Original Article

Seroepidemiology of HBV, HCV, HIV, HTLV, and CMV in Pregnant Women Referring to Sari Birth Cohort

Golnar Rahimzadeh[1], Mohammad Jafar Safar[1], Shaghayegh Rezai[2], Mohammad Sadegh Rezai[1], Faezeh Sadat Movahedi[3]

[1]Pediatric Infectious Diseases Research Center, Communicable Diseases Institute, Mazandaran University of Medical Sciences, Sari, Iran, [2]Department of Microbiology and Virology, School of Medicine, Mashhad University of Medical Sciences, Mashhad, Iran, [3]Students Research Committee, Mazandaran University of Medical Sciences, Sari, Iran

Abstract

Background: Congenital infections are among the most important conditions threatening human fetal health, the majority of which are caused by viral agents. Screening pregnant women for viral infections is essential because such infections can cause serious consequences for both the mother and the infant. So, this study aimed to serologically investigate sexually transmitted viral infections in pregnant women and also find the association between the prevalence of viral infections and epidemiological parameters in pregnant women of Sari, Iran.

Materials and Methods: This descriptive, observational study was performed in pregnant women referring to Sari Birth Cohort Center between 2018 and 2020. A total of 1092 blood samples were investigated for hepatitis B (HBV), hepatitis C (HCV), human immunodeficiency virus (HIV), human T-lymphotropic virus (HTLV), and cytomegalovirus (CMV) serological markers by enzyme-linked immunosorbent assay (ELISA).

Results: The prevalence of HBsAg positivity, HCV, HIV, and HTLV was 0.2%, 0.09%, 0.09%, and 0.2%, respectively. The percentage of participants with CMV-IgM and -IgG antibody titers above normal was 0.2% and 91.8%, respectively. Pregnant women whose educational level was bachelor's degree or lower, those who did not use a male condom before pregnancy, or those with a family history of infectious disease were found to be more likely to have HBV, HCV, HIV, HTLV, and CMV infections.

Conclusion: Family history, maternal age, pregnancy stage, and not using a male condom are among the risk factors for sexually transmitted viral infections in pregnant women in Sari.

Keywords: Sexually transmitted diseases, pregnant women, viral infections

Address for correspondence: Prof. Mohammad Sadegh Rezai, Professor, Pediatric Infectious Diseases Research Center, Communicable Diseases Institute, Mazandaran University of Medical Sciences, Sari, Iran.
E-mail: rezai@mazums.ac.ir
Submitted: 03-Oct-2022; **Revised:** 25-Oct-2022; **Accepted:** 29-Oct-2022; **Published:** 22-Nov-2022

Introduction

Congenital infections are among the most important conditions threatening human fetal health, the majority of which are caused by viral agents. Viral infections, which are more prevalent among pregnant women, are considered a major health problem in developing countries. Age, race, socioeconomic status, and can increase the risk of sexually transmitted viral infections (STIs) in pregnant women.[1,2]

Human immunodeficiency virus (HIV), human T-lymphotropic virus (HTLV), hepatitis B virus (HBV), hepatitis C virus (HCV), and cytomegalovirus (CMV) are among the most frequent STIs. It has been estimated that the number of pregnant women with STIs is increasing by about 500 million a year in developing countries and by half that number in developed countries.[3] These infections are mainly transmitted through contaminated blood transfusions, sharing injectable drug

Access this article online

Quick Response Code:

Website: www.advbiores.net

DOI: 10.4103/abr.abr_334_22

How to cite this article: Rahimzadeh G, Safar MJ, Rezai S, Rezai MS, Movahedi FS. Seroepidemiology of HBV, HCV, HIV, HTLV, and CMV in pregnant women referring to Sari Birth Cohort. Adv Biomed Res 2022;11:97.

equipment, contaminated organ transplant, unprotected sex, vertical transmission from mother to baby during pregnancy, birth and breastfeeding, cervical discharge at delivery, and contact with the saliva and urine of the patients.

