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Prevalence of hepatitis B virus infection and associated factors among adults intrafamilial household contacts attending antenatal care clinics in the Central Ethiopian region: from pregnant women index cases

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Abstract

Background In Ethiopia, hepatitis B virus infections are prevalent and highly endemic. Additionally, there has been a significant increase in hospital admissions, morbidity, and mortality associated with hepatitis B virus infections. This study aimed to assess the prevalence of hepatitis B virus infection and associated factors among adult intrafamilial household contacts of pregnant women index cases attending antenatal care clinics in the central Ethiopian region.

Methods A community-based cross-sectional study was conducted between October 1, 2023, and March 1, 2024. Three hundred eighty-five adult intrafamilial household contacts were randomly selected via lottery methods. A 3 ml venous blood sample was taken from adult intrafamilial household contacts and checked for hepatitis B virus infection through hepatitis B surface antigen. An interviewer-administered questionnaire was used to collect the data. A logistic regression model predicted the relationship between predictor and outcome variables. A p-value of <0.05 indicated statistical significance.

Results The overall response rate was 96.1%. Two-thirds of the adults of intrafamilial household contacts ($n=229$; 61.9%) were aged between 18 and 28 years, with a mean age of 28 years. The prevalence rate of hepatitis B virus infection among adults of intrafamilial household contacts with pregnant women as the index case was 11.6% (95% CI, 8.6 to 15.1). Being male (AOR: 0.09; 95% CI: 0.03, 0.37) and a duration of stay with the index case of less than six months (AOR: 0.30; 95% CI: 0.11, 0.81) were associated with a reduced risk of hepatitis B virus infection. Meanwhile, large family sizes (≥ 7) (AOR: 4.32; 95% CI: 1.34, 13.98), genital discharge (AOR: 3.14; 95% CI: 1.60, 6.15), engagement in unsafe sex (AOR: 2.37; 95% CI: 1.13, 4.97), and a history of mortality due to hepatitis in the family (AOR: 3.03; 95% CI: 1.09, 8.42) were associated with an increased risk of hepatitis B virus infection.

Conclusion This study found that hepatitis B surface antigen seropositivity among adult intrafamilial household contacts with pregnant women index cases in the central Ethiopia region was high at 11.6%. These findings suggest

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that interventions to prevent HBV infection should prioritize educational campaigns targeting adult intrafamilial household contacts of HBV-positive index cases, focusing on risk factors associated with HBV transmission, prevention, counselling, testing, and vaccination.

Keywords Intrafamilial, Hepatitis B Virus, Hepatitis B Surface Antigen, Adult, Ethiopia

Background

Hepatitis is a medical condition characterized by the infection of liver cells [1, 2]. Hepatitis B virus (HBV) infection is one of the most prevalent types and the second leading cause of cancer-related deaths globally [3]. HBV infection can present as either acute or chronic, depending on the duration of the presence of the hepatitis B surface antigen (HBsAg) for less than or more than six months [2, 4]. Acute hepatitis B frequently occurs as an asymptomatic infection, mainly when transmission occurs in childhood or perinatal [2]. The symptoms of acute HBV infection may vary depending on the severity of the infection and an individual's immune status [3]. Chronic HBV infection can progress to cirrhosis and liver cancer [2, 3, 5]. However, patients often remain unaware of their status as carriers of acute or chronic HBV infection, thus unknowingly transmitting it to others. Common symptoms include mild jaundice in the eyes and skin and fatigue [2].

Several potential factors have been identified as contributors to the transmission of infections among family members [6]. Risk factors associated with HBV infection transmission include sharing personal and household items such as toothbrushes, towels, handkerchiefs, clothing, razors, combs, beds, and bedding. Additional modes of transmission include sexual contact and mother-to-child transmission (MTCT) [7, 8]. Exposure to body fluids from infected individuals, such as semen, saliva, blood or blood products, female genital mucus, menstrual blood, and contact with mucous membranes and skin lesions are also factors to consider [2, 9, 10].

In regions with a high prevalence of HBV infection, the main transmission routes are MTCT and early perinatal transmission [8, 11]. The elevated incidence of intrafamilial transmission of HBV is attributed to the proximity and frequent contact among family members, intravenous drug abuse, and transmission through sexual contact between spouses [6].

The family members of individuals infected with HBV are considered to be at high risk due to the frequent transmission of HBV within households among contacts of HBsAg carriers [12]. Among family members, the prevalence of HBsAg positivity is four times greater than that in the general population, ranging from 11 to 57% [9]. Therefore, this situation is also a significant public health concern and substantially burdens healthcare systems [13].

In Ethiopia, HBV infections are widely prevalent and highly endemic [4, 14]. Moreover, there has been a significant increase in hospital admissions, morbidity, and mortality associated with HBV infection, which is a cause for concern [1]. A previous study conducted in Ethiopian hospitals revealed that HBV contributes to 12% of hospital admissions and 31% of fatalities [15]. Understanding how HBV is transmitted within families can provide valuable insights into overall transmission patterns and specific characteristics of intrafamilial spread. Contact tracing for HBV infection is essential for preventing the spread of HBV infection [16].

