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RESEARCH ARTICLE

Prevalence of Hepatitis B in Healthy Population in Kupang City, East Nusa Tenggara, Indonesia

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Abstract

Hepatitis B virus (HBV) infection has remained a global health problem. Around 2 billion people worldwide are infected, and more than 257 million are categorized as chronic patients with a risk of developing progressive liver diseases, such as cirrhosis, liver failure, and hepatocellular carcinoma. In 2013, East Nusa Tenggara province had the most hepatitis B cases in Indonesia. Several factors cause a lack of information on HBV prevalence in the general population. First, they are inadequate disease surveillance systems with a high possibility of some acute and chronic infections being unreported. Second, geographical barriers to achieving suitable and sufficient data collection, considering the total population of 250 million people distributed in more than 17,000 islands. Third, the limited testing facilities for detecting chronic HBV resulted in many people being undiagnosed. This study was conducted to discover the prevalence of hepatitis B in healthy populations. It was a cross-sectional study with a random sampling method from April 2016 to March 2020 in Kupang city, East Nusa Tenggara. Subjects are prison inmates, pregnant women, primary school students, high school students, health workers, orphanage children, and families who live under the same roof with hepatitis B patients. We screened 11,152 subjects for HBsAg positivity using the ELISA and rapid detection tests. We found that 1,490 subjects (13.4%) were reactive to HBsAg. This HBsAg-positive prevalence stood far above the national rate of 7.1% in 2013, meaning that Kupang city is a region with high hepatitis B endemicity. Therefore, the local government should develop prevention strategies, diagnosis, post-infection management, and effective treatment, including mass vaccination programs for at-risk groups.

Keywords: Healthy population, hepatitis B, prevalence

Introduction

Hepatitis B virus (HBV) infection remains one of the most critical health issues in the world, with approximately 257 million people worldwide having been chronically infected.[1,2] Chronic HBV infection can develop into severe liver complications like liver cirrhosis and hepatocellular carcinoma, causing around 887,000 deaths annually.[3,4] In high HBV endemic areas, hepatitis B is transmitted from mother to child at birth or through horizontal transmission via exposure to infected blood.[5,6] Around 90% of less-than-a-year-old children who are infected will develop chronic HBV infections, while in people who are infected as adults, only 5% will develop chronic infections.[5] HBV diagnosis is based on detecting the hepatitis B surface antigen (HBsAg), with chronic HBV infection characterized as HBsAg persistence in the blood for more than six months.[5]

Indonesia, with a population of more than 250 million people, had an HBsAg prevalence of 9.4% in 2007,[7] which dropped to 7.1% in 2013, suggesting a shift from a high HBV endemic country to moderate endemicity.[3,7,8] As with other countries in Southeast Asia, Indonesia experiences a double burden of HBV transmission, perinatal and horizontal transmissions.[9,10] Efforts to prevent and control HBV transmission in Indonesia have been taken, although some challenges remain. The infant hepatitis B vaccination program has been implemented since 1997 and has reduced cases of HBV infection, yet HBsAg was still detected in 5% of children under the age of 5 years old.[1] It may be caused by the uneven coverage of birth-dose vaccination, commonly lower in several provinces with low socioeconomic levels.[11]

Further, high HBsAg prevalence in pregnant

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women may contribute to significant HBV transmission to children in the perinatal period.[1] As such, the government implemented a triple elimination program for HIV, syphilis, and HBV infections in 2015 through mandatory screening for those three infections in pregnant women. Similar to the vaccination coverage, the coverage of hepatitis B early detection in pregnant women is still uneven, with several provinces' coverage lower than the nation's average of 69.95%.[11]