Viral infections before or during pregnancy can cause adverse pregnancy outcomes including spontaneous abortion, intrauterine fetal death, growth disorders, preterm labor, changes in the volume of amniotic fluid, congenital infection, and various sequelae in surviving neonates.[2-4] Therefore, early diagnosis and treatment of viral infections in pregnant women can play a major role in maintaining maternal and fetal health.[5] Without antiviral treatment, the risk of HIV transmission from infected mothers to their fetuses is about 15%–30% during pregnancy and labor.[6]

Other measures such as elective cesarean section, breastfeeding avoidance, antiretroviral drug therapy during pregnancy and after birth, and the treatment of the infant up to 6 weeks after birth can minimize the risk of vertical transmission of HIV to only 1%.[7] The risk of HTLV transmission from mother to infant ranges between 15% and 30%, depending on the maternal viral load, antibody titer against HTLV in the mother's body, and duration of breastfeeding.[8] The risk of transmission in children who are not breastfed is less than 5%, but they may become infected inside the uterus or at birth.[9] The risk of HBV infection in children born to hepatitis B surface antigen (HBsAg)-positive mothers is 70%–90%; however, these figures can be reduced to 3% if the infection is diagnosed during pregnancy or before delivery.[1]

Congenital CMV infection with an estimated birth prevalence of 1%, ranging from 0.2% to 2.5% depending on the population studied, results in tens of thousands of newborns each year born with CMV infection in the USA.[10] CMV infects 60% of women of childbearing age in developed countries and 90% of women in developing countries.[5] Maternal CMV infection may cause fetal infection. So, screening for CMV infection in pregnant women through more comprehensive genetic and ultrasound examinations can help to take the necessary measures by predicting possible fetal infections and detecting long-term sequelae such as hearing loss and neurodevelopmental disabilities.[1,10]

Screening pregnant women for viral infections is essential because such infections can cause serious consequences for both mother and infant, and also, their prevalence may vary from country to country depending on age, region, population, and time. Such screening and monitoring programs can help us predict possible fetal viral infections, measure their complications through advanced examination of amniotic fluid and fetal ultrasound, and take the necessary therapeutic measures.[1-5]

The number of prenatal care visits for non-complicated pregnancies according to the guideline of the Ministry of Health and Medical Education of Iran is eight.[11] Prenatal care is optional in Iran, and for normal pregnancies, it should be at least four visits. The first visit is performed 3 months before pregnancy, which includes a screening program for infections like HIV, HBV, TORCH (toxoplasmosis, other congenital syphilis, and viruses), rubella, CMV, and herpes simplex virus (HSV) and Venereal Disease Research Laboratory (VDRL) test for gonorrhea, chlamydia, and syphilis in high-risk mothers. Most of the visits to health centers are free, but the paraclinical evaluation is of high cost and may not be performed by all pregnant women.[1,10-14] Epidemiological information about these agents based on ethnic, cultural, and geographic differences in different regions of Iran is still scarce in Iran. No comprehensive data are available on viral infections in pregnant women of northern Iran. Also, more comprehensive investigations of infections during pregnancy, the extent of diseases in the fetus is follow-up and the necessary measures are taken for the fetus. Thus, an evaluation of the seroprevalence of these viral infections in pregnant women and detection of the association between the prevalence of viral infections and epidemiological parameters in pregnant women attending the Sari Birth Cohort (SBC) was performed in this study.

Materials and Methods

Study population

This observational, descriptive study was performed on pregnant women attending the SBC center in Mazandaran province, northern Iran, from 2018 to 2020. Ethical approval was obtained from the ethical committee of the Mazandaran University of Medical Sciences, Iran (#IR. MAZUMS. REC.1397.1609), and written informed consent was obtained from women before they participated in the study.

This is a multidisciplinary, longitudinal study linked to a multicenter Persian birth cohort running in five different provinces of Iran (Sari, Isfahan, Yazd, Semnan, and Rafsanjan cities). Pregnant women living in Sari city and in villages around Sari were enrolled between June 2017 and June 2020 in this study.[15] The SBC investigated the impact of socioeconomic status, lifestyle, diet, and occupational and environmental exposures before and during pregnancy and also during early life of the infant on some major health concerns of the fetuses. At the end of the study enrollment, totally 3000 mother–child pairs were included, and the offspring are followed up to at least 10 years of age.

