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Risk Factors for Hepatitis B and C Infection in 10 to 40 Year Olds in Mongolia

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Objective: To determine the prevalence of hepatitis B and C infection and its risk factors in Mongolians from 10 to 40 years of age. **Method:** Randomly selected Mongolians underwent phlebotomy and completed a questionnaire about their medical and family history and risk factors. Participants were screened for qHBsAg, anti-HBs, HBeAg, anti-HBe, anti-HBc markers, and Anti-HCV. **Results:** 6811 people, 2900 (42.7%) males, and 3911 (57.3%) females participated. Most were from Ulaanbaatar (4685, 69%), with the remaining 2126 (31%) from rural areas. Seven percent were HbsAg positive, 4.2% were HCV positive. Of those10-20 years of age, 5.8% (29) had hepatitis B, 6% (17) had hepatitis C. Of those 21 to 40 years of age, 94.2% (469) had hepatitis B, and 94%(268) had hepatitis C. Children whose mother was HBsAg positive were at higher risk of HBsAg positivity (OR 2.152; 95% CI 1.4; 3.2, $p < .0001$) as well as those with male gender (OR 1.703; 95% CI 1.17;2.46, $p < .005$), those phlebotomized for lab tests (OR 1.768; 95% CI 1.14; 2.74, $p = .011$) ,and those immunized against hepatitis B (OR 0.508; 95% CI 0.35; 0.74, $p < .0001$). HCV infection was associated with history of dental procedures (OR 1.681; 95% CI 1.01; 2.79, $p = .045$), using glass syringes (OR 2.131; 95% CI 1.54; 2.95, $p < .0001$), and previously used needles (OR 2.411; 95% CI 1.09;5.29, $p = .028$). **Conclusions:** Among the Mongolian population between 10 and 40 years of age, 7.3% were HbsAg positive, 4.2% were Anti-HCV positive. The risk factors were maternal HbsAg positivity, utilization of glass syringes, reusing needles, phlebotomy for laboratory tests, receiving dental treatment, and the absence of hepatitis B immunization.

Keywords: Hepatitis, Risk Factors, Mongolia, Young Adult, Immunization

Introduction

Hepatitis B virus (HBV) and Hepatitis C virus (HCV) infections can lead to serious health complications such as liver cirrhosis, hepatic cancer, and other liver chronic diseases [1]. Approximately 25%–50% of children infected between the ages of 1 and 5 years with HBV become chronically infected, while only 5% of adults who become infected develop chronic infections [2]. However, between 75–85% of people infected with HCV develop chronic infection [3]. According to the World

Health Organization, there are 257,700 and 71,000 chronic carriers of hepatitis, respectively HBV and HCV, all of whom are at high risk of having complications, most commonly primary hepatic cancer [1-4]. There are 600,000 deaths due to acute or chronic HBV and 350,000 deaths due to HCV worldwide [1-4]. Mongolia is considered to be one of the countries with a high prevalence of HBV and HCV.

The detection of HBV infection involves the measurement of several HBV virus-specific antigens and antibodies. Different serologic tests or combinations of tests are used to identify different phases of HBV infection, including whether a person has acute or chronic HBV infection, is immune to HBV because of prior infection or vaccination, or is susceptible to infection. HBV surface antigen (HBsAg) is a protein on the surface of the HBV. It can be detected in high levels in serum during acute or chronic HBV infection. The presence of HBsAg indicates that the person has an ongoing infection. The body normally produces antibodies to HBsAg as part of the normal immune response to infection. The presence of this HBV surface antibody (anti-HBs) generally indicates recovery and immunity from HBV infection. Anti-HBs also develops in a person who has been successfully vaccinated against HBV. The HBV core antibody (anti-HBc) appears at the onset of acute HBV infection and persists for life [5]. The detection of HCV infection involves the measurement of anti-HCV antibodies, which are present in the ongoing or previous infection. If the anti-HCV test is reactive, an RNA blood test is needed to determine if a person is currently infected with HCV [6]. In Mongolia, the chronic health complications due to hepatitis, such as liver cirrhosis and hepatic cancer, have a high mortality rate. So it is one of the leading public health problems [4,7].

According to a study in 2017, it was found that there is 1.0 in 10000 people had HBV, and 0.3 had HCV in Mongolia [4,7]. Many researchers have found that there are many risk factors in transmission of HBV, HCV, such as blood transfusion, usage of drugs, work-related risks (health workers, hairdresser, etc.), a family member who has been infected with HBV or HCV, a partner with HBV or HCV, doing surgery on a patient with HBV or HCV, having dental procedures, being immune deficient, getting a dialysis and getting a tattoo [8-17]. Researchers in Mongolia define the risk factors of transmission of HBV and HCV among teenagers. These are having dental therapy, staying in hospitals as an inpatient, getting surgery, giving a blood test, getting an injection, sharing usage of toothbrush, and living with someone with HBV or HCV [18].