East Nusa Tenggara (Nusa Tenggara Timur, NTT) was one of the island provinces in the eastern part of Indonesia. NTT has a high level of HBV infection, especially in the East Sumba and West Sumba regions, where most HBV cases in 2013 were found.[12] In 2017, HBV and hepatitis C virus (HCV) prevalence among blood donors in NTT were 3.5% and 0.5%, respectively.[11,13] NTT reported the national highest HBsAg prevalence of 5.53% in pregnant women (national average of 1.8%), based on the hepatitis B early detection screening in 2018.[11] It indicated a high rate of mother-to-child HBV transmission in NTT, which may be exacerbated by the still low coverage of infant vaccination of 51.72% (national average of 90.61%).[11] HBV horizontal transmissions also occurred in NTT. A 2016 study on 89 people with household contacts with 11 hepatitis B cases in Kupang, NTT, showed that 18/89 (20.2%) were positive for HBsAg.[14] A similar study in Alak subdistrict, Kupang, in 2019 showed five out of 33 (15.2%) household contacts of 12 hepatitis B index patients were found positive for HBsAg.[15] A recent study reported a high prevalence of HBsAg (13.2%), antibody to HBsAg (anti-HBs), and antibody to hepatitis B core antigen (anti-HBc), 13.2%, 39.8%, and 28.7%, respectively, in a population of 341 high school students from Kupang (age 13–22).[16] A similar study in six orphanages in Kupang reported 15 HBsAg-positive children out of 310 subjects.[6]

Considering the high HBV transmissions in NTT, HBV prevalence data on healthy populations and high-risk populations in NTT are required to identify the proportion of HBV carriers in the people that can potentially transmit HBV infections to others. This data can also be used as baseline data to improve hepatitis B prevention, management, and treatment programs in NTT. To date, there is no public hepatitis B screening program available. Therefore, this study aimed to determine the HBsAg prevalence in healthy-looking and high-risk populations in Kupang, NTT.

Methods

A cross-sectional study with a random sampling method was conducted from April 2016 to March 2020 in Kupang, East Nusa Tenggara. A total of 11,152 subjects were recruited, consisting of seven subject groups: (1) 328 elementary school students: mean age 8.3±1.95 years (5–12 years), 152 males; (2) 346 high school students: mean age 18.4±1.65 years (15–21 years), 123 males; (3) 321 prison inmates: mean age 32.9±4.4 years (19–45 years), 151 males; (4) 325 healthcare workers, mean age 32.5±1.6 years (20–57 years), 177 males; (5) 359 orphanage residents: mean age 14.5±6.8 years (6–27 years), 189 males; (6) 531 household contacts with 66 index cases with hepatitis B: mean age 39.5±7.8 years (5–64 years), 236 males; and (7) 8,942 pregnant women: mean age 33.5±2.3 years (19–46 years). All subjects were healthy individuals with no liver disease-related clinical symptoms. HBV vaccination history for each subject is not available.

Approximately five mL of venous blood samples were collected from April 2016 to March 2020 from the six subject groups. They are (1) elementary schools: SD Inpress RSS Oesapa, SD GMIT No. 7 Oebufu, SDN 3 Oeba, SDN Inpres 2 Oeba, SDN 1 Liliba, SD Noelbaki, and SDN Naikoten 2; (2) high schools: SMAN 1, SMAN 2, SMAN 3, SMAN 4, and SMAN 9; (3) prisons: Lapas Kelas IIA Kupang, Lapas Kelas III Wanita Kupang, Rutan Kelas IIB Kupang, Lapas Kelas IIA Anak Kupang; (4) healthcare facilities: RSUD Prof. Dr. W.Z. Johannes Kupang, RSUD S.K. Lerik Kupang, RSD Naibonat, Puskesmas Pasir Panjang, Puskesmas Alak, Puskesmas Manutapen, Puskesmas Sikumana, Puskesmas Oebobo, Puskesmas Kota Atambua, Puskesmas Camplong, Puskesmas Tarus, Puskesmas Bakunase, Puskesmas Tarus, dan Puskesmas Kupang Kota; (5) orphanages: Panti Asuhan At-Tiin, Panti Asuhan Asyiyah, Panti Asuhan Nurusaadah, Panti Asuhan Sonaf Maneka, Panti Asuhan Kasih Agape, dan Panti Asuhan Syalom; and (6) 85 households. All samples were taken to the Laboratory of Immunology and Serology, Health Analyst Study Program, Poltekkes Kemenkes Kupang, and stored in a −20°C freezer until use. In addition, HBsAg data from the pregnant women group were taken from the hepatitis B screening results in 2017–2019 conducted at several public health centers (*puskesmas*) and hospitals in Kupang, NTT, including Puskesmas Pasir Panjang, Puskesmas