Pregnant women in the first, second, or third trimester of pregnancy who were unaware of infection with CMV, HIV, HTLV, HBV, or HCC and who signed the informed consent for participation in the study were tested for all serologies.

Serological testing

After preparing the serum samples, the titers of CMV-IgG and -IgM antibodies, HBsAg, HBs-Ab, HBc-Ab, HIV-Ab, HTLV-Ab, and HCV-Ab were measured using a commercially available enzyme-linked immunosorbent assay (ELISA) kit (DIA.PRO, Milano-Italy), with a sensitivity and specificity

of 100%, and an ELISA device (Sunrise TECAN, Männedorf, Switzerland), following the manufacturer's instructions. To confirm acute and primary infection with CMV, the pregnant women whose CMV-IgM and IgG titers were higher than normal were also examined in terms of CMV-IgG avidity titers. Ethical approval was obtained from the ethical committee of the Mazandaran University of Medical Sciences, Iran (#IR.MAZUMS.REC.1397.1609), and written informed consent was obtained from women before they participated in the study.

Data analysis

The prevalence of HBV, HCV, HIV, HTLV, and CMV was calculated and presented in descriptive statistics. Finally, to determine any significant relationship between the infection rate and demographic characteristics of the subjects, a comparison of proportions was performed using the Chi-square and logistic regression tests. Statistical Package for Social Sciences (SPSS) version 22.0 was used for data analysis, and *P* values less than 0.05 were considered to be statistically significant.

Results

Totally, 1092 pregnant women aged 17–51 years with a mean age of 30.31 ± 5.30 years agreed and signed the informed consent to participate in the study. Of them, 48.5% were ≥31 years old, 986 (90.3%) lived in the city, 934 (86.8%) had a bachelor's degree and below, 792 (73.9%) were housewives, and 448 women (41.4%) were in their third trimester of pregnancy. In addition, 102 (9.3%) and 36 (3.3%) participants had a smoking and drinking history. Of these women, 22 (11%) and 11 (1%) suffered from hypertension and diabetes mellitus, respectively [Table 1].

The number of participants with CMV-IgG and -IgM antibody titers above normal was 1003 (91.8%) and 2 (0.2%), respectively. A significant difference was found between education ($P = 0.002$) and stage of pregnancy ($P = 0.012$) in women with positive and negative CMV-IgG [Table 1].

The prevalence of positive HBsAg and HBcAb was 2 (0.2%) and 14 (1.3%), respectively. Totally, 993 (90.93%) mothers had been vaccinated against HBV and 503 (46.06%) women had HBsAb ≥10 mIU/mL and were immune, while 588 (53.84%) participants had HBsAb <10 mIU/mL.

More than 10 years following hepatitis B vaccination, 251 (42.7%) women were unimmune and 260 (51.7%) women were immune (HBsAb ≥10), while more than 20 years following HepB vaccination, 238 (40.5%) women were unimmune and 244 (48.5%) women were immune (HBsAb ≥10).

As shown in Table 2, 14 women were HBcAb positive and most of them were 25–30 years old (57.1%). No significant association was found between demographic variables and positive HBcAb ($P > 0.05$).

Among the risk factors, not using a male condom for contraception before pregnancy and a family history of HepB had a significant association with positive HBcAb ($P = 0.041$ and $P < 0.001$, respectively). In addition, the risk of HBSAg positivity was 2.847 times higher in individuals without male condom use compared to condom users. There was a significant association between a history of diabetes mellitus and no condom use with being nonimmune against the virus (HBsAb < 10, $P = 0.004$ and $P < 0.001$, respectively) [Table 3].