Hepatitis B is a disease that can be prevented through vaccination, making vaccination an indispensable preventive measure [1, 5, 17]. The Federal Ministry of Health (FMOH) has formulated and implemented various strategic plans to combat the prevalence of HBV infection in Ethiopia. These plans encompass routine screening for viral hepatitis in patients and targeted vaccination initiatives for high-risk groups, such as healthcare workers and people in close contact with the population [1, 18]. However, conducting a study to attain accurate data on the prevalence of HBV infection among family members in the Central Ethiopia Region (CER) is imperative. Hence, this study aims to assess the prevalence of HBV infection and the associated factors among adult intrafamilial households contact with pregnant women index cases attending antenatal care clinics in the central Ethiopian region in 2023.

Patients and materials

Study design, area, and period

A community-based cross-sectional study was conducted from October 1, 2023, to March 1, 2024, among adult intrafamilial household contacts in the central Ethiopian region. The central Ethiopian region is 232 km from Addis Ababa, Ethiopia's capital city. The estimated total population of the region was 6,430,235, comprising 3,186,824 (49.56%) men and 3,243,411 (50.44%) women. The central Ethiopian region is the most rural in Ethiopia, with a total rural population of 5,425,189 (84.4%) and an urban population of 1,005,046 (15.6%). The total estimated number of households was 1,312,411 (20.41%), with women of childbearing age accounting for 1,498,245 (23.3%) and pregnant women accounting for 222,486 (3.46%) in the selected study area. This region comprises seven zones and three special districts, with 1,656 public and private health facilities (2 comprehensive specialized

hospitals(Wachemo University Nigist Eleni Mohammed Memorial Comprehensive Specialized Hospital (WCUCSH) and Worabe University Comprehensive Specialized Hospital (WUCSH)), five general hospitals, 21 primary hospitals, 228 health centers, 1,067 health posts, and 333 private clinics) [19].

Sample size determination

Using the single population proportion formula [20], the sample size was determined with the following considerations: $P = 9\%$ [21] (where P represents the HBsAg incidence of HBV among adults in Southwest Ethiopia; $Z1\text{-}\alpha/2 = 1.96$ (where $Z1\text{-}\alpha/2$ refers to the critical value at a 95% confidence level); $d = 3\%$ (indicating the margin of error); and a 10% nonresponse rate. The intended sample size was $n = (1.96)^2\ 0.09(1\text{-}\ 0.09)/\ (0.03)^2 = 350$. Finally, by adding a 10% nonresponse rate during the study, the total sample size was 385 ($n = 350 + 10\%$ of 350, which was 35).

Sampling procedure

In the first phase, 195 pregnant women index cases who tested positive for HBV (HBsAg+) were retrospectively selected from five purposively chosen public hospitals in central Ethiopia, including two teaching hospitals (WCUCSH and WUCSH) and three general hospitals (Butajira, Durame, and Halaba Kulito). The cases were drawn from 29,400 pregnant women attending Antenatal Care (ANC) clinics before a six-month period of actual data collection between April 1 and September 30, 2023.

In the second phase, 385 adults intrafamilial household contacts were randomly selected from the HBV index cases using a lottery method. In households with multiple eligible adults, on average, two individuals were randomly chosen, and all selected contacts were traced and screened for HBV (HBsAg) until the 385-sample size was achieved.

Population

All adult intrafamilial household members aged 18 years and older living with pregnant women index cases in the central Ethiopian region were considered the source population. In contrast, the study population was randomly selected from all adult intrafamilial household members aged 18 years and older living with pregnant women index cases in the central Ethiopian region.

Inclusion and exclusion criteria

Individuals residing in the same household as the index cases, who had been in contact with them and were 18 years or older, were included. However, adults who were severely ill and unable to communicate, as well as those who were fully vaccinated against HBV infection or those adults with intrafamilial household contacts diagnosed with human immunodeficiency virus (HIV) infection and started antiretroviral therapy (ART) and who declined to provide consent, were excluded from the study.

Measurement of variables

The purpose of this study was to assess the prevalence of HBV infection and the associated factors among adult intrafamilial households in contact with pregnant women attending antenatal care clinics in the central Ethiopian region. The dependent variable in this study was HBV (HBsAg) (1: Yes, 0: No). The predictor variables were as follows: Basic sociodemographic characteristics include gender, age, residence, relationship with index cases, marital status, educational status, occupational status, family size, average monthly income, and sources of information about HBV infection. Past medical history and behavioral risk factors such as hospital admission, history of surgery, tonsillectomy, phlebotomy, history of blood donation, tattooing, body piercing, genital discharge, history of intravenous drug use, injectable medications, dental procedures, multiple sexual partners, unsafe sex, history of contact with hepatitis patients, history of mortality due to hepatitis in the family, previous history of emigration, history of sexually transmitted illness (STI), provision of traditional delivery care, presence of opportunistic infection, alcohol consumption, Khat chewing, and smoking cigarettes.

