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Ethnicity, socioeconomic status, transfusions and risk of hepatitis B and hepatitis C infection

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Abstract This study identifies the risk factors for hepatitis B virus (HBV) and hepatitis C virus (HCV) and measures the prevalence of hepatitis B surface antigen (HBsAg) and antibody to hepatitis C (anti-HCV) in the general population of Jakarta. A population-based sample of 985 people aged 15 and above was surveyed. Risk factors were identified through questionnaires and home visits. Serum was analysed for HBsAg, antibody to hepatitis B surface antigen (anti-HBs), anti-HCV, aspartate aminotransferase (AST) and alanine aminotransferase (ALT). The seroprevalence was: 4.0% (39/985) for HBsAg, 17.2% (170/985) for anti-HBs, and 3.9% (38/985) for anti-HCV. The risk factors for hepatitis B and hepatitis C infection had little in common. Low socioeconomic status was a strong risk factor for HBsAg (adjusted odds ratio (OR) 18.09; 95% confidence interval (CI) 2.35–139.50). In addition, the Chinese group has 2.97 higher risk of having HBV infection compared with the Malayan ethnic group (adjusted OR 2.97; 95% CI 1.22–7.83). There was moderate positive trend between family size and risk of HBsAg positivity ($P = 0.130$). Age over 50 (adjusted OR 14.72; 95% CI 4.35–49.89) and history of transfusion were significant risk factors for hepatitis C (adjusted OR 3.03; 95% CI 1.25–7.33). Hepatitis B and hepatitis C infections have different risk factors in Jakarta, a high risk in population for both diseases. Hepatitis B transmission is associated with low socioeconomic status, Chinese ethnic group and large family size, while hepatitis C is associated with an older age and a history of transfusions.

Key words: ethnicity, hepatitis B, hepatitis C, socioeconomic risk, transfusion.

INTRODUCTION

The development of a sensitive serological test for hepatitis C virus infection (HCV) has shown that this virus is the primary aetiological agent of parenterally transmitted non-A, non-B hepatitis (NANB hepatitis) and an important cause of acute and chronic hepatitis worldwide. Risk factors and routes of transmission for this disease are known to include transfusions with blood and its products. The role of intimate contact remains to be elucidated.[1] Most previous studies of the epidemiology of antibody to hepatitis C (anti-HCV) and hepatitis B virus (HBV) markers have focused on special groups such as blood donors, haemophilia patients and hospital-based patients, who are at risk as a result of percutaneous exposures to blood products. Although most studies of hepatitis C have focused on transfusion recipients, the majority of HCV infections are currently outside the transfusion setting.[1,2]

Previous studies of high-risk groups in South-East Asia suggest that the risk factors for hepatitis C and hepatitis B in this part of the world may differ from those in Europe and the United States.[3–6,9] Epidemiological studies among blood donor populations and hospital-based patients do not really represent the general population.[10] This study presents some risk factors for HCV and HBV infection in the general population and defines the roles of socioeconomic status, ethnic group,

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and family size as risk factors for HBV infection; and age and transfusion as risk factors for HCV infection.

METHODS

This study was conducted from January to June 1994 in an urban subdistrict of Central Jakarta, Indonesia and consisted of 34 666 people in 7017 households. We randomly selected 340 households and all the household members aged 15 and above were asked to participate. A total of 1150 subjects from these households were eligible to participate in the study. Specially trained nurse-midwives visited the houses of eligible subjects to evaluate their socioeconomic condition and to invite the subjects to visit a local, participating hospital for this study. The nurse-midwives then conducted structured interviews with the subjects at the participating hospital regarding demographic characteristics and risk factors for HBV and HCV infection. Blood samples for the examination of hepatitis B surface antigen (HBsAg), antibody to hepatitis B surface antigen (anti-HBs), anti-HCV, aspartate aminotransferase (AST), and alanine aminotransferase (ALT) were taken.

Self-reported factors under study included gender, age (15–29, 30–49, 50 and above), education level (high, study at college/university or a higher level; middle, study at junior or senior high school; low, illiterate, capable of reading only, or study not beyond primary school), current alcohol use (yes/no), current cigarette smoking (yes/no), participation in regular sport (yes/no), history of surgical operations (yes/no), history of transfusion (yes/no), history of jaundice (yes/no), family history of jaundice (yes/no), and history of hepatitis B vaccination (yes/no). Socioeconomic status (high/middle/low) was determined by the evaluation of the nurse-midwife, based on the housing condition, ownership of transportation, ownership of housing appliances, and the availability of electricity.