HIV, HTLV, and HCV-Ab were positive in one (0.09%), two (0.2%), and one (0.09) mother, respectively. The HIV+ mother was 35 years old, with a history of miscarriage, surgery, and dental visit and without the use of a male condom. Of the two HTLV+ women, the first one was a 43-year-old woman in her first trimester with a history of surgery and dental visits. The other one was a 23-year-old woman in her second trimester with a history of a dental visit. Both of them did not use a male condom. The HCV-Ab+ mother was 37 years old in her first trimester with a history of a dental visit and no condom use. Any coinfection was not found in these mothers.

Discussion

This study was performed on 1092 pregnant women from the initial study population of 3000 pregnant women attending the SBC. The mothers were unaware of infection with CMV, HIV, HTLV, HBV, or HBC. Our results showed that most of the participants (91.8%) presented the IgG antibody to CMV and 0.2% had anti-CMV IgM. In the study by Barbosa *et al.* conducted in Brazil, CMV IgG antibody was positive in 96.3% and 2.2% had anti-CMV IgM.[16]

Similar results were obtained on the prevalence of a positive CMV-IgG in pregnant women in the USA (57.9%), Brazil (85%), Egypt (96%), Turkey (94.9%), and Iran (98%),[17-20] and positive CMV-IgM (2.2%).[21] In Figueiró-Filho *et al.*'s[20] study, 0.05% of IgM-reactive cases for CMV were observed. In a study carried out in 2004, Spano *et al.*[22] found a frequency of 0.2% of acute cases of CMV. The prevalence of CMV infection is lower in developed countries than in the developing world and is higher in Africa, Asia, and South America and lower in Western Europe and North America.[23] CMV seroprevalence estimates of pregnant women are needed for planning strategies against congenital CMV transmission.[22] A higher prevalence of anti-CMV IgM is worrying because congenital CMV infection rates increase with maternal seroprevalence, causing congenital malformation, a higher risk of infection, and consequent vertical transmission of CMV.[21] This difference is most likely caused by lower economic status, busy living conditions, and lack of knowledge about essential health measures.[22]

In this study, a significant difference was found between education and pregnancy stage in women with positive and negative CMV-IgG, as those with a bachelor's degree and lower were at higher risk of being CMV-IgG positive compared to higher educated mothers. No significant difference was observed between abortion and CMV infection, as 0.2% of pregnant women had a positive CMV-IgM. A higher incidence