Previous research in Mongolia has identified that the main risk factors of transmission of HBV and HCV among teenagers were having dental procedures, staying in hospitals as an inpatient, getting surgery, giving a blood test, getting an injection, sharing a toothbrush, and living with someone with HBV or HCV [18,19]. While there are several studies on prevalence and risk factors of HBV and HCV in Mongolia, they rarely assess young adults. National programs for screening and diagnosis in Mongolia have mainly been implemented for people over 40 years of age. People under 40 years of age are often neglected, so it is necessary to estimate HBV and C virus risk factors of transmission among the Mongolian population, between ages 10 and 40. So our study aims to assess the prevalence of HBV and HCV and the risk factors for their transmission among the Mongolian population between 10 to 40 years of age.

Materials and Methods

Study Design and Sampling

This was a population-based cross-sectional study that included 6811 Mongolians between 10 and 40 years of age. Participants were selected randomly from 4 districts of Ulaanbaatar, 26 sums, 8 provinces, and 4 regions of Mongolia.

Questionnaire

We used the questionnaire survey to determine the study participant's general information, medical history, vaccination, HBV and HCV transmission risk factors, family history, and their medical history as well. Written informed consent was obtained before participating in the study.

Laboratory Tests and Interpretation

All participants underwent phlebotomy, and their blood serum was screened for qHBsAg, anti-HBs, HBeAg, anti-HBe, anti-HBc markers for HBV, and Anti-HCV marker for HCV using a fully automatic analyzer (HISCL-5000 Sysmex Corporation, Japan), which had a sensitivity of 98%. For purposes of this research using binary logistic regression, a participant was considered HBV positive when they had not been immunized, and either their HBsAg or anti-HBc serology was positive. A participant was considered to be HBV negative when both their HBsAg

and anti-HBc titers were negative. A participant was considered to be HCV positive when their Anti-HCV titer was positive and negative when their Anti-HCV serology was negative.

Statistical Analysis

Statistical analysis was done using the IBM SPSS Statistics 25.0 package. Quantitative variables were assessed normality using the Shapiro-Wilk Test. Categorical variables, such as demographic variables and risk factors associated with hepatitis infection, were expressed as proportions, were compared using the chi-square test. Multiple logistic regression was used to calculate the adjusted odds ratio (aOR). An OR>1 was considered as a risk factor for infection, while OR<1 was protective. The regression dependent variable was a binary outcome (with or without HBV virus infection and with or without HCV virus infection). Some main independent predictor variables were whether the mother had an ongoing HBV infection, whether the patient had been immunized against HBV, had a history of dental procedures, had received immunizations using glass syringes and reused needles, and whether the patient had had surgery. A test was considered as statistically significant when its two-tailed p-value was <.05.

Ethical Statement

Our research protocol was submitted to the Ethical Review Committee of Mongolian National University of Medical Sciences, and approval was obtained (protocol number 16/3/2016-16). Written informed consent was obtained from all study participants before blood sampling.

Results

Demographic Prevalence

Table 1 contains the prevalence of HBV and HCV infection stratified by demographic factors for our 6811 study participants. Regarding participants who were both HBV and HCV positive, there was a much higher prevalence in those in the group 21 – 40 years of age ($X^2(N = 6001,1) = 10.03$, $p = .002$). Similarly, regarding participants who were only HBV positive, there was a slightly higher prevalence of infection in males ($X^2(N = 6452,1) = 35.46$, $p < .0001$) and a much higher prevalence in those in older age group ($X^2(N = 6452,1) = 185.76$, $p < .0001$). In those participants who were only HBV positive, there was a much higher prevalence in the older age group ($X^2(N = 6252,1) = 105.97$, $p < .0001$). The location of their residence did not influence the proportion of those infected with either virus.

Active Hepatitis B Infection

Seven percent of the participants were HbsAg positive, indicating active HBV infection during which they can transmit the disease. Of those who were HBsAg positive, 66.5% (331) lived in Ulaanbaatar, 11.2% (56) in provinces, 22.3% (111) lived in Soums. Of these, 5.8% (29) were 10-20 years old, and 94.2%

Table 1. Prevalence of Hepatitis B and C infections stratified by demographic factors.

