Virus Research 354 (2025) 199542

Contents lists available at ScienceDirect

Virus Research

journal homepage: www.elsevier.com/locate/virusres

Screening for HBV, HCV, TP and HIV in pregnant women from various ethnic groups in Yili, Xinjiang, China

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ARTICLE INFO

Keywords:
Pregnant women
Infectious diseases
Ethnic groups
MTCT

ABSTRACT

Analyze the infection status of four blood-borne infectious diseases, namely hepatitis B, hepatitis C, syphilis, and acquired immune deficiency syndrome (AIDS), among pregnant women from different ethnic groups in Yili, Xinjiang. The objective is to assess the prevalence of four infectious diseases among pregnant women in this region and provide reference for the prevention and elimination of mother-to-child transmission. Pregnant women of Han and Uygur ethnicity who underwent prenatal screening at our outpatient clinic between 2016 and 2022 were selected for screening for hepatitis B virus surface antigen (HBsAg), antibody to hepatitis C virus (anti-HCV), antibody to treponema pallidum (anti-TP) and antibody to human immunodeficiency virus (anti-HIV) using an enzyme-linked immunosorbent assay (ELISA). A total of 13,437 pregnant women were tested, aged between 18 and 47. The positive rate of four infectious disease markers in Han and Uygur pregnant women in this region was 6.97 % (936/13,437). The total positive rate of HBsAg was 6.44 % (865/13,437), among which the Han women of HBsAg positive rate was 6.63 % (836/12,608), and the HBsAg positive rate in Uygur women was 3.63 % (29/829) ($\chi2$=12.673, P = 0.000); the total positive rate of anti-HCV was 0.16 % (21/13,437), of which the anti-HCV positive rate of Han women was 0.15 % (19/12,608), and anti-HCV positive rate in Uygur women was 0.24 % (2/829). ($\chi2$=0.034, P = 0.853); the total positive rate of anti-TP was 0.34 % (46/13,437), of which the positive rate of anti-TP in Han women was 0.24 % (30/12,608), and the positive rate of anti-TP in Uygur women was 1.93 % (16/829) ($\chi2$=65.280, P = 0.000); the total positive rate of anti-HIV was 0.03 % (4/13,437), of which Han nationality anti-HIV positive rate was 0 % (0/12,608), and the anti-HIV positive rate in Uygur nationality was 0.48 % (4/829) (P = 0.000). The positive rate of hepatitis B surface antibodies (anti-HBs) positive in Han nationality was 56.44 % (7116/12,608) and the positive rate of anti-HBs in Uygur nationality was 41.62 % (345/829) ($\chi2$=65.219, P = 0.000); the all-negative detection rate of Han nationality was 29.04 % (3661/12,608) and the Uygur nationality of all-negative detection rate was 46.20 % (383/829) ($\chi2$=104.352, P = 0.000). Our results suggest that the difference in infection rates between Han and Uygur pregnant women in Yili, Xinjiang, may be related to the different genetic susceptibility among different ethnic groups.

1. Introduction

Mother-to-child transmission (MTCT) is one of the main transmission routes of hepatitis B, hepatitis C, syphilis and Acquired Immune Deficiency Syndrome (AIDS), which may seriously affect the pregnancy outcome and the health of the newborn. In recent years, global guidelines have been developed to eliminate mother-to-child transmission of HIV, syphilis and hepatitis B virus (HBV) (Amin et al., 2021; Keuning et al., 2020; Cheung and Lao, 2020). In the World Health Organization's Global Health Strategy 2022–2030, it is proposed to eliminate the

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https://doi.org/10.1016/j.virusres.2025.199542
Received 10 October 2024; Received in revised form 20 January 2025; Accepted 4 February 2025
Available online 17 February 2025

prevalence of AIDS, viral hepatitis and sexually transmitted infections by 2030 (Lolekha et al., 2021). China's Integrated Prevention Program for Mother-to-child Transmission of HIV, syphilis and Hepatitis B virus was launched in 2010 and promoted nationwide in 2015 (Wang et al., 2018). Prenatal screening for HBsAg, anti-HCV, anti-TP and anti-HIV is an important means to prevent the transmission of mother-to-child infectious diseases. Early implementation of standardized and comprehensive interventions can effectively prevent vertical transmission of these diseases between infected pregnant women and their newborns. In this study, the detection results of HBsAg, anti-HCV, anti-TP and anti-HIV in the blood of pregnant women in our hospital were analyzed to understand the prevalence of infectious diseases among Han and Uygur pregnant women in this area. The aim is to assess progress made in eliminating mother-to-child transmission of diseases and identify remaining challenges to lay the foundation for the prevention of four infectious diseases among newborns in the region.