Table 1: Demographic information of the pregnant women

Demographic characteristic	CMVIgG+	*P*	CMVIgM+	HBsAb <10	*P*	HBsAg+	HBcAb+	*P*	HIV+	HTLV+	HCV-Ab	Total (%)
Age (years)												
17-24	151 (15.1)	0.377	0	99 (16.9)	**<0.001**	0	1 (7.1)	0.251	0	1	0	164 (15.1)
25-30	368 (36.9)		1	169 (28.8)		1	8 (57.1)		0	0	0	394 (36.3)
≥31	478 (47.9)		1	318 (54.3)		1	5 (35.7)		1	1	1	526 (48.5)
Location												
Urban	904 (90.1)	0.540	2	536 (91.2)	0.293	2	13 (92.9)	0.744	1	2	1	986 (90.3)
Rural	99 (9.9)		0	52 (8.8)		0	1 (7.1)		0	0	0	106 (9.7)
Education												
Bachelor's and lower	868 (87.8)	**0.002**	1	517 (89.6)	**0.003**	2	12 (85.7)	0.904	0	2	1	934 (86.8)
Above bachelor's	121 (12.2)		1	60 (10.4)		0	2 (14.3)		1	0	0	142 (13.2)
Job												
Housewife	743 (75.2)	**0.001**	1	466 (80.6)	**<0.001**	2	11 (78.6)	0.688	1	2	1	792 (73.9)
Employed	245 (24.8)		1	112 (19.4)		0	3 (21.4)		0	0	0	280 (26.1)
Number of marriages												
1	943 (94.0)	0.052	2	557 (94.7)	0.095	1	13 (92.9)	0.910	1	2	1	1022 (93.6)
2	60 (6.0)		0	31 (5.3)		1	1 (7.1)		0	0	0	70 (6.4)
Number of pregnancies												
1	419 (41.8)	0.562	2	258 (43.9)	0.191	2	8 (57.1)	0.249	0	2	1	459 (42.0)
≤2	584 (58.2)		0	330 (56.1)		0	6 (42.9)		1	0	0	633 (58.0)
Number of live births												
≥2	993 (99.0)	0.909	2	581 (98.8)	0.515	2	14 (100.0)	0.440	1	2	1	1081 (99.0)
≥3	10 (1.0)		0	7 (1.2)		0	0		0	0	0	11 (1.0)
Number of previous abortions												
1	175 (17.4)	0.992	0	94 (16.0)	0.284	0	1 (7.1)	0.629	1	0	0	192 (17.6)
≤2	44 (4.4)		0	28 (4.8)		0	0		0	0	0	48 (4.4)
Current abortion	15 (1.5)	0.245	0	9 (1.5)	0.633	0	0	0.657	0	0	0	15 (1.4)
Stillbirth ≥1	36 (3.6)	**0.013**	0	12 (2.0)	**<0.001**	0	0	0.440	0	0	0	44 (1.0)
Tattoo	245 (24.5)	0.782	0	156 (26.5)	0.102	0	4 (28.6)	0.731	0	0	0	268 (24.6)
Piercing	121 (12.1)	0.058	0	85 (14.5)	0.058	0	3 (21.4)	0.322	0	0	0	138 (12.7)
No condom use	741 (73.9)	0.998	1	465 (79.2)	**<0.001**	1	7 (50.0)	**0.041**	1	2	1	806 (73.9)
Blood transfusion	23 (2.3)	0.054	0	15 (2.6)	0.976	0	0	0.541	0	0	0	28 (2.6)
History of surgery	575 (57.7)	0.56	0	338 (58.0)	0.696	0	10 (71.4)	0.288	1	1	0	623 (57.5)
History of dental visit	975 (97.2)	0.361	2	572 (97.3)	0.654	1	14 (100.0)	0.513	1	2	1	1060 (97.1)
Alcohol consumption	32 (3.2)	0.495	0	23 (3.9)	0.219	0	0	0.487	0	0	0	36 (3.3)
Smoking	95 (9.5)	0.639	0	63 (10.7)	0.092	0	2 (14.3)	0.523	0	0	0	102 (9.3)
History of diabetes	10 (1.0)	0.900	0	1 (0.2)	**0.003**	0	0	0.589	0	0	0	11 (1.0)
History of hypertension	19 (1.9)	0.332	0	10 (1.7)	0.425	0	0	0.704	0	0	0	22 (2.0)
Infection of family with hepatitis B	12 (1.2)	0.390	0	7 (1.2)	0.771	0	2 (14.3)	**<0.001**	0	0	0	14 (1.3)
Stage of pregnancy												
1st trimester	209 (21.0)	**0.012**	0	125 (21.5)	**<0.001**	0	1 (7.1)	0.517	0	1	1	224 (20.7)
2nd trimester	387 (38.9)		0	260 (44.8)		1	5 (35.7)		1	1	0	410 (37.9)
3rd trimester	399 (40.1)		1	196 (33.7)		1	7 (50.0)		0	0	0	448 (41.4)

CNV=Cytomegalovirus, HBV=Hepatitis B virus, HCV=Hepatitis C virus, HIV=Human immunodeficiency virus, HTLV=Human T-lymphotropic virus, Bold numbers: These are significant in terms of statistics

Table 2: Association between demographic variables and HBsAb and HBcAb titers in pregnant women