Family size: The number of household members, including the study participants with a small-sized family (1–3 members), a medium-sized family (4–6 members), and a large-sized family (≥ seven members) [21]. Close contact traced: defined as a close contact who had been tested and started a vaccination course within 60 days of the index case's date of diagnosis [5]. Index case: The pregnant woman already detected positive for HBsAg [12, 13]. Close family contacts/family members/household contacts: The adults, intrafamilial contacts older than 18 years and who lived on the same premises/house with the index case [5, 12].

Data collection and quality assurance procedures

The data were collected through the use of a structured interviewer-administered questionnaire. The questionnaire included questions sourced from various literature references [2, 3, 5, 21]. Prior permission was obtained from the original questionnaire owner. The questionnaire developed by the investigators contained the following sections: 1) Basic sociodemographic characteristics,2) Past medical history and behavioral risk-related characteristics of study participants. The questionnaire was initially prepared in English and then translated into the common language, Amharic, to check the consistency of the items. It was then translated back to English to verify the accuracy of the Amharic translation. To ensure uniformity, the survey was pretested on a sample of 5%

($n = 19$) of individuals from outside the study area, with private interviews. Two trained supervisors rigorously reviewed the data daily for validity and completeness. Emphasis was placed on the simplicity of the data collection instrument and the utilization of standardized community rating scales to maintain the data's integrity, validity, and reliability.

Laboratory tests

During home visits, 3 mL of venous blood was collected from selected adult intrafamilial household contacts of pregnant women with HBV-positive index cases and tested at a nearby health institution. Blood plasma was separated using a manual and portable centrifuge within 1.5 min [22]. The plasma was screened for HBV (HBsAg) using the Guangzhou Wondfo Biotech rapid immunochromatographic assay test cassette, following the manufacturer's guidelines. This one-step test qualitatively detects HBV through HBsAg in human blood plasma. The result is available in 15 min. It can be stored at temperatures of 4°C to 30°C. It is efficient to test 5 items at a time; it is simple to use, and no equipment is required to process the specimen and read the result. It is also visual, rapid, sensitive, and accurate. It has a sensitivity of 96.2% and a specificity of 99.3%, comparable to the results obtained with commercial test kits. The blood samples were added to the cassette according to the manufacturer's instructions [23].

Finally, the results were interpreted based on seropositive (HBsAg+) presence, indicated by two distinct red bands in the test and control regions. Conversely, seronegative (HBsAg-) is indicated by a single red band solely in the control region, and no apparent red or pink band is present in the test region. No red or pink band should be present in the test region, indicating an improper test result. HBsAg is invalid if the control band fails to appear, which means an improper testing procedure or deterioration of reagents; therefore, the test should be repeated [24]. Adults who were intrafamilial household contacts and tested positive for HBsAg were referred to a nearby health facility for further management. Additionally, all unvaccinated participants at the household level were advised to visit health facilities for HBV vaccination.

Data processing and analysis

The Epi-Data version 3.1 software, which was used for data entry and validation [25]. The coded data were then exported to the Statistical Package for Social Sciences (SPSS) version 26 for analysis. SPSS version 26, developed in New York, United States of America (USA), was used for data management and advanced analysis [26]. The data were entered under the principal investigator's purview, with no missing data. Descriptive results were reported using tables, graphs, and charts. According to the bivariate analysis, variables with P values less than 0.25 were included in the multivariable analysis, with significance testing conducted at the 5% level. Logistic regression was used with adjusted odds ratios (AORs) and 95% confidence intervals (95% CIs) to assess the relationship between the independent and dependent variables. The Hosmer and Lemeshow test evaluated the model's fit, and the variance inflation factor determined whether there was multicollinearity among the independently associated variables.

Results

Sociodemographic characteristics of the study participants

Of the 385 eligible adult intrafamilial household contacts traced and identified from 195 index cases of HBsAg-positive pregnant women attending ANC clinic, 15 adult intrafamilial household contacts were excluded due to a known history of HBV infection and having received HBV treatment. These excluded data sets were not considered for analysis, resulting in a response rate of 96.1%.

Of the 370, 213 (57.6%) were married, and nearly two-thirds of the participants ($n = 229$; 61.9%) were aged 18–28. The mean age of the adult intrafamilial household contacts was 28 years, with a standard deviation of ± 6.34 years, and more than half of the participants were female ($n = 203$; 54.9%). Nearly two-thirds (224, 60.5%) of the participants were identified as Protestants in religion, while 239 (64.6%) resided in urban areas. In this study, 96 (25.9%) participants could not read or write. Two hundred seventy-nine (74.1%) participants were unemployed, and 97 (26.2%) identified themselves as Hadiya. The relationships of adult intrafamilial household contacts with the pregnant women's index case were 164 (44.1%) parents, 108 (29.2%) sisters, 63 (17.0%) brothers, and 36 (9.7%) husbands. The majority, 223 (60.3%), of the adult intrafamilial household contacts were medium-sized families (4–6 members). The majority, 239 (64.6%), of the participants had access to information on HBV, with 120 (50.21%) stating that their friends, family, or neighbors were their primary source of information. Nearly two-thirds of the participating adults who were intrafamilial contacts, specifically 229 (61.9%), reported having a low household income (≤ 2000ETB (≤ 35.21USD)) (Table 1).