Oebobo, Puskesmas Manutapen, Puskesmas Alak, RSUD Prof. Dr. W.Z. Johannes Kupang, RSUD S.K. Lerik Kupang, and RSUD Naibonat. HBsAg tests were performed using Hepanostika HBsAg Ultra (Batch B1V10P01; Biomerieux, Paris, France) immunoassay kit according to the manufacturer's instructions. HBsAg screening on pregnant women at *puskesmas* and hospitals was conducted using (Mono Test®, Raseny Safety®, Nova Test®, and Egens®) HBsAg rapid diagnostic test.

Statistical analyses were performed using Statistical Package for Social Sciences v.26 (SPSS Inc., Chicago, IL, USA). To assess the relationship between variables using the chi-square test. Odd ratio (OR) value to determine the size of risk factors with disease incidence; calculated from the incidence of disease in the risk group compared to the incidence of illness in the non-risk group. The contingency coefficient (Cc) shows the correlation percentage between independent and dependent variables. The Cc value is used when statistical results do not find an OR value.

The nature of the study was explained to all the participants and all of them signed the informed consent form by the principles of the Revised Declaration of Helsinki. The protocol of the study was approved by the Health Research Ethics Committee of the Peltekkes Kemenkes Kupang, NTT (Approval No. LB.02.03/1/0045/2019).

Results

From a total of 11,152 subjects, 1,490 subjects (13.4%) were detected with positive HBsAg, comprising 18.9% (62/328) elementary school students, 19% (66/346) high school students, 16.5% (53/321) prison inmates, 16.9% (55/325) healthcare workers, 20.8% (75/359) orphanage residents, 14.7% (78/531) household contacts, and 12.3% (1,101/8,942) pregnant women. HBsAg-positive prevalence was higher in the younger population group (<19 years old) of orphanage residents (20.8%), high school students (19%), and elementary school students (18.9%), compared to the older subjects' groups. HBsAg-positive subjects in the school students (both elementary and high) and inmates' groups were primarily male, while the other three groups were mainly female. HBsAg positivity in the older subjects' groups (>19 years old) was detected in all levels of education, regardless of gender. The high-risk populations: prison inmates, household contacts of hepatitis B patients, and healthcare workers all have a higher HBsAg prevalence than 13.4%. A higher percentage of positive HBsAg in the healthcare workers group was found in midwives (5.5%) and nurses (4.3%). Older pregnant women (>29 years old) have a higher percentage of HBsAg positivity (>30%).Detailed demographic characteristics of the subjects are described in Table 1.

The association between the characteristics of subjects and HBsAg positivity was described in Table 2. Males were associated with positive HBsAg status in elementary school students (p=0.000, OR=2.978 [1.658–5.350]), high school students (p=0.003, OR=2.280 [1.323–3.930]), and healthcare workers (p=0.008, OR=0.451 [0.249–0.818]) groups. Male students had a 2.978 and 2.280 times higher risk of being infected with HBV than females in elementary and high school, respectively. Male orphanage residents, prison inmates, and household contacts were 0.645, 1.206, and 0.960 times likelier to be infected with HBV than females. In contrast, male healthcare workers had a 0.451 lower risk for HBV infection than females.

