [17] Zhuang, J., Ji, Y.P. and Huang, L.H. (2021) Analysis of the Characteristics of Hepatitis E Virus-Infected Population among Unpaid Blood Donors in Lishui City, Zhejiang Province in 2020. *Practical Preventive Medicine*, **28**, 1372-1374.
- [18] Tsoi, W., Zhu, X., To, A.P. and Holmberg, J. (2019) Hepatitis E Virus Infection in Hong Kong Blood Donors. *Vox Sanguinis*, **115**, 11-17.
<https://doi.org/10.1111/vox.12846>
- [19] Zhang, L.M., Zhang, Z.J., Xu, L., et al. (2021) Investigation and Analysis of the Prevalence of HEV among Blood Donors in Qingdao Area. *International Medicine & Health Guidance News*, **27**, 828-831.
- [20] Ji, W.F., Wen, G.P., Tang, Z.M., et al. (2016) Research Progress on Laboratory Diagnostic Methods for Hepatitis E Virus Infection. *Chinese Journal of Virology*, **32**, 385-392.
- [21] Riveiro-Barciela, M., Rando-Segura, A., Barreira-Díaz, A., Bes, M., P. Ruzo, S., Piron, M., et al. (2020) Unexpected Long-lasting Anti-HEV IGM Positivity: Is HEV Antigen a Better Serological Marker for Hepatitis E Infection Diagnosis? *Journal of Viral Hepatitis*, **27**, 747-753. <https://doi.org/10.1111/jvh.13285>
- [22] Hu, L.P., Fang, Z.L., Wang, X.Y., et al. (2024) Epidemiological Characteristics Analysis of Hepatitis E Virus in Guangxi from 2011 to 2021. *Journal of Tropical Diseases and Parasitology*, **22**, 27-30+46.