2. Methods

2.1. Sample collection

Subjects from 2016 to 2022, a total of 13,437 pregnant women of Han nationality and Uygur nationality, aged 18 to 47 years, underwent perinatal screening in the outpatient department of our hospital were included in the study. Serum was obtained from 3 to 5 ml of venous blood collected from pregnant women and centrifuged at 3500 RPM for 5 mins.

2.2. Reagents and instruments

Serum samples for hepatitis B virus (HBV), hepatitis C virus (HCV), Treponema pallidum (TP), and human immunodeficiency virus (HIV) were analyzed using enzyme-linked immunosorbent assay (ELISA). The following ELISA kits were used for detection: HBV surface antigen (HBsAg), HBV surface antibody (HBsAb), HBV e antigen (HBeAg), HBV e antibody (HBeAb), HBV core antibody (HBcAb), HCV antibody, TP antibody, and HIV antibody. All kits were manufactured by Beijing Wantai Bio-Pharmaceutical Co., Ltd. (Beijing, China). For samples that tested positive for anti-HCV or anti-TP during the initial ELISA screening, a confirmatory test was performed. Only samples that tested positive in both the initial and confirmatory tests were classified as positive. For samples that tested positive for anti-HIV in the initial screening, a secondary ELISA was conducted using an alternative anti-HIV diagnostic kit manufactured by Intech Technology Co., Ltd. (Xiamen, China). Individuals who tested positive twice were referred to the Centers for Disease Control and Prevention for confirmation through Western blot analysis; those confirmed as positive were deemed infected. The instruments used in these procedures included the Shanghai Kehua ST-36 W washing machine, Shanghai Kehua ST-360 enzyme label analyzer, and Adcom automatic ELISA E400 system. All operations strictly adhered to the instructions provided with each instrument and reagent.

2.3. Quality control

The laboratory operators have obtained the corresponding qualification certification and strictly adhere to the instructions for instruments and reagents. Each experiment undergoes positive quality control, negative quality control, critical value quality control, and blank control tests, with a report issued after quality control. All data are entered by two individuals to ensure reliability of the original data.

2.4. Statistical analysis

The age distribution of the research subjects followed a normal distribution and was expressed as such. The Chi-square test was used to compare the difference in positive rates across ethnic groups and age groups, while the Fisher test was used when the theoretical cell count was <5. A significance level of $P < 0.05$ was considered statistically significant.

3. Results

3.1. The analysis of positive rates of the four infectious diseases in different ethnic groups

Among the 13,437 subjects, 12,608 (93.83 %) were Han Nationality and 829 (6.17 %) were Uygur nationality. Their ages ranged from 18 to 47 years old with a mean age of (28.62±0.08) years. The positive rates of four infectious disease markers in pregnant women of Han nationality and Uygur nationality were 6.97 % (936 cases). The total positive rate of HBsAg was 6.44 % (865 cases), among which the positive rate of HBsAg was 6.63 % (836 cases) in Han nationality and 3.63 % (29 cases) in Uygur nationality ($\chi2$=12.673, $P = 0.000$). The total positive rate of anti-TP was 0.34 % (46 cases), among which the positive rate of anti-TP was 0.24 % (30 cases) in Han nationality and 1.93 % (16 cases) in Uygur nationality, the difference is statistically significant ($\chi2$=65.280, $P = 0.000$). The anti-HIV positive rate was 0.03 % (4 cases), among which the anti-HIV positive rate was 0 % (0 cases) in Han nationality and 0.48 % (4 cases) in Uygur nationality, the difference was statistically significant ($P = 0.000$) (Table 1).

3.2. The results of four infectious diseases in pregnant women of different ages

Pregnant women aged 18 to 47 were divided into six age groups. The positive rate of HBsAg was 3.43 % to 9.77 %. The positive rate of anti-HCV was 0.00 % to 1.32 %, anti-HCV of pregnant women has a higher positivity rate between the ages of 18 and 25. The positive rate of anti-TP was 0.00 % to 1.04 %, anti-TP of pregnant women has a higher positivity rate between the ages of 21 and 40. The positive rate of anti-HIV was 0.00 % to 0.12 %, and anti-HIV of pregnant women has a higher positivity rate between the ages of 26 and 35 (Table 2).