Laboratory factors under study included HBsAg, anti-HBs, anti-HCV, AST and ALT levels. Aspartate aminotransferase and ALT laboratory tests were carried out with an automated photometric analyser (model 737, Hitach-Boehringer Mannheim, Hitachi, Tokyo, Japan). Normal AST level was considered to be less than 38 IU/dL for males and less than 32 IU/dL for females; normal ALT level was considered to be less than 42 IU/dL for males and less than 32 IU/dL for females.

Tests for HBsAg and anti-HBs were done using reverse passive haemagglutination (RPHA) and passive haemagglutination (PHA) consecutively. Anti-HCV testing was done using a dipstick test developed at Laboratoria Hepatika Mataram, Lombok, Indonesia. This test uses HCV core-derived synthetic peptides CP9 (amino acid [aa] 39–74) and CP14 (aa 5–40) as solid antigens which are recognized by anti-core antibodies. It has been shown to have equal sensitivity to commonly used second-generation enzyme-linked immunosorbent assay (anti-HCV Elisa II; Ortho Diagnostics Systems, Tokyo, Japan).[7] All sera were collected and kept at −20°C prior to the assessment.

Logistic regression analysis[8] was used to control the confounding effects of other characteristics and exposures on the relation to HBsAg and anti-HCV. A variable was considered to be a confounder if its inclusion in a model changed the odds ratio by more than 10%. Characteristics that fulfilled this definition as confounders are included in the models presented. Odds ratios were estimated by the method of maximum likelihood, and their 95% confidence intervals (CI) were based on the standard error of coefficient estimates.

The Ethics Committee of the Department of Internal Medicine, School of Medicine, University of Indonesia approved this study. Informed consent was obtained from participants in this study.

RESULTS

Of the 1150 invited subjects, 1020 respondents (89%) participated in this study. Of these we excluded 35/1020 subjects (3.4%) due to incomplete and/or conflicting data, leaving a total of 985 subjects.

The excluded 35 subjects consisted of 17 male and 18 female. By socioeconomic status the excluded subjects were as follows: seven belonged to high-level socioeconomic status, 12 middle-level socioeconomic status and 16 low-level socioeconomic status; by age group there were 14 persons aged 15–29 years old, 12 persons aged 30–49 years old, and nine persons aged 50 years and over. The 130 non-respondents consisted of 56 males and 74 females; 26 of high-level socioeconomic status, 46 of middle-level socioeconomic status, and 58 of low-level socioeconomic status. By age group there were 55 persons aged 15–29 years old, 43 persons aged 30–49 years old and 32 persons aged 50 years and over. In terms of gender, socioeconomic status, and age group, the excluded subjects and non-respondents were not significantly different compared with the 985 subjects which were included in this analysis.

We assumed there were not acute hepatitis cases found in our study because the maximum range of AST and ALT among our subjects was less than 2.5 times the normal limits. The range of AST in our study was 11–92 U/L, while ALT ranged from 9 to 87 U/L.

Hepatitis B

Thirty-nine subjects tested positive for HBsAg and 946 tested negative, giving an overall prevalence of 4.0%. The positive HBsAg were more likely to be found among the younger age groups (Table 1).

In addition, we noted 39 HBsAg positive cases were found in 21 households. Among the 21 positive HBsAg households, 15 had only one case for each household, and two or more cases among six households. The positive HBsAg was more prevalent among households of five people and more.

Positive HBsAg status was less likely to occur among people of high socioeconomic status compared with low and middle socioeconomic status; and it was more likely among the Chinese ethnic group.

Positive and negative HBsAg status were similarly distributed with respect to gender, education, current