Prevalence of hepatitis B virus infection

Overall, the prevalence of HBV infection among adult intrafamilial household contacts with pregnant women index cases was 11.6% (43/370) (95% CI, 8.6–15.1) (Fig. 1).

With HBV-positive index cases were stratified by sex, revealing that females accounted for 34 (16.7%) of HBsAg-positive cases. The highest rates of HBsAg

Table 1 Sociodemographic characteristics of adults intrafamilial household contacts with pregnant women index cases on the prevalence and associated factors of hepatitis B virus infection in the Central Ethiopia region, 2023 ($n=370$)

Variables	Categories	*n* (%)
Sex	Male	167(45.1)
	Female	203(54.9)
Age groups of household contacts	18–28	229(61.9)
	29 to 39	124(33.5)
	≥ 40	17(4.6)
Residence	Urban	239(64.6)
	Rural	131(35.4)
Relationship with index case	Parent	163(44.1)
	Husband	36(9.7)
	Brother	63(17)
	Sister	108(29.2)
Marital status	Single	111(30)
	Married	213(57.6)
	Ever Married	46(12.4)
Religion	Orthodox	70(18.9)
	Muslim	76(20.5)
	Protestant	224(60.5)
Educational level	Unable to read and write	96(25.9)
	Primary and secondary education	188(50.8)
	Diploma	21(5.7)
	Degree and above	65(17.6)
Occupation	Employed	69(18.6)
	Self-employed	27(7.3)
	Unemployed	279(74.1)
Family size	1–3(Small family)	117(31.6)
	4–6(Medium family)	223(60.3)
	≥ 7(Large family)	30(8.1)
Ethnicity of respondent	Hadiya	97(26.2)
	Kembata	67(18.1)
	Gurage	78(21.1)
	Silte	59(15.9)
	Halaba	54(14.6)
	Yem	12(3.2)
	Wolaita	3(0.8)
Information about HBV infection	Yes	239(64.6)
	No	131(35.4)
Sources of information about HBV infection (more than one possible answer possible)	TV or Radio	16(6.69)
	Health workers or healthcare providers	59(24.68)
	Social media	100(41.84)
	Their friends, family, or neighbor	120(50.21)
	Religious leaders or teachers	71(29.71)
Average monthly income	≤ 2000ETB (≤ 35.21USD)	229(61.9)
	2001–4000(35.21-70.42USD)	74(20)
	> 4001ETB (> 70.42 USD)	67(18.1)

Where: Ever married: Separated, widowed, and divorced; HBV: Hepatitis B Virus; TV: television; ETB: Ethiopian Total Birr; USD: United States dollars

positivity were observed among adults aged 29 to 39 years, with 17 cases (13.7%). Among household contacts, husbands of the index cases had the highest rate of positivity at 9 (25%), followed by parents at 28 (17.2%), brothers at 3 (4.8%), and sisters at 3 (2.8%) (Table 2).

Epidemiological characteristics of study participants

Of the 370 adult intrafamilial household contacts who participated in the study, 300 (81.1%) had lived with the index case for more than or equal to six months. Among these contacts, 10 (8.4%) had not received any vaccination, whereas 109 (91.6%) had received partial