Association between age and HBsAg positive status was found in elementary school students (p=0.000, OR=0.227 [0.122–0.422]), prison inmates (p=0.000), orphanage residents (p=0.009), and household contacts (p=0.001) groups. Stratified by age, elementary school students aged 0–9 years old had 0.227 times lower risk of HBV infection, while the 10–19 years old high school students had 1.060 higher risk for HBV infection. Orphanage residents aged 10–19 also had a 9.395 times higher risk of being infected with HBV than those aged 0–9 and 20–29 years old. The correlation between age and HBV infection in inmates was 42%, suggesting a 42% higher possibility of HBsAg negativity as they grew older. In household contacts and healthcare workers' groups, the correlation between age and HBV infection was 17% and 26%, respectively. Finally, the correlation between age and HBV infection in pregnant women was 70%, indicating a 70% chance of avoiding HBV infection as they grew older.

Educational levels were associated with HBsAg-positive in orphanage residents (p=0.021), prison inmates (p=0.000, OR=3.692 [1.975–6.901]), healthcare workers (p=0.002), household contacts (p=0.000) and pregnant

Table 1 Demographic Characteristics of Study Subjects

Subject Groups Characteristics	Total n	HBsAg	
		Positive n (%)	Negative n (%)
Elementary school students			
Gender			
Male	152	42 (12.8)	110 (33.5)
Female	176	20 (6.1)	156 (53.7)
Age (years)			
0–9	225	20 (6.1)	205 (62.5)
10–19	103	31 (9.5)	72 (22.0)
Total	328	62 (18.9)	266 (81.1)
High school students			
Gender			
Male	123	34 (9.8)	89 (25.7)
Female	223	32 (9.2)	191 (55.2)
Age (years)			
10–19	246	49 (74.2)	197 (70.4)
20–29	100	19 (28.8)	81 (28.9)
Total	346	66 (19.1)	280 (80.9)
Prison inmates			
Gender			
Male	151	27 (8.4)	124 (38.6)
Female	170	26 (8.1)	144 (44.9)
Age (years)			
10–19	51	3 (5.7)	48 (17.9)
20–29	90	10 (18.9)	80 (29.9)
30–39	152	20 (37.7)	132 (49.3)
40–49	28	20 (37.7)	8 (3.0)
Education level			
Elementary school	121	21 (6.5)	100 (31.2)
Junior high school	97	22 (6.9)	75 (23.4)
High school	82	10 (3.1)	72 (22.4)
University	21	0 (0)	21 (6.5)
Total	321	53 (16.5)	268 (83.5)
Healthcare workers			
Gender			
Male	177	21 (6.5)	156 (48.0)
Female	148	34 (10.5)	114 (35.1)
Occupation			
Midwife	153	18 (5.5)	135 (41.5)
Doctor	20	2 (0.6)	18 (5.5)
Pharmacist	43	9 (2.8)	34 (10.5)
Nurse	53	14 (4.3)	39 (12.0)
Lab technician	56	12 (3.7)	44 (13.5)
Age (years)			
10–19	10	0 (0)	10 (3.1)
20–29	46	8 (2.5)	38 (11.7)
30–39	146	26 (8.0)	120 (36.9)
40–49	123	21 (6.5)	102 (31.4)
Education level			
High school	67	23 (7.0)	44 (13.5)
University	258	32 (9.0)	226 (69.5)
Total	325	55 (16.5)	270 (83.1)
Orphanage residents			
Gender			
Male	189	33 (9.2)	156 (43.5)
Female	170	42 (11.7)	128 (35.7)
Age (years)			
0–9	78	10 (13.3	68 (18.9)
10–19	192	37 (49.3)	155 (43.2)
20–29	89	28 (37.3)	61 (17.0)
Education level			
Elementary school	136	21 (5.8)	115 (32.0)
Junior high school	105	23 (6.4)	82 (22.8)
High school	95	21 (5.8)	74 (20.6)
University	23	10 (2.8)	13 (3.6)
Total	359	75 (20.9)	284 (79.1)
Household contacts			
Gender			
Male	236	34 (6.4)	202 (38.0)
Female	295	44(8.3)	251 (47.3)
Age (years)			
0–9	24	1 (0.2)	23 (4.3)
10–19	76	11 (2.1)	65 (12.2)
20–29	131	6 (1.1)	125 (23.5)
30–39	146	32 (6.0)	114 (21.5)
40–49	150	27 (5.1)	123 (23.2)
50–59	4	1 (0.2)	3 (0.6)
Education level			
Elementary school	98	23 (4.4)	75 (14.2)
Junior high school	148	21 (4.0)	127 (24.1)
High school	138	21 (4.0)	117 (22.2)
University	147	10 (1.9)	137 (25.8)
Total	531	78 (14.7)	453 (85.3)
Pregnant women			
Age (years)			
10–19	1,021	148 (13.4)	873 (11.1)
20–29	1,721	164 (14.9)	1,557 (19.9)
30–39	3,214	390 (35.4)	2,,824 (36.0)
40–49	2,986	399 (36.2)	2587 (33.0)
Education level			
Elementary school	2,632	326 (3.6)	2,306 (25.8)
Junior high school	2,321	245 (2.7)	2,076 (23.2)
High school	2,507	289 (3.2)	2,218 (24.8)
University	1,482	241 (2.7)	1,241 (13.9)
Total	8,942	1101 (12.3)	7,841 (87.7)
Total	**11,152**	**1,490 (13.4)**	**9,662 (86.6)**