Variables	*n*	HBsAb, *n* (%)		*P*	HBcAb, *n* (%)		*P*
		<10	≥10		Positive	Negative	
Age (years)							
<30	480 (44.3)	244 (50.8)	236 (49.2)	0.054	6 (1.3)	474 (98.8)	0.914
≥30	604 (55.7)	342 (56.7)	261 (43.3)		8 (1.3)	596 (98.7)	
Location							
Urban	986 (90.3)	536 (54.4)	449 (45.6)	0.293	13 (1.3)	973 (98.7)	0.744
Rural	106 (9.7)	52 (49.1)	54 (50.9)		1 (0.9)	105 (99.1)	
Migration							
Yes	250 (22.9)	124 (49.6)	126 (50.4)	0.116	1 (0.4)	249 (99.6)	0.158
No	841 (77.1)	464 (55.2)	376 (44.8)		13 (1.5)	828 (98.8)	
Education							
Bachelor's and lower	934 (86.8)	517 (55.4)	416 (44.6)	0.003	12 (1.3)	922 (98.7)	0.904
Above bachelor's	142 (13.2)	60 (42.3)	82 (57.7)		2 (1.4)	140 (98.6)	
Job status							
Housewife	792 (73.9)	466 (58.8)	326 (41.2)	<0.001	11 (1.4)	781 (98.6)	0.688
Employed	280 (26.1)	112 (40.1)	167 (59.9)		3 (1.1)	277 (98.9)	
Gestational age							
≤24 weeks	632 (62.6)	385 (61.0)	246 (39.0)	0.005	6 (0.9)	626 (99.1)	0.216
>24 weeks	377 (37.4)	196 (52.0)	181 (48.0)		7 (1.9)	370 (98.1)	

of CMV-IgG was reported in less-educated pregnant women in Porobic-Jahic *et al.*'s[24] study, wherein this percentage was 10.2% in women who completed college, while 5.4% of women with secondary education were CMV-IgG positive. The results of Nasir *et al.*'s[25] study in Nigeria showed that CMV seropositivity decreases significantly with the level of education. Hamdan *et al.*[26] reported that low level of education increased the risk of developing CMV infections. The CMV-IgG–positive population of our study was not large enough to comment on abortion. In addition, pregnant women were investigated in their third trimester and since abortion is more common in the first and second trimesters, it may have influenced the results. A higher risk of having CMV infection found in pregnant women with bachelor's degree and below may be attributed to their lack of knowledge and poor follow-up.

In this study, there was no significant correlation between the seropositivity of CMV infection and maternal income and age, which complies with the study of Arabzadeh *et al.*[11] Yamamoto *et al.*[19] found a tendency toward higher levels of CMV antibody in the youngest age group and reported that most low-income pregnant women utilizing the public health system of a southeast Brazilian city are CMV seropositive from an early age. Younger maternal age appears to be an independent risk factor for delivery of a baby with symptomatic CMV infection.[9] Low socioeconomic conditions, maternal age, number of children, and sexual behavior have a direct impact on the rate of developing CMV infection.[16]

The prevalence of HBsAg positivity was 0.2% in our study. The prevalence of HBV in Iran was 0% in Zanjan and 2.3% in Jiroft.[27] In Guerra *et al.*'s[21] study, 10.5% of the participants had HBV infection. Also, 7.1% of pregnant women were HBS-Ag positive in Opaleye *et al.*'s[3] study. Difference in HBV prevalence rates in different counties is attributed to the socioeconomic status, health status, and vaccination.[28]

In our study, among the study variables, education, occupation, and stage of pregnancy were not correlated with immunity against HBV. Sixty-one percent of those who were not immune were in their first and second trimesters.

In the study by Mueller *et al.*,[29] there was a significant association between age and developing HBV infection. However, in the study by Shoghli *et al.*,[27] although the age group ≥37 years had the highest rate of positive HBsAg prevalence, no significant association was found between age, residence, immigration, education, and occupation and the prevalence of hepatitis B.

In this study, the prevalence of positive HIV was 0.09% who the pregnant woman with a history of dental treatment, history of surgery, and did not use a male condom. The HIV prevalence in pregnant women in Mumbai varied from 0.9% in 2008 to 0.63% in 2012.[30] Guerra *et al.*'s[21] study and Opaleye *et al.*'s[3] study reported the prevalence of HIV infection in pregnant women to be 0.3% and 4.9%, respectively. Incidence and prevalence of HIV have increased in the Eastern Mediterranean Region (EMR) since 1990, and EMR has the lowest antiretroviral therapy (ART) coverage globally at a median of 17% in 2015.[31] In Iran, religion prevents individuals from expressing high-risk relationships and sexual matters and therefore, in this study, it could not be said whether pregnant women have had high-risk sexual behaviors or not. In a study by Yaghoobi *et al.*[15] conducted in 2017 in Bushehr, Iran, most HIV-infected patients were aged 18–44 years and 42.5% were infected through sexual contact.