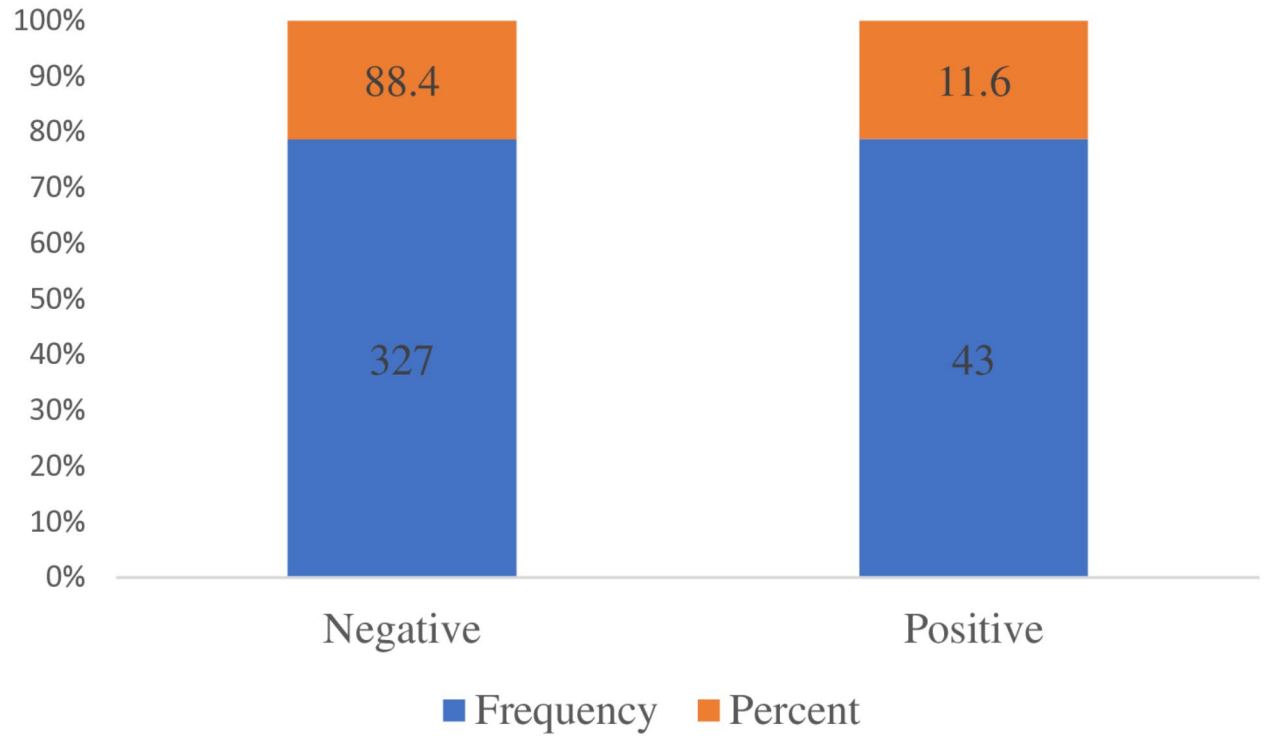

Fig. 1 Prevalence of hepatitis B virus infection among adult intrafamilial household contacts with pregnant women index cases attending antenatal care clinics in the central Ethiopian region, 2023 ($n=370$)

Table 2 Stratification by age, sex, and relationship of adult intrafamilial household contacts with pregnant women index cases attending antenatal care clinics in the Central Ethiopia region, 2023 ($n=370$)

	Categories	Hepatitis B surface antigen		Total
		Negative, *n* (%)	Positive, *n* (%)	
Sex	Male	158(94.6)	9(5.4)	167
	Female	169(83.3)	34(16.7)	203
Age	18–28	204(89.1)	25(10.9)	229
	29 to 39	107(86.3)	17(13.7)	124
	≥40	16(94.1)	1(5.9)	17
Relationship with index case	Parent	135(82.8)	28(17.2)	163
	Husband	27(75)	9(25)	36
	Brother	60(95.2)	3(4.8)	63
	Sister	105(97.2)	3(2.8)	108
Total		327(88.4)	43(11.6)	370(100)

vaccination, specifically the first doses of the HBV vaccine. Furthermore, a majority of 328 (88.6%) of the adult intrafamilial household contacts were with pregnant women index cases with their husbands (Table 3).

Of the 370 study participants, 296 (80%) had a history of hospital admission. Additionally, 93 (25.1%) patients had undergone surgery during their lifetime, 63 (17%) had undergone tonsillectomy, and 121 (32.7%) had undergone phlebotomy. Regarding blood transfusions, 31 (8.4%) adult intrafamilial household contacts reported a history of blood transfusions. A total of 49 (13.2%) adult intrafamilial household contacts had tattoos, 41 (11.1%) had body piercings, 135 (36.5%) had genital discharge, 95 (25.7%) had a history of intravenous drug use, 62 (16.5%) had dental procedures, and 37 (10%) had experience with injectable medications. Approximately 66 (17.8%) of the study participants had multiple sexual partners, 67 (18.1%) engaged in unsafe sex, 83 (22.4%) had a family history of hepatitis, 120 (32.4%) had previously come into contact with hepatitis patients, 23 (6.2%) had experienced hepatitis-related mortality in their family, 29 (7.8%) of the adult intrafamilial household contacts had

Table 3 Summary of vaccination status and contact tracing of adult intrafamilial household contacts with pregnant women index cases attending antenatal care clinics in the central Ethiopian region, 2023 ($n=370$)

Variables	Categories	*n* (%)
Duration of stay with index case	≥ 6 months	300(81.1)
	< 6 months	70(18.9)
Number contact successfully traced*	Yes	92(24.9)
	No	278(75.1)
Number of contacts eligible for hepatitis B vaccination	Yes	119(32.2)
	No	251(67.8)
Vaccination status($n=119$)	Not-vaccinated	10(8.4)
	Partial vaccination	109(91.6)
Sexual contact relationship to index case	Husband	328(88.6)
	Partner	42(11.4)
HBsAg test result	Negative	327(88.4)
	Positive	43(11.6)

Where: HBsAg: hepatitis B surface antigen; *Defined as contacts tested and immune or infected OR tested and vaccinated [27]

been stabbed or had contact with potentially contaminated cutting objects, 42 (11.4%) had a history of emigration, 115 (31.1%) had a history of sexually transmitted illnesses, and 62 (16.8%) had provided traditional delivery care. Twenty-two (5.9%) reported the presence of opportunistic infections. Among the total participants, 74 (20%) had a history of alcohol consumption, 90 (24.3%) had a history of chewing Khat, and 82 (22.2%) had a history of smoking cigarettes (Table 4).