3.3. Age composition ratio of four infectious diseases positive in Han and Uygur women

The age group with the highest HBsAg positive rate among Han and Uygur women was 26 to 30 years old. The age group with the highest anti-HCV positive rate among Han nationality was 21 to 25 years old, and the age group with the highest anti-HCV positive rate among Uygur nationality was 31 to 40 years old. The age group with the highest anti-TP positive rate among Han nationality was 26 to 30 years old, and the age group with the highest anti-TP positive rate among Uygur nationality was 26 to 30 years old and 36 to 40 years old, with an infection rate of 31.3 % . The age group with the highest anti-HIV positive rate among Uygur was 31 to 35 years old (Table 3).

3.4. Detection of five serological markers of hepatitis B

The detection rate of "small Sanyang" in Han nationality was 4.56 % (575 cases), and the rate in Uygur nationality was 2.77 % (23 cases), the difference was statistically significant ($\chi2$=5.952, $P = 0.015$). The positive rate of hepatitis B surface antibody was 56.44 % (7116 cases) in Han nationality and 41.62 % (345 cases) in Uygur ethnic groups, the difference was statistically significant ($\chi2$=65.219, $P = 0.000$). The overall negative rate was 29.04 % (3661 cases) in Han nationality and 46.20 % (383 cases) in Uygur ethnic groups, the difference was statistically significant ($\chi2$=104.352, $P = 0.000$). There was no difference in the detection rates of other serological patterns between Han and Uygur ethnic groups (Table 4).

Table 1
Comparison of the positive rates of four infectious diseases between Han and Uygur nationalities (%).

Test items	Number of positive cases	Positive rate	Han nationalities		Uygur nationalities		χ^2	*P*
			Number of positive cases	Positive rate	Numberof positive cases	Positive rate		
HBsAg	865	6.44	836	6.63	29	3.63	12.673	0.000*
AntiHCV	21	0.16	19	0.15	2	0.24	0.034	0.853
TP-AB	46	0.34	30	0.24	136	1.93	65.280	0.000*
Anti -HIV	4	0.03	0	0.00	4	0.48	—	0.000*
Total	936	6.97	885	7.02	51	6.15	0.903	0.342

Table 2
Detection results of relevant infectious disease indicators for pregnant women of various ages (%).

Age	Number of cases	HBsAg		Anti-HCV		TP-AB		Anti-HIV	
		Number of cases	Positive rate	Number of cases	Positive rate	Number of cases	Positive rate	Number of cases	Positive rate
18~20	379	13	3.43	5	1.32	0	0.00	0	0.00
21~25	3135	172	5.49	9	0.29	10	0.32	0	0.00
26~30	6294	391	6.21	3	0.05	15	0.24	1	0.02
31~35	2498	182	7.29	3	0.12	10	0.40	3	0.12
36~40	957	90	9.40	1	0.10	10	1.04	0	0.00
41~47	174	17	9.77	0	0.00	1	0.57	0	0.00
Total	13,437	865	6.44	21	0.16	46	0.34	4	0.03

Table 3
The age composition ratio of the four positive infections of Han and Uygur pregnant women in different age groups (%).

Age	HBsAg		Anti-HCV		TP-AB		Anti-HIV	
	Han	Uygur	Han	Uygur	Han	Uygur	Han	Uygur
18~20	1.6 % (13)	0.0 % (0)	26.3 % (5)	0.0 % (0)	0.0 % (0)	0.0 % (0)	0.0 % (0)	0.0 % (0)
21~25	19.9 % (166)	20.7 % (6)	47.4 % (9)	0.0 % (0)	20.0 % (6)	25.0 % (4)	0.0 % (0)	0.0 % (0)
26~30	45.1 % (377)	48.3 % (14)	15.8 % (3)	0.0 % (0)	33.3 % (10)	31.3 % (5)	0.0 % (0)	25.0 % (1)
31~35	21.1 % (176)	20.7.% (6)	10.5 % (2)	50.0 % (1)	30.0 % (9)	6.2 % (1)	0.0 % (0)	75.0 % (3)
36~40	10.5 % (88)	6.9 % (2)	0.0 % (0)	50.0 % (1)	16.7 % (5)	31.3 % (5)	0.0 % (0)	0.0 % (0)
41~47	1.9 % (16)	3.4 % (1)	0.0 % (0)	0.0 % (0)	0.0 % (0)	6.2 % (1)	0.0 % (0)	0.0 % (0)
Total	100 % (836)	100 % (29)	100 % (19)	100 % (2)	100 % (30)	100 % (16)	100 % (0)	100 % (4)

Table 4
Five makers of hepatitis B in Han and Uygur (%).