women (p=0.000) groups. Orphanage residents with higher educational levels had a 9.694 times lower risk of being infected with HBV than those with lower academic levels. Inmates with a high school educational level showed a 3.692 times higher risk for HBV infection. The correlation between educational levels and HBV infection in household contacts and healthcare

Table 2 Association between Subject Characteristics and Positive HBsAg

Subject Groups	Characteristics	p	OR (Cc)
Elementary school students	Gender	0.000*	2.978 (1.658–5.350)
	Age	0.000*	0.227 (0.122–0.422)
High school students	Gender	0.003*	2.280 (1.323–3.930)
	Age	0.845	1.060 (0.588–1.912)
Prison inmates	Gender	0.533	1.206 (0.669–2.175)
	Age	0.000*	Cc=42%
	Education level	0.000*	3.692 (1.975–6.901)
Health workers	Gender	0.008*	0.451 (0.249–0.818)
	Occupation	0.082	Cc=15%
	Age	0.000*	Cc=26%
	Education level	0.002*	Cc=70%
Orphanage residents	Gender	0.092	0.645 (0.386–1.076)
	Age	0.009*	Cc=16%
	Education level	0.021*	Cc=16%
Household contacts	Gender	0.869	0.960 (0.592–1.558)
	Age	0.001*	Cc=17%
	Education level	0.000*	Cc=15%
Pregnant women	Age	0.000*	Cc=2%
	Education level	0.000*	Cc=5%

Note: *p<0.05 significant

workers' groups was 66.6% and 70%, suggesting percentages of people with lower HBV risks due to their higher educational levels. The correlation between the academic level and HBsAg positivity in pregnant women was 5%, indicating a 5% chance of higher educational levels in reducing HBV infection in pregnant women.

Discussion

Robust epidemiological data on HBV infection is needed to develop effective and efficient strategies for hepatitis B prevention and management. There was a lack of HBV prevalence in the general population of Indonesia due to inadequate surveillance systems, geographical barriers, and limited testing facilities for HBV detection.[13] Therefore, many people in Indonesia are unaware of their HBV infection status. Thus, there is a need for HBV screening in the general population and in high-risk populations such as dialysis patients, people in prisons, people who inject drugs, people with multiple sex partners, household contacts of hepatitis B patients, and healthcare workers.[5] HBsAg prevalence in high-risk populations is higher than in the general healthy populations. For example, HBsAg prevalence in young adults in Indonesia was 15.7% (mostly male).[3] In South Korea, HBsAg positivity was highest in men and women in their 40s and 50s (5.7% and 4.7%, respectively).[10] In Burkina Faso, HBsAg positivity in pregnant women (11.11%), blood donors (11.73%), and HIV-positive people (12.61%) were higher than in the general populations (9.41%).[17] Positive HBsAg was found in 9.2% of pregnant women in Gambia,[18] while 1.04% of blood donors in Burundi were reportedly HBsAg positive.[19] In Europe, the highest HBsAg prevalence was found in people in prisons (0.3–25.2%), drug users (0.5–6.1%), and men who had sex with men (0–1.4%).[20] In the USA, 11% of mentally disordered people were infected with HBV,[21] and 20.2% of male prisoners were HBsAg-positive.[22] Meanwhile, 8% of prison inmates in the UK have positive anti-HBc antibodies.[23]