Factors Associated with the prevalence of Hepatitis B virus infection

Multivariable logistic regression analysis revealed that the overall prevalence of HBV infection among adult intrafamilial household contacts with pregnant women index cases was 11.6% (95% CI, 8.6–15.1). Our findings demonstrated that male was approximately 91% less likely to develop HBV infection compared to their female counterparts (AOR = 0.09; 95% CI = 0.03, 0.367) and that a duration of stay with the index case of less than six months was 70% less likely to develop HBV infection compared to those with a duration of stay greater than six months (AOR: 0.30; 95% CI: 0.11, 0.81), were associated with the reduced risk of hepatitis B virus infection. Meanwhile, adult intrafamilial household contacts from large family sizes (≥ 7) were 4.30 times more likely to develop HBV infection compared to medium-sized families (4–6) (AOR: 4.3; 95% CI: 1.34, 13.98); genital discharge was 3.14 times more likely to develop HBV infection compared to those without genital discharge (AOR: 3.14; 95% CI: 1.60, 6.15); engagement in unsafe sex was 2.37 times more likely to develop HBV infection compared to those who had practiced safe sex (AOR: 2.37; 95% CI: 1.13, 4.97); and history of mortality due to hepatitis in the family was 3.03 times more likely to develop HBV infection compared to adults without a family history of hepatitis-related mortality (AOR: 3.03; 95% CI: 1.09, 8.42).These factors were associated with the increased risk of hepatitis B virus infection, with a *p*-value of less than 0.05 (Table 5).

Discussion

To our knowledge, this study represents the first attempt to determine the prevalence of HBV infection and associated factors among adult intrafamilial household contacts with ANC following pregnant women index cases who tested positive for HBsAg in the central Ethiopian region. The study findings revealed that a high prevalence of HBV infection among adult intrafamilial household contacts of pregnant women index cases who tested positive for HBsAg was high at 11.6% (95% CI, 8.6 to 15.1); this result is classified as high according to the WHO classification (≥ 8.0%) [28].

The prevalence of HBV infection among adults of intrafamilial household contacts with pregnant women index case was relatively high compared to other studies in Southwest Ethiopia at 9% [21], Gojam zones, Northwest Ethiopia at 3.1% [29], and other studies done outside the Ethiopia region, the result of the study was higher than the results reported by Beijing, China at 4.3% [30], Northeast China at 4.38% [31], and Mwanza, Tanzania at 7.16% [3]. However, these findings are lower than other studies conducted in Northeastern Ethiopia at 27.4% [32], and other studies done outside the African region, the result of the study was lower than the results reported by Kupang, Indonesia at 15.15% [2], Zahedan, Iran at 19.3% [9], Hamadan, Iran at 20.5% [33], Arak, Central Iran at 23.3% [34], and Eastern Turkey at 30.5% [35]. The results were relatively high compared to studies in the Central Highlands, Vietnam, at 11.2% [36]. The observed disparities may be attributed to variations in sociodemographic, cultural, and behavior-related factors contributing to HBV infection risk. Furthermore, variations

Table 4 Past medical history and behavioral risk-related factors of adult intrafamilial household contacts with pregnant women index cases on the prevalence and associated factors of hepatitis B virus infection in the Central Ethiopia region, 2023 ($n=370$)

Variables	Categories	*n* (%)
History hospital admission	Yes	296(80)
	No	74(20)
History of surgery	Yes	93(25.1)
	No	277(74.9)
Tonsillectomy	Yes	63(17)
	No	307(83)
Phlebotomy	Yes	121(32.7)
	No	249(67.3)
History of blood transfusion	Yes	31(8.4)
	No	339(91.6)
Type of donation	Voluntary	27(87.1)
	Replacement	4(12.9)
Frequency of donation	First time	26(83.9)
	Repeated	5(16.1)
Tattooing	Yes	49(13.2)
	No	321(86.8)
Body piercing	Yes	41(11.1)
	No	329(88.9)
Genital discharge	Yes	135(36.5)
	No	235(63.5)
History of intravenous drug use	Yes	95(25.7)
	No	275(74.3)
Injectable medications	Yes	37(10)
	No	333(90)
Dental procedures	Yes	62(16.5)
	No	309(83.5)
Multiple sexual partners	Yes	66(17.8)
	No	304(82.2)
Unsafe sex	Yes	67(18.1)
	No	303(81.9)
Family history of hepatitis	Yes	83(22.4)
	No	287(77.6)
Previous history of contact with hepatitis patients	Yes	120(32.4)
	No	250(67.6)
History of mortality due to hepatitis in family	Yes	23(6.2)
	No	347(93.8)
Stabbing, contact with possibly contaminated cutting objects	Yes	29(7.8)
	No	341(92.2)
Previous history of emigration	Yes	42(11.4)
	No	328(88.6)
History of sexually transmitted illness	Yes	115(31.1)
	No	255(68.9)
Provision of traditional delivery care	Yes	62(16.8)
	No	308(83.2)
Presence of opportunistic infection	Yes	22(5.9)
	No	348(94.1)
Alcohol consumption	Yes	74(20)
	No	296(80)
Khat chewing	Yes	90(24.3)
	No	280(75.7)
Smoking Cigarettes	Yes	82(22.2)
	No	288(77.8)

Where: Tonsillectomy: surgery to remove the tonsils; phlebotomy: a procedure in which a needle takes blood from a vein, usually for laboratory testing

in study design, population, occupation, and geographic factors may have also played a role.