Table 1 Characteristics of subjects

	Hepatitis B surface antigen status				Anti-hepatitis C virus status			
	Positive ($n = 39$)		Negative ($n = 946$)		Positive ($n = 38$)		Negative ($n = 947$)	
	n	%	*n*	%	*n*	%	*n*	%
Gender								
Male	22	56.4	434	45.9	19	50.0	437	46.1
Female	17	43.6	512	54.1	19	50.0	510	53.9
Age group								
15–29 years	20	51.3	389	41.1	3	7.9	406	42.9
30–49 years	13	33.3	328	34.7	8	21.1	333	35.2
50 years and over	6	15.4	229	24.2	27	71.1	208	22.0
Education								
High	5	12.8	200	21.1	11	28.9	194	20.5
Middle	23	59.0	523	55.3	16	42.1	530	56.0
Low	11	28.2	223	23.6	11	28.9	233	23.5
Socioeconomic status								
High	1	2.6	237	25.1	12	31.6	226	23.9
Middle	17	43.6	306	32.3	13	34.2	310	32.7
Low	21	53.8	403	42.6	13	34.2	411	43.4
Ethnic group								
Malayan	33	84.6	870	92.0	37	97.4	866	91.4
Chinese	6	15.4	76	8.0	1	2.6	81	8.6
Family size								
1–2 persons	11	28.2	278	29.4	13	34.2	276	29.1
3–4 persons	10	25.6	375	39.6	14	35.8	371	39.2
5 persons and over	18	46.2	293	31.0	11	28.9	300	31.7
Cigarette smoking								
No	27	69.2	711	75.2	25	65.8	713	75.3
Yes	12	30.8	235	24.8	13	34.2	234	24.7
Alcohol use								
No	36	92.3	897	94.8	36	94.7	897	94.7
Yes	3	7.7	49	5.2	2	5.3	50	5.3
Play sport								
No	16	41.0	411	43.4	18	47.4	409	46.2
Yes	23	59.0	535	56.6	20	52.6	538	56.8

cigarette smoking, current alcohol use and participation in regular sport.

Our data showed that there were no medical risk factors (such as ever having jaundice, history of transfusion, history of operation, family history of jaundice, hepatitis B vaccination, anti-HBs, and abnormality of ALT/AST level) associated with HBsAg (Table 2).

Anti HBs were found in 170 out of 985 subjects (17.2%). There was no significant association between anti-HBs and anti-HCV (OR 1.09; 95% CI 0.47–2.51).

A suitable model to assess the probability of having HBsAg consisted of the variables: socioeconomic status, ethnic group, and family size. The relationship among these risk factors is shown in Table 3.

Compared with high socioeconomic status, middle and low socioeconomic status (SES) were strongly associated with HBsAg (adjusted OR 14.72; 95% CI 1.79–112.20 for middle SES and adjusted OR 18.09; 95% CI 2.35–139.50 for low SES).

The Chinese subgroup had almost a three-times higher risk of having HBsAg relative to the Malayan subgroup (adjusted OR 2.97; 95% CI 1.12–7.83).

The trend of being HBsAg positive was moderately associated with the number of persons in a household (test for trend $P < 0.130$). A person who lived in a household with five or more persons had 1.8 times the risk of being HBsAg positive (adjusted OR 1.84; 95% CI 0.82–4.12).

Hepatitis C

Thirty-eight subjects tested positive for anti-HCV and 947 were negative, giving an overall prevalence of 3.9% (Table 1). The 38 positive anti-HCV cases were found in 38 households (i.e. only one case per household).

Socioeconomic status, family size and ethnic group were not associated with the risk of having anti-HCV. Positive and negative anti-HCV status were similarly distributed with respect to gender, education, current cigarette smoking, current alcohol use and participation in regular sport (Table 1).

Other medical risk factors (such as ever having jaundice, history of operation, family history of jaundice,

Table 2 Medical risk factors related to hepatitis B surface antigen (HBsAg) and antibody to hepatitis C virus (anti-HCV)

	HBsAg status			Anti-HCV status		
	Positive ($n=39$)	Negative ($n=946$)	OR (95% CI)	Positive ($n=38$)	Negative ($n=947$)	OR (95% CI)
Ever had jaundice						
No	35	875	1.00 (reference)	36	874	1.00 (reference)
Yes	4	63	1.59 (0.46–4.87)	2	65	0.75 (0.12–3.28)
Unknown	0	8	N/A	0	8	N/A
Transfusion history						
No	36	880	1.00 (reference)	30	886	1.00 (reference)
Yes	3	66	1.11 (0.27–3.59	8	61	3.87 (1.56–9.31)
History of operation						
No	33	769	1.00 (reference)	29	773	1.00 (reference)
Yes	6	177	0.79 (0.29–2.01)	9	174	1.38 (0.59–3.11)
History of family jaundice						
No	34	771	1.00 (reference)	29	776	1.00 (reference)
Yes	2	117	0.39 (0.09–1.63)	5	114	1.17 (0.45–3.09)
Unknown	3	58	1.17 (0.35–3.93)	4	57	1.88 (0.64–5.53)
Hepatitis B vaccination						
No	39	878	1.00 (reference)	35	882	1.00 (reference)
Yes	0	68	N/A	3	65	1.16 (0.35–3.88)
Anti-hepatitis B surface antigen						
Negative	39	776	1.00 (reference)	31	784	1.00 (reference)
Positive	0	170	N/A	7	163	1.09 (0.47–2.51)
AST						
Normal	33	794	1.00 (reference)	30	797	1.00 (reference)
Abnormal	6	152	0.95 (0.39–2.30)	8	150	1.42 (0.59–3.31)
ALT						
Normal	38	913	1.00 (reference)	36	915	1.00 (reference)
Abnormal	1	33	0.77 (0.34–1.25)	2	32	1.59 (0.37–6.89)

N/A, not available; AST, aspartate aminotransferase; ALT, alanine aminotransferase.

and abnormality of ALT/AST level) were not associated with anti-HCV (Table 2).