		Total	[a]Hepatitis B Positive	p-value	[b]Hepatitis C Positive	p-value	[c]Both Hepatitis B & C Positive	[d]p-value
			n (%)		n (%)		n (%)	
Gender				.0001		.469		.983
	Male	2873	277 (55.6)		124 (43.5)		394 (51.4)	
	Female	3877	221 (44.4)		161 (56.5)		372 (48.6)	
Age groups				.0001		.0001		.002
	10-20	2270	29 (5.8)		17 (6.0)		46 (6.0)	
	21-40	4480	469 (94.2)		268 (94.0)		720 (94.0)	
Residence				.145		.039		.451
	Province	839	56 (11.2)		48 (16.8)		103 (13.4)	
	Soum	1293	111 (22.3)		54 (18.9)		160 (20.9)	
	Urban	4618	331 (66.5)		183 (64.2)		503 (65.7)	

[a]Participants with current or previous Hepatitis B infection, [b]Participants with current or previous Hepatitis C infection, [c]Participants with current, or previous combined Hepatitis B and C infection. [d]Calculated with the chi-square test.

(469) were 21-40 years old.

Table 2 describes contains the prevalence of infection based on factors from the participant's medical histories. Regarding participants who were both HBV and HCV positive, those with a history of blood transfusion (X^2(N = 5824,1) = 6.69, p = .010)), and had a mother who was actively infected with HBV (X^2(N= 3875,1) = 4.6, p= .032)) were associated with higher prevalence, while those with a history of tattoo significant (X^2(N = 5862,1) = 3.7, p = .054)) and a history of dental procedures (X^2(N = 5806,1) = 3.47, p = .062)) were nearly statistically significant. Regarding those who were only HBV positive, receiving injections from a glass syringe (X^2(N = 4394,1) = 25.33, p = .0001)), frequent blood tests (X^2(N = 6282,1) = 28.31, p = .0001)), and having a mother who were currently infected with HBV (X^2(N = 4137,1) = 18.03, p = .0001)) were associated with a higher prevalence of infection. However, there were far more factors associated with a higher prevalence with being HCV positive, suggesting it was more transmissible through common health related procedures. Regarding those who were only HCV positive, a history of dental procedures (X^2(N=6049,1) = 14.85, p = .0001)), receiving injections from a glass syringe (X^2(N = 4235,1) = 63.17, p = .0001)), surgery (X^2(N = 6068,1) = 16.92, p = .0001)), transfusion (X^2(N = 6067,1) = 18.46, p = .0001)), tattoo (X^2(N = 6109,1) = 16.39, p = .0001)), frequent blood tests (X^2(N = 6084,1) = 12.47, p = .0001)), bloodletting treatment (X^2(N = 4946,1) = 12.35, p = .0001)), and acupuncture (X^2(N = 6067,1) = 18.09, p = .0001)) were associated with a high prevalence of infection. Interestingly, receiving frequent injections, sharing toothpaste, sharing razors, and not being immunized against HBV were not associated with a higher prevalence of being HBV or HCV positive with the numbers available in our study.

Table 3 shows multiple logistic regression results for risk factors associated with HBV and HCV infections. Regarding the risks of HBV infection, participants whose mother was actively infected with HBV, as evidenced by positive serology, had the highest odds of being infected themselves (OR 2.152; 95% CI 1.4; 3.2, p < .0001). Males had a higher risk of HBV infection than females (OR 1.703; 95% CI 1.17; 2.46, p = .005), and those having frequent blood tests were likely than those who did not (OR 1.768; 95% CI 1.14; 2.74, p = .011). Those reporting an immunization against HBV reduced their infection risk by 50% (OR 0.508; 95% CI 0.35; 0.74, p< .0001). Regarding the risks of HCV infection, those who reporting injections using glass syringes were at highest risk of infection (OR 2.131; 95% CI 1.54; 2.95, p< .0001) followed by those who received injections with previously used needles (OR 2.411; 95% CI 1.09; 5.29, p = .028), and those who had dental procedures (OR 1.681; 95% CI 1.01; 2.79, p = .045). With the numbers available in our study, history of previous surgery, transfusions, tattoos, piercings, bloodletting, injections, and sharing toothbrushes were not associated with an increased risk of HBV or HCV infection.

Discussion

This is study is a nationwide survey to assess HBV and HCV infection and its associated risk factors. A sample of 6811 participants is of adequate size to make inferences regarding the target population of the Mongolians between 10 and 40 years of age. We used state of the art technology in our study. The HISCL 5000 is a fully automatic chemiluminescence emitting analyzer, which can detect the smallest amount of HBV, HCV in a blood sample.