Mode	HBsAg	anti -HBs	HBeAg	anti -HBe	anti -HBc	Han		Uygur		χ^2	*P value*
						Number of cases	detection rate	Number of cases	detection rate		
1	+	−	+	−	+	146	1.16	7	0.84	0.680	0.410
2	+	−	−	+	+	575	4.56	23	2.77	5.952	0.015*
3	+	−	+	−	−	13	0.10	3	0.36	−	0.072
4	+	−	−	−	+	98	0.78	5	0.60	0.316	0.574
5	+	−	−	−	−	4	0.03	1	0.12	−	0.265
6	−	+	−	+	+	339	2.69	29	3.50	1.474	0.225
7	−	+	−	+	−	371	2.94	24	2.89	0.022	0.883
8	−	+	−	−	+	157	1.25	3	0.36	5.193	0.023*
9	−	+	−	−	−	7116	56.44	345	41.62	62.219	0.000*
10	−	−	−	+	+	57	0.45	2	0.24	0.698	0.403
11	−	−	−	+	−	6	0.05	1	0.12	0.797	0.372
12	−	−	−	−	+	43	0.34	2	0.24	0.232	0.630
13	−	−	−	−	−	3661	29.04	383	46.20	104.352	0.000*
Other						22	0.17	1	0.12	0.000	1.000
Total						12,608	100.00	829	100.00		

4. Discussion

Hepatitis B, hepatitis C, syphilis and AIDS are mainly blood-borne infectious diseases that seriously endanger human health. The four tests of infectious diseases in pregnant women have been widely paid attention to as routine examinations during childbirth. There are about 86 million cases of hepatitis B virus infection in China (Dolan et al., 2016). Mother-to-child vertical transmission and sexual transmission are important ways of hepatitis B transmission, studies have shown that the hepatitis B virus carrying rate of women of childbearing age is 12.5 %. Therefore, hepatitis B virus infection in women of childbearing age is the source of hepatitis B transmission and epidemic. This study shows that the positive rate of HBsAg among pregnant women in this region is 6.97 %. The low positive rate of HBsAg in young pregnant women may be related to the long-term hepatitis B vaccine immunization policy in China. China has included hepatitis B vaccine in its immunization program since 1992. China's immunization program work has achieved remarkable results, and it is related to the continuous enhancement of national health awareness. Hepatitis B vaccine combined with immunoglobulin is still the main prevention and control means to block