Age was identified as a strong risk factor for anti-HCV. Age over 50 years was strongly associated with anti-HCV compared with the 15–29 year age group (adjusted OR 14.72; 95% CI 4.35–49.89).

Our data showed that the history of transfusion was strongly associated with anti-HCV (adjusted OR = 2.95; 95% CI 1.25–7.33; Table 4).

DISCUSSION

There are several limitations that must be considered in the interpretation of our findings. We do not have data on tattooing, intravenous drug use, or sexual transmission. In spite of these limitations, the value of our observations derives largely from the use of a general population sample to estimate the prevalence of and some risk factors for HBsAg and anti-HCV in Indonesia.

Our findings in this population-based study are different from the results of surveys performed previously on blood donors. For example, a study on blood donors, patients with acute and chronic hepatitis, liver cirrhosis, hepatocellular carcinoma, and chronic haemodialysis that was performed in Jakarta in 1991, reported the prevalence of HBsAg and anti-HBs among blood donors to be 5.5 and 32.9%, respectively.[3] A survey of a large number of blood donors also found the prevalence of HBsAg among blood donors to be 5.5%.[4] These estimates of the prevalence of HBsAg were higher compared with our data. In the other islands of Indonesia such as Sumatra, Sulawesi and the islands of eastern Indonesia, the prevalence of HBsAg among blood donors was reported to be higher than our findings: 7.0, 12.5 and 26%, respectively.[4]

These differences illustrate the problems of comparing general population-based studies with those derived from selected groups of blood donors and patients. Our findings of lower prevalences of HBsAg and anti-HBs are very likely to be due to our testing a general population sample, whereas other studies have tested subjects known to be at increased risk of having HBV infection.

Another population-based study in North Jakarta, where most of the respondents came from low socioeconomic status and a younger population, found the prevalence of HBsAg and anti-HBs to be 3.7 and 25.6%, respectively.[14] The exposure rates of HBV infection in that study (HBsAg and anti-HBs) were rather higher than in our study. This may be due to different demographic factors; for example, in the present study low socioeconomic status is a strong risk factor for HBsAg.

Table 3 Relationship of socioeconomic status, ethnic group and family size to hepatitis B surface antigen (HBsAg)

	HBsAg status		
	Positive ($n = 39$)	Negative ($n = 946$)	OR* (95% CI)
Socioeconomic status			
High	1	237	1.00 (reference)
Middle	17	306	14.72 (1.79–112.20)
Low	21	403	18.09 (2.35–139.50)
Ethnic group			
Malay	33	870	1.00 (reference)
Chinese	6	76	2.97 (1.12–7.83)
Family size			
1–2 persons	11	278	1.00 (reference)
3–4 persons	10	375	0.69 (0.28–1.66)
5 persons and over	18	293	1.84 (0.82–4.12)

*Odds ratio for socioeconomic status adjusted for ethnic group and family size. Odds ratio for ethnic group adjusted for socioeconomic status and family size. Odds ratio for family size adjusted for ethnic group and socioeconomic status.

Table 4 Relationship of age group and history of transfusion to antibody to hepatitis C virus (anti-HCV)

	Anti-HCV status		
	Positive ($n = 38$)	Negative ($n = 947$)	OR* (95% CI)
Age group			
15–29 years	3	406	1.00 (reference)
30–49 years	8	333	2.59 (0.65–10.31)
50+ years	27	208	14.72 (4.35–49.89)
Transfusion history			
No	30	886	1.00 (reference)
Yes	8	61	3.03 (1.25–7.33)

*Odds ratio for age group adjusted for transfusion history. Odds ratio for transfusion history adjusted for age group.

Our data revealed that there is a moderate positive trend (adjusted test for trend: $P = 0.130$) between family size and risk of HBsAg positivity. The test for trend was adjusted for socioeconomic and ethnic status. This finding was similar to those of other studies.[13,16]

The Chinese population in our present study appeared more susceptible to acquiring the HBsAg carrier state. This finding is also noted in other studies indicating that ethnicity might play a role in the difference of the HBsAg prevalence and could be due to differences in immunological responses.[15,17]

We studied other risk factors that have been reported to be associated with HBsAg but none of these risk factors showed statistically significant associations with this viral infection. In contrast, history of surgery was reported as a risk factor for being HBsAg positive.[4,9] This difference was most likely due to the small number of subjects in our study who were HBsAg positive and have ever had an operation ($n = 6$ subjects).