Previous studies found that 9.6% of the Mongolian were HBV positive, including 5.2-9.8% children, 8.2% of blood donors, and 49.5-56.3% who were chronically ill. Between 11-16% were HCV antibody positive [13-21]. Compared to these studies, ours had found similar results with7.3% being HbsAg positive, 4.2%Anti-HCV positive. Baatarkhuu O, et al. [18] found that the prevalence of anti-HCV in Ulaanbaatar was 13.7%, and HBV positivity was 9.3%, prevalence of anti-HCV was 9.0%, and HBV 8.0% in apparently healthy populations in Ulaanbaatar. In Ulaanbaatar, the prevalence of HBV positivity was 32.7%, HCV 6.4%, and HBV/HDV coinfection 1.8% of the patients were diagnosed with this. Two previous studies had a higher prevalence than in our study [22-26]. We found that participants whose mothers were HBsAg positive had the highest risk of infection (OR 2.152; 95% CI 1.4; 3.2, p< .0001), followed by those of male gender (OR 1.703; 95% CI 1.17; 2.46, p = .005), and those who had laboratory tests (OR 1.768; 95% CI 1.14; 2.74, p = .011). A history of immunization against HBV was strongly protective (p≤ .0001). Baha, et al. [26] study on blood donors showed that having dental procedures (OR= 3.8, p < .01), using glass syringes (OR= 2.1, p < .01), having surgery (OR= 1.4, p < .01) increased risk of infection while transfusion history (OR =1.1, p = .40), piercing and tattoos (OR= 1.1, p= .50), getting acupuncture (OR=3.1, p= 0.30) did not. These

Table 2. Prevalence of Hepatitis B and C infections stratified by factors from the participant's medical history.

	[a]Hepatitis B & C Negative	[b]Hepatitis B Positive	p-value	[c]Hepatitis C Positive	p-value	[d]Both Hepatitis B & C Positive	p-value
Dental history			0.554		0.0001		0.062
Yes	4702 (81.2%)	377 (82.3%)		234 (90.7%)		15 (100.0%)	
No	1089 (18.8%)	81 (17.7%)		24 (9.3%)		0 (0.0%)	
Used glass syringe			0.0001		0.0001		0.929
Yes	885 (22.0%)	127 (33.4%)		100 (45.2%)		3 (23.1%)	
No	3129 (78.0%)	253 (66.6%)		121 (54.8%)		10 (76.9%)	
Surgery			0.832		0.0001		0.168
Yes	1638 (28.2%)	131 (28.7%)		104 (40.0%)		7 (43.8%)	
No	4170 (71.8%)	326 (71.3%)		156 (60.0%)		9 (56.3%)	
Transfusion history			0.222		0.0001		0.010
Yes	280 (4.8%)	28 (6.1%)		28 (10.8%)		3 (18.8%)	
No	5528 (95.2%)	431 (93.9%)		231 (89.2%)		13 (81.3%)	
Tattoo			0.803		0.0001		0.054
Yes	1365 (23.3%)	110 (23.9%)		90 (34.2%)		7 (43.8%)	
No	4481 (76.7%)	351 (76.1%)		173 (65.8%)		9 (56.3%)	
Frequent blood tests			0.0001		0.0001		0.406
Yes	4188 (71.9%)	382 (83.4%)		213 (81.9%)		13 (81.3%)	
No	1636 (28.1%)	76 (16.6%)		47 (18.1%)		3 (18.8%)	
Bloodletting treatment			0.936		0.0001		0.315
Yes	279 (5.9%)	27 (6.0%)		29 (11.4%)		0 (0.0%)	
No	4413 (94.1%)	420 (94.0%)		225 (88.6%)		16 (100.0%)	
Injection			0.245		0.810		0.916
Yes	4260 (74.5%)	345 (77.0%)		194 (75.2%)		11 (73.3%)	
No	1456 (25.5%)	103 (23.0%)		64 (24.8%)		4 (26.7%)	
Acupuncture			0.366		0.0001		0.147
Yes	715 (12.3%)	63 (13.8%)		55 (21.3%)		0 (0.0%)	
No	5094 (87.7%)	395 (86.2%)		203 (78.7%)		15 (100.0%)	
Shared toothpaste			0.314		0.562		0.534
Yes	484 (8.2%)	44 (9.6%)		24 (9.2%)		2 (12.5%)	
No	5405 (91.8%)	416 (90.4%)		236 (90.8%)		14 (87.5%)	
Shared razor			0.095		0.322		0.311
Yes	619 (10.9%)	60 (13.4%)		32 (12.9%)		3 (18.8%)	
No	5086 (89.1%)	387 (86.6%)		217 (87.1%)		13 (81.3%)	
Anti-HBs positive mother			0.0001		0.406		0.032
Yes	286 (7.4%)	40 (14.5%)		15 (9.1%)		3 (23.1%)	
No	3576 (92.6%)	235 (85.5%)		149 (90.9%)		10 (76.9%)	
Hepatitis B immunization			0.246		0.740		0.129
Yes	5017 (98.4%)	357 (97.5%)		218 (98.6%)		14 (93.3%)	
No	84 (1.6%)	9 (2.5%)		3 (1.4%)		1 (6.7%)	