Table 3: Association between risk factors and HBsAb and HBcAb titers in pregnant women

Risk factors	HBsAb, *n* (%)		RR (95% CI)	*P*	HBcAb, *n* (%)		RR (95% CI)	*P*
	<10	≥10			Positive	Negative		
Tattoo								
Yes	156 (58.4)	111 (41.6)	0.792 (0.599-1.048)	0.102	4 (1.5)	264 (98.5)	1.227 (0.382-3.946)	0.756
No	432 (52.7)	388 (47.3)			10 (1.2)	810 (98.8)		
Piercing								
Yes	85 (61.6)	53 (38.4)	0.703 (0.488-1.014)	0.058	3 (2.2)	135 (97.8)	1.897 (0.523-6.886)	0.322
No	503 (33.0)	446 (47.0)			11 (1.2)	939 (98.8)		
History of abortion								
Yes	122 (50.8)	118 (49.2)	1.171 (0.879-1.560)	0.281	1 (0.4)	239 (99.6)	0.270 (0.035-2.075)	0.177
No	466 (54.8)	385 (45.2)			13 (1.5)	839 (98.5)		
Current abortion								
Yes	9 (60.0)	(40.0) 6	0.777 (0.275-2.197)	0.633	0 (0)	15 (100.0)	-	0.657
No	579 (53.8)	(46.2) 497			14 (1.3)	1063 (98.7)		
History of hypertension								
Yes	10 (45.5)	(54.5) 12	1.410 (0.604-3.292)	0.425	0 (0)	(100.0) 22	-	0.589
No	577 (54.0)	491 (46.0)			14 (1.3)	1055 (98.7)		
History of diabetes								
Yes	1 (9.1)	10 (90.9)	11.886 (1.516-93.178)	0.004	0 (0)	11 (100.0)	-	0.704
No	(54.3) 586	493 (45.7)			14 (1.3)	1066 (98.7)		
Blood transfusion								
Yes	15 (53.6)	13 (46.4)	1.012 (0.477-2.147)	0.976	0 (0)	28 (100.0)	-	0.541
No	572 (53.9)	490 (46.1)			14 (1.3)	1049 (98.7)		
History of surgery								
Yes	338 (54.3)	284 (45.7)	0.953 (0.749-1.213)	0.696	10 (1.6)	613 (98.4)	1.864 (0.581-5.980)	0.288
No	(53.1) 245	216 (46.9)			4 (0.9)	457 (99.1)		
History of dental visit								
Yes	(54.0) 572	(46.0) 487	0.851 (0.421-1.720)	0.720	14 (1.3)	1046 (98.7)	-	0.513
No	16 (50.0)	16 (50.0)			0 (0)	32 (100.0)		
Use of condoms								
Yes	122 (42.8)	63 (57.2)	1.827 (1.391-2.401)	<0.001	7 (2.5)	278 (97.5)	2.874 (0.999-8.267)	0.041
No	465 (57.8)	340 (42.2)			7 (0.9)	799 (99.1)		
Alcohol consumption								
Yes	23 (63.9)	13 (36.1)	0.651 (0.326-1.298)	0.238	14 (1.3)	1041 (98.7)	-	0.487
No	564 (53.5)	(46.5) 490			0 (0)	36 (100.0)		
Smoking								
Yes	(61.8) 63	39 (38.2)	0.699 (0.460-1.062)	0.096	2 (2.0)	100 (98.0)	1.628 (0.359-7.379)	0.523
No	524 (53.0)	464 (47.0)			12 (1.2)	977 (98.8)		
Infection of family with hepatitis B								
Yes	7 (50.0)	7 (50.0)	1.169 (0.407-3.357)	0.771	2 (1.1)	12 (85.7)	14.792 (2.982-73.368)	<0.001
No	580 (53.9)	496 (46.1)			12 (14.3)	1065 (98.99)		