mother-to-child transmission (Wirahmadi et al., 2024). The populations with the highest HBsAg positive rate in both Han and Uygur are 26 to 30 years old, which may be due to the concentration of women of childbearing age in this age group and the coverage of testing. The positive rate of anti-HBS in the Han nationality was significantly higher than that in the Uygur nationality, and the total negative rate in the Uygur nationality was significantly higher than that in the Han nationality. The differences in hepatitis B virus positivity rates among different ethnic groups may be due to variations in host immune factors and host single nucleotide polymorphisms. Studies have shown that many determining factors in chromosomes are associated with human susceptibility to HBV infection, including mutations in human leukocyte antigens (HLAs), cytokines genes, toll-like receptors (TLRs), and other genes (Xu et al., 2021). Studies have shown the relationship between HLA-DP/DQ and STAT4 gene polymorphisms and HBV infection outcomes in Chinese Han population, and found that some HLA genotypes are significantly correlated with HBV infection susceptibility (Liao, et al., 2014). Clinicians need to further test HBV-DNA and liver function of HBsAg positive pregnant women, so as to determine the virus replication and liver function, and guide breastfeeding to reduce the incidence of mother-to-child transmission. HCV infection can cause acute and chronic hepatitis, cirrhosis and extrahepatic diseases, and is also a major risk factor for hepatocellular carcinoma (Torres et al., 2017). Lay summary although effective treatments against hepatitis C virus (HCV) are available, 500,000 people die from liver disease caused by HCV each year and approximately 1.75 million newly infected (Merat et al., 2019). After HCV infection in pregnant women, the incidence of pregnancy complications and neonatal perinatal adverse outcomes are high. Mother-to-child transmission is a common way of hepatitis C virus infection. Studies have shown that the positive detection rate of hepatitis C antibody in pregnant women in China is 0.235 %, and the transmission of hepatitis C virus from positive mothers to newborns accounts for about 2 % (Mei and Lu, 2021). The survey showed that the total positive rate of hepatitis C virus in pregnant women was 0.16 %, and blood transmission and mother-to-child transmission were still the main transmission routes of HCV. It has been suggested that the polymorphism of IL28B rs12979860 gene is significantly correlated with the clearance rate of HCV infection, and the different distribution of some genotypes in African and Asian populations may lead to differences in infection outcomes (Ge et al., 2009). Syphilis is an infectious disease caused by treponema pallidum, which can be transmitted to the fetus from mother to child if untreated during pregnancy, resulting in serious adverse pregnancy outcomes (Rac et al., 2020). Nonlatent syphilis and maternal titers over 1 : 4 were risk factors for stillbirth, and complete treatment is the only protective factor for stillbirth (Duan et al., 2021). De Oliveira (de Oliveira et al., 2020) showed that the vertical transmission rate of syphilis from mother to child was as high as 56.8 %, the main reason is that syphilis was diagnosed in the late pregnancy, and some pregnant women were diagnosed during or after childbirth. In recent years, the incidence of syphilis has increased rapidly. The total positive rate of syphilis in pregnant women in this survey was 0.34 %, but the positive rate of Uygur was 1.93 %, which could be related to low health awareness and no early detection and treatment. Pregnant women infected with syphilis can cause mother-to-child transmission at any time of pregnancy, but mother-to-child vertical transmission often occurs at 14–16 weeks of gestation (Wang et al., 2018). Early syphilis screening and timely intervention can effectively prevent the occurrence of congenital syphilis in infants (Wu et al., 2022). Perinatal transmission is one of the main ways of HIV transmission (Brown et al., 2018). Over the years, with the continuous improvement of public awareness of HIV worldwide, routine prenatal HIV antibody testing and the use of anti retroviral drugs, the vertical transmission rate from mother to child has dropped from 25 to 30 % to <2 % (Connor et al., 1994). The number of pregnant women infected with HIV is on the rise. Timely standardized and systematic antiviral treatment for pregnant women infected with HIV is an effective measure to prevent and control mother-to-child transmission of HIV. The rs10800309 AA genotype of FcγRIIa encoding gene FCGR2A was found to be significantly associated with HIV control (Carapito et al., 2020).

In conclusion, ELISA method is simple, sensitive and specific, and is widely used in clinical practice. Hepatitis B, hepatitis C, syphilis and AIDS can be transmitted vertically through the placenta. The detection of infectious diseases in pregnant women is conducive to the early detection, prevention and treatment of infectious diseases, and is conducive to improving the quality of the population. Prenatal screening for HBV, HCV, TP and HIV infections is a standard practice strongly recommended by the WHO to reduce the risk of mother-to-child transmission and improve maternal and neonatal health outcomes. Early detection and timely intervention are essential for preventing vertical transmission and ensuring appropriate management of these infections during pregnancy.

5. Conclusions

There are differences in infection rates between Han and Uygur pregnant women in Yili, Xinjiang. May be related to the different genetic susceptibility among different ethnic groups. Prenatal detection of infectious diseases is conducive to early detection, early prevention and early treatment of infectious diseases.

Availability of data and materials

Not applicable.

Ethical approval

The clinical study was reviewed and approved by the Medical Ethics Committee of the Fourth Division Hospital,approval number: BTSSHEC—C-2022–028–01.

Funding

This project is funded by Qingdao University Medical Group (NO: YLJT20231006).

Consent for publication

Not applicable.

CRediT authorship contribution statement

Zhenzhen Pan: Writing – original draft, Project administration, Funding acquisition, Formal analysis, Data curation, Conceptualization. **Yuning Song:** Writing – original draft, Project administration, Funding acquisition, Formal analysis, Data curation, Conceptualization. **Xiangyi Zhe:** Conceptualization. **Qin Zhang:** Project administration, Methodology, Investigation. **Shumei Yuan:** Methodology, Investigation. **Zhe Zhao:** Methodology, Investigation. **Hongwei Dong:** Methodology, Investigation. **Jingru Hu:** Methodology, Investigation. **Yu Zhao:** Methodology, Investigation. **Guomei Zhang:** Software, Resources. **Zemin Pan:** Writing – review & editing, Conceptualization. **Shaoqiang Zhang:** Writing – review & editing, Funding acquisition.

Declaration of competing interest

The authors declare that they have no competing interests.

Data availability

Data will be made available on request.

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