HBV prevalence data is required, both at the country and sub-national levels, to estimate the hepatitis B disease burden and to direct the appropriate health policies and prevention programs (vaccination) regarding hepatitis B.[24] NTT is one of the HBV-endemic provinces in Indonesia.[12] The risks for HBV transmission in NTT are high, either vertically or horizontally, with low coverage of hepatitis B universal vaccination and pregnant women screening compared to the nation's average.[11,12] There are no data on HBV

prevalence in general populations and high-risk populations in NTT. However, the prevalence of HBsAg positivity in a specific population may indicate the level of HBV endemicity in that region.[1] This study was conducted from 2016 to 2020 to determine HBsAg prevalence in the general healthy-looking populations, including several high-risk people in Kupang, NTT.

This study revealed HBsAg positivity in 1,490 subjects (13.4%) from a total of 11,152 healthy-looking subjects in Kupang, NTT. This HBsAg prevalence was significantly higher than the national average of 7.1%, confirming NTT as HBV endemic province in Indonesia. High-risk populations, such as prison inmates, household contacts of hepatitis B patients, and healthcare workers, all have higher HBsAg prevalence than the general populations. Higher percentages of HBsAg positivity in the younger population (<19 years old) might indicate the increased risks of horizontal HBV transmission among peer groups in Kupang. In addition, high HBsAg-positive prevalence in pregnant women groups in Kupang indicates the high incidence of mother-to-child transmission in Kupang. According to the subject groups, the orphanage residents have the highest HBsAg prevalence of 20.9% compared to the other subject groups.

HBsAg positivity in this study was found proportionally similar between gender in the first six groups of elementary school and high school students, orphanage residents, prison inmates, healthcare workers, and household contacts (males: 49.1% vs females: 50.9%). Separated per subject group, males were significantly associated with HBsAg positivity ($p<0.01$) in elementary school students, high school students, and healthcare workers' groups. Males were also associated with a higher risk for HBV infection, except in the healthcare workers' groups. The association between the male gender and HBsAg positivity has been shown previously.[25] This association might reflect the HBV pathogenesis-related mechanisms involving the sex hormones or related to the different lifestyles between males and females, including smoking, drinking, personal hygiene, and sexual activity.[25]

This study's younger subjects (<19 years old) have an average higher HBsAg than the older subjects' groups. All the younger subjects in this study were born after implementing the mandatory national hepatitis B immunization program in 1997 and were expected to have lower HBsAg prevalence. This result may be caused by the possibility of hepatitis B vaccination failure and the high rate of vertical HBV transmission.[9,26] Hepatitis B vaccination in children resulted in immunity to HBV in the form of antibodies against HBsAg (anti-HBs),[1,26] and this protection against HBV infection may last lifelong. However, those who received incomplete vaccination doses may not produce protective anti-HBs levels,[5] and as reported, NTT has low coverage of hepatitis B universal vaccination.[12] Failure to pay protective anti-HBs levels may also be caused by the appearance of vaccine-escape mutants, where amino acid substitutions in HBsAg cause its escape from antibody detection and neutralization, leading to reinfection with HBV.[27] However, the cause of high HBsAg positivity in these subjects cannot be confirmed due to unavailable HBV vaccination records and no additional measurement of anti-HBs levels.[16]