The present study revealed that male participants were approximately 91% less likely to have developed HBV infection than their female counterparts. These findings contradict previous studies conducted in Mwanza, Tanzania [3], northeastern Ethiopia [32], the Central Highlands, Vietnam [36], Rwanda [37], and a population of adults in northeast China [31]. The possible reasons behind this association could be that females were more susceptible to sexual violence, including rape, attempted rape, and sexual harassment. Furthermore, females currently engage in high-risk behaviours for HBV transmission, such as smoking, alcohol use, and chewing, as victims [38]. Consequently, the data may result in a lower HBsAg rate in males because of high mother-to-child transmission rates in regions with a high prevalence of HBV infection [8, 11].

Adults with intrafamilial household contacts who lived with large families (≥7 members) had a 4.3 times more likely to have developed HBV infection than did those living in medium-sized families (4–6 members). These findings are consistent with previous studies conducted in southern Ethiopia [39], in the Gojam zone in northwestern Ethiopia [29], and in Addis Ababa, Ethiopia [40]. The increased incidence of HBV infection in larger families may be due to the greater likelihood of transmission among family members. The higher rate of HBV infection in larger families may be explained by horizontal transmission within the family.

Adults with a stay duration with an index case of less than six months had a 70% less likely to have developed HBV infection than did those with a duration of stay greater than six months. A high rate of HBV infection is observed in household contacts of chronic HBV carriers, indicating a high prevalence of HBV transmission within carrier family members [8]. This may be attributed to reduced exposure time, which limits the cumulative risk of acquiring the infection. The transmission of HBV, mainly through intrafamilial contact, is influenced by the intensity and duration of exposure to the virus. Shorter exposure times likely decrease the likelihood of HBV transmission through shared household items, minor cuts, or close physical contact, which could facilitate infection. Furthermore, individuals with shorter stays may have better immunity or vaccination status than those with prolonged exposure [41].

Table 5 Factors associated with the prevalence of hepatitis B virus infection among adult intrafamilial household contacts of pregnant women index cases attending antenatal care clinics in the central Ethiopia region, 2023 ($n=370$)

Variable	Hepatitis B virus surface antigen				
	Negative, *n* (%)	Positive, *n* (%)	COR (95%CI)	AOR (95%CI)	*P* value
Sex					
Male	158(48.3)	9(20.9)	0.28(0.13,0.61)	0.09(0.03,0.37) *	0.001
Female	169(51.7)	34(79.1)	1	1	
Family Size					
Small family (1–3)	106(32.4)	11(25.6)	0.86(0.41,1.82)	0.81(0.26,2.57)	0.723
Medium family (4–6)	199(60.9)	24(55.8)	1	1	
Large family (≥ 7)	22(6.7)	8(18.6)	3.02(1.210,7.516)	4.3(1.34,13.98) *	0.015
Duration of stay with index case					
≥ 6 months	268(82)	32(74.4)	1	1	
< 6 months	59(18)	11(25.6)	0.46(0.17,1.06)	0.30(0.11,0.81) *	0.017
Genital discharge					
Yes	110(33.6)	25(58.1)	2.74(1.43,5.24)	3.14(1.60,6.15) *	0.001
No	217(66.4)	18(41.9)	1	1	
Unsafe sex					
Yes	54(16.5)	13(30.2)	2.19(1.07,4.47)	2.37(1.13,4.97) *	0.023
No	273(83.5)	30(69.8)	1	1	
History of mortality due to hepatitis in family					
Yes	17(5.2)	6(14)	2.96(1.10,7.97)	3.03(1.09,8.42) *	0.034
No	310(94.8)	37(86)	1	1	

Where: COR is the crude odds ratio, AOR is the adjusted odds ratio, 1 is the reference, and * is the variable significance at a p-value < 0.05 in the multivariable analysis

Adults who experienced genital discharge were 3.14 times more likely to have developed HBV infection than those without genital discharge. These findings align with previous research conducted in Hawassa City, southern Ethiopia [42], and among HIV-positive pregnant women in Ethiopia [43]. This correlation may be attributed to the increased vulnerability to infectious diseases of adults with genital ulcers.

Adults who had engaged in unsafe sex were 2.37 times more likely to have developed HBV infection than those who had practiced safe sex. These findings are consistent with those of other studies conducted in the Bench Maji Zone, Southwest Ethiopia [21], among HIV-positive pregnant women in Ethiopia [43], and in Hawassa City, Ethiopia [42]. This similarity may be attributed to the fact that unsafe sex continues to be a significant contributor to HBV transmission, particularly in sub-Saharan Africa. Social and behavioral factors also play a crucial role in transmitting HBV infection [21]. One possible explanation is that having multiple sexual partners increases the risk of low adherence to condom use, thereby increasing the transmission of the virus to others. This finding can be explained by the fact that the hepatitis B virus is transmitted through blood, semen, and other body fluids, suggesting that sexual contact is a mode of transmission [2, 9, 10]. Therefore, sexually active women, especially those who engage in unprotected sex with multiple partners, have a greater chance of acquiring the infection. Consequently, changing sexual practices and adopting behavioral modifications are essential for reducing the risk of HBV infection [42].