A previous study in Indonesia found the prevalence of anti-HCV to be 2.5% among blood donors, using a first generation test (Ortho-HCV ELISA; Ortho Diagnostics, Tokyo, Japan).[3] This number was in contrast with our finding of a prevalence of 3.9% for anti-HCV (using a second generation test). Our finding of a higher prevalence of anti-HCV may reflect our use of a newer, more sensitive test rather than any true difference in risk of HCV or differences of respondents that we used. Another extensive study using a second generation immunosorbent assay on blood donors throughout Indonesia found the prevalence of anti-HCV among blood donors was 2.1% nationwide and 2.5% in Jakarta. After adjustment for age, their estimates of anti-HCV prevalence were virtually identical to ours. In other islands of Indonesia such as Sumatra, Sulawesi and the islands of eastern Indonesia, the prevalence of anti-HCV among blood donors were lower than our findings, 1.7, 1.8 and 1.0%, respectively.[4] The seroprevalence in these two studies rises with age,[3,4] similar to our findings. Studies in Japan and Taiwan also indicate that the seroprevalence of anti-HCV in blood donors and healthy individuals rises with age at a rate of 0.3–1% with each decade.[5,13]

The occurrence of several risk factors for HCV infection vary in different geographical areas.[1,6] In Western countries and Australia, anti-HCV are associated with tattooing, intravenous drug abuse, sexual contact, and history of blood transfusion.[1,17] One study in Taiwan among healthy young men who did not engage in intravenous drug use or multiple sexual activity, revealed that anti-HCV was associated with tattooing, while in another Taiwanese study among prostitutes anti-HCV did not associate with tattooing.[18,19] The significant risk factors for anti-HCV among prostitutes were apparently related to a history of paid sex longer than six months and blood transfusion.[19] An extensive survey of 7572 healthy volunteer blood donors in Indonesia identified age, blood transfusions and a history of surgery to be associated with anti-HCV, but it was not found to be associated with tattooing and acupuncture.[4] No intravenous drug use found.

A population-based study conducted in Jakarta in other urban areas found the prevalence of anti-HCV to be 4.4%.[14] Anti-HCV was associated with age, skin disease, sharing toothbrush and utensils but was not associated with history of transfusion, tattooing, surgery, and intravenous drug abuse. In this study only one case of intravenous drug abuse found.[14] The other study in Jakarta also reported no association between anti-HCV cases and intravenous drug abuse.[12]

Our results indicate that increased age and history of transfusion, but not socioeconomic status, are strong risk factors for anti-HCV. We also observed other risk factors that might be related to anti-HCV such as history of surgery, alcohol use, and cigarette smoking, but none of these showed statistically significant associations with this viral infection. Our data showed

the familial clustering was not a risk factor for anti-HCV (adjusted OR 0.35; 95% CI 0.04–2.67). Furthermore, we found only one member who had anti-HCV positivity for each household where there was infection. This finding showed that HCV infection in intrafamilial clusters in households is low compared with HBV infection.

We also noted that the Chinese population was not more susceptible to developing anti-HCV (Table 1). This finding was similar to another report in Indonesia.[14]

Our data revealed that strong risk factors for HBsAg differed with anti-HCV. Our findings showed the risk factors for HBsAg to be socioeconomic status, ethnicity, and family size, while the risk factors for anti-HCV were age group, and a history of transfusion. We found that poverty does not facilitate transmission of HCV, whereas it does facilitate HBV transmission.

Only 2/985 (0.2%) subjects were positive for both HBsAg and anti-HCV, indicating that concurrent infection with both agents is rare. This finding is in close agreement with another study that found 0.18% of subjects in Indonesia screened were positive for markers of both HBV and HCV.[4] Only 7/985 (0.7%) of our subjects were positive for both anti-HBs and anti-HCV and, of the 170 subjects who were positive for anti-HBs, seven (4.1%) were positive for anti-HCV. This means the prevalence of anti-HCV in our study is not higher among subjects who had a recent or past infection with hepatitis B virus.

In conclusion, hepatitis B and hepatitis C infections have different risk factors in Jakarta. Hepatitis B transmission is associated with low socioeconomic status and Chinese ethnic group, and there is a moderate positive trend that a large family size has more risk of developing hepatitis B. Hepatitis C is associated with older age and blood transfusions.

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