The highest HBsAg-positive prevalence (20.8%) was found in orphanage residents, which their living situation may cause. Orphanage residents are not usually categorized as high-risk populations. Still, considering their similar living situation to prison inmates, they should also be regarded as high-risk populations for horizontal HBV transmission. The orphans mostly live in one large room, shared between an average of 10–20 people, allowing for frequent close contact between the residents.[6] They also commonly share personal hygiene products like toothbrushes, nail clippers, razors, towels, and soaps, increasing the possibility of HBV transmission among them.[6,28]

The HBsAg prevalence in the prison inmates group, as one of the high-risk groups for HBV transmission, was 16.5%, higher than the average HBsAg prevalence of 13.4% in the general population. The prevalence rate of chronic hepatitis B infection among prison inmates was generally higher (1.0–3.7%) in comparison with the general population. It is caused by their high-risk behaviors, including injection drug use and unsafe sex practice, and their living conditions, where they commonly share personal items.[22,23]

Household contact with hepatitis B patients was also considered a high-risk population as they frequently share household items like razors, plates, cutlery, glassware, face towels, and toothbrushes.[15,29] Previous studies in several Asian countries have shown that the potential of HBV transmission from hepatitis B patients to those living in the same household is high. Especially

for parents, siblings, or other household residents who were in close contact, share household items, have poor personal hygiene habits, and have previous blood transfusion history.[30,31] In this study, HBsAg positivity in household contacts was 14.7%, confirming previous studies' results of high HBsAg prevalence in household contacts in Kupang.[15]

The percentage of positive HBsAg in healthcare workers in Kupang was significantly high at 16.9%. As one of the high-risk population groups for HBV transmission, there is still no mandatory hepatitis B immunization program for healthcare workers in Indonesia. Direct contact with hepatitis B patients and patient samples of patients may increase healthcare workers' risks of contracting HBV(8). Accordingly, higher HBsAg-positive prevalence was observed in those with direct contact with patients and patients' samples, midwives (5.5%), nurses (4.3%), and laboratory assistants (3.7%) compared to pharmacists (2.8%). Female healthcare workers have higher HBsAg positivity than male healthcare workers (10.5% vs 6.5%), most likely because most midwives and nurses were females. These findings confirmed previous study results in healthcare workers in Makassar, South Sulawesi, where HBsAg prevalence was higher in midwives and laboratory staff.[8]

Vertical HBV transmission from mother to child is the primary source of HBV transmission in endemic areas1. HBsAg prevalence in pregnant women in this study was 12.3%, higher than previously reported in other regions in Indonesia.[32] It confirms the previous 2018 report of the national highest HBsAg prevalence in pregnant women in NTT.[11] Maternal age and educational level significantly affect HBsAg positivity, with higher percentages of HBsAg positivity in older pregnant women (>29 years old) and lower percentages of HBsAg positivity in those with higher educational levels. Association of HBV infection with the mother's age and academic levels have been reported previously. Younger women are more likely to have higher HBV DNA viral load, and positive hepatitis B e antigen (HBeAg) compare to older women.[32] Meanwhile, lower educational levels are associated with a higher risk of HBV infection and preterm labor.[33] Academic levels were also negatively associated with HBsAg positivity in other subject groups of orphanage residents, prison inmates, healthcare workers, and household contacts. Higher educational levels may reduce the risk of HBV infection. In addition, higher academic levels may cause behavioral changes that increase HBV testing, vaccination, and treatment rates.[34]