Adults with a history of hepatitis-related mortality in their family were 3.03 times more likely to have developed HBV infection than adults without a family history of hepatitis-related mortality. These findings are consistent with similar studies conducted among adults in northeastern Ethiopia [32], among HIV-positive pregnant women in Ethiopia [43], and in the Central Highlands of Vietnam [36]. The increased likelihood of HBV transmission among adult household contacts with a history of HBV infection may be attributed to the use of contaminated materials such as razors, toothbrushes, towels, and eating utensils.

Strengths and limitation

The study's strengths include using a standardized questionnaire, a large sample size, and blood screening for HBV (HBsAg) infections. However, several limitations exist. First, alternative methods such as molecular nucleic acid testing (NAT), hepatitis B surface antibody (anti-HBs), hepatitis B e antigen (HBeAg), and anti-hepatitis B core IgM (anti-HBc IgM) assays were not performed on HBsAg-positive samples due to limited resources. Additionally, the study did not assess the chronicity of the virus or antibody levels in fully vaccinated adults, which would have confirmed immunity and excluded them from HBsAg testing. Furthermore, the study's cross-sectional design limits its ability to establish causal relationships. Selection bias occurred in choosing index cases, and the lack of

hepatitis B virus treatment centers hindered their screening and management. Finally, social desirability bias may have affected participant responses, as potential stigma was associated with HBsAg-positive adults and intrafamilial contacts of pregnant women who were index cases.

Conclusion and recommendations

When comparing other research studies, the prevalence of HBV infection among adult intrafamilial household contacts of pregnant women in the central Ethiopian region was high at 11.6%. Significant factors contributing to this prevalence include larger family sizes, genital discharge, unsafe sexual practices, and a family history of hepatitis-related mortality. Conversely, being male and living with the index case for less than six months are associated with lower occurrences of HBV infection. These findings suggest that interventions to prevent HBV infection should prioritize educational campaigns targeting adult intrafamilial household contacts of HBV-positive index cases, focusing on risk factors associated with HBV transmission, prevention, counseling, testing, and vaccination. Specifically, females and individuals engaging in unsafe sexual practices should receive special attention.

Policy-makers Mandate the expansion of HBV screening for the general population, including household members of pregnant women testing positive, in addition to ANC screening for pregnant women.

Future researchers To conduct longitudinal follow-up studies to monitor the effectiveness of household screening and vaccination programs.

Abbreviations

ANC	Antenatal Care
AOR	Adjusted Odds Ratio
ART	Antiretroviral Therapy
CER	Central Ethiopia Region
COR	Crude Odds Ratio
CUTN	Central University of Tamil Nadu
EPH	Epidemiology and Public Health
FMOH	Federal Ministry of Health
HBsAg	Hepatitis B Surface Antigen
HBV	Hepatitis B Virus
HIV	Immunodeficiency Virus
ICA	Immunochromatographic Assay
IRB	Institutional Review Board
MTCT	Mother-To-Child Transmission
SPSS	Statistical Package for Social Sciences
WCU	Wachemo University

Supplementary Information

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Supplementary Material 1

Supplementary Material 2

Supplementary Material 3

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Author contributions

YM: Conceptualization, Data curation, Formal analysis, Funding acquisition, Investigation, Methodology, Project administration, Resources, Software, Supervision, Validation, Visualization, Writing – original draft, and Writing – review and editing.AA: Conceptualization, Data curation, Formal analysis, Funding acquisition, Investigation, Methodology, Resources, Software, Supervision, Validation, Visualization, and Writing – review and editing. SK: Conceptualization, Data curation, Funding acquisition, Investigation, Methodology, Project administration, Resources, Supervision, Validation, Visualization, and Writing – review and editing.NG: Conceptualization, Data curation, Funding acquisition, Investigation, Methodology, Project administration, Resources, Software, Supervision, Validation, Visualization, and Writing – review and editing.

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Data availability

No datasets were generated or analysed during the current study.

Declarations

Ethics approval and consent to participate

The Institutional Review Board (IRB) of Wachemo University (WCU) has diligently reviewed and approved the study, with Ethical Approval Number Ref. No. 977/2015, dated 06/03/2023. Before commencing the investigation, comprehensive permission was obtained from the Central Ethiopia Regional Health Bureau, the Zonal Health Department, the Woreda Health Office, and the hospitals involved. Furthermore, the Kebele administrator in each selected study area acquired a formal permission letter.

Consent for publication

Not applicable.

Competing interests

The authors declare no competing interests.

Consent to participate

All the adult participants had to provide written informed consent forms before participating in the interviews and blood sampling. To maintain confidentiality, all the collected information was kept anonymous.

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