[a]Participants without current or previous Hepatitis B or C infection, [b]Participants with current or previous Hepatitis B infection, [c]Participants with current or previous Hepatitis C infection, [d]Participants with current or previous combined Hepatitis B and C infection. [d]Calculated with the chi-square test.

Table 3. Multiple logistic regressions of risk factors associated with Hepatitis B and C virus infections

Variables	Hepatitis B Positive[a]			Hepatitis C Positive[b]		
	[c]OR	[d]95% C.I.	p-value	OR	95% C.I.	p-value
Mother has HBV						
No	1					
Yes	2.152	(1.434-3.230)	.0001			
Hepatitis B Immunization						
No	1					
Yes	0.508	(0.347-0.742)	.0001			
Dental history						
No	1			1		
Yes	1.141	(0.750-1.734)	.538	1.681	(1.011-2.793)	.045
Glass syringe						
No	1			1		
Yes	1.370	(0.991-1.894)	.057	2.131	(1.540-2.948)	.0001
Surgery						
No	1			1		
Yes	0.997	(0.724-1.373)	.984	1.272	(0.919-1.7630	.147
Transfusion history						
No	1			1		
Yes	1.024	(0.558-1.882)	.938	1.608	(0.966-2.6770	.068
Gender						
No	1			1		
Yes	1.703	(1.176-2.464)	.005	0.914	(0.617-1.354)	.654
Tattoo						
No	1			1		
Yes	1.181	(0.844-1.653)	.331	1.132	(0.799-1.604)	.486
Frequent blood tests						
No	1			1		
Yes	1.768	(1.140-2.741)	.011	0.866	(0.576-1.302)	.489
Piercing						
No	1			1		
Yes	0.796	(0.554-1.146)	.220	0.767	(0.524-1.125)	.175
Bloodletting treatment						
No	1			1		
Yes	0.688	(0.360-1.315)	.257	1.598	(0.962-2.655)	.07
Injection						
No	1			1		
Yes	0.961	(0.665-1.389)	.834	0.765	(0.524-1.118)	.166
Previously-used needle						

	No	1			1		
	Yes	1.094	(0.365-3.281)	.872	2.411	(1.098-5.292)	.028
Shared toothbrush							
	No	1			1		
	Yes	1.012	(0.604-1.694)	.965	1.072	(0.656-1.751)	.781

[a]Participants with current or previous Hepatitis B infection, [b]Participants with current or previous Hepatitis C infection. Abbreviations: [c]OR- Odds Ratio, [d]95% C.I. - 95% Confidence Interval

results are similar to ours. Our results were also dissimilar with the studies conducted among 1050 Pakistanis, who found that having any family member suffering from HBV or C dramatically increased the risk of infection (OR =15.6, p = .001), as well as using glass syringes (OR =8.6, p = .001) [26-28]. While our study is valid statistically, it does have some limitations. We conducted this study using a large sample size on a national scale, including both rural and urban areas. Cross-sectional data collection might impede the ability to assess the directional nature of the relationship between HBV and C viruses and risk factors. Due to the nature of the cross-sectional study design, we are impossible to infer strong causal inferences between potential risk factors associated with hepatitis virus infection groups. We could not entirely exclude the possibility of information bias, given that this study was partially based on information obtained through a questionnaire. A cohort study should be performed in future studies. Additionally, children under ten and over forty were not included in our study. Therefore, expanded research is needed.

Conclusion

Among the Mongolian population aged between 10 to 40 years old, 7.3% were HbsAg positive, 4.2% were Anti-HCV positive. The potential risk factors were, having a mother with active HBV infection, a history of injection using glass syringes, having dental procedures and, receiving injections with previously-used needles.

Conflict of Interest

The authors declare that they have no competing interests.

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