The high rates of HBV infection in the healthy population in Kupang, NTT, warrants improved HBV prevention and management programs to minimize future HBV-related disease burden in NTT. Hepatitis B vaccination is a proven method to stop both HBV vertical and horizontal transmission in the population. It is effective for hepatitis B prevention and HBV-related liver cirrhosis and hepatocellular carcinoma.[29–31] The hepatitis B vaccine may prevent perinatal HBV transmission in highly endemic countries if the initial dose is given immediately after delivery (>12 hours).[35] All infants, unvaccinated children, and young adults aged <19 years old living in HBV-endemic countries should also be vaccinated to reduce their risks of contracting HBV infection.[2,32,35] Additional hepatitis B vaccination programs for high-risk populations can be performed to prevent specific HBV pre-exposure and minimize horizontal HBV transmission in the population.[35] The populations were hemodialysis patients, injecting drug users, people having household contact with positive HBsAg patients, healthcare and public safety workers, people with HIV infection, and people who are imprisoned can be performed to prevent specific HBV pre-exposure and minimize horizontal HBV transmission in the population.[35]

Improving the low coverage of infant vaccination and hepatitis B early detection screening in pregnant women in NTT is crucial in managing HBV infection in the province. One of the essential things to do is to raise people's awareness and understanding of hepatitis B. Topics, especially its risks of transmission and ways of prevention, and available screening, care, and treatment options.[34,36] Hopefully, people will be more aware of doing HBV testing and actively seeking hepatitis B vaccination if they have high risks for HBV infection. Several comprehensive strategies to reduce the risk of HBV transmission in NTT are (1) mandatory HBsAg testing in pregnant women and prophylactic administration for babies born to HBsAg-positive mothers; (2) universal hepatitis B vaccination in newborns; (3) additional vaccination/booster for children and adolescents who were not previously vaccinated; (4) vaccination in adults with high risks of HBV infection, especially the healthcare workers and

hepatitis B patients' household contacts.[6-10,21–26,37]

Early hepatitis B screening in pregnant women should also be complemented by administering hepatitis B vaccination and antiviral therapy during pregnancy to reduce the risk of perinatal HBV transmission.[35–37] Regular hepatitis B screening in high-risk population groups will help identify those infected with the virus and minimize the risk of horizontal transmission by advocating for good personal hygiene habits and discouraging personal sharing items. Additionally, providing complete personal protective equipment for healthcare workers and frequent personnel rotation in public health facilities may help minimize the risk of horizontal HBV transmission.

Our study showed a high HBsAg-positive rate of 13.4% in the general healthy-looking population in Kupang, NTT. This study included many subjects, allowing for the determination of HBsAg prevalence in different subpopulations and the association between age, gender, and educational levels and HBV infection. The limitation of the study was only HBsAg was screened, and no other HBV markers were detected, which may limit HBV infection profile interpretation in the subjects. The high HBV prevalence in the general population calls for more effective HBV prevention and control programs in NTT. So far, the hepatitis B program is not the main priority of the local health officials, as NTT also has high rates of maternal and neonatal mortality,[15,38,39] child stunting,[40,41] malaria,[42,43] and tuberculosis[44] infections. Because hepatitis B is a chronic silent disease, HBV-related morbidity and mortality are likely underestimated.[36] They will only get higher if no effective HBV prevention and control steps are taken. Increasing public education and awareness of the risks of hepatitis B transmission should be done, as well as increasing universal infant vaccination coverage in NTT. Increasing access to HBV testing facilities might also encourage people to test for HBsAg and reduce the risks of HBV transmission in the population. An effective hepatitis B prevention and control program needs robust epidemiological data on HBV prevalence in the population. Thus, additional studies on the prevalence of HBsAg and other HBV markers in the people of the other regencies in NTT will provide complete HBV epidemiological data in the province. Further studies on anti-HBs protective levels and HBV DNA analysis in vaccinated adolescents and young adults will provide the molecular background on the high rate of HBsAg in these subpopulations.

Conclusions

A high prevalence of hepatitis B was found in healthy populations in Kupang, NTT based on HBsAg detection. Therefore, this HBV prevalence data can be used by the regional government of NTT as primary data for hepatitis B prevention and management programs to reduce HBV transmission and disease burden in the population.

Conflict of Interest

The authors declare no competing interests.

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