CI=confidence interval, RR=relative risk

In the present study, there were two HTLV-positive women (0.2%). The women were 23 and 43 years old, respectively, with a history of dental treatment, history of surgery, and did not use a male condom. In the study by Kalavi *et al.*,[13] 0.29% of participants in Golestan were HTLV antibody positive. Khorasan was identified as an endemic region with the highest HTLV prevalence rate (2.6%) in the study by Rafatpanah *et al*.[14] in 2011. Carles *et al*.,[32] in 2004, reported the HTLV prevalence to be 4.4%, 2.1%, 5.5%, and 6.3% in the French Guiana, east of Africa, Noir Marron, and Haitians, respectively. In Guerra *et al.*'s[21] study, two of 324 pregnant adolescents had HTLV infection and they were 15 and 16 years of age, respectively. In Opaleye *et al.*'s[3] study, the highest prevalence of HTLV infections was found among pregnant women within the age group of 25–29 years. As reported in some studies, the HTLV prevalence increases with age (over 35 years old).[14,32]

The increasing trend of positive HTLV antibodies with age is due to the cumulative effects of different contacts throughout life, HTLV transmission from man to woman, and sexual activity increases with age.

In this study, the two HTLV-positive women were housewives with an educational degree below a bachelor's degree.

Dourado *et al.*[33] reported the effect of education and low income on the HTLV prevalence in women in Salvador, Brazil. The low incidence of HTLV infection in those with higher academic degrees is due to their knowledge of health issues. Improvement in socioeconomic status causes increased treatments and health-care facilities.[34]

In this study, a prevalence rate of 0.09% was obtained for anti-HCV antibodies, a pregnant woman with positive HCV-Ab was 37 years old with a history of dental treatment, was in her first trimester, and did not use a male condom. In another cohort study a prevalence rate of anti-HCV antibody was reported between 0.1 to 3.6%,[19,35] but Opaleye *et al*.[3] reported a higher prevalence rate of 2.7%, which may be due to other changes or differences in lifestyles that could not be investigated in that study. In the study by Farshadpour *et al*.,[12] 1.33% were positive for anti-HCV antibody in pregnant women on the northern shores of the Persian Gulf, south of Iran. The main risk factors contributing to HCV infection include a history of injectable drug use and blood product transfusion.[35]

Limitations of the study are that it did not investigate the partner's risk factors or virus carrier state and did not include known cases. Also, HIV and HTLV were not confirmed by molecular biology methods since they are expensive, and we just aimed to report the serology evaluation of pregnant women.

Limitations of the study are that it did not investigate the partner's risk factors or virus carrier state and did not include known cases. Also, HIV and HTLV were not confirmed by molecular biology methods since they are expensive, and we just aimed to report the serology evaluation of pregnant women.

Conclusion

In conclusion, the seroprevalence of these viral infections in pregnant women showed that family history of the disease, maternal age, stage of pregnancy, not using a male condom, and education lower than bachelor's degree were the risk factors contributing to STIs in pregnant women in Sari.

Ethics statement

This study involving human participants was reviewed and approved by the ethics committee of Mazandaran University of Medical Sciences with the code IR.MAZUMS.REC.1397.1609. The patients/participants provided their written informed consent to participate in this study. No potentially identifiable human images or data is presented in this study.

Acknowledgements

The authors would like to thank the Pediatric Infectious Diseases Research Center lab at Bou-Ali Sina hospital in Sari for collecting samples and performing laboratory tests and for their cooperation in the use of equipment and materials in their laboratory.

Declaration of patient consent

The authors certify that they have obtained all appropriate patient consent forms. In the form, the patient(s) has/have given his/her/their consent for his/her/their images and other clinical information to be reported in the journal. The patients understand that their names and initials will not be published and due efforts will be made to conceal their identity, but anonymity cannot be guaranteed.

Financial support and sponsorship

Nil.

Conflicts of interest

There are no conflicts